DESIGN AND DEVELOPMENT OF BOX TAIL UAV POWERED WITH SOLAR PANEL

A PROJECT REPORT

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ABSTRACT

This paper exhibits a prologue to box tail UAV innovation and an outline of ebb and flow look into endeavors right now. Box tail innovation offers high lifting capacities, diminishing wing vortices and less unpredictable flight controls. Instead of utilizing aileron a lift we are going for elevons. Anyway at the present condition of innovation the plan of half and half box tail presents numerous difficulties and requires imaginative answers for both the airplane arrangement just as vitality stockpiling framework. For this solar panel (sun oriented boards) are implemented to give power. The airplane's shut wing configuration, named a "twofold box tail", is proposed to bring down initiated drag and be slow down safe, alongside limit layer control techniques. The twin level tails articulate, giving synchronous power over roll and pitch.

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CHAPTER 1

INTRODUCTION

1.1 History:

In recent years, awareness of the potential of unmanned aerial vehicle(UAVs) for multiple missions has increased the level of research into improving UAV design and technologies. Studies found that electric or fossil fuel powered UAVs have inadequate flying hours for various tasks. Increased focus has been placed recentlyon developing hybrid powered electric UAVs, especially with the combination of solar energy and battery or fuel cells in a battery powered system. The current study of our project considers various power systems and examines the design and development of solar cells in battery powered UAVs. A synthesized UAV mathematical design model suitable for sizing and configuration design of small solar powered and battery powered electric systems was developed to fulfil the previously mentioned requirements.

The design of UAV requires innovative solutions for both the aircraft configuration as well as the propulsion and energy storage systems. To enable a flight endurance, the propulsion system needs to be able to provide the power for the flight day and night , which leads to very heavy fuel load when using a non regenerative system. If a regenerative system is used however, the power train needs doubled.

An unmanned aerial vehicle (UAV) (or uncrewed aerial vehicle, commonly known as a drone) is an aircraft without a human pilot on board and a type of unmanned vehicle. UAVs are a component of an unmanned aircraft system (UAS), which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy either under remote control by a human operator or autonomously by onboard computers.

Compared to crewed aircraft, UAVs were originally used for missions too "dull, dirty or dangerous" for humans. While they originated mostly in military applications, their use is rapidly expanding to commercial, scientific, recreational, agricultural, and other applications, such as policing and surveillance, product

deliveries, aerial photography, infrastructure inspections, smuggling, and drone racing. Civilian UAVs now vastly outnumber military UAVs, with estimates of over a million sold by 2015. Multiple terms are used for unmanned aerial vehicles, which generally refer to the same concept. The term unmanned aircraft system (UAS) was adopted by the United States Department of Defence (DoD) and the United States Federal aviation administration in 2005 according to their Unmanned Aircraft System Roadmap 2005–2030. The International Civil Aviation Organization (ICAO) and the British Civil Aviation Authority adopted this term, also used in the European Union's Single European Sky(SES) Air Traffic Control (ATC) Research (SESAR Joint Undertaking) roadmap for 2020A box wing configuration assures saving in fuel consumption because of lower induced drag. In a study the box wing configuration has proven to consume 9% less fuel as a result of 14% increase in the glide ratio. Also, because of the improved lift to drag ratio, we can expect lesser noise by the UAV making the surveillance mission without making noise. In practise, this design could potentially have other advantages and disadvantages including altered pilot handling characteristics.

This term emphasizes the importance of elements other than the aircraft. It includes elements such as ground control stations, data links and other support equipment. A similar term is an unmanned-aircraft vehicle system (UAVS), remotely piloted aerial vehicle (RPAV), remotely piloted aircraft system (RPAS).

1.2 UAVs typically fall into one of six functional categories:

- Target and decoy – providing ground and aerial gunnery a target that simulates an enemy aircraft or missile.
- Reconnaissance – providing battlefield intelligence.
- Combat – providing attack capability for high-risk missions Unmanned Combat Aerial vehicle (UCAV)).
- Logistics – delivering cargo.
- Research and development – improve UAV technologies.
- Civil and commercial UAVs – agriculture, aerial photography, data collection.
- Vehicles can be categorized in terms of range/altitude.

- Hand-held 2,000 ft (600 m) altitude, about 2 km range.
- Close 5,000 ft (1,500 m) altitude, up to 10 km range.
- NATO type 10,000 ft (3,000 m) altitude, up to 50 km range.
- Tactical 18,000 ft (5,500 m) altitude, about 160 km range.
- MALE (Medium altitude long endurance) up to 30,000 ft (9,000 m) and range over 200 km.
- HALE (High altitude long endurance) over 30,000 ft (9,100 m) and indefinite range.
- Hypersonic high-speed, supersonic (Mach 1–5) or hypersonic (Mach 5+) 50,000 ft (15,200 m) or suborbital altitude, range over 200 km.
- Orbital low earth orbit (Mach 25+).
- CIS Lunar Earth-Moon transfer.
- Computer Assisted Carrier Guidance System (CACGS) for UAVs.

1.3 Other categories include:

- Hobbyist UAVs – which can be further divided into o Ready-to-fly (RTF)/Commercial-off-the-shelf (COTS) o Bind-and-fly (BNF) – require minimum knowledge to fly the platform o Almost-ready-to-fly (ARF)/Do-it-yourself (DIY) – require significant knowledge to get in the air o Bare frame – requires significant knowledge and your own parts to get it in the air.
- Midsize military and commercial UAVs.
- Large military-specific UAVs.

1.4 Classifications according to aircraft weight are quite simpler:

- Micro Air Vehicle (MAV) – the smallest UAVs that can weigh less than 1g
- Miniature UAV (also called SUAS) – approximately less than 25 kg
- Heavier UAVs
- Stealth combat UAVs.
- Crewed aircraft transformed into uncrewed (and Optionally Piloted UAVS or OPVs)

1.5 Design objective:

This paper exhibits a prologue to box tail UAV innovation and an outline of ebb and flow look into endeavors right now. Box tail innovation offers high lifting capacities, diminishing wing vortices and less unpredictable flight controls. Insteadof utilizing aileron a lift we are going for Elevons. Anyway at the present condition of innovation the plan of half and half box tail presents numerous difficulties and requires imaginative answers for both the airplane arrangement just as vitality stockpiling framework. For this solar panel (sun oriented boards) are implemented to give power. The airplane's shut wing configuration, named a "twofold box tail", is proposed to bring down initiated drag and be slow down safe, alongside limit layer control techniques. The twin level tails articulate, giving synchronous power over roll and pitch.

CHAPTER 2

LITERATURE REVIEW

2.1 Development of design methodology for a small solar powered UAV:

This paper presents preliminary design of a joined wing high altitude long endurance UAV. The wing structural weight will be reduced and also stiffness is added by closed the wing box. The current study considers the pros and cons of various power systems and examines the design and development of solar cells in battery-powered UAVs.

A general analysis work was conducted on the mathematical design model that covers both solar (solar- and battery-powered) and nonsolar (battery-powered) UAV sizing. The simulation was also subject to UAVs that can perform a minimum of 9 hours of flight operation beginning at 12 noon on 22 June 2014 at Cranfield, United Kingdom, with an iteration sizing accuracy of 1cm or 1g.

The relationship between the mass of the payload and battery of both solar and nonsolar UAVs (Figure 7) indicates that the mass of the battery gradually increases with payload. This result can be attributed to the minimum size of the battery pack, which comes in multiples of 150g± 10%. This finding proves another advantage of applying the electric propulsion modeling as part of this design modeling, where sizing small UAVs provides an accurate weight prediction.

2.2 Preliminary design of a joined wing HALE UAV:

HALE UAVs could provide an improved service and/or flexibility over existing systems for a vast number of civil applications, ranging from border patrol and coastal surveillance over monitoring of natural disasters, meteorology and cartography to highly flexible telecommunication relay stations. Airborne platforms that remain a loft for weeks to months at altitudes between 15 and 22 km namely

provide an advantage over satellite systems in terms of reduced costs, increased flexibility and higher precision.

However, at the current state of technology, the design of HALE UAVs poses many challenges and requires innovative solutions for both the aircraft configuration as well as the propulsion and energy storage systems If a regenerative system is used however, the power train needs to be doubled. One system is needed for the daytime and a second one provides the power for the flight throughout the night. As a consequence of this unavoidable redundancy, a low propulsive power is a key driver in the design.

Not only will the Oswald efficiency factor be increased to values in the order of1.2, the wing structural weight will be reduced too, seen the stiffness added by closing the wing box. As the low power requirement, a key driver for HALE UAVs, leads to low cruise speeds and high wing surfaces, the joined-wing potentially offers a significant benefit for this particular application. In a next step, a more detailed assessment of the aerodynamic and structural characteristics of the wing will be made. The refined results will then be used to iterate on the overall design of the UAV.

2.3 Design and optimization of a MALE UAV wingbox structure:

The latest designs and innovations in structures and materials have been critical to the improvement of aircraft performance. Lightweight panels and composite materials have allowed designers to lower aircraft structural weight while still maintaining the required stiffness and integrity associated with metallic structures. Improving the weight of an aircraft plays an important role in reducing operating costs, and improving range and efficiency.

An optimization implies that the design concept will not only meet the set specification, but does so when a target criterion is imposed. In this research project the target was to obtain a minimal structural mass while still maintaining a positive Margin-of-Safety (MOS). This ensured that the lightweight structures would still have the capability to support the aircraft design loads.

The sandwich panel designs demonstrated the lowest wing box mass within the acceptable safety limits. As expected the greatest panel thickness and mass was located at the wing root, which experienced the greatest loading and resultant stress. The use of ply drops allowed for the large reduction in panel height across the span. This allowed for a unique structural solution to be obtained at each of the three wing locations (root, midpoint and tip).

The wingbox was designed to incorporate an I-beam wing spar (figure 13). This beam was able to provide the greatest beam stiffness and strength while still having the lightest weight. Each of the beam dimensions was used as a sizing variable to obtain the lowest possible beam mass.

2.4 Multi-objective optimization of the composite wing box of solar powered HALE UAV:

The main goal of this work is to design the composite wing box of the SHAMPO's configuartion that ensures a high strength to weight ratio, compliance with regulatory requirements and respects the constraints imposed a priori, including maximum wing-tip deflection, mass minimization, buckling and impact threshold limit. As it is worded, the multi-constraints design problem coupled with mass minimization becomes a Multi-objective Optimization problem. To achieve this goals, several different tools, both for design and optimization, have been developed and validated before being used for the final design.

A Genetic Algorithm has been developed to optimize the wing structure of innovative composite aircraft. A set of penalty functions has been activated during the optimization process in order to guarantee adequate stiffness and strength requirements and to avoid local or global buckling. A limit of 3000 με has been considered to cope with static and fatigue behaviour of damaged composite structures. An optimal lay-up configuration has been identified for a solar powered HALE UAV. A maximum deflection of 6.81 m is reached at the ultimate load; the optimized wing box weight is 160 Kg with maximum number of plies of 56 at the root section. The results are in good agreement with those reported in literature for same kind of aircraft.

2.5 Structural and aeroelastic design of a joined wing UAV:

The ability to fly nonstop for extended periods of time at very high altitudes has been an ongoing goal of the aeronautics community. The characteristics of such an aircraft would allow it to perform a varietyof missions for a host of possible users. Potential missions include military reconnaissance, civil border patrol, environmental and weather monitoring, traffic control, and a wide variety of civil communication applications. The aircraft desired would surely be unmanned, and capable of continuous operation for weeks, months, or even years. This type of UAV would be capable of performing many of the tasks that small low earth orbit satellites presently perform, but at a substantially reduced cost.

Results of this study showed the impact of power system component performance and mission conditions on UAV aircraft size. The most significant reduction in aircraft size was found to occur by increasing the energy storage (fuel cells in this case) specific energy, whereas the effects of PV module and power electronics efficiency and mass play a marginal role in comparison. Flight altitude, flight latitude, time of year, and payload mass also play significant roles in determining aircraft size. It was found that an energy storage specific energy of 250- 500 Whr/kg is required to enable most useful missions, and that operation in the winter at northern latitudes may not be possible. Also, it is concluded that PV cells with AM0 efficiencies greater than - 12% , possibly even thin-film PV cells, are suitable for solar-powered UAV use.

Results for the following analysis can be separated into two categories; the first considers the impact of varying the power system components, the second considers the impact of varying mission requirements.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Types of tail used in UAV:

- Conventional tail
- V- Tail
- T- Tail

3.1.1 Conventional Tail:

The conventional tail design is the most common form. It has one vertical stabilizer placed at the tapered tail section of the fuselage and one horizontal stabilizer divided into two parts, one on each side of the vertical stablilzer. For many airplanes, the conventional arrangement provides adequate stability and control with the lowest structural weight.

Conventional tail configurations are the most common configuration used in UAVs.

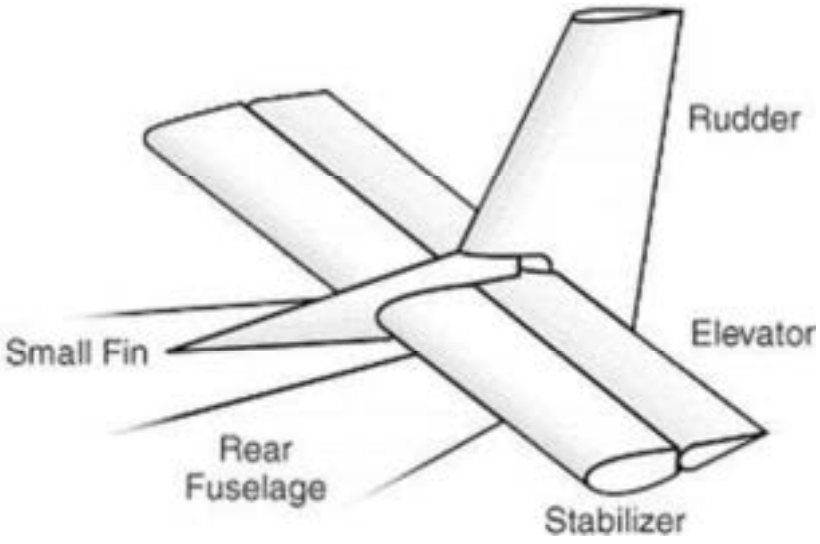

Fig-3.1(Conventional Tail)

3.1.2 V- Tail:

The V-Tail, sometimes called the "butterfly" tail, has had limited application in airplane design, the most significant of which has been by the Beech Company in the Beech-craft Bonanza V-35. Clearly, the usual definition of horizontal and vertical stabilizers has no application to the V tail. The intended advantage of the V-tail design is that two surfaces might serve the same function as the three required in the conventional tail and its variants. Removal of one surface then would reduce the drag of the tail surfaces as well as the weight of the tail region. However, wind tunnel studies by the National Advisory Committee on Aeronautics (NACA) have shown that for the V tail to achieve the same degree of stability as a conventional tail, the area of the V tail would have to be about the same size as that of the conventional tail.

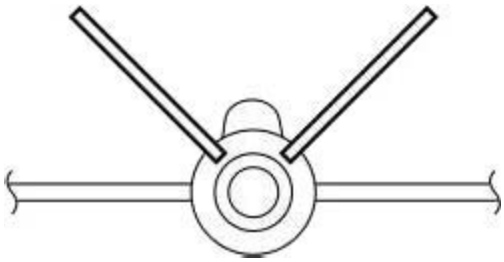

Fig-3.2(V-Tail)

3.1.3 T- Tail:

In the T-tail design, a common variation of the conventional tail, the horizontal stabilizer is positioned at the top of the vertical stabilizer. The horizontal stabilizer is then above the propeller flow, or prop wash, and the wing wake. Because the horizontal stabilizer is more efficient, it can therefore be made both smaller and lighter. The placement of the horizontal stabilizer on top of the vertical stabilizer can also make the vertical stabilizer more aerodynamically efficient. By making the vertical stabilizer more effective, its size may be reduced. However, the horizontal stabilizer in the T-tail layout imposes a bending and twisting load on the vertical stabilizer,

requiring a stronger, and therefore, a heavier, structure. These loads are avoided in the conventional design. There is also the possibility that at the high pitch angle usually associated with landing the airplane, the horizontal stabilizer of the T tail will be immersed in the slower and more turbulent flow of the wing wake. In some cases, it is possible to compromise severely the control function of the horizontal tail. Nevertheless, the T tail is the second-most common tail design after the conventional. Both major American transport plane builders, Boeing and McDonnell-Douglas, use the T-tail design.

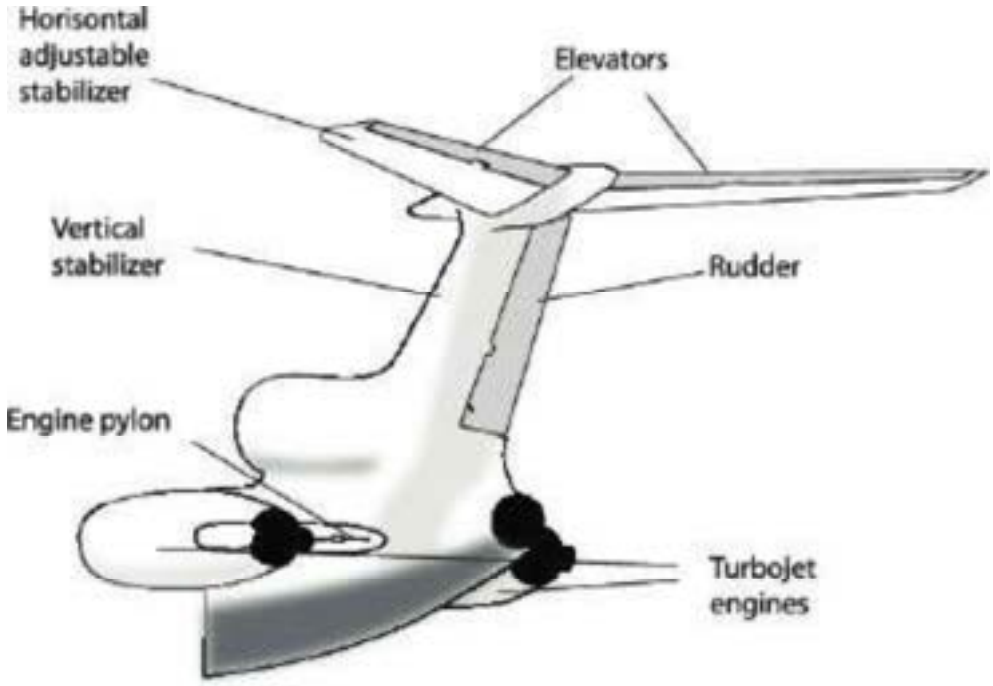

Fig-3.3(T-Tail)

3.2 Boxtail configuration:

The boxtail configuration lowers induced drag (the drag due to lift) to the theoretical limit. Its 3-D span efficiency is 1.46 times that of a normal wing of the same span, in a strong, compact form more capable of higher speeds than a long, glider-style wing. Decreasing the induced drag of an airplane provides benefits in climb, at lower speeds, when racing or maneuvering, at higher weights, and at higher altitudes.

The Synergy configuration eliminates complexity because none of our simple, seamless flight surfaces have any controls or spanwise gaps in them. Two moving surfaces provide a majority of flight control. Like a flying wing, which is a less efficient configuration than DBT, pitch and roll controls are combined. We don't have separate elevators and ailerons; our two elevons are just simple, one-piece airfoils, supported at both ends and rotated for control. (Thanks to its natural turn coordination, Synergy's twin, V-tail-mounted rudders are rarely required in flight, but yes, we have (two) rudders on the full size aircraft!) Reduced complexity translates directly into reduced weight and reduced cost.

Fig-3.4(Boxtail)

Laminar flow and high span efficiency allows a bigger wing in comparison to typical high-performance designs. Providing increased fuel storage and slower landings, the wings can be stronger and stiffer for a given span loading. The twisting tendency of a swept wing is balanced out of the system under G-loading by an always-proportionate, opposing down force from the tails.

Double boxtail configuration creates constructive, beneficial wing- tail interaction, rather than (destructive) "biplane interference", allowing wing and tail to cooperate together for lower drag. In addition, all airfoil surfaces continue the low pressure or high pressure famous interference drag problem common to box wing designs. Every wingtip or stabilizer tip is a drag source on an airplane.

CHAPTER 4

MATERIAL USED

4.1 Material used in boxtail UAV:

- Brushless motor
- Electronic Speed Controller(ESC)
- Servo motor
- Propeller
- Lipo Battery
- Coro Sheet
- Transmitter and Receiver
- Solar panel
- Solar Controller

4.1.1 Brushless motor:

Brushless motors can be constructed in several different physical configurations: In the 'conventional' (also known as in runner) configuration, the permanent magnets are part of the rotor. Three stator windings surround the rotor. In the out runner (or external-rotor) configuration, the radial-relationship between the coils and magnets is reversed; the stator coils form the center (core) of the motor, while the permanent magnets spin within an overhanging rotor which surrounds the core. The flat or axial flux type, used where there are space or shape limitations, uses stator and rotor plates, mounted face to face. Out runners typically have more poles, set up in triplets to maintain the three groups of windings, and have a higher torque at low RPMs. In all brushless motors, the coils are stationary.

Although efficiency is greatly affected by the motor's construction, the Wye winding is normally more efficient. In delta-connected windings, half voltage is applied across the windings adjacent to the driven lead (compared to the winding directly between the driven leads), increasing resistive losses. In addition, windings

can allow high-frequency parasitic electrical currents to circulate entirely within the motor. A Wye-connected winding does not contain a closed loop in which parasitic currents can flow, preventing such losses.

A brushless DC electric motor (BLDC motor or BL motor), also known as electronically commutated motor (ECM or EC motor) and synchronous DC motors, are synchronous motors powered by direct current (DC) electricity via an inverter or switching power supply which produces electricity in the form of alternating current (AC) to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor.

The advantages of a brushless motor over brushed motors are high power-to-weight ratio, high speed, electronic control, and low maintenance. Brushless motors find applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles.

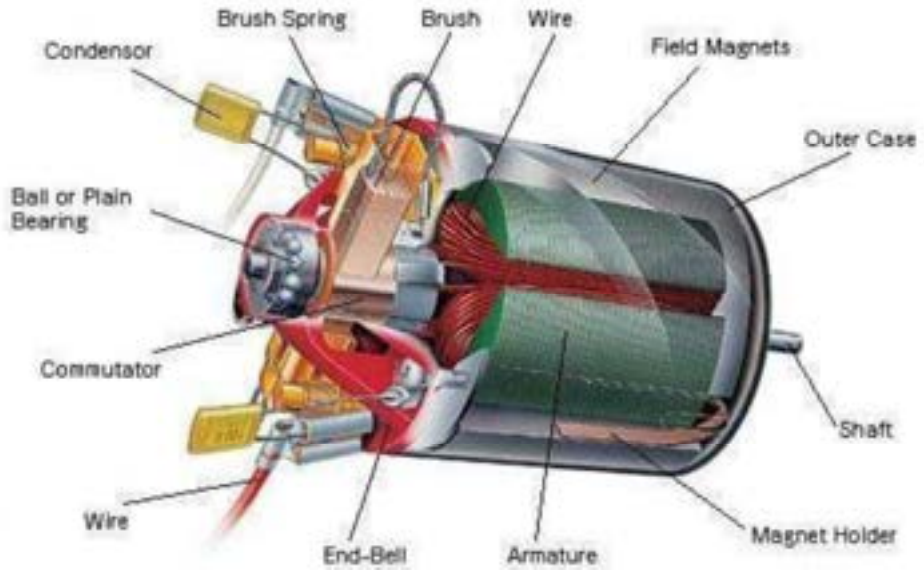

Fig-4.1(Brushless Motor)

4.1.1 Electronic Speed Controller (ESC):

An electronic speed control or ESC is an electronic circuit that controls and regulates the speed of an electric motor. It may also provide reversing of the motor and dynamic braking. Miniature electronic speed controls are used in electrically powered radio controlled models. Full-size electric vehicles also have systems to control the speed of their drive motors.

An electronic speed control follows a speed reference signal (derived from a throttle lever, joystick, or other manual input) and varies the switching rate of a network of field effect transistors (FETs). By adjusting the duty cycle or switching frequency of the transistors, the speed of the motor is changed. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.

Different types of speed controls are required for brushed DC motors and brushless DC motors. A brushed motor can have its speed controlled by varying the voltage on its armature. (Industrially, motors with electromagnet field windings instead of permanent magnets can also have their speed controlled by adjusting the strength of the motor field current.) A brushless motor requires a different operating principle. The speed of the motor is varied by adjusting the timing of pulses of current delivered to the several windings of the motor.

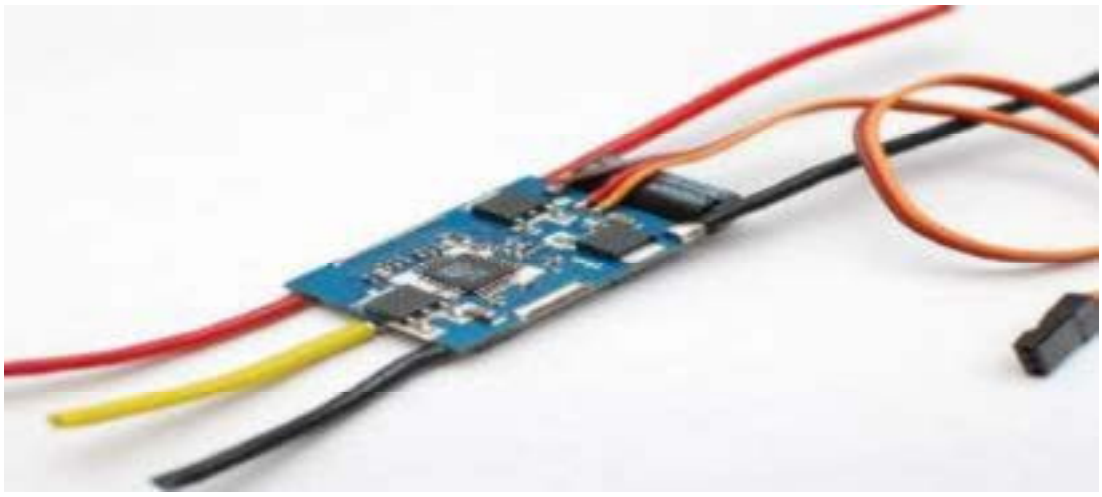

Fig-4.2(ESC)

4.1.2 Servo Motor:

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

The motor is paired with some type of position encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models.

Fig-4.3(Servo motor)

Servomotors may use resistive potentiometers as their position encoder. These are only used at the very simplest and cheapest level, and are in close competition with

stepper motors. They suffer from wear and electrical noise in the potentiometer track. Although it would be possible to electrically differentiate their position signal to obtain a speed signal, PID controllers that can make use of such a speed signal generally warrant a more precise encoder.

4.1.3 Propeller:

In aeronautics, a propeller, also called an airscrew, converts rotary motion from an engine or other power source into a swirling slipstream which pushes the propeller forwards or backwards. It comprises a rotating power-driven hub, to which are attached several radial airfoil-section blades such that the whole assembly rotates about a longitudinal axis. The blade pitch may be fixed, manually variable to a few set positions, or of the automatically-variable "constant-speed" type.

Very small pitch and helix angles give a good performance against resistance but provide little thrust, while larger angles have the opposite effect. The best helix angle is when the blade is acting as a wing producing much more lift than drag. However, 'lift-and-drag' is only one way to express the aerodynamic force on the blades. To explain aircraft and engine performance the same force is expressed slightly differently in terms of thrust and torque since the required output of the propeller is thrust. Thrust and torque are the basis of the definition for the efficiency of the propeller as shown below. The advance ratio of a propeller is similar to the angle of attack of a wing.

Fig-4.4(Propeller)

Propellers are similar in aerofoil section to a low-drag wing and as such are poor in operation when at other than their optimum angle of attack. Therefore, most propellers use a variable pitch mechanism to alter the blades' pitch angle as engine speed and aircraft velocity are changed.

4.1.4 Li-Po Battery:

A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid (gel) polymers form this electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, like mobile devices and radio-controlled aircraft.

Just as with other lithium-ion cells, LiPos work on the principle of intercalation and de-intercalation of lithium ions from a positive electrode material and a negative electrode material, with the liquid electrolyte providing a conductive medium. To prevent the electrodes from touching each other directly, a micro porous separator is in between which allows only the ions and not the electrode particles to migrate from one side to the other.

Fig-4.5(Lipo Battery)

LiPo batteries are now almost ubiquitous when used to power radio-controlled aircraft, radio-controlled cars and large scale model trains, where the advantages of lower weight and increased capacity and power delivery justify the price. Test reports warn of the risk of fire when the batteries are not used in accordance with the instructions.

4.1.5 Transmitter and Receiver:

In electronics and telecommunications a transmitter or radio transmitter is an electronic device which produces radio waves with an antenna. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves.

Transmitters are necessary component parts of all electronic devices that communicate by radio, such as radio and television broadcasting stations, cell phones, walkie-talkies, wireless computer networks, Bluetooth enabled devices, garage door openers, two-way radios in aircraft, ships, spacecraft, radar sets and navigational beacons. The term transmitter is usually limited to equipment that generates radio waves for communication purposes; or radiolocation, such as radar and navigational transmitters. Generators of radio waves for heating or industrial purposes, such as microwave ovens or diathermy equipment, are not usually called transmitters, even though they often have similar circuits.

Fig-4.6Transmitter and Receiver)

In radio communications, a radio receiver, also known as a receiver, wireless or simply radio is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. The antenna intercepts radio waves (electromagnetic waves) and converts them to tiny alternating currents which are applied to the receiver, and the receiver extracts the desired information. The receiver uses electronic filters to separate the desired radio frequency signal from all the other signals picked up by the antenna, an electronic amplifier to increase the power of the signal for further processing, and finally recovers the desired information through demodulation.

4.1.6 Coro Sheet:

Coroplast, or Coro, which is a brand name given to Fluted PolyPropylene sheets, is a lightweight, sturdy, resilient material extensively used in packaging and advertising. Coroplast sheets have parallel hollow flutes which make the material very light and strong. The material usually crushes, instead of breaking upon impact. Coro bonds well with epoxy hot glue, and CyanoAcrylate (CA) Adhesive. These characteristics make it suitable for RC applications. This material is of choice for making S.P.A.D. (Simple Plastic Airplane Designs). The fluted design helps in hinging and folding and curving.

Fig-4.7(Coro sheet)

This material is commonly used to erect commercial, political or other types of signs and for constructing plastic containers and reusable packaging. It is widely used in the signwriting industry for making signs for real estate sales, construction sites and promotions.

The last decade has found its increasing use among guinea pig, rabbit, domesticated hedgehog and other small pet enthusiasts as components of DIY cages. Additionally, it is used by members of the remote-controlled aircraft community to build nearly indestructible SPAD model aircraft.

4.1.7 Solar Panel:

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaic (PV), indirectly using concentrated solar power, or a combination. Concentrated solar power systems use lenses or mirrors and solar tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect.

Photovoltaic were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid rooftop PV system. Commercial concentrated solar power plants were first developed in the 1980s. As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions and utility-scale photovoltaic power stations with hundreds of megawatts are being built. Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun.

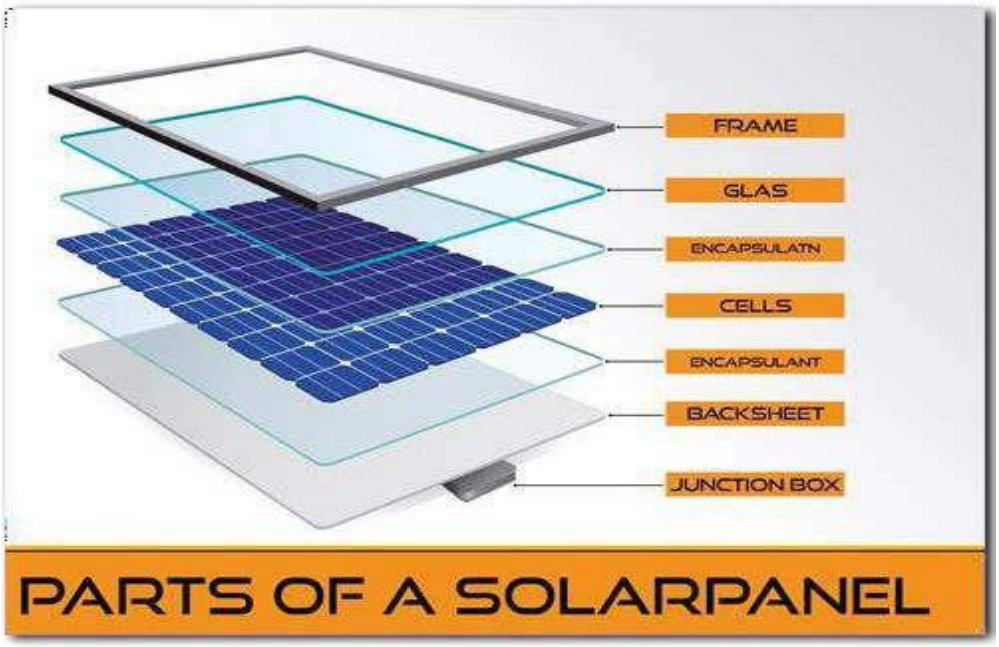

Fig-4.8(solar panel)

Emerging, third generation solar technologies use advanced thin-film cells. They produce a relatively high-efficiency conversion for the low cost compared to other solar technologies. Also, high-cost, high-efficiency, and close-packed rectangular multi-junction (MJ) cells are preferably used in solar panels on spacecraft, as they offer the highest ratio of generated power per kilogram lifted into space. MJ-cells are compound semiconductors and made of gallium arsenide (GaAs) and other semiconductor materials. Another emerging PV technology using MJ-cells is concentrator photovoltaic (CPV).

4.1.8 Solar Controller:

A solar controller is an electronic device that controls the circulating pump in a solar hot water system to harvest as much heat as possible from the solar panels and protect the system from overheating. The basic job of the controller is to turn the circulating pump on when there is heat available in the panels, moving the working fluid through the panels to the heat exchanger at the thermal store. Heat is available whenever the temperature of the solar panel is greater than the temperature of the water

in the heat exchanger. Overheat protection is achieved by turning the pump off when the store reaches its maximum temperature and sometimes cooling the store by turning the pump on when the store is hotter than the panels.

Fig-4.9(Solar controller)

One claimed advantage of PV power is that it reduces the overall carbon emissions associated with operating the system since it avoids the need to supply this energy from fossil sources. However, the energy required to operate the system is very small in comparison to the energy produced by the system and the carbon emissions reduction of adding PV power fractional.

The most practical benefit of a PV powered controller is the resultant simplicity of the overall system. Rather than using complex algorithms based on store and panel temperatures, the pump is driven directly by the PV panel: when the sun shines, the pump runs. In practice this is nearly (90-99%) as efficient a practical control algorithm as most others achieve and has obvious advantages for reduced system complexity.

The benefits of a PV powered solar controller comes at a cost in reduced system performance in the range of 1-10%. This is due to heat losses at times when the panel may be hotter than the water store but there is insufficient sunlight to power the pump.

CHAPTER 5

DESIGN METHODOLOGY

5.1 Design Specification:

1. Length of the UAV	52cm
2. Breadth of the UAV	5cm
3. Wing span	90cm
4. Weight of the UAV	850g
5. Volume of the fuselage	4.5cm
6. Endurance	10-15mins

5.2 Model constructions:

5.2.1 Over View:

To construct the model and also maintaining low weight, coro sheet is used. Firstly the model frame is built. To construct the model frame, airfoil sections are cut from coro sheet and these sections configure overall shape of the plane and then it is covered to complete the model. Electronic instruments are mounted in the central part of the wing .The model has two servo motors that are connected to elevons. This model is a radio control model. The shape of tail portion is closed box model. This model also called as double box tail UAV.

5.2.2 Fuselage and Tail construction:

The fuselage had been designed by using the coro sheet. The sheet had cut in the chosen dimension and the fuselage had been mounted. And tail design also made by the same sheet in the Box tail configuration.

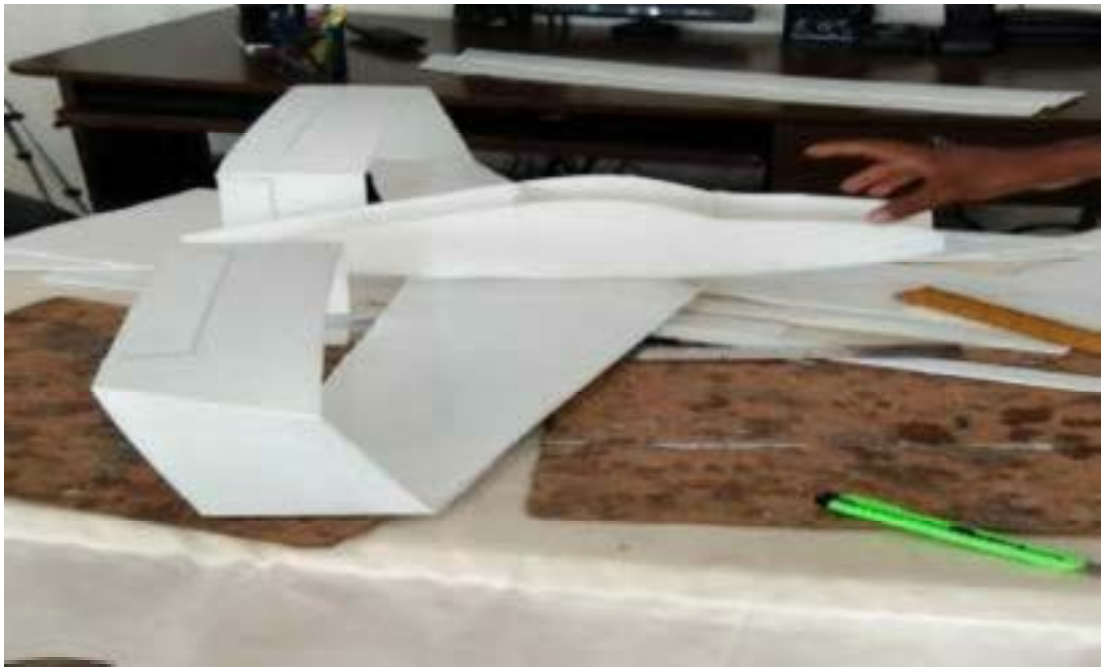

Fig-5.1(Fuselage construction)

Fig-5.2(Fuselage Construction)

5.2.3 Wing Configuration:

In wing design by using the coro sheet. First to making the airfoil by using coro sheet by made the delta wing configuration. An airfoil-shaped body moving through a fluid produces an aerodynamic force. The component of this force perpendicular to the direction of motion is called lift. The component parallel to the direction of motion is called drag. Subsonic flight airfoils have a characteristic shape with a rounded leading edge, followed by a sharp trailing edge, often with a symmetric curvature of upper and lower surfaces. Foils of similar function designed with water as the working fluid are called hydrofoils.

Fig-5.3(Wing Design)

Fig-5.4(Wing Construction)

The delta wing form has unique aerodynamic characteristics and structural advantages. Many design variations have evolved over the years, with and without additional stabilising surfaces. Its long root chord also allows a deeper structure for a given aerofoil section, providing more internal volume for fuel and other storage without a significant increase in drag. However, on supersonic designs the opportunity is often taken to use a thinner aerofoil instead, in order to actually reduce drag.

5.2.4 Electronic instrument mounted in UAV:

Electronic instruments are mounted in the central part of the wing. First the brushless motor to mount most forward or nose portion of the UAV. The lipo battery is mounted on back portion of the UAV. At the top of fuselage the solar panel is fixed at the back portion. The solar controller had mounted on front portion inside the fuselage.

Fig-5.5(Electronic Mounts)

5.2.5 Solar Panel Mounted:

At the top of the fuselage the solar panel is fixed at the back portion. The solar panel to connected by the solar controller. The battery also connected by the solar controller. The solar panel to provide the power source the battery has continuously be charged.

Fig-5.6(Solar panel mount)

5.3 Weight Estimation:

An aircraft's gross weight is limited by several weight restrictions in order to avoid overloading its structure or to avoid unacceptable performance or handling qualities while in operation.

Aircraft gross weight limits are established during an aircraft's design and certification period and are laid down in the aircraft's type certificate and manufacturer specification documents.

An aircraft's structural weight capability is typically a function of when the aircraft was manufactured, and in some cases, old aircraft can have their structural weight capability increased by structural modifications.

Total weight Wt = Wpayload + Wempty

Where,

I. Empty weight is only fixed wing UAV
II. Payload weight is solar panel, solar controller, LED light

Empty weight (W_o) =700gram

Payload weight (W_p) =150gram

Total weight of an UAV (W_t) =150+700

=850gram

5.4 Thrust Estimation:

Thrust is a reaction force described quantitatively by Newton's third law. When a system expels or accelerates mass in one direction, the accelerated mass will cause a force of equal magnitude but opposite direction on that system.

A fixed-wing aircraft generates forward thrust when air is pushed in the direction opposite to flight.

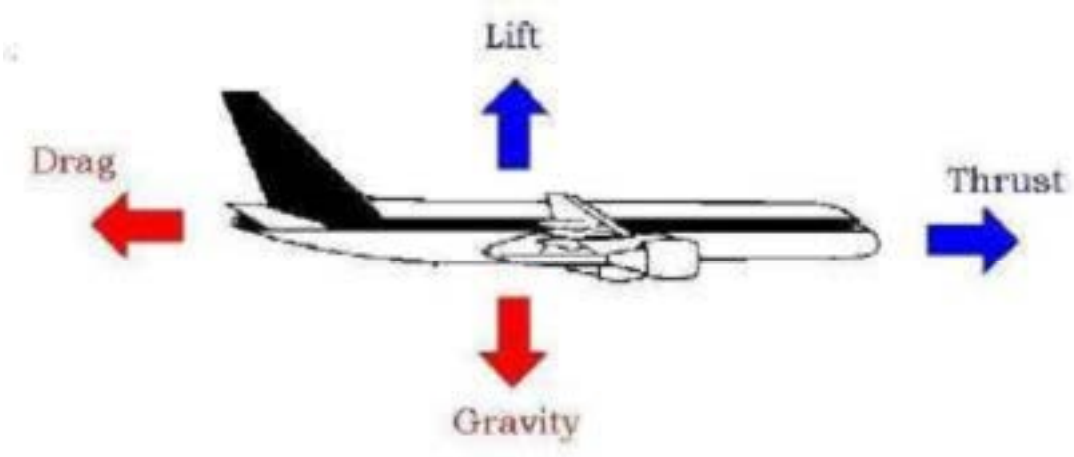

Fig-5.7(Aerodynamic forces)

In our design we are using the 1000kv Brushless motor and propeller size is 10*4.5 inch. It can produce 900 gram thrust, but our design weight only 850 gram. So it can produce high thrust.

To increase high thrust it can reduce motor kv and increase the propeller size.

5.5 Landing gear:

Landing gear is the undercarriage of an aircraft or spacecraft and may be used for either takeoff or landing. For aircraft it is generally needed for both. For aircraft, the landing gear supports the craft when it is not flying, allowing it to take off, land, and taxi without damage. Wheeled landing gear is the most common with skis or floats needed to operate from snow/ice/water and skids for vertical operation on land. Faster aircraft have retractable undercarriages, which fold away during flight to reduce drag.

Conventional landing gear, or tail wheel-type landing gear, is an aircraft undercarriage consisting of two main wheels forward of the centre of gravity and a small wheel or skid to support the tail. The term tail dragger is also used, although some claim it should apply only to those aircraft with a tailskid rather than a wheel.

Tricycle gear is a type of aircraft undercarriage, or landing gear, arranged in a tricycle fashion. The tricycle arrangement has a single nose wheel in the front, and two or more main wheels slightly aft of the center of gravity. Tricycle gear aircraft are the easiest to take-off, land and taxi, and consequently the configuration is the most widely used on aircraft.

In our design we are using tricycle landing gear arrangement.Tricycle gear aircraft are much less liable to 'nose over' as can happen if a taildragger hits a bump or has the brakes heavily applied. In a nose-over, the aircraft's tail rises and the propeller strikes the ground, causing damage.

Fig-5.8(Landing gear design)

CHAPTER 6

THREE VIEW DIAGRAM

6.1 FRONT VIEW:

Fig-6.1(Front view)

6.2 SIDE VIEW:

Fig-6.2(side view)

6.3 TOP VIEW:

Fig-6.3(Top view)

CHAPTER 7

TESTING AND RESULT

7.1 Testing and Result:

Result of tests as follow: In the first test, model showed good maneuverability and acceptable stability properties of box tail UAV. Consequently, two side box tail configuration model the maximum speed was about 1.5m/s, and flying time was 15 minutes.

In the second test, the maximum speed was about 1m/s, and flying time was 10 minutes. The UAV showed a better stability with proper maneuverability.

CHAPTER 8

CONCLUSION

The goal was to design a Unmanned Aerial Vehical in boxtail configuration powered with solar panel. Consequently, two box shaped tail model were fabricated, both boxtail are fixed to make delta wing by using rods. To compute aerodynamic properties it is assumed that lift distribution is ideal.

In this box tail elevons are used as control surface to control the UAV. And also winglets are used to reduce wingtip vortices. Flight test proven that the stability properties become high when winglets should be used.

This design gives high performance and stability by using that delta wing. The small solar panel are used for this UAV which produces only less power. That we also using lipo battery to produce high power. The box tail was designed to give better performance which achieved a good stability and maneuvetability.

REFERENCES

1) Y. Naidu and S. Adali "Design and Optimization Of a Medium Altitude Long Endurance UAV Wingbox structure". (4 Jun 2014)
2) Giulio Romeo "Manufacturing And Testing Of Graphite – Epoxy Wing Box And Fuselage Structures For A Solar powered UAV – HALE". (5 May 2015)
3) Giulio Romeo "Design, manufacturing and testing of a HALE – UAV structural Demonstrator". (18 April 2007)
4) G. Romeo, F. Danzi, E. Cestino "Multi-Objective Optimization Of the Composite Wing Box of Solar Powered HALE UAV". (7 Sep 2014)
5) L. Jorge, Ivan Gonzalez, Rogelio Lozano "Sun Tracking Technique Applied to a Solar Unmanned Aerial Vehicle". (22 Jun 2019)
6) Parvathy Rajendran, Howard smith "Development of Design Methodology for a Small Solar – Powered Unmanned Aerial Vehicle". (27 Mar 2018)
7) Ahmad Alsahlani, Thurai Rahulan "Composite Structural Analysis of a High Altitude, Solar Powered UAV". (1 Jan 2017)
8) Giacomo Frulla "Structural Analysis of High Altitude Very Long Endurance Solar Powered Platform for telecommunication and Earth Observation Application". (14 Feb 2018)
9) Skander Taamallah "Low-Order Modeling For A Small-Scale Flybarless Helicopter UAV A Grey-Box Time-Domain Approach. (Sep 2017)
10) EnricoCestino "Design of solar high altitude long endurance aircraft for multi payload & operations".(june 20016)
11) M. Saleem,E. Gopi &R. Ramesh Kumar "Fabrication of solar energy UAV". (Nov 2017)

LIST OF JOURNAL;

1. 2nd International Conference on Materials, Manufacturing and Machining for Industry 4.0, Bannari Amman Institute of Technology, Virtual Conference, Erode, Tamil Nadu, 9th - 10th October 2020

EXPERIMENTAL INVESTIGATION OF PROPELLER PERFORMANCE WITH PROPELLER SURFACE CORRUGATION

A PROJECT REPORT

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in

AERONAUTICAL ENGINEERING

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(AUTONOMOUS)

MAY 2020

ABSTRACT

The propeller is the primary component of flying vehicles powered by electric motors, internal combustion engines, and turboprops for producing thrust. A propeller thrust is produced in the engine by effective spinning of the propeller through air for cost-effective and environmental friendly flight. Natural flyers like birds as well as aquatic animals like humpback whales effectively use its wings and flippers with its surface features for capturing its prey and escaping from their enemies. As part of this work, corrugations are established in the leading edges or in the suction surfaces of the propeller to modify the flow field prevailing over there. Because of the flow field, the surface corrugations or leading edge corrugations energize the boundary layer in the surfaces of the propeller by counter-rotating vortices which, in turn, delays the separation of the boundary layer from the surface. The performance parameters of the propeller such as thrust, torque, propeller efficiency, power consumption etc., are measured using propeller test rig. Depending on the location of surface or leading corrugations, the variations in the performance of the propeller are investigated for further optimization on the selection of better propeller to the applications of UAVs operating at low Reynolds No.

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LIST OF SYMBOLS AND ABBREVIATION

AC	-Alternating Current
ATM	-Air Traffic Management
APC	-Advanced Precision Computer
BT	-Battery
C_L	-Co efficient Lift
C_D	-Co efficient Drag
C_P	- Coefficient pressure
CAD	-Computer Aided Design
CFD	-Computational Fluid Dynamics
CACGS	-Computer Assisted Carrier Guidance System
DC	-Direct Current
ESC	-Electronic Speed Controller
η	-Efficiency
ηp	-Propulsive Efficiency
Ft	-Feet
HALE	-High Altitude Long Endurance
In	-Inches
Kg	-Kilogram
Km	- Kilometer
Kgf/w	-Kilogram force/weight
Kgf	-kilogram force
LE	-Leading Edge
LIPO	-Lithium Ion Polymer
M	-Meter
Nm	-Nanometer
PMSM	-Permanent Magnet Synchronous motor
PID	- Proportional Integral Derivation
RN	-Reynolds Number

RPM	-Revolutions per minute
RPAS	-Remotely Piloted Aircraft System
T	-Thrust
UAV	-Unmanned Aerial Vehicles
UAS	-Unmanned Aircraft System
V	-Velocity
VFD	-Variable Frequency Drive
VTOL	-Vertical Take Off Landing

CHAPTER 1
INTRODUCTION

An Unmanned Aerial Vehicles capable of Vertical Take-Off and Landing (VTOL UAVs), are increasingly deployed for various applications such as surveillance, autonomous parcel delivery, oil and gas spill detection and firefighting. The development of Unmanned Aerial Vehicles (UAV) for civil and military applications has increased significantly over the last decade. More industries such as agricultural, educations, communications, and energy sector are becoming more courageous to venture into the utilizations of UAV to carry our various missions. As the advancement of technologies, the implementation of UAV may contribute to increase in productivity as well as reducing the risk, allowing replacement of manned mission. This is because UAVs are cost and maintenance friendly. Hence, it is very important to have high-performance UAV design so that it could deliver the mission efficiently.

An unmanned aerial vehicle (UAV) is an aircraft without a human pilot on board and a type of unmanned vehicle. UAVs are a component of an unmanned aircraft system (UAS); which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by onboard computers. Compared to crewed aircraft, UAVs were originally used for missions too "dull, dirty or dangerous" for humans. While they originated mostly in military applications, their use is rapidly expanding to commercial, scientific, recreational, agricultural, and other applications, such as policing and surveillance, product deliveries, aerial photography, infrastructure inspections, smuggling, and drone racing. Civilian UAVs now vastly outnumber military UAVs, with estimates of over a million sold by 2015.The term drone, more widely used by the public, was coined in reference to the early remotely-flown target aircraft used for practice firing of a battleship's guns, and the term was first used with the 1920s Fairey Queen and 1930's de Havilland Queen Bee target aircraft. These two were followed in service by the similarly-named Airspeed Queen Wasp and Miles Queen Martinet, before ultimate replacement by the GAF Jindivik.

The term unmanned aircraft system (UAS) was adopted by the United States Department of Defences (DoD) and the United States Federal Aviation Administration in 2005 according to their Unmanned Aircraft System Roadmap 2005–2030. The International Civil Aviation Organization (ICAO) and the British Civil Aviation Authority adopted this term, also used in the European Union's Single-European-Sky (SES) Air-Traffic-Management (ATM) Research (SESAR Joint Undertaking) roadmap for 2020. This term emphasizes the importance of elements other than the aircraft. It includes elements such as ground control stations, data links and other support equipment. A similar term is an unmanned-aircraft vehicle system (UAVS), remotely piloted aerial vehicle (RPAV), remotely piloted aircraft system (RPAS).

The performance of a UAV is significantly influenced by the efficiency of the propeller. Thus, it is very important to investigate the propeller performance to ensure that the design led to a reliable UAV performance. Generally, propeller used for UAVs operates at a very low Reynolds number, measured at the 75% chord of the propeller. Currently, most small UAVs use off-shelf propeller blade due to its availability and economical advantage. The process of selecting the best propeller may be tedious, as it need to be tested to fit the specification and requirements of the UAV. In addition, the selection for propeller blade are concentrated to conventional blade design. Unconventional blade designs such as slotted, serrated, tubercle and adaptive structure are less likely to be implemented as it need to be designed and fabricated independently based on the requirements of the flight. Slotted blade designs are proposed in this study to engaged novel blade design implementations for UAV.

Figure 1.1: DJI Mavic 2 pro drone

1.1 History:

The earliest recorded use of an unmanned aerial vehicle for war fighting occurred on July 1849, serving as a balloon carrier in the first offensive use of air power in naval aviation. Austrian forces besieging Venice attempted to launch some 200 incendiary balloons at the besieged city. The balloons were launched mainly from land; however, some were also launched from the Austrian ship SMS Volcano. At least one bomb fell in the city; however, due to the wind changing after launch, most of the balloons missed their target, and some drifted back over Austrian lines and the launching ship Volcano. UAV innovations started in the early 1900s and originally focused on providing practice targets for training military personnel. UAV development continued during World War I, when the Dayton-Wright Airplane Company invented a pilotless aerial torpedo that would explode at a present time.

The earliest attempt at a powered UAV was A. M. Low's "Aerial Target" in 1916. Nikola Tesla described a fleet of uncrewed aerial combat vehicles in 1915. Advances followed during and after World War I, including the Hewitt-Sperry Automatic Airplane. This development also inspired the development of the Kettering Bug by Charles Kettering from Dayton, Ohio. This was initially meant as an uncrewed plane that would carry an explosive payload to a predetermined target.

The first scaled remote piloted vehicle was developed by film star and model-airplane enthusiast Reginald Denny in 1935. More emerged during World War II – used both to train antiaircraft gunners and to fly attack missions. Nazi Germany produced and used various UAV aircraft during the war. Jet engines entered service after World War II in vehicles such as the Australian GAF Jindivik, and Teledyne Ryan Firebee I of 1951, while companies like Beechcraft offered their Model 1001 for the U.S. Navy in 1955. Nevertheless, they were little more than remote-controlled airplanes until the Vietnam War.In 1959, the U.S. Air Force, concerned about losing pilots over hostile territory, began planning for the use of uncrewed aircraft. Planning intensified after the Soviet Union shot down a U-2 in 1960. Within days, a highly classified UAV program started under the code name of "Red Wagon".

The August 1964 clash in the Tonkin Gulf between naval units of the U.S. and North Vietnamese Navy initiated America's highly classified UAVs into their first combat missions of the Vietnam War. During the War of Attrition (1967–1970) the first

tactical UAVs installed with reconnaissance cameras were first tested by the Israeli intelligence, successfully bringing photos from across the Suez Canal. This was the first time that tactical UAVs, which could be launched and landed on any short runway, were developed and tested in battle.

Figure 1.2: Quadcopter

In the 1973 Yom Kippur War, Israel used UAVs as decoys to spur opposing forces into wasting expensive anti-aircraft missiles. After the 1973 Yom Kippur war, a few key people from the team that developed this early UAV joined a small startup company that aimed to develop UAVs into a commercial product, eventually purchased by Tadiran and leading to the development of the first Israeli UAV. In 1973, the U.S. military officially confirmed that they had been using UAVs in Southeast Asia (Vietnam). Over 5,000 U.S. airmen had been killed and over 1,000 more were missing or captured. During the 1973 Yom Kippur War, Soviet-supplied surface-to-air missile batteries in Egypt and Syria caused heavy damage to Israeli fighter jets. As a result, Israel developed the first UAV with real-time surveillance.

The images and radar decoys provided by these UAVs helped Israel to completely neutralize the Syrian air defenses at the start of the 1982 Lebanon War, resulting in no

pilots downed. The first time UAVs were used as proof-of-concept of super-agility post-stall controlled flight in combat-flight simulations involved tailless, stealth technology-based, three-dimensional thrust vectoring flight control, jet-steering UAVs in Israel in 1987. With the maturing and miniaturization of applicable technologies in the 1980s and 1990s, interest in UAVs grew within the higher echelons of the U.S. military.

In the 1990s, the U.S. DoD gave a contract to AAI Corporation along with Israeli company Malat. Many of these UAVs saw service in the 1991 Gulf War. UAVs demonstrated the possibility of cheaper, more capable fighting machines, deployable without risk to aircrews. Initial generations primarily involved surveillance aircraft, but some carried armaments, such as the General Atomics MQ-1 Predator, that launched AGM-114 Hellfire air-to-ground missiles.

Figure 1.3: A General Atomics MQ-9 Reaper, a hunter-killer surveillance UAV

1.2 Classifications:

UAVs typically fall into one of six functional categories:

1. Target and decoy
2. Reconnaissance
3. Combat
4. Logistics

5. Research and Development
6. Civil and Commercial UAVs

Vehicles can be categorized in terms of range/altitude. The following has been advanced as relevant at industry events such as ParcAberporth Unmanned Systems forum:

- Close 5,000 ft (1,500 m) altitude, up to 10 km range
- Tactical 18,000 ft (5,500 m) altitude, about 160 km range
- MALE (medium altitude, long endurance) up to 30,000 ft (9,000 m) and range over 200 km
- HALE (high altitude, long endurance) over 30,000 ft (9,100 m) and indefinite range
- CIS Lunar Earth-Moon transfer
- Computer Assisted Carrier Guidance System (CACGS) for UAVs

Drones can be classified on a different basis – say based on usage like Drones for Photography, Drones for aerial Mapping, Drones for Surveillance etc. However, the best classification of Drones can be made on the basis of aerial platforms. Based on the type of aerial platform used, there are 4 major types of drones.

1. Multi Rotor Drones
2. Fixed Wing Drones
3. Single Rotor Helicopter
4. Fixed Wing Hybrid VTOL

1.3 Components of an UAV:

Crewed and uncrewed aircraft of the same type generally have recognizably similar physical components. The main exceptions are the cockpit and environmental control system or life support systems. Some UAVs carry payloads (such as a camera) that weigh considerably less than an adult human, and as a result can be considerably smaller. Though they carry heavy payloads, weaponized military UAVs are lighter than their crewed counterparts with comparable armaments. Small civilian UAVs have no lifecritical systems, and can thus be built out of lighter but less sturdy materials and shapes, and can use less robustly tested electronic control systems.

For small UAVs, the quadcopter design has become popular, though this layout is rarely used for crewed aircraft. Miniaturization means that less powerful propulsion technologies can be used that are not feasible for crewed aircraft, such as small electric motors and batteries. Control systems for UAVs are often different than crewed craft. For remote human control, a camera and video link almost always replace the cockpit windows; radio transmitted digital commands replace physical cockpit controls.

A drone or UAV consists of the following essential parts:

1. Frame
2. Motors
3. ESC (electronic speed controller)
4. Propeller
5. Battery
6. Flight Controller
7. RC Receiver

Although slotted design has been implemented for several other applications, none has been developed for low Reynolds number small scale UAV propeller. Thus, this study aims to provide an extensive research on novel slotted designs for small scale propeller blade operating at low Reynolds number, typically less than 100,000. The Reynolds number is measured based on the velocity and chord at 75% span blade station. The objective of this work is to design and study the performance of slotted trailing edge propeller blade operating with Reynolds number less than 100,000. The flow simulations are performed through three-dimensional computational fluid dynamic software (FLUENT) to determine the thrust coefficient, power coefficient and overall efficiency measured in advancing flow conditions.

The analyses were done with both experimental and numerical, in which the experimental data collected are used to validate numerical data. The result shows that the slotted blade design manage to improve the overall performance of the blade, compared to straight and tubercle design. In addition, the result shows that slotted design performed better at low wind speed condition. The size and shape of the propellers used vary just as much as the type of UAV flown. These UAV's are fairly inexpensive and use small motors and propellers with diameters less than 10 in. to provide thrust.

Many of the UAV propellers are operates at higher power consumption. For increasing propeller performance thrust is an important factor while analyzing the

performance of UAV. In order to increase the performance of these propeller we create a corrugated surface in leading edge of a propeller. A corrugated surface of a propeller increases the performance of a UAV with low power consumption. The main objective of our project is to reduce the power consumption of working propeller and produce high thrust and efficiency of UAV while flying. From the development of corrugations in the leading edge we minimize the power consumption and energy losses.

The propeller and propulsion system configuration present losses due to interference with the multi-rotor arms and mutual interference between propellers. In this we are focusses on the effects of propeller configuration on the propulsion system efficiency of the UAV's. The testing choices that are often made during the process of a UAV discussed in this paper, and investigated by a set of experiments.

The influence of shape and thickness of the propeller arm is discussed as a part of our experiment. The various performances are experimented with different parameters and found a small influence on the performance of the UAV. Finally, the mutual influence of propellers in coaxial and overlapping setups is presented. The propeller characteristics obtained from the static tests are used for estimation of UAV performance. These characteristics are presented in terms of certain parameters.

The propeller performance is expressed using non-dimensional coefficients like power coefficient, thrust coefficient, torque coefficient, advance ratio and efficiency of the propeller. The overall propeller thrust, propeller efficiency, rpm and torque will be obtained by integrating the individual element performance from root to tip. The recent measurements of corrugated surface propeller is effective than older model propeller in aerodynamic performances of an UAV's and other applications.

1.4 SUMMARY:

From this chapter we conclude that the performance or uav propeller is differd with the flow pattern. The propeller of an uav will difine the performance of an uav.

CHAPTER 2
LITERATURE REVIEW

2.1 Propeller Aerodynamic Analysis:

A propeller system with increased propulsive thrust, with a sufficiently high level of aerodynamic efficiency for a selected radio-controlled aircraft model. All these improvements to the design of the propeller will be achieved by means of a thorough analysis of the effects of varying the different elements and their geometries, together with experimentation of different sizes and types of propellers. If changes were to be made to the propeller systems to such an extent whereby its propulsive thrust can be further improved for low speed propeller aircrafts, in addition to its already known advantage of being fuel efficient at these low speeds, large costs can be saved, in the manufacturing of the propulsion system itself, on its maintenance, and also on running the flights of the aircrafts especially in a world of soaring fuel prices and ever increasing material costs, as a result or mere consequence of exploiting the earth's natural resources near its limited capacity.

The focus of this report is mainly to analyse and design a propeller system with increased propulsive thrust, without too much of a significant loss in efficiency, for a selected radio-controlled aircraft model. With the known details of the radio-controlled aircraft, a propeller will be designed for maximum performance under optimum conditions. Propeller efficiency, thrust and torque produced will be the primary guidelines along which the propeller design will be achieved.

The main tools being used for the design of the propeller and its dimensions are softwares such as 'Javafoil', 'JavaProp', 'X-foil' and 'GUI Software'. Hand calculations and analytical methods are then carried out to verify the results obtained from the softwares, before an actual propeller is printed from the new "Best" propeller design.The propellers are scanned using a prototype model and further developed by CAD drawing to obtain the geometry of a propeller. The values of thrust, torque and propeller efficiency were measured using GUI software. With that results the propeller is designed by manipulating each individual variables that makes up the geometry. The performance of both propellers are compared using GUI Software again, and then verified with Excel Spreadsheet calculations as well thrust measurement experiments.

The software and analytical thrust values are both within 10% range of the experimental value. However, the software figures for tend to be slightly lower than the experimental, whereas the analytical figures tend to be slightly higher. The torque figures have quite a significant difference between the software and analytical methods, being closer to 20%. This may be attributed to the fact that no comparison is made to an experimental value for torque, which otherwise most likely fall in between the software and analytical values and would make the percentage difference closer to those of the thrust produced, if not similar.

2.2 Review on Tubercles Design:

The design of propellers in aeronautics is still earning high interest. This has led to the application of biomimetic for improving aerodynamic performance. One such design is the usage of tubercles in either leading or trailing edge of airfoils. So the usage of tubercles has so far been in the design of wing or wind-turbines. Recent studies have aimed to study tubercles for the design of a propeller. The studies have so far gained reputations in improving the aerodynamic performance on a few but not all of the airfoil shapes. Similar results have been identified for propeller designs with improvement in thrust at low torque. We have so far led research works on developing new propeller designs with the aim to improve the thrust and torque performance of propeller. Tubercles are sinusoidal wavy formations on the leading edge (LE) that takes the form throughout the surface from leading to trailing edge (TE).

The implementation of tubercles on modern airfoil surfaces originated from the works of Fish humpback whales are found to provide improved aerodynamics with reduced drag while diving and catching prey. The tubercle design has so far been adapted to many but not limited to design of aircraft, marine propeller as well as wind turbine blades.The studies on tubercles so far have been on non-thrust generating designs of fixed aircraft wing and wind turbine and very few studies exist that have been implemented directly on wither aircraft or marine propellers the non-thrust generating platform try to improve lift and stall angle whereas propellers with tubercles have been studied to improve thrust generation.

Tubercles are implemented on LE of the airfoil. The wavelength, amplitude, airfoil, propeller diameter and blade number are fixed for a single design. The analysis is performed numerically in CFD for different advance ratios. The amount of performance in

thrust and torque and aerodynamic efficiency improvements are predicted and compared with a baseline propeller. The sizes of the oblate spheroid are varied as well as the spacing between them and tested for 9 different cases in total. The widths are assumed to be 5, 6.25 and 8 percent of propeller radius. The tubercle intervals are assumed to be 7.14, 8.33, and 10 percent of the effective propeller radius. The height of the spheroid tubercle is assumed to be 2/3 of widths. All the 9 cases were tested for similar Reynolds number (RN) of 5x104. The model with tubercles is assumed to be similar to that of the humpback whale flipper's cross-section resembling a NACA 634-021 airfoil. Both models are identical with one a scaled up version of the other and having similar NACA 0021 cross-sections. The models are compared to a straight-edged model of similar sizes. The study was performed for flow conditions of 1.2x105 and 1.5x106 RN.

The design of aircraft wing or turbine blades, the maximum lift co-efficient (CLmax) and CD achieved in simulation or experiments is provided. The performance of NACA 634-021 airfoil sections. The results of the studies indicate positive maximum increment of CL of 4.8% and 25% respectively compared to baseline. Similarly, the CD has 10.9% and 20% decrement were obtained for RN of 5x104. The performance of NACA 0020 CLmax of 0.93 and 0.88 is achieved for scalloped and smooth flipper and the AOA 12º the models have to develop higher CD at 34% and 69%. The performance of NACA 0014 airfoil RN 1.2x10 Both CL and CD have shown a large decrement compared to baseline. A pressure co-efficient (CP) of 0.39 is achieved marginally higher over straight edged.

The NACA 0020 and NACA 0021 sectional models, the lift and drag performance are found to be inferior compared to baseline straight-edged models. Only for NACA 634-021 airfoil sectional designs, a relatively higher lift and lower drag values have been achieved. This does not preclude the fact that for a propeller, the results showed only a marginal change in CT over baseline in all test cases. The results primarily present a not-so-highly optimistic case for tubercled propellers.

2.3 Performance Data at Low Reynolds Numbers:

The propeller performance for full-scale airplanes has been well documented since the pioneering days of aviation, data on propellers at low Reynolds numbers has been scarce. Many UAVs use propellers that must operate in the low Reynolds number range of

50,000 to 100,000 based on the propeller chord at the 75% propeller-blade station. Tests were performed at the University of Illinois at Urbana-Champaign (UIUC) to quantify the propeller efficiency at these conditions. During the tests, the propeller speed (RPM) was fixed while changing the wind-tunnel speed to sweep over a range of advance ratios until reaching the windmill state (zero thrust).

The experimental setup for this research covers six various sections and the measurements were conducted separately for each parameters.

1. Thrust and Torque Measurements
2. Propeller Speed Measurement
3. Freestream Flow Speed Measurement
4. Motor, Speed Controller and Propellers

From the above measurements all signals were acquired using a National Instruments NI PCI-6031E 16-bit analog-to-digital data acquisition board driven by custom software developed using Lab view, which is a C-based software suite from National Instruments, for creating Graphical User Interfaces (GUIs). The propeller speed measurement required a high data acquisition rate to ensure that the signal from the photo reflector was accurately recorded. Due to limitations on the data acquisition board, this prohibited acquiring all of the data simultaneously. Thus, the propeller speed was first acquired at the higher data acquisition rate, then the remaining quantities (thrust, torque, dynamic pressure, atmospheric pressure, and temperature) were acquired simultaneously immediately thereafter at a reduced rate.

The experimental procedure included setting up the experimental hardware and data acquisition system, calibration and calibration checks of the various instruments, and acquiring the performance data. Acquiring the performance data included obtaining the static performance data as well as obtaining the remaining performance data in one of two test modes. The two possible test modes allowed the experimenter to sweep the advance ratio range by varying either the freestream velocity or propeller speed, while holding the other constant.The propellers tested here are limited to non-folding, two-bladed propellers, a wide range of propeller styles were tested nonetheless. The majority of the propellers tested had diameters ranging from 9 in. to 11 in., though a few larger sizes were tested. For this series of tests, all of the propellers were tested without any alterations.

For this research almost 79 propellers were tested and nearly all fit in the 9- to 11-in. diameter range. Thrust and torque were measured over a range of propeller advance ratios for discrete propeller speeds (RPM's) – typically four different values of RPM to examine low Reynolds number effects. Also static thrust was measured over a range of propeller speeds from nominally 1,500 to 7,500 RPM depending on the propeller diameter. The results showed significant Reynolds number effects with degradation in performance with lower.

2.4 Aerodynamic Characterization of Leading Edge Protrusions:

The relatively large tubercles or protruding bumps on the leading edge of the hump- back whale fin create counter-rotating chord wise vortices. At high Reynolds numbers, these vortices have been shown to delay stall with minimal effect on drag. The range of Reynolds numbers that these types of vortices form is unknown, and so an investigation of the potential for an increased envelope of operation for small aircraft propellers was done. Because of the inherent restrictions on propeller chord length and wind speeds due to rotational speed, which in turn limits the Reynolds number, it is unlikely that the type of modification tested in beneficial for small aircraft propellers typical of unmanned aerial vehicles.

Design of Experiments:

1. Propeller Type Selection
2. Propeller Aerodynamic Design
3. Leading Edge Protrusion Size and Spacing

The size of the propeller and a 5.5 inch diameter and 4 inch pitch propeller was chosen, typical of small aircraft. This propeller had a calculated Reynolds number range of 2.9_104 to 5.3_104 with the variation due to the dynamic wind tunnel speed. The simple design used for full scale wood propellers was chosen. The points of each cross section were then imported into a CAD modelling program, and surface modelling was used to construct the propeller. Three sizes and three spacing's were chosen, resulting in nine test propellers.The height was defined as 2/3 the width, similar to the humpback whale tubercle sizing. The ranges of widths were sized at 5, 6.25, and 8 percent of the effective propeller

radius, or distance from root to tip. The spacing's between protrusions were defined as 7.14, 8.33, and 10 percent of the effective propeller radius, which was 2.5 inches.

The first was efficiency versus advance ratio, which gave insight into the efficiency effects over a wide range of angles of attack represented by the advance ratio. The second was coefficient of thrust versus advance ratio, which gave insight into the thrust effects over a wide range of angles of attack. This induced a small change in the Reynolds number which changed the 8,000 RPM case from 2.9×104 to 3.0×104 and changed the 14,000 RPM case from 4.9×104 to 5.3×104. The record data points consisting of 10 seconds of raw sensor voltages at 400 hertz. To hold the propeller rotational speed (n) constant, a 10 bit micro controller running a PID (proportional-integral-derivative) control algorithm. The result was a constant RPM with a 5 second or less response regardless of load until the maximum system capacity.

The base propeller tested, it has been the leading edge protrusions of the size, spacing, and type in this only contributed to degraded performance. In the case of the small protrusion size and slowest RPM, there were negligible negative effects with little or no positive effects at any of the advance ratios tested. It is possible that testing at higher Reynolds numbers will produce positive results. Where there is an increased chord length or velocity due to rotation, such as a larger aircraft propeller, may see positive results. Larger propellers, or create a validated CFD model and experiment with varying propeller sizes and leading edge geometries. Alternate geometry with the same propeller size and operating conditions may also yield different results.

2.5 SUMMARY:

From this literature survey we conclud that the performance of curregauted propeller in the low renolds number will create high thrust over the surface of the propellers. The analysis of propeller performance in static propeller testing is done based on the survey.

CHAPTER 3

METHODOLOGY

The theory behind this setup, which was experimentally verified, is that the airflow upstream of the propeller is slower than the airflow downstream. The airflow around the propeller has a cone shape. The area of the air affected upstream of the propeller is larger and, due to the conservation of mass, it is also slower. Since drag losses are proportional to the square of the velocity, an obstacle upstream will has a smaller effect on the thrust than an obstacle downstream. The air moving slower causes less drag losses due to the testing equipment, which is why we recommend testing in the configuration of the image above. Testing with the thrust in the other direction can create results 3-20% different due to the airflow interaction with the fixture. In the configuration presented in the image above, the thrust will be positive by default. You can always reverse the reading by activating the reverse thrust checkbox of our software in the "Utilities" tab if you prefer not to have to do that operation in your spreadsheet editor after. Note that your quadcopter arm or airframe will also have an impact on the thrust in flight.

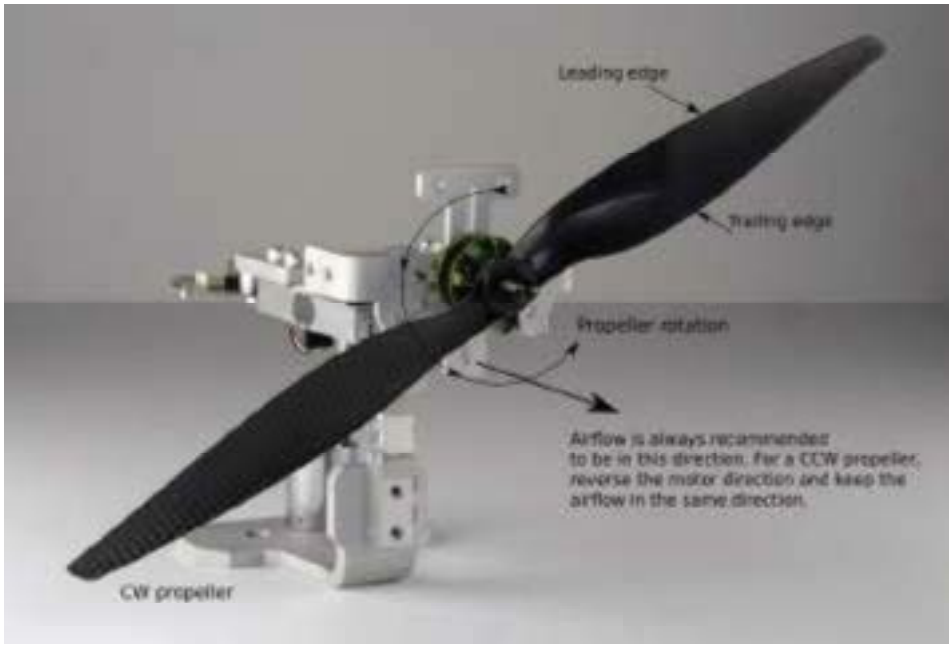

Figure 3.1: Static propeller test

When testing in a wind tunnel, you also have to run a test with the propeller removed from the test fixture to characterize the drag of the measuring instrument. Most of the studies on tubercles so far have been on non-thrust generating designs of fixed aircraft wing and wind turbine and very few studies exist that have been implemented directly on wither aircraft or drone propellers. Studies on non-thrust generating platform try to improve lift and stall angle whereas propellers with tubercles have been studied to improve thrust generation .To hold the propeller rotational speed (n) constant, a 10 bit micro controller running a PID (proportional-integral-derivative) control algorithm was used.

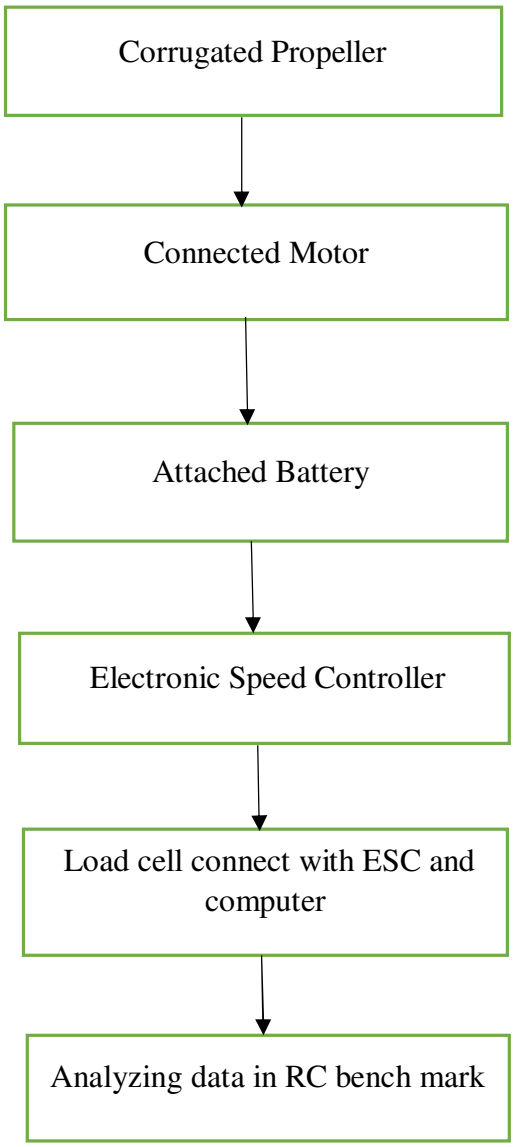

Figure 3.2 Flow chart for static propeller test

The PID algorithm was defined by the open source PID library from Adriano. The micro-controller was set up to measure the motor RPM from the voltage pulses coming from the three leads of the brushless motor using an Eagle tree rpm sensor. Pulses were counted, polled, and reset at a set interval. Using a strobe tachometer, the relation between the rpm and the number of pulses per interval was found to be linear and the relation was implemented into the PID controller. The proportional, derivatives, and integral gains were chosen to give an adequate response time without oscillation. The result was a constant RPM with a 5 second or less response regardless of load until the maximum system capacity.

3.1 Static test:

Static testing is a software testing method that involves examination of the program's code and its associated documentation but does not require the program be executed. It is primarily checking of the code and/or manually reviewing the code or document to find errors.

This type of testing used to find

Motor efficiency

Thrust efficiency

Power efficiency

Propeller vibration

3.1.1 Motor efficiency:

Electric motor efficiency is the ratio between power output (mechanical) and power input (electrical). Mechanical power output is calculated based on the torque and speed required (i.e. power required to move the object attached to the motor), and electrical power input is calculated based on voltage and current supplied to the motor. Mechanical power output is always lower than the electrical power input, as energy is lost during conversion (electrical to mechanical) in various forms, such as heat and friction. Design of an electric motor aims to minimize these losses to improve efficiency.

$$\text{Motor efficiency} = \frac{output\ power}{input\ power} \times 100$$

The brushless motor and system used a 200-W motor with ratio that was capable of driving the propeller to a maximum speed of 7,500 RPM. For simplicity in the laboratory, a variable voltage switch mode power supply, made by BK Precision, is used to power the motor. The model used, the BK1692, can be set to an output voltage of 3 V to 15 V with a maximum current of 40 A. Given the brushless motor designed to work with a speed controller, a method was needed to send the appropriate signal to the speed controller. To set the rotational speed, a device called the Servo EF, made by Vexa Control, was used. This device is designed to be used for testing R/C servos by allowing the operator to adjust the pulse-width of the signal being sent to the server.

3.1.2 Thrust efficiency:

It is defined as the ratio of useful power output to the rate of energy input. For flight, propulsive efficiency is expressed as: thrust flight speed. Kinetic energy increase of fluid.The thrust produced by a right-handed propeller. The thrust measurement was obtained outside the static test through a pendulum T-shaped structure that pivoted about two flexural pivots while being constrained by a load cell outside of the stand. The Interface model SM-10 load cell was used, having a maximum capacity of 2 kg. To ensure that the Freestream flow did not produce a drag force on the beam located the stand, the torque produced by the propeller was measured using the reaction torque transducers made by Transducer Techniques.

3.1.3 Power efficiency:

Power efficiency is defined as the ratio of the output power divided by the input power: $\eta = 100\% \cdot P_{out} / P_{in}$. η is the efficiency in percent (%). P_{in} is the input power consumption in watts (W). P_{out} is the output power or actual work in watts (W).

$$\eta_p = \frac{P_{out}}{P_{in}} = \frac{T \times V}{E \times I}$$

Where:

η_p = Propulsive efficiency

T = Thrust

V = Flight velocity (knots)

a = Velocity increment at the propeller disc (knots)

To measure the propeller rotation speed, to count the number of revolutions the output shaft made in a fixed time interval. Which has a transistor output and allows the sensor to be placed up to 0.5 in. From the reflective surface. When combined with a simple circuit of resistors and a 9-V battery, the output voltage was near 2 V when aimed at a reflective surface and near 0 V when aimed at a non-reflective surface. The circuit had a response time around 5 μsec. The output voltages and response time of the circuit proved to be more than sufficient for measuring the rotational speed of the propellers, which never exceeded 7,000 RPM in these tests.

3.1.4 Propeller Torque:

Torque effect is the influence of engine torque on aircraft movement and control. It is generally exhibited as a left turning tendency in piston single engine propeller driven aircraft. The torque produced by the propeller was measured using the reaction torque transducers made by Transducer Techniques. These devices are simply force transducers housed and calibrated so that, when placed appropriately, a torque can be measured. The rig was designed with the torque transducer placed between the motor housing and support arm of the thrust mechanism, as is shown in one of two torque transducers was used depending on the expected maximum torque.

3.2 SUMMARY:

Static propeller test rig is mainly used to find propeller's thrust, torque, efficiuency and other characteristics with various rotational speeds. In this setup we simply change the rpm of the propeller to find the results.

CHAPTER 4
MATERIAL USED AND CHARACTERISATION

The materials used in our project are explain in detail in this chapter. The selection of various materials are listed and its characteristics are listed in this chapter.

4.1 Brushless motor:

A brushless DC electric motor (BLDC motor or BL motor), also known as electronically commutated motor (ECM or EC motor) and synchronous DC motors, are synchronous motors powered by direct current (DC) electricity via an inverter or switching power supply which produces electricity in the form of alternating current (AC) to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor. The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor.

The advantages of a brushless motor over brushed motors are high power-to-weight ratio, high speed, electronic control, and low maintenance. Brushless motors find applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles.

Figure 4.1: Brushless motor

The simplest type of motor is the brushed DC motor. In this type of motor, electrical current is passed through coils that are arranged within a fixed magnetic field. The current generates magnetic fields in the coils; this causes the coil assembly to rotate, as each coil is pushed away from the like pole and pulled toward the unlike pole of the fixed field. To maintain rotation, it is necessary to continually reverse the current so that coil polarities will continually flip, causing the coils to continue "chasing" the unlike fixed poles. Power to the coils is supplied through fixed conductive brushes that make contact with a rotating commutator; it is the rotation of the commutator that causes the reversal of the current through the coils. The commutator and brushes are the key components distinguishing the brushed DC motor from other motor types. Illustrates the general principle of the brushed motor.

4.2 ESC:

The Drone Electronic Speed Controller (ESC) on a drone is a hard-working, powerful component. The ESC connects the flight controller and the motor. Given that each brushless motor requires an ESC, a quadcopter will require 4 ESCs. The ESC takes the signal from the flight controller and power from the battery and makes the brushless motor spin. Although it sounds simple, it is anything but! Although some micro drones use brushed motors, the mini quads used in racing and freestyle rely on brushless motors. Like the name implies, a brushless motor lacks contacts, or "brushes" inside the motor. The brush acts as what is called a commutator, which uses physical contact of the motor's windings to spin the motor. Because they lack the brush, brushless motors use a different way to turn direct current (DC), the one-way flow of electrons, into a type of alternating current (AC).

An electronic speed control follows a speed reference signal (derived from a throttle lever, joystick, or other manual input) and varies the switching rate of a network of field effect transistors (FETs) by adjusting the duty cycle or switching frequency of the transistors, the speed of the motor is changed. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.

Figure 4.2: ESC 30 amp

Different types of speed controls are required for brushed DC motors and brushless DC motors. A brushed motor can have its speed controlled by varying the voltage on its armature. (Industrially, motors with electromagnet field windings instead of permanent magnets can also have their speed controlled by adjusting the strength of the motor field current.) A brushless motor requires a different operating principle. The speed of the motor is varied by adjusting the timing of pulses of current delivered to the several windings of the motor. Brushless ESC systems basically create three-phase AC power, like a VFD variable frequency drive, to run brushless motors. Brushless motors are popular with radio controlled airplane hobbyists because of their efficiency, power, longevity and light weight in comparison to traditional brushed motors. Brushless DC motor controllers are much more complicated than brushed motor controllers.

The correct phase varies with the motor rotation, which is to be taken into account by the ESC: Usually, back EMF from the motor is used to detect this rotation, but variations exist that use magnetic (Hall effect) or optical detectors. Computer-programmable speed controls generally have user-specified options which allow setting low voltage cut-off limits, timing, acceleration, braking and direction of rotation. Reversing the motor's direction may also be accomplished by switching any two of the three leads from the ESC to the motor.

4.3 Gas and glow propellers:

Gas and glow props are designed to withstand the power surges of an internal combustion engine, and are stronger, heavier, and designed for (usually) larger diameter shaft mounts. Electric props are lighter, and props designated for Slow Fly use tend to have wider blades for greater efficiency at lower RPM APC propellers are made from composite materials using long glass fibers or long carbon fibers with a Nylon matrix. Three types of APC propellers were tested, namely the Slow Flyer, Sport, and Thin Electric propellers. Both the Slow Flyer and Thin Electric propellers are designed to be used solely with electric motors. The Sport propellers are designed to handle the increased torque produced by gas powered engines. The airfoil profiles on the Slow Flyer propellers are quite thin with a sharp leading edge, where the remaining two have thicker airfoil sections with rounded leading edges. All of the APC propellers show some variation in the performance curves that is consistent with the overall trends. The Slow Flyers show the least variation in efficiency and the differences are larger near peak.

Figure 4.3: Gas and glow propeller

APC preserves a close rapport with the competitive aviation community to benefit from the technical interchange that is so important to improving designs. There is continuous evolution in aircraft design and engine performance. Consequently, propeller designs must continuously evolve to keep pace with changing technologies. APC excels at providing the model aviation community the right propellers for a wide range of applications.

The molding compound used in APC propellers is manufactured using a pultrusion process. This method causes the fiberglass "fibers" to be oriented axially in 1/2 inch long pellets. This long fiber compound allows a higher fiber (60%) to resin (nylon binder) density than short or chopped fiber compounds. Reground material is never used for APC propellers. Viscous (skinning) effects during injection molding cause these long fibers to remain dominantly oriented in the propeller span-wise axis.

4.4 Load cell:

A load cell is a type of transducer, specifically a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally.

Figure 4.4: 2kg load cell

A strain gauge is constructed of very fine wire, or foil, set up in a grid pattern and attached to a flexible backing. When the shape of the strain gauge is altered, a change in its electrical resistance occurs. The wire or foil in the strain gauge is arranged in a way that, when force is applied in one direction, a linear change in resistance results. Tension force stretches a strain gauge, causing it to get thinner and longer, resulting in an increase in resistance. Compression force does the opposite. The strain gauge compresses, becomes thicker and shorter, and resistance decreases. The strain gauge is attached to a flexible backing enabling it to be easily applied to a load cell, mirroring the minute changes to be measured. Strain gauge load cells are the kind most often found in industrial settings.

It is ideal as it is highly accurate, versatile, and cost-effective. Structurally, a load cell has a metal body to which strain gauges have been secured. The body is usually made of aluminium, alloy steel, or stainless steel which makes it very sturdy but also minimally elastic. This elasticity gives rise to the term "spring element", referring to the body of the load cell. When force is exerted on the load cell, the spring element is slightly deformed, and unless overloaded, always returns to its original shape. As the spring element deforms, the strain gauges also change shape. The resulting alteration to the resistance in the strain gauges can be measured as voltage. The change in voltage is proportional to the amount of force applied to the cell, thus the amount of force can be calculated from the load cell's output.

4.5 Battery:

A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid (gel) polymers form this electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, like mobile devices and radio-controlled aircraft. Just as with other lithium-ion cells, LiPos work on the principle of intercalation and de-intercalation of lithium ions from a positive electrode material and a negative electrode material, with the liquid electrolyte providing a conductive medium. To prevent the electrodes from touching each other directly, a microporous separator is in between which allows only the ions and not the electrode particles to migrate from one side to the other.

The lithium battery packs used to power quadcopters have two common chemistries: Lithium polymer (LiPO) and lithium polymer high voltage (LiHV). The primary difference between the two is that a LiPO cell has a fully charged voltage of 4.2V compared to a LiHV cell which has a voltage of 4.35V at full charge. A LiPO has a resting or nominal voltage of 3.7V versus a LiHV which has a storage voltage of 3.8V. In regards to the performance of the two packs, a LiHV battery will initially provide more power but abruptly drops in voltage when discharged whereas a LiPO has a more linear discharge making it easier to qualitatively gauge the remaining flight time.

Figure 4.5: lithium polymer Battery

LiPO packs are the most commonly used across all sizes of quadcopters however LiHV packs are quite popular for use on "Tiny Whoop" micro drones because the extra voltage moderately improves the quadcopters performance. Battery voltage is the potential energy difference between the positive and negative terminals. A higher FPV Drone Battery voltage allows the pack to provide more power to the quadcopter without increasing the current or amp draw. A standard lithium polymer cell has a nominal (storage) voltage of 3.7V hence to increase the power that a single LiPO pack can deliver, these cells are grouped together in series (meaning the ground/negative lead from the first cell is connected to the positive lead of the next cell, forming a chain of individual cells) to increase the overall battery pack voltage.

LiPO packs are commonly sold in 1S, 2S, 3S, 4S, 5S or 6S configurations where the digit followed by the 'S' stands for number of cells in that specific pack. The more cells that are grouped together, the more voltage the overall battery pack will have. The battery pack voltage is important as it impacts the maximum motor speed of a quadcopter. This is explained further here [insert hyperlink to the article on motors/ section on KV] but simply, more battery voltage allows the motors to spin with greater speed (RPM). For this reason, 4S LiPO's are the most commonly used for racing quadcopters as they provide a balance between speed and weight.

It is important to note that the quadcopter applications listed in the following table are only typical examples from the many different battery-quadcopter combinations in existence. Exotic setups such as 5S 150mm racing quadcopters or 2S micro brushed quadcopters do exist however they are just quite uncommon.

4.6 Static propeller stand:

The theory behind this setup, which was experimentally verified, is that the airflow upstream of the propeller is slower than the airflow downstream. The airflow around the propeller has a cone shape. The area of the air affected upstream of the propeller is larger and, due to the conservation of mass, it is also slower. Since drag losses are proportional to the square of the velocity, an obstacle upstream will has a smaller effect on the thrust than an obstacle downstream. The air moving slower causes less drag losses due to the testing equipment, which is why we recommend testing in the configuration of the image above. Testing with the thrust in the other direction can create results 3-20% different due to the airflow interaction with the fixture.

In the configuration presented in the image above, the thrust will be positive by default. You can always reverse the reading by activating the reverse thrust checkbox of our software in the "Utilities" tab if you prefer not to have to do that operation in your spreadsheet editor after. Note that your quadcopter arm or airframe will also have an impact on the thrust in flight. When testing in a wind tunnel, you also have to run a test with the propeller removed from the test fixture to characterize the drag of the measuring instrument, which you will subtract from your test results.

Figure 4.6: Static propeller stand

4.7 SUMMARY:

The materials discussed in this chapter are used in our projet for their better experience and working profiles besd on the characteristics. The major material in this chapter is static propeller stand that mainly used to find the results.

CHAPTER 5

RESULT AND DISCUSSION

The experiments have been performed for investigating the static performance of the gas and glow (APC brand) propeller with and without heading edge modifications. The performance parameters such as thrust, torque and propeller efficiency have been measured in the propeller test rig for different type propellers with constant diameter and varying pitch vice versa. By inspiring the maneuvers done by humpback whales, the leading edge flippers like structures are incorporated in the hub or in the tip to study its capability in increasing thrust and propeller efficiency without increasing the torque. Illustrates the variation of thrust, torque and propeller efficiency with rotated speed of the propeller with and without leading edge modifications with increase in rotational speed of the propeller, the thrust, and torque increases for all the propeller combinations studied here. At the same time, the propeller efficiency initially shows a drastic increase for increase in rotational speed is in line with the similar variation reported in the literatures.

By introducing a leading edge flippers near the tip of the propeller the thrust and propeller efficiency shows lower magnitude but torque does not show any change in magnitude than the propeller without any leading edge flipper. At the same time, the thrust and propeller efficiency has higher magnitude without increasing the torque required for running the propeller while introducing flippers near the hub of the propellers. However, while increasing the number of flippers near the hub of the propeller, the thrust and propeller efficiency has lower magnitude than the propeller without any leading edge flippers. The increment in performance of the propeller has been mainly attributed to the counter rotating vortices formed due to the leading edge flippers lower the speed near the hub of the propeller are effective in harnessing effect of counter rotating vortices. At the same, the blade speed is very high at the tip which in turn creating instability within counter rotating vortices. This results in reducing the magnitude of the performance parameters. The experimental testing of the propeller performance study proves the performance of the propeller can be increased by introducing leading edge flipper near the hub of the propeller.

5.1 Data and result for 7×4 propeller testing

5.1.1Table: 7×4 propeller testing

S.NO	Acceleration (g)	Torque (nm)	Thrust (kgf)	Voltage (V)	Current (A)	Motor optical speed (RPM)
1	-0.00625		0.000974	12.33144	0.24338	1036
2	-0.03125	0.001889		12.3316	0.247375	1227
3	-0.02344		0.001133	12.3324	0.242027	1314
4	-0.03125	0.001809		12.33202	0.245004	1440
5	-0.00977		0.002262	12.33175	0.243255	1493
6	-0.03711	0.001403		12.33075	0.244372	1571
7	-0.04883		0.003915	12.33094	0.247293	1610
8	-0.04688	0.001048		12.33177	0.245002	1661
9	-0.0625		0.004625	12.33165	0.241711	1684
10	-0.01172	0.000899		12.33177	0.249224	1722
11	0		0.00428	12.33173	0.248519	1739
12	-0.01563	0.000993		12.3315	0.247522	1768
13	-0.04883		0.004143	12.33127	0.252721	1782
14	-0.00977	0.001036		12.33122	0.260493	1827
15	-0.03711		0.002547	12.33081	0.259349	1839
16	-0.01563	0.000933		12.33072	0.259672	1876
17	-0.03125		0.006814	12.33055	0.262011	1882
18	-0.02344	0.00091		12.3309	0.260411	1906
19	0		0.008641	12.33099	0.260699	1915
20	-0.03711	0.001464		12.33014	0.262462	1932

Table no: 5.1 Summary data for 7×4 propeller testing

Based on the reading table is estimated. When the above reading for 7×4 propeller is tested and result is estimated.

5.1.2 Table: 7×4 propeller testing:

S.NO	Acceleration (g)	Electrical power (W)	Motor efficiency (%)	Propeller Mech. Efficiency (kgf/W)	Overall Efficiency (kgf/W)
1	-0.00625	3.001223	5.200843		0.000324
2	-0.03125	3.05053	7.953326	0.004013	0.000319
3	-0.02344	2.98478	8.708644		0.00038
4	-0.03125	3.021396	9.029296	0.004154	0.000375
5	-0.00977	2.99976	9.254771		
6	-0.03711	2.99976	9.429316		0.000754
7	-0.04883	3.049358	7.754751		0.001284
8	-0.04688	3.021313	6.036028	0.021465	0.001296
9	-0.0625	2.98069	6.202908		0.001552
10	-0.01172	3.073375	5.274132	0.028531	0.001505
11	0	3.064669	5.342039		0.001397
12	-0.01563	3.052321	6.023719	0.023278	0.001402
13	-0.04883	3.116369	5.94818		0.00133
14	-0.00977	3.212199	6.173795	0020893	0.00129
15	-0.03711	3.197987	6.242119		0.00796
16	-0.01563	3.201948	5.724324	0.013896	0.000795
17	-0.03125	3.230737	5.693534		0.002109
18	-0.02344	3.211102	5.658974	0.0375	0.002122
19	0	3.214673	5.679268		0.002688
20	-0.03711	3.236191	9.13546	0.02917	0.00267

Table no 5.1: Summary data for 7×4 propeller testing

Based on the reading table is estimated. When the above reading for 7×4 propeller is tested and result is estimated.

5.1.3 Propeller mechanical efficiency vs. propeller speed

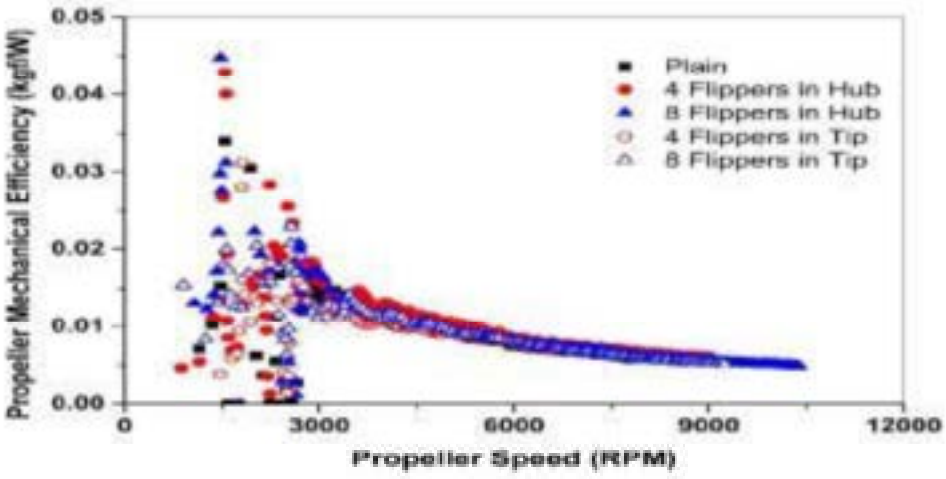

Figure 5.1: Propeller mechanical efficiency vs. propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 9000 RPM for 7×4 propeller to analysis of propeller mechanical efficiency.

5.1.4 Thrust vs. propeller speed

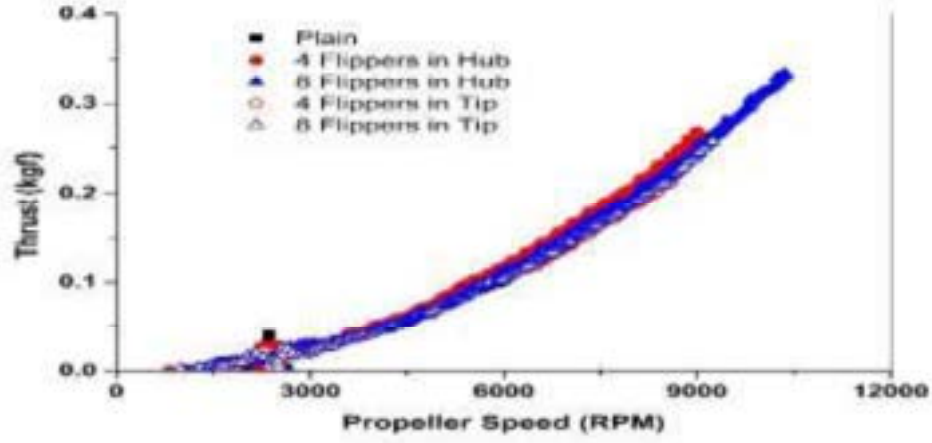

Figure 5.2: Thrust vs. propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 8500 RPM for 7×4 propeller to analysis of thrust.

5.1.5 Torque vs. Propeller speed

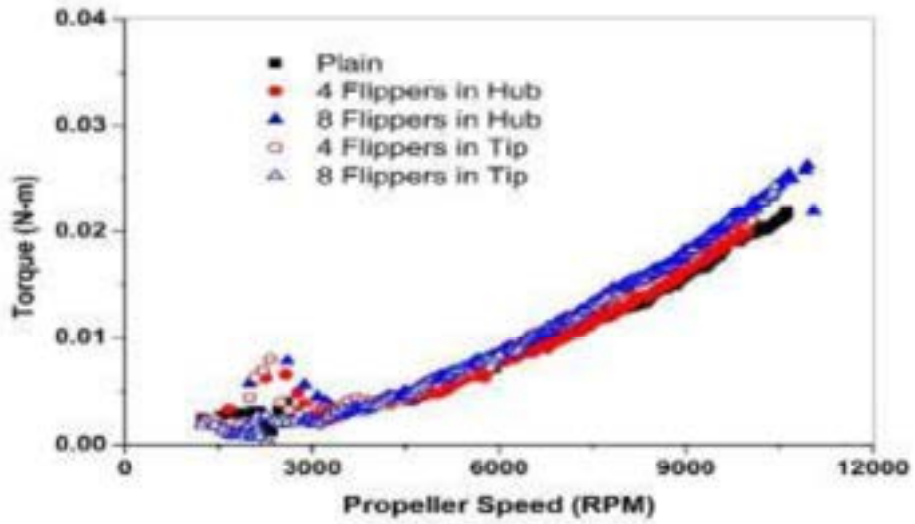

Figure 5.3: Torque vs. Propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 9500 RPM for 7×4 propeller to analysis of torque.

5.2 Data and result for 7×9 propeller testing

5.2.1 Table: 7×9 propeller testing:

S.NO	Acceleration (g)	Torque (N·m)	Thrust (kgf)	Voltage (V)	Current (A)	Motor Optical Speed (RPM)
1	-0.01172	0.001214		12.43302	0.244356	908
2	-0.00977		0.002515	12.43293	0.249915	994
3	-0.03711			12.43223	0.261493	1060
4	-0.03711	0.002278	0.004334	12.4321	0.262963	1110
5	0.011719	0.002209		12.43206	0.26824	1207
6	-0.07813		0.005874	12.43199	0.268597	1168
7	-0.01172	0.002056		12.43119	0.273921	1293
8	-0.02344		0.006516	12.4315	0.274682	1251
9	-0.01172	0.001984		12.43175	0.268685	1320
10	0.015625		0.006724	12.43158	0.26783	1365
11	-0.01172	0.002321		12.43222	0.264118	1395
12	-0.07422		0.006227	12.43206	0.266697	1412
13	-0.05273	0.002584		12.43129	0.285672	1439
14	-0.03906		0.006025	12.43115	0.290743	1449
15	-0.02344	0.002675		12.42989	0.308231	1470
16	-0.02344		0.00598	12.42984	0.312247	1489
17	0	0.002543		12.42948	0.340622	1499
18	-0.02344		0.008413	12.42943	0.349838	1514
19	-0.04688	0.002492		12.42928	0.370755	1524
20	-0.01172		0.009795	12.42941	0.375593	1531

Table no 5.3: Summary data for 7×9 propeller testing

Based on the reading table is estimated. When the above reading for 7×9 propeller is tested and result is estimated.

5.2.2 Table: 7×9 propeller testing:

S.NO	Acceleration (g)	Motor Efficiency (%)	Propeller Mech. Efficiency (kgf/W)	Overall Efficiency (kgf/W)
1	-0.01172	3.798573	0.015362	0.000584
2	-0.00977	4.066921		0.000809
3	-0.03711	9.487598		0.001333
4	-0.03711	9.125513	0.00843	0.000769
5	0.011719	9.98261	0.013019	0.0013
6	-0.07813	10.04131		0.001759
7	-0.01172	9.634457	0.017903	0.001725
8	-0.02344	9.655215		0.001908
9	-0.01172	9.785364	0.019934	0.001951
10	0.015625	9.849491		0.002019
11	-0.02344	11.8251	0.017317	0.002048
12	-0.07422	11.72145		0.001878
13	-0.05273	12.36302	0.014183	0.001753
14	-0.03906	12.28738		0.001573
15	-0.02344	12.46035	0.01262	0.001541
16	-0.02344	12.40306		0.001412
17	0	11.37763	0.012414	0.001935
18	-0.02344	11.17773		0.002098
19	-0.04688	10.85058	0.016825	0.001826
20	-0.01172	10.81648		0.002098

Table no: 5.3 Summary data for 7×9 propeller testing

Based on the reading table is estimated. When the above reading for 7×9 propeller is tested and result is estimated.

5.2.3 Propeller mechanical efficiency vs. propeller speed

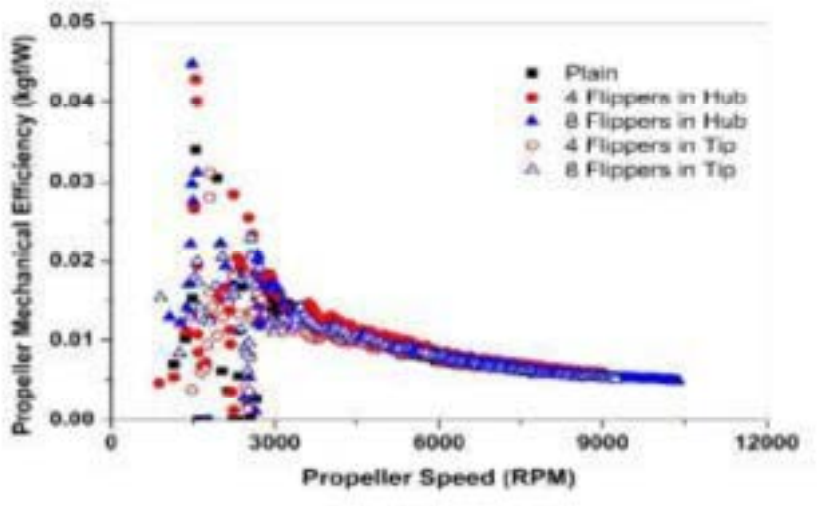

Figure 5.4: Propeller mechanical efficiency vs. propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 9500 RPM for 7×9 propeller to analysis of propeller mechanical efficiency.

5.2.4 Thrust vs. propeller speed

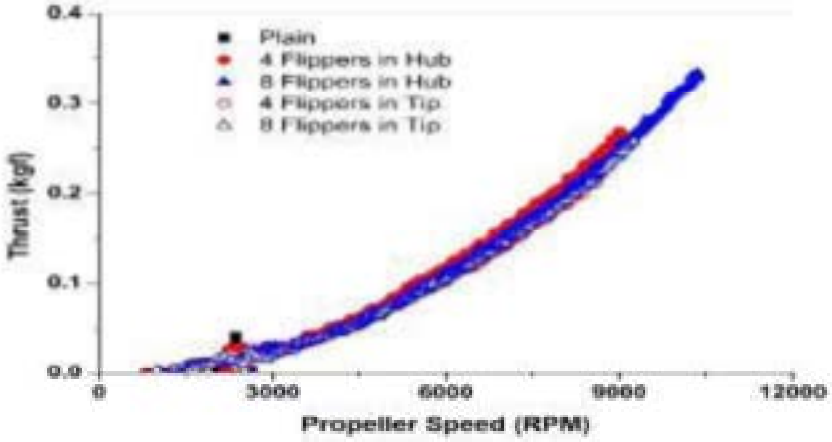

Figure 5.5: Thrust vs. propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 9000 RPM for 7×9 propeller to analysis of thrust.

5.2.5 Torque vs. propeller speed

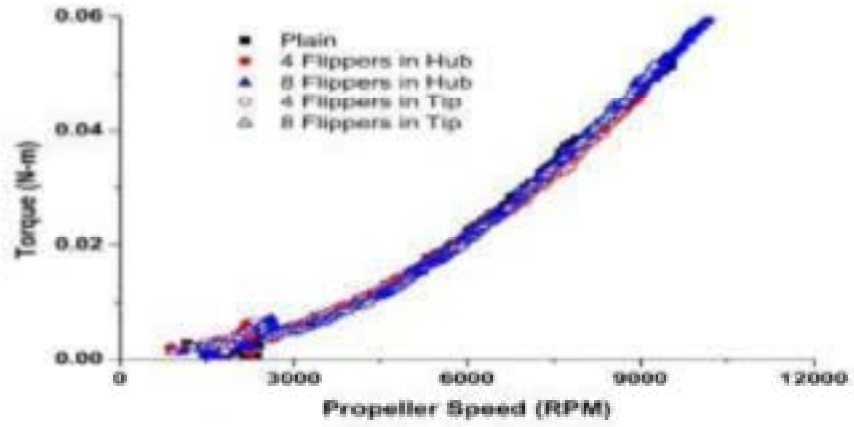

Figure 5.6: Torque vs. propeller speed

Based on the reading above graph is plotted. Highest range of rpm in the graph is 9000 RPM for 7×9 propeller to analysis of torque.

The increasing number of flippers near the hub of the propeller, the thrust and propeller efficiency has lower magnitude than the propeller without any leading edge flippers. The increment in performance of the propeller has been mainly attributed to the counter rotating vortices formed due to the leading edge flippers lower the speed near the hub of the propeller are effective in harnessing effect of counter rotating vortices. At the same, the blade speed is very high at the tip which in turn creating instability within counter rotating vortices. This results in reducing the magnitude of the performance parameters. The experimental testing of the propeller performance study proves the performance of the propeller can be increased by introducing leading edge flipper near the hub of the propeller.

5.3 SUMMARY:

The results of our propeller test is consolidated in this chapter with various propeller speeds. The performance of propeller like thrust, torque, and efficiency are collected and graphs were ploted based on the result values.

CHAPTER 6
CONCLUSION

The development and validation of a propeller, suitable to test a wide range of low Reynolds number propellers up to a diameter of about 7×4 and 7×9. The surface corrugations in the leading edge of a propeller will increases the performance of an UAV with normal power consumption. Furthermore, the performance of gas and glow propellers was measured over a range of different rotational speeds. It was shown that as the increases of performance with the increase of propeller rpm, the propellers performance is significantly affected by increasing their thrust coefficient and efficiency. While increasing the number of flippers near the hub of the propeller, the thrust and propeller efficiency has lower magnitude than the propeller without any leading edge flippers.

The increment in performance of the propeller has been mainly attributed to the counter rotating vortices formed due to the leading edge flippers lower the speed near the hub of the propeller are effective in harnessing effect of counter rotating vortices. At the same, the blade speed is very high at the tip which in turn creating instability within counter rotating vortices. This results in reducing the magnitude of the performance parameters. The experimental testing of the propeller performance study proves the performance of the propeller can be increased by introducing leading edge flipper near the hub of the propeller.

The tests done in this study operating low Reynolds number. The inherent propeller size and operating conditions in this study gave a Reynolds number of about high, an order of magnitude lower.

The leading edge corrugation in the tests done in this report seem to only contribute to vibration and drag. It is possible that testing at higher Reynolds numbers will produce positive results.

REFERENCE

1. Moore, K., and Ning, A., 'Aerodynamic Performance Characterization of Leading Edge Protrusions on Small Propellers', AIAA Aerospace Sciences Meeting, San Diego, CA, Jan. 2016.

2. A Seeni., 'A Critical Review on Tubercles Design for Propellers', IOP Conf. Ser.: Mater. Sci. Eng. 2015.

3. John B. Brandt and Michael S., 'Propeller Performance Data at Low Reynolds Numbers', AIAA Aerospace Sciences Meeting AIAA January 2011, Orlando.

4. M. F. Shariff., 'Propeller Aerodynamic Analysis and Design' School of Aerospace, Mech. & Manufacturing Eng., RMIT University, 2017.

5. Arun Prakash J, Sweta S Radhakrishnan, Ramavijay N, Vishnupriya S., 'Experimental investigation of stepped aerofoil using propeller test rig', IJRET: International Journal of Research in Engineering and Technology, 2017.

6. Donghun Park, Yunggyo Lee, Taehwan Cho and Cheolwan Kim., 'Design and Performance Evaluation of Propeller for Solar-Powered High-Altitude Long-Endurance Unmanned Aerial Vehicle', Hindawi International Journal of Aerospace Engineering Volume 2018.

7. Yuchuan Zhang, Zhiqiang Hu, Yi Yang Lingbo Geng, Chao Wang., 'A Performance Analysis Method of High Speed and Small Diameter Propeller', IOP Conf. Series: Materials Science and Engineering, 2018.

8. Robert W. Deters and Michael S. Selig., 'Static Testing of Micro Propellers', 26th AIAA Applied Aerodynamics Conference 18 - 21 August 2008, Honolulu, Hawaii.

9. Yuying Xia, Onur Bilgen and Michael I Friswell., 'The effect of corrugated skins on aerodynamic performance', Journal of Intelligent Material Systems and Structures, February 2014.

10. M Khasyofi and F Hartono., 'Development Testing Method and Analysis Static Thrust for Propeller Based Propulsion', IOP Conf. Series: Materials Science and Engineering 2019

LIST OF PUBLICATION

S. No	Journal Title	Publisher	Published on
1	Experimental investigation of propeller efficiency with propeller surface corrugation	Journal of Aerospace Technology and Management – JATM Arda conference	September 2020

EXPERIMENTAL INVESTIGATION OF PROPELLER EFFICIENCY WITH PROPELLER SURFACE CORRUGATIONS

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Abstract: The propeller is the primary component of flying vehicles powered by electric motors, internal combustion engines, and turboprops for producing thrust. A propeller thrust is produced in the engine by effective spinning of the propeller through air for cost-effective and environmental friendly flight. Natural flyers like birds as well as aquatic animals like humpback whales effectively use its wings and flippers with its surface features for capturing its prey and escaping from their enemies. As part of this work, corrugations are established in the leading edges or in the suction surfaces of the propeller to modify the flow field prevailing over there. Because of the flow field, the surface corrugations or leading edge corrugations energize the boundary layer in the surfaces of the propeller by counter-rotating vortices which, in turn, delays the separation of the boundary layer from the surface. The performance parameters of the propeller such as thrust, torque, propeller efficiency, power consumption etc., are measured using propeller test rig. Depending on the location of surface or leading corrugations, the variations in the performance of the propeller are investigated for further optimization on the selection of better propeller to the applications of UAVs operating at low Reynolds No.

Introduction: An Unmanned Aerial Vehicles capable of Vertical Take-Off and Landing (VTOL UAVs), are increasingly deployed for various applications such as surveillance, autonomous parcel delivery, oil and gas spill detection and firefighting. The development of Unmanned Aerial Vehicles (UAV) for civil and military applications has increased significantly over the last decade. More industries such as agricultural, educations, communications, and energy sector are becoming more courageous to venture into the utilizations of UAV to carry our various missions. As the advancement of technologies, the implementation of UAV may contribute to increase in productivity as well as reducing the risk, allowing replacement of manned mission [1-3]. This is because UAVs are cost and maintenance friendly. Hence, it is very important to have high-performance UAV design so that it could deliver the mission efficiently.

An unmanned aerial vehicle (UAV) is an aircraft without a human pilot on board and a type of unmanned vehicle. UAVs are a component of an unmanned aircraft system (UAS); which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by onboard computers. Compared to crewed aircraft, UAVs were originally used for missions too "dull, dirty or dangerous" for humans [4-7]. While they originated mostly in

CONCEPTUAL DESIGN AND PERFORMANCE ANALYSIS OF TURBO JET ENGINE

A PROJECT REPORT

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

AERONAUTICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

MAY 2020

ABSTRACT

The selection of aero-engine that can meet the design specifications of aircraft is the primary step to the overall design program of an aircraft. Global aviation traffic is expected to increase at an annual rate of 5% for the foreseeable future. However, the engine emissions such as CO, CO_2, UHC, and NO_X have greater adverse impact on the earth atmosphere and human health in addition to its performance degradation. Proper design of the aero-engine to the design requirements of the particular aircraft is essential for meeting the highly competitive airline market. Turbojet is an air-breathing engine which works under the basis of Brayton Cycle. The efficiency and thrust produced by the engine depend on the individual performance of the turbojet components such as Intake, Compressor, Combustion Chamber, Turbine, and Propelling Nozzle in addition to its various operating atmospheric conditions. Here, program has been developed to do a conceptual design of the aero-engine and also performance analysis chart will be developed for the aero-engine to meet the design requirements of the aircraft.

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NOMENCLATURE

Δh0	Stagnation enthalpy change
Hpol	Polytrophic efficiency
AR	Axial Aspect Ratio
CO2	Carbon dioxide
UHC	unburned hydrocarbon
EINOx	Nitrogen Oxides Emissions Index
EIS	Entry into Service
FAR	Federal Aviation Regulations
FB	Fuel Burn
FL	Flight Level
HPC	High Pressure Compressor
HPT	High Pressure Turbine
ICAO	International Civil Aviation Organization
IPC	Intermediate Pressure Compressor
ISA	International Standard Atmosphere
IPT	Intermediate Pressure Turbine
LR	Long Range
MT	Medium Term
NOx	Nitrogen Oxides
OPR	Overall Pressure Ratio
PW	Power
RQL	Rich-burn/Quick-quench/Lean-burn
SFC	Specific Fuel Consumption
SLS	Sea Level Static
SR	Short Range
T4	Burner exit temperature
T/O	Take-Off
TEC	Turbine Exhaust Case
TET	Turbine Entry Temperature

CHAPTER – I

INTRODUCTION

Since the introduction of the first operational jet engine, engine development has been on larger engines to meet the increasing demands of thrust , SFC, specific thrust etc., Now a days there are numerous ideas to design an engine to increase the performance but before starting the process we are undergoing the conceptual design to analyse the performance characteristic to check the design satisfies our mission requirements. Conceptual design is the first step of the multiphase process involved in creating a new product. The conceptual design phase is immediately followed by the schematic design phase. In this process we are using multiple input parameter like operating altitude, Mach.No& component efficiency like compressor ratio, turbine inlet temperature and mechanical transmission efficiency. To determine the compressor stagnation properties from compressor pressure ratio, work done on the compressor and isentropic efficiency of compressor and also find the turbine outlet stagnation condition by equating the work done on the compressor with work done by the turbine through mechanical transmission efficiency and turbine inlet temperature. The compressor exit stagnation condition, turbine inlet temperature and stagnation pressure loss in the combustor using to estimation of fuel-air through energy balance analysis. The above condition will then form the basis for the conceptual design of the component. Our motivation is to provide performance analysis data sheet using MATLAB for the various mission requirement which is used to find whether the engine design was efficient or not.

1.1 CLASSIFICATION OF ENGINE

The turbojet is an airbreathing jet engine, typically used in aircraft. It consists of a gas turbine with a propelling nozzle. The gas turbine has an air inlet, a compressor, a combustion chamber, and a turbine (that drives the compressor). The compressed air from the compressor is heated by the fuel in the combustion chamber and then allowed to expand through the turbine. The turbine exhaust is then expanded in the propelling nozzle where it is accelerated to high speed to provide thrust. Two engineers, Frank Whittle in the United Kingdom and Hans von Ohain in Germany, developed the concept independently into practical engines during the late 1930s.

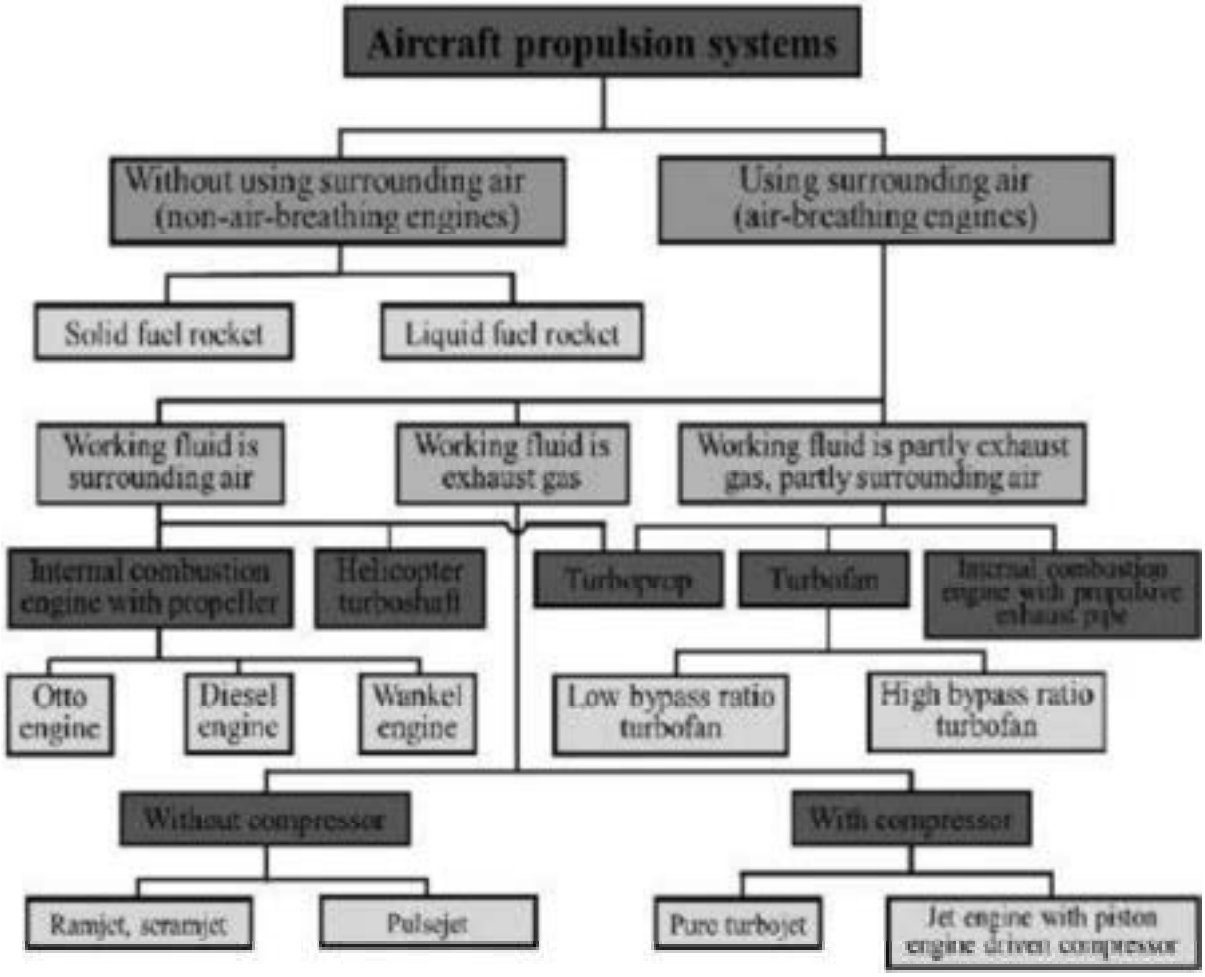


Figure.no: 1.1 Classification of jet engine

The turbojet is an airbreathing jet engine, typically used in aircraft. It consists of a gas turbine with a propelling nozzle. The gas turbine has an air inlet, a compressor, a combustion chamber, and a turbine (that drives the compressor). The compressed air from the compressor is heated by the fuel in the combustion chamber and then allowed to expand through the turbine. The turbine exhaust is then expanded in the propelling nozzle where it is accelerated to high speed to provide thrust. Two engineers, Frank Whittle in the United Kingdom and Hans von Ohain in Germany, developed the concept independently into practical engines during the late 1930s.

While the turbojet was the first form of gas turbine powerplant for aviation, it has largely been replaced in use by other developments of the original concept. In operation, turbojets typically generate thrust by accelerating a relatively smallamount of air to very high supersonic speeds, whereas turbofans accelerate a larger amount of air to lower transonic speeds. Turbojets have been replaced in slower aircraft by turboprops because they have better specific fuel consumption. At medium speeds, where the propeller is no longer efficient, turboprops have

been replaced by turbofans. The turbofan is quieter and has better range-specific fuel consumption than the turbojet. Turbojets can be highly efficient for supersonic aircraft.

Turbojets have poor efficiency at low vehicle speeds, which limits their usefulness in vehicles other than aircraft. Turbojet engines have been used in isolated cases to power vehicles other than aircraft, typically for attempts on land speed records. Where vehicles are 'turbine powered' this is more commonly by use of a turboshaft engine, a development of the gas turbine engine where an additional turbine is used to drive a rotating output shaft. These are common in helicopters and hovercraft. Turbojets were used on Concorde and the longer-range versions of the TU-144 which were required to spend a long period travelling supersonically. Turbojets are still common in medium range cruise missiles, due to their high exhaust speed, small frontal area, and relative simplicity. They are also still used on some supersonic fighters such as the MiG-25, but most spend little time travelling supersonically, and so employ turbofans and use afterburners to raise exhaust speed for supersonic sprints.

1.2 DESIGN

1.2.1 AIR INTAKE

An intake, or tube, is needed in front of the compressor to help direct the incoming air smoothly into the moving compressor blades. Older engines had stationary vanes in front of the moving blades. These vanes also helped to direct the air onto the blades. The air flowing into a turbojet engine is always subsonic, regardless of the speed of the aircraft itself.

The intake has to supply air to the engine with an acceptably small variation in pressure (known as distortion) and having lost as little energy as possible on the way (known as pressure recovery). The ram pressure rise in the intake is the inlet's contribution to the propulsion system's overall pressure ratio and thermal efficiency.

The intake gains prominence at high speeds when it transmits more thrust to the airframe than the engine does. Well-known examples are the Concorde and Lockheed SR-71 Blackbird propulsion systems where the intake and engine contributions to the total powerplant were 63%/8%at Mach 2 and 54%/17%at Mach 3+. Intakes have ranged from "zero-length" on the Pratt & Whitney TF33 installation in the Lockheed C-141 Star lifter, to the twin, 65 feet-long, intakes on the North American XB-70 Valkyrie, each feeding three engines with an intake airflow of about 800 lb/sec.

1.2.2 COMPRESSOR

The compressor is driven by the turbine. It rotates at high speed, adding energy to the airflow and at the same time squeezing (compressing) it into a smaller space. Compressing the air increases its pressure and temperature. The smaller the compressor, the faster it turns. At the large end of the range, the GE-90-115 fan rotates at about 2,500 RPM, while a small helicopter engine compressor rotates around 50,000 RPM.

Turbojets supply bleed air from the compressor to the aircraft for the environmental control system, anti-icing, and fuel tank pressurization, for example. The engine itself needs air at various pressures and flow rates to keep it running. This air comes from the compressor, and without it, the turbines would overheat, the lubricating oil would leak from the bearing cavities, the rotor thrust bearings would skid or be overloaded, and ice would form on the nose cone. The air from the compressor, called secondary air, is used for turbine cooling, bearing cavity sealing, anti-icing, and ensuring that the rotor axial load on its thrust bearing will not wear it out prematurely. Supplying bleed air to the aircraft decreases the efficiency of the engine because it has been compressed, but then does not contribute to producing thrust. Bleed air for aircraft services is no longer needed on the turbofan-powered Boeing 787.

Compressor types used in turbojets were typically axial or centrifugal. Early turbojet compressors had low pressure ratios up to about 5:1. Aerodynamic improvements including splitting the compressor into two separately rotating parts, incorporating variable blade angles for entry guide vanes and stators, and bleeding air from the compressor enabled later turbojets to have overall pressure ratios of 15:1 or more. For comparison, modern civil turbofan engines have overall pressure ratios of 44:1 or more. After leaving the compressor, the air enters the combustion chamber. There are three basic categories of gas turbine engine compressor.

1. Axial compressor
2. Centrifugal compressor
3. Mixed- flow compressor

1.2.2.1 WORKING PRINCIPLE OF COMPRESSOR

The basic working principle of an air compressor is to compress atmospheric air which is the used as per the requirements. In the process, atmospheric air is drawn in through an intake valve; more and more air is pulled inside a limited space mechanically by means of piston, impeller, or vane.

1.2.2.2 AXIAL COMPRESSOR

Axial compressors are used in medium to large thrust gas turbine engines, because the alternative centrifugal units would be too heavy and too large in the cross-sectional area. At smaller sizes, the axial blading at the rear of the compressor losses its robustness and is difficult to manufactured accurately. Consequently, manufacturers tend to replace the rear stages with a centrifugal unit. The compression system is then said to be axial centrifugal. In case of power generation axial compressors are used in turbines which have capacity to generate more than 5MW.

ADVANTAGES :

- The ability to handle large volumes of airflow and a high-pressure ratio.
- Small frontal area for given airflow.

- Straight-through flow, allowing high ram efficiency

DISADVANTAGES:

- More susceptible to foreign object damage.
- Expensive to manufacture.
- Very heavy in comparison to the centrifugal compressor with the same compression ratio.

1.2.2.3 CENTRIFUGAL COMPRESSOR:

At even smaller sizes particularly in turboprop by turboshaft applications, the compression system is either a single centrifugal or has two centrifugal units connected in series (i.e. double- centrifugal).It basically consists of an impeller(rotor), a diffuser(stator), and a compressor manifold. The two main elements are impeller and diffuser. The impeller function is to pick up and accelerate the air outwardly to the diffuser. The double impeller is to two impellers are the duct and ducting arrangements. Double entry types have a smaller diameter, but are usually operated at a higher rotational speed to ensure sufficient airflow. A single-entry impeller permits ensure convenient ducting directly to the impeller eye as opposed to the more complicated ducting necessary to reach the rear side of the double entry type.

ADVANTAGES:

- Light weight.
- High pressure rise per stage.
- Simplicity of manufacture, thus low cost.
- Low weight.

DISADVANTAGES:

- Large frontal area for given airflow.
- More than two stages are not practical, because of losses in turns between stages.

1.2.2.4 MIXED-FLOW COMPRESSOR:

In the future, mixed flow compressor may feature at the small end of the market, particularly in turbofans where the relatively large diameter across the diffuser of a centrifugal compressor is significant disadvantages.

1.2.2.5 STAGED COMPRESSION:

TWO STAGE:

At high overall pressure ratios, the compression system is usually split into two units; a low pressure (LP) compressor mounted on one shaft followed by a high pressure (HP) compressor mounted on the HP shaft and driven by its own (HP) turbine. On civil turbofan the first stage of the LP compressor is often a single stage fan. if the compressor if the HP compressor pressure ratio exceeds about 4.5:1, then the unit will probably have variable geometry(i.e, variable stators)on the first few stages, to meet the surge line on the compressor map more shallow, to accommodate the shallow working line.

THREE STAGES:

On their large civil turbofans, Rolls Royce split the compression system into three: a fan, an intermediate compressor, and HP compressor each unit being driven by its own turbine unit the RB199 military turbofan also has this arrangement.

1.2.3 COMBUSTION CHAMBER

The burning process in the combustor is significantly different from that in a piston engine. In a piston engine, the burning gases are confined to a small volume, and as the fuel burns, the pressure increases. In a turbojet, the air and fuel mixture burn in the combustor and pass through to the turbine in a continuous flowing process with no pressure build-up. Instead, a small pressure loss occurs in the combustor.

The fuel-air mixture can only burn in slow-moving air, so an area of reverse flow is maintained by the fuel nozzles for the approximately stoichiometric burning in the primary zone. Further compressed air is introduced which completes the combustion process and reduces the temperature of the combustion products to a level which the turbine can accept. Less than 25% of the air is typically used for combustion, as an overall lean mixture is required to keep within the turbine temperature limits.

1.2.3.1 CAN

Can combustors are self-contained cylindrical combustion chambers. Each "can" has its own fuel injector, igniter, liner, and casing. The primary air from the compressor is guided into each individual can, where it is decelerated, mixed with fuel, and then ignited. The secondary air also comes from the compressor, where it is fed outside of the liner (inside of which is where the combustion is taking place). The secondary air is then fed, usually through slits in the liner, into the combustion zone to cool the liner via thin film cooling.

In most applications, multiple cans are arranged around the central axis of the engine, and their shared exhaust is fed to the turbine(s). Can type combustors were most widely used in early gas turbine engines, owing to their ease of design and testing (one can test a single can, rather than have to test the whole system). Can type combustors are easy to maintain, as only

a single can needs to be removed, rather than the whole combustion section. Most modern gas turbine

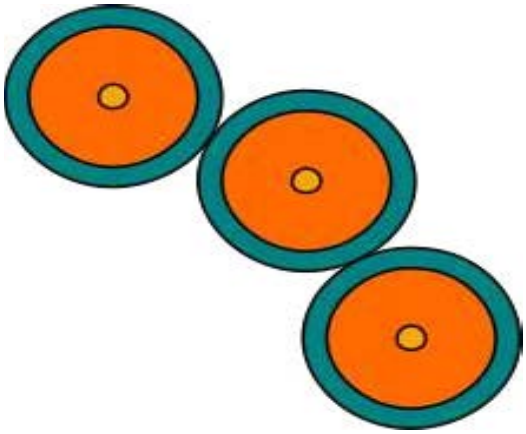


Figure.no: 1.2 Can type combustion chamber

engines (particularly for aircraft applications) do not use can combustors, as they often weigh more than alternatives. Additionally, the pressure drop across the can is generally higher than other combustors (on the order of 7%). Most modern engines that use can combustors are turbo-shafts featuring centrifugal compressors.

1.2.3.2 CANNULAR

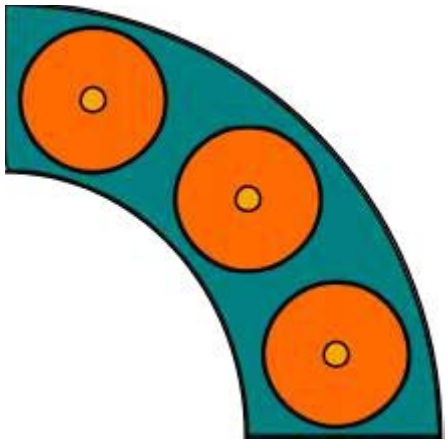


Figure.no: 1.3 Cannular type combustion chamber

Cannular combustor for a gas turbine engine, viewing axis on, through the exhaust

The next type of combustor is the cannular combustor; the term is a portmanteau of "can annular". Like the can type combustor, can annular combustors have discrete combustion zones contained in separate liners with their own fuel injectors. Unlike the can combustor, all the combustion zones share a common ring (annulus) casing. Each combustion zone no longer has to serve as a pressure vessel. The combustion zones can also "communicate" with each other via liner holes or connecting tubes that allow some air to flow circumferentially. The exit flow from the cannular combustor generally has a more uniform temperature profile,

which is better for the turbine section. It also eliminates the need for each chamber to have its own igniter. Once the fire is lit in one or two cans, it can easily spread to and ignite the others. This type of combustor is also lighter than the can type, and has a lower pressure drop (on the order of 6%). However, a cannular combustor can be more difficult to maintain than a can combustor. Examples of gas turbine engines utilizing a cannular combustor include the General Electric J79 turbojet and the Pratt & Whitney JT8D and Rolls-Royce Tay turbofans.

1.2.3.3 ANNULAR

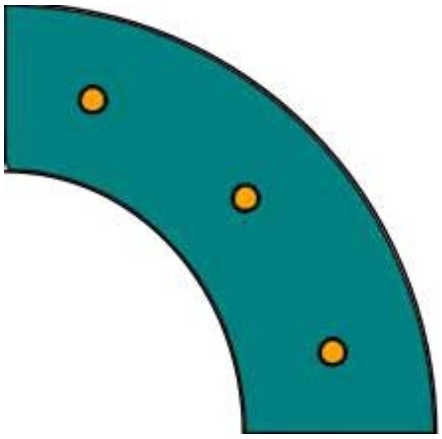


Figure.no: 1.4 Annular type combustion chamber

Annular combustor for a gas turbine engine, viewed axis on looking through the exhaust. The small orange circles are the fuel injection nozzles.

The final, and most commonly used type of combustor is the fully annular combustor. Annular combustors do away with the separate combustion zones and simply have a continuous liner and casing in a ring (the annulus). There are many advantages to annular combustors, including more uniform combustion, shorter size (therefore lighter), and less surface area. Additionally, annular combustors tend to have very uniform exit temperatures. They also have the lowest pressure drop of the three designs (on the order of 5%). The annular design is also simpler, although testing generally requires a full size test rig. An engine that uses an annular combustor is the CFM International CFM56. Almost all of the modern gas turbine engines use annular combustors; likewise, most combustor research and development focuses on improving this type.

1.2.3.4 DOUBLE ANNULAR COMBUSTOR

One variation on the standard annular combustor is the double annular combustor (DAC). Like an annular combustor, the DAC is a continuous ring without separate combustion zones around the radius. The difference is that the combustor has two combustion zones around the ring; a pilot zone and a main zone. The pilot zone acts like that of a single annular combustor, and is the only zone operating at low power levels. At high power levels, the main zone is used as well, increasing air and mass flow through the combustor. GE's implementation of

this type of combustor focuses on reducing NOx and CO2 emissions. A good diagram of a DAC is available from Purdue. Extending the same principles as the double annular combustor, triple annular and "multiple annular" combustors have been proposed and even patented.

1.2.4 EMISSION

One of the driving factors in modern gas turbine design is reducing emissions, and the combustor is the primary contributor to a gas turbine's emissions. Generally speaking, there are five major types of emissions from gas turbine engines: smoke, carbon dioxide (CO_2), carbon monoxide (CO), unburned hydrocarbons (UHC), and nitrogen oxides (NO_x).

Smoke is primarily mitigated by more evenly mixing the fuel with air. As discussed in the fuel injector section above, modern fuel injectors (such as airblast fuel injectors) evenly atomize the fuel and eliminate local pockets of high fuel concentration. Most modern engines use these types of fuel injectors and are essentially smokeless.

Carbon dioxide is a product of the combustion process, and it is primarily mitigated by reducing fuel usage. On average, 1 kg of jet fuel burned produces 3.2 kg of CO_2. Carbon dioxide emissions will continue to drop as manufacturers make gas turbine engines more efficient.

Unburned hydrocarbon (UHC) and carbon monoxide (CO) emissions are highly related. UHCs are essentially fuel that was not completely combusted, and UHCs are mostly produced at low power levels (where the engine is not burning all the fuel). Much of the UHC content reacts and forms CO within the combustor, which is why the two types of emissions are heavily related. As a result of this close relation, a combustor that is well optimized for CO emissions is inherently well optimized for UHC emissions, so most design work focuses on CO emissions.

Carbon monoxide is an intermediate product of combustion, and it is eliminated by oxidation. CO and OH react to form CO_2 and H. This process, which consumes the CO, requires a relatively long time ("relatively" is used because the combustion process happens incredibly quickly), high temperatures, and high pressures. This fact means that a low CO combustor has a long residence time (essentially the amount of time the gases are in the combustion chamber).[35]

Like CO, Nitrogen oxides (NO_x) are produced in the combustion zone. However, unlike CO, it is most produced during the conditions that CO is most consumed (high temperature, high pressure, long residence time). This means that, in general, reducing CO emissions results in an increase in NO_x and vice versa. This fact means that most successful emission reductions require the combination of several methods.

1.2.5 TURBINE

Hot gases leaving the combustor expand through the turbine. Typical materials for turbines include inconel and Nimonic. The hottest turbine vanes and blades in an engine have internal cooling passages. Air from the compressor is passed through these to keep the metal temperature within limits. The remaining stages do not need cooling.

In the first stage, the turbine is largely an impulse turbine (similar to a Pelton wheel) and rotates because of the impact of the hot gas stream. Later stages are convergent ducts that accelerate the gas. Energy is transferred into the shaft through momentum exchange in the opposite way to energy transfer in the compressor. The power developed by the turbine drives the compressor and accessories, like fuel, oil, and hydraulic pumps that are driven by the accessory gearbox.

1.2.5.1 STEAM TURBINES

Steam turbine are used for the generation of electricity in thermal power plants, such as plants using coal, fuel oil or nuclear fuel. They were once used to directly drive mechanical devices such as ships' propellers but most such applications now use reduction gears or an intermediate electrical step, where the turbine is used to generate electricity, which then powers an electric motor connected to the mechanical load. Turbo electric ship machinery was particularly popular in the period immediately before and during World War II, primarily due to a lack of sufficient gear-cutting facilities in US and UK shipyards.

1.2.5.2 GAS TURBINES

Gas turbine are sometimes referred to as turbine engines. Such engines usually feature an inlet, fan, compressor, combustor and nozzle (possibly other assemblies) in addition to one or more turbines.

1.2.5.3 TRANSONIC TURBINE

The gas flow in most turbines employed in gas turbine engines remains subsonic throughout the expansion process. In a transonic turbine the gas flow becomes supersonic as it exits the nozzle guide vanes, although the downstream velocities normally become subsonic. Transonic turbines operate at a higher pressure ratio than normal but are usually less efficient and uncommon.

1.2.5.4 CONTRA-ROTATING TURBINES

With axial turbines, some efficiency advantage can be obtained if a downstream turbine rotates in the opposite direction to an upstream unit. However, the complication can be counter-productive. A contra-rotating steam turbine, usually known as the Ljungström

turbine, was originally invented by Swedish Engineer Fredrik Ljungström (1875–1964) in Stockholm, and in partnership with his brother BirgerLjungström he obtained a patent in 1894. The design is essentially a multi-stage radial turbine offering great efficiency, four times as large heat drop per stage as in the reaction (Parsons) turbine, extremely compact design and the type met particular success in back pressure power plants. However, contrary to other designs, large steam volumes are handled with difficulty and only a combination with axial flow turbines (DUREX) admits the turbine to be built for power greater than ca 50 MW. In marine applications only about 50 turbo-electric units were during 1917-19, and during 1920-22 a few turbo-mechanic not very successful units were sold. Only a few turbo-electric marine plants were still in use in the late 1960s while most land plants remain in use 2010.

1.2.5.5 STATORLESS TURBINE

Multi-stage turbines have a set of static (meaning stationary) inlet guide vanes that direct the gas flow onto the rotating rotor blades. In a stator-less turbine the gas flow exiting an upstream rotor impinges onto a downstream rotor without an intermediate set of stator vanes (that rearrange the pressure/velocity energy levels of the flow) being encountered.

1.2.5.6 CERAMIC TURBINE

Conventional high-pressure turbine blades (and vanes) are made from nickel based alloys and often use intricate internal air-cooling passages to prevent the metal from overheating. In recent years, experimental ceramic blades have been manufactured and tested in gas turbines, with a view to increasing rotor inlet temperatures and/or, possibly, eliminating air cooling. Ceramic blades are more brittle than their metallic counterparts, and carry a greater risk of catastrophic blade failure. This has tended to limit their use in jet engines and gas turbines to the stator (stationary) blades.

1.2.5.7 SHROUDED TURBINE

Many turbine rotor blades have shrouding at the top, which interlocks with that of adjacent blades, to increase damping and thereby reduce blade flutter. In large land-based electricity generation steam turbines, the shrouding is often complemented, especially in the long blades of a low-pressure turbine, with lacing wires. These wires pass through holes drilled in the blades at suitable distances from the blade root and are usually brazed to the blades at the point where they pass through. Lacing wires reduce blade flutter in the central part of the blades. The introduction of lacing wires substantially reduces the instances of blade failure in large or low-pressure turbines.

1.2.5.8 SHROUDLESS TURBINE

Modern practice is, wherever possible, to eliminate the rotor shrouding, thus reducing the centrifugal load on the blade and the cooling requirements.

Bladeless turbine uses the boundary layer effect and not a fluid impinging upon the blades as in a conventional turbine.

1.2.5.9 WATER TURBINES

- Pelton turbine, a type of impulse water turbine.
- Francis turbine, a type of widely used water turbine.
- Kaplan turbine, a variation of the Francis Turbine.
- Turgo turbine, a modified form of the Pelton wheel.
- Cross-flow turbine, also known as Banki-Michell turbine, or Ossberger turbine.

1.2.6 NOZZLE

A propelling nozzle is a nozzle that converts the internal energy of a working gas into propulsive force; it is the nozzle, which forms a jet, that separates a gas turbine, being gas generator, from a jet engine.

After the turbine, the gases expand through the exhaust nozzle producing a high velocity jet. In a convergent nozzle, the ducting narrows progressively to a throat. The nozzle pressure ratio on a turbojet is high enough at higher thrust settings to cause the nozzle to choke.

If, however, a convergent-divergent de Laval nozzle is fitted, the divergent (increasing flow area) section allows the gases to reach supersonic velocity within the divergent section. Additional thrust is generated by the higher resulting exhaust velocity. Types are

- Convergent nozzle
- Divergent nozzle
- Convergent-divergent nozzle

1.2.6.1 CONVERGENT NOZZLE:

Convergent nozzles are used on many jet engines. If the nozzle pressure ratio is above the critical value convergent nozzle will choke, resulting in some of the expansion to atmospheric pressure taking place downstream of the throat (i.e., smallest flow area), in the jet wake. Although jet momentum still produces much of the gross thrust, the imbalance between the throat static pressure and atmospheric pressure still generates some (pressure) thrust.

1.2.6.2 DIVERGENT NOZZLE:

The supersonic speed of the air flowing into a scramjet allows the use of a simple divergent nozzle.

1.2.6.3 CONVERGENT-DIVERGENT (C-D) NOZZLE:

Engines capable of supersonic flight have convergent-divergent exhaust duct features to generate supersonic flow. Rocket engines the extreme case owe their distinctive shape to the very high area ratios of their nozzles.

When the pressure ratio across a convergent nozzle exceeds a critical value, the flow chokes, and thus the pressure of the exhaust exiting the engine exceeds the pressure of the surrounding air and cannot decrease via the conventional Venturi effect. This reduces the thrust producing efficiency of the nozzle by causing much of the expansion to take place downstream of the nozzle itself. Consequently, rocket engines and jet engines for supersonic flight incorporate a C-D nozzle which permits further expansion against the inside of the nozzle. However, unlike the fixed convergent-divergent nozzle used on a conventional rocket motor, those on turbojet engines must have heavy and expensive variable geometry to cope with the great variation in nozzle pressure ratio that occurs with speeds from subsonic to over Mach 3.

1.2.7 THRUST AUGMENTATION

Thrust was most commonly increased in turbojets with water/methanol injection or afterburning. Some engines used both at the same time.

Liquid injection was tested on the Power Jets W.1 in 1941 initially using ammonia before changing to water and then water-methanol. A system to trial the technique in the Gloster E.28/39 was devised but never fitted.

1.2.7.1 AFTERBURNER

An afterburner or "reheat jet pipe" is a combustion chamber added to reheat the turbine exhaust gases. The fuel consumption is very high, typically four times that of the main engine. Afterburners are used almost exclusively on supersonic aircraft, most being military aircraft. Two supersonic airliners, Concorde and the Tu-144, also used afterburners as does Scaled Composites White Knight, a carrier aircraft for the experimental SpaceShipOne suborbital spacecraft.

Reheat was flight-trialled in 1944 on the W.2/700 engines in a Gloster Meteor I

1.2.8 CYCLE IMPROVEMENTS

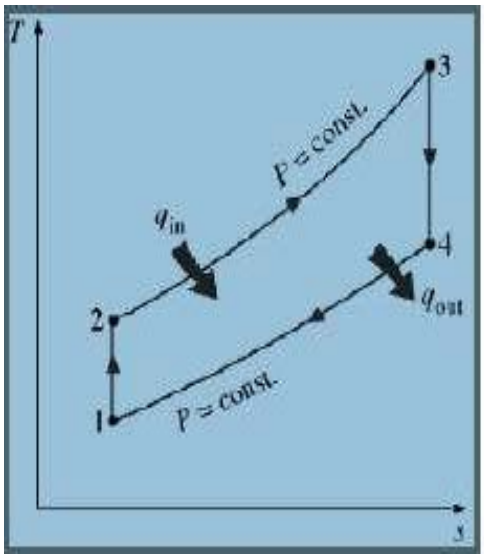
The operation of a turbojet is modelled approximately by the Brayton cycle.

The efficiency of a gas turbine is increased by raising the overall pressure ratio, requiring higher-temperature compressor materials, and raising the turbine entry temperature, requiring

better turbine materials and/or improved vane/blade cooling. It is also increased by reducing the losses as the flow progresses from the intake to the propelling nozzle. These losses are quantified by compressor and turbine efficiencies and ducting pressure losses. When used in a turbojet application, where the output from the gas turbine is used in a propelling nozzle, raising the turbine temperature increases the jet velocity. At normal subsonic speeds this reduces the propulsive efficiency, giving an overall loss, as reflected by the higher fuel consumption, or SFC. However, for supersonic aircraft this can be beneficial, and is part of the reason why the Concorde employed turbojets. Turbojet systems are complex systems therefore to secure optimal function of such system, there is a call for the newer models being developed to advance its control systems to implement the newest knowledge from the areas of automation, so increase its safety and effectiveness.

1.3 THERMODYNAMIC CYCLE

Thermodynamic working cycle for the jet engine is based on Brayton cycle. It is an open cycle (but usually represented as closed for thermodynamic analysis) designed for a piston engine and it is basis for the gas turbine engine cycle. T-s diagram of ideal Brayton cycle is shown here in Figure 4 with processes associated.



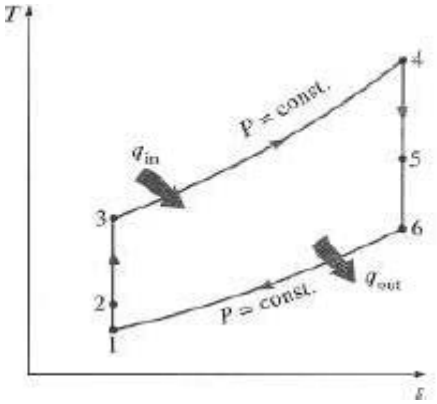
1-2, isentropic compression
2-3, constant pressure combustion
3-4, isentropic expansion
4-1, constant pressure heat release

Figure.no: 1.5 T-s Diagram for the ideal closed Brayton cycle

1.4 IDEAL TURBOJET CYCLE

Temperature-entropy (T-s) diagram of the ideal jet engine cycle is shown in Figure 5. The pressure of the air rises slightly as it is decelerated in the diffuser. Then, air is compressed by

the compressor. It is mixed with fuel in the combustion chamber, where the mixture is burned at constant pressure. The high-pressure and high-temperature combustion gases partially expand in the turbine, producing enough power to drive the compressor and other auxiliary equipment. Finally, the gases expand in a nozzle to the ambient pressure and leave the aircraft at a high velocity



1-2, inlet flow decelerates in diffuser
2-3, flow is compressed in compressor
3-4, mixing and combustion in burner
4-5, flow is expanded in turbine
5-6, outlet flow accelerates in nozzle

Figure.no: 1.6 T-s Diagram for the ideal turbojet cycle

1.5 WORK DONE

For the ideal jet engine, work done on the turbine is assumed to be equal to the compressor work and the processes in the diffuser, the compressor, the turbine and the nozzle are assumed to be isentropic. So the net work done in a turbojet engine is zero. However, for the actual cycle analysis, the irreversibility associated with in the compressor, turbine, nozzle and diffuser should be considered. Therefore, in a steady state operation of the jet engine, the turbine and the compressor work should be equal. Any difference in these parameters runs engine into the transient mode of operation.

1.6 PERFORMANCE PARAMETERS

The performance parameters for an aero-engine are defined in this section. Each parameter has its formula.

1.6.1 SPECIFIC THRUST

This is the amount of output thrust per unit of mass flow entering the engine. It is particularly important to maximize specific thrust in applications where engine weight or volume is crucial for aircraft that fly at high Mach numbers where the drag per unit frontal area is high.

1.6.2 SPECIFIC FUEL CONSUMPTION

This is the mass of fuel burnt per unit time per unit of output power or thrust. It is important to minimize SFC for applications where the weight and/or cost of the fuel are significant. When specifying the SFC values, it is important to state whether the lower or higher calorific value of the fuel is used.

1.6.3 THERMAL EFFICIENCY

Thermal efficiency for jet engines is defined as the rate of addition of kinetic energy to the air divided by the rate of fuel energy supplied, usually expressed as a percentage. The energy in the jet is proportional to the difference in the squares of jet and flight velocities. Generally thermal efficiency increases as pressure ratio and SOT increase together, as these results in a higher jet velocity for a given energy input.

$$\eta_{th} = \frac{\text{increase in kinetic energy}}{\text{heat energy added}}$$

1.6.4 PROPULSIVE EFFICIENCY

Propulsive efficiency for jet engines is defined as the useful propulsive power produced by the engine divided by the rate of kinetic energy addition to the air, again usually expressed as a percentage. The net thrust is proportional to the difference in the jet and flight velocities. Since power is force times velocity, propulsive power is proportional to the flight speed times the difference in the jet and flight velocities. From the formula, propulsive efficiency is improved by low jet velocities, due to lower energy wastage as jet kinetic energy. This requires high pressure ratio and low SOT. However, low jet velocities produce lower thrust output, hence to achieve high propulsive efficiency, as well as a required thrust, high engine mass flow must be coupled with low jet velocities. This leads to engines of low specific thrust, which are large and heavy. Turbofan engines are based upon this principal.

$$\eta_p = \frac{FN * v_0}{\text{increase in kinetic energy}}$$

1.6.5 OVERALL EFFICIENCY

Overall efficiency of a jet engine is the product of the thermal and the propulsive efficiencies of the engine.

$$\eta_{ov} = \eta_{th} * \eta_{p}$$

CHAPTER-II
LITERATURE REVIEW

2.1 DYNAMIC PERFORMANCE

Hsiao-wei, D.chiang, and chih-nenghsu was conducting the experiment. In this project, they are 'investigating about the current steady and dynamic performance of a 12- pound thrust turbojet engine'. This program includes both design and off-design conditions in order to analyse the baseline performance of the engine. Using the pc-based data acquisition system we will able to test the engine for both steady and dynamic performance. A full engine testing setup was established for this study, a pc-based subsystem, and the subsystems of engine including starting system, fuel and control system, and oil lubrication system. The engine testing involved the bench testing of the engine, at 135000 rpm in order to establish the baseline performance including temperature, pressure, speed and thrust.

The engine was accelerated to top speed, decelerated to around 40,000 to 50,000rpm range then repeated cycle runs, and recorded data for stabilized running conditions. The engine performance was predicted using GASTURB program to provide the compressor map data. GASTURB is a software program used to calculate the design and off-design performance. An experimental analytical program was conducted toperform a study of small turbojet engine steady and dynamic performance.

This program was mainly to investigate the current performance of a 12-pound thrust turbojet engine, and also to provide modeling for future designs. Current tests did not reveal thrust drop-off after repeated cycle run times as previously cited, however, problems with rear ball bearing integrity after extended run times may becaused by the following over-temperature cited during dynamic performance testing. This dynamic performance testing has demonstrated performance enhancements at moderate to fast acceleration rates during this type of engine testing. Especially, during the fast acceleration, the design point of 12-pound thrust was achieved at 70% part speed.

However, quick throttle applications were found to cause temporary exhaust gas temperature (EGT) overshoot to as high as 2192°F(1200°C). In summary, this investigation of engine testing and analysis has provided very good insight of small turbojet engine performance. Taking advantage of the experimentally determined compressor performance map and actual small turbojet bench test results, a gas turbine cycle analysis software program was successfully used to predict both the steady state and transient dynamic performance of the engine. The results of the performance prediction program were then compared to actual engine test data with reasonably good agreements.

2.2 CONCEPTUAL DESIGN &MISSION ANALYSIS

Lindelarsion, Tomasgrorsledt, Konstantinosg.kypriarid was conducting this experiment. In this topic 'conceptual design &mission analysis for a geared turbofan and an rotor configuration' , they compared geared turbofan and open rotor configuration by the multidisciplinary studies. So that the open rotor concept can offer a substantial fuel saving potential, compared to ducted fans for a given set of design consideration &customer requirement. These design point calculations were produced assuming constant engine overall pressure ratio, and turbine entry temperature and reflect mid cruise condition and optimal by-pass ratio for SFC. By improving fan and low-pressure turbine polytropic efficiency directly improves SFC; off-design performance effects as well as nacelle drag and engine weight was not considered.

The prediction of engine performance, aircraft design and performance, direct operating costs, and emissions for the two-engine design is made using the EVA code. The engine performance output is used as input in the conceptual design tool Weico for carrying out mechanical and aerodynamic design to drive engine component weight and dimensions. These two tools are integrated together and run in sequence using a commercial integration and optimization environment. Multi objective optimization, design studies, parametric studies, and sensitivity analysis can readily be performed within this environment. In this paper a comparison between a geared turbofan engine and a geared open rotor engine with year 2020 technology level was carried out. Design constraints in the form of customer requirements (such as time between overhaul, runway length, time to height etc.) as well as technology limitations (such as component efficiencies, maximum stage Loading , minimum blade height etc.) were taken into consideration.

Although the open rotor engine is somewhat heavier, the reduced SFC and nacelle drag makes up for this and the resulting mission fuel burn is improved by approximately 15% compared to the geared turbofan engine. It can also be observed that for the open rotor configuration the location of the mid cruise operating point is not at the bottom of the SFC loop. Sizing the engine and choosing an appropriate design point for the propeller involves complex trade- offs, since for short haul aircraft large parts of the business case mission is spent climbing to cruise altitude, rather than cruising.

There is not only a great potential to reduce fuel consumption for the open rotor engine, and consequently decrease the CO2 emissions however the open rotor engine also demonstrates similar cruise EINOx figures compared to turbofan concepts, as well as similar margins from ICAO NOx certification limits. With current fuel prices, 6% lower DOC can be expected from the geared open rotor concept than from the GTF. This figure is very sensitive to the fluctuation of fuel prices.

If the fuel price increases then the impact of fuel consumption on the DOC will be even higher. The question then rises is: "Can the potential reduction in DOC outweigh the technological risks involved in introducing an open rotor configuration into the market." The answer is left to be given by the choices the aero engine industry makes in the years to come.

2.3 OFF-DESIGN PERFORMANCE ANALYSIS

x.Zhao, s.Sahook. kyprianids and j. rantzerm.sielemann was conducting this experiment. In this topic 'off-design performance analysis of hybridised aircraft gas turbine', they are concentrated only off-design performance analysis. They are parallel hybrid concept to reduce the cost efficiency. The hybridization will help us to minimize the power efficiency. The benefit of hybridization appears primarily at the thermomechanical design. There are propulsion system powered from electrical system hold the potential to achieve zero fuel consumption. That the fuel consumption level will be reduced or reducing the purpose there are used to electrical energy. An existing engine equipped with such provisions for power off-take off is the Rolls Royce Trent100.

As required by the more electric aircraft boeing787, which features no bleed air but ahigh power extraction requirement, extracting power from the intermediate pressure shaft has the benefits of enabling high power take off and improving operability of intermediate pressure compressor at low power. For engine performance prediction, an in-house tool was used along with open-source high performance computing platform for systems analysis and multi-disciplinary optimisation open MDAO. Open MDAO allows integration of different models created with different tools. The present work analysed the off-design performance of a geared turbofan under different degrees of hybridisation at different mission phases.

In more detail, the research has been focused on the operability of the compressors with varying hybridisation degrees and the potential of utilising hybridisation on the improvement of operability and specific fuel consumption. Through the baseline establishment, there is still some room for the conventional gas turbine improvement without major modifications to the current state-of-the-art configuration. About 1% of fuel burn can still be expected if the OPR can be pushed higher with better turbine materials capability. To hybridise the conventional gas turbine, as the case shown in the paper, the results indicate that positive hybridisation is good for high-load operations while negative hybridization can improve the operability of part-load operations. To be more specific, a take-off hybridization of 500kW gives a maximum of 0.5% cruise SFC by re-designing the turbine cooling flow system. Only minor changes need to be done to the engine core for the higher optimal

between engine operating/ maintenance costs and the resulting fuel burn increase is realised. Additionally, it is well supported if on-flight charging is needed for busy flights routes. Therefore, overall optimization of a flight mission would be highly specific with all the possibilities and trade-offs included.

2.4 PERFORMANCE MODELING OF AERO ENGINE

Sebastian Samuelsson, Konstantinosg.kyprianidis, Tomasgronstedt. In this paper 'consistent conceptual design and performance modeling of aero engine', they are concentrating mainly on the concept of conceptual design process of an engine. They providing addition of parameters indicating the level of technology assumed such as diffusion factor & stage loadings as part of the process. It represents the component technology level explicit, the ability to trade efficiency for weight or efficiency for cost. The traditional approach for the implementation of aero engine simulation systems has been to use two different modes in the simulation code, the design and off-design modes. For the design mode the governing equations are put in a form that allows the user to specify parameters that can easily be estimated at the preliminary stage of engine design.

The parameters specifying the design point are usually obtained from estimates on technology levels or projected technology levels. Using thermodynamic cycle analysis number of performance operating point, they find the efficiency of an engine. The benefit is obtained thoroughly exploring the pressure ratio distribution between the engine components, as a result of the consistent optimization methodology. The consistent conceptual design allows for the automatic trade of the number of turbomachinery stages against component and engine efficiencies. The implementation of a consistent conceptual design framework has been described, both from a perspective of numerical implementation and from a practical computational viewpoint. Implementing an automated consistent analysis re- duces the risk that component parameters are estimated incor rectly during the definition and optimization of an engine cycle.

The process also reduces the risk that ad hoc engineering judgment influences the definition of analysis input. The use of linear parameter bounds combined with a back tracking algorithm showed to be particularly useful for obtaining a robust solution process while performing consistent conceptual design optimization. Since most commercial gas turbine performance tools use secant methods with a Broyden update, this approach should generally be a useful one and it is recommended. However, for the optimization process, the choice is more open.

The algorithm described for consistent conceptual design optimization is independent of optimizer and the choice of optimizer depends on the topology of the search space, i.e., whether the gas turbine design space is multi-modal. In addition, computational performance requirements should be considered when selecting optimizer. In this study, an SQP method was successfully applied, but genetic algorithm based optimizers should work equally well, albeit with an expected performance penalty. Through example, it is illustrated that consistent conceptual design allows for the automatic trade of the number of turbomachinery stages

Against component and engine efficiencies. This is illustrated by the year 2030 engines for which the consistent polytropic efficiency optimization established a lower SFC despite the fact that the stage numbers were fixed to the year 2020 configuration. By optimally redistributing pressure ratio between the components and fully exploring the design space, the limitations of constant stage numbers could be compensated for.

2.5 THERMODYNAMIC ANALYSIS

Santosh Yarlagadda , was conducting this experiment. Jet engines are required to operate at a higher rpm for the same thrust values in cases such as aircraft landing and military loitering. High rpm reflects higher efficiency with increased pressure ratio. This work is focused on 'performance analysis of a J85 turbojet engine with an inlet flow control mechanism to increase rpm for same thrust values'. Developed a real-time turbojet engine integrating aerothermodynamics of engine components, principles of jet propulsion and inter component volume dynamics represented in 1-D non-linear unsteady equations. Software programs SmoothC and SmoothT were used to derive the data from characteristic rig test performance maps for the compressor and turbine respectively. Simulink, a commercially available model-based graphical block diagramming tool from MathWorks has been used for dynamic modeling of the engine. Dynamic Look-up tables in Simulink were used to interpolate the real-time performance of the engine from rig-test data. Simulink model for the J85 turbojet engine was verified for performance accuracy with available test data of the engine.

A flow control mechanism that produces a pressure drop across inlet is assumed and the analysis is carried with reduced compressor inlet pressure for matching thrust. Compressor inlet pressure is reduced to a percentage of atmospheric pressure and to produce the desired thrust with reduced inlet pressure, the engine operates at a higher shaft rpm. With increase in shaft rpm, pressure and temperature ratio values across the compressor-turbine assembly increases. Performance parameters of the engine are analyzed with the increase in compressor pressure ratio and shaft rpm.

Specific fuel consumption, specific thrust, component pressure ratios, thermal and propulsive efficiencies are the performance parameters of the engine that are analyzed on the model with reduced inlet pressure for the real-time test cases of desired thrust range. Limitations of the analysis are discussed along with possible industrial applications of this flow control mechanism. Overall performance of the turbojet engine decreases with reduced compressor inlet pressure for the same thrust if the engine is operated continuously with this mechanism. But has significant importance for applications where a certain amount of efficiency could be spent for the power demands.

It is observed that the thermal efficiency and fuel flow rate do not have a significant change in lower thrust range of operations. But the engine has the advantage of operating at a higher rpm. This particular application can be applied to any aircraft engine during the time of descent and landing. There will be cases where the aircraft need to gain maximum power from lower thrust range in the minimum time. For an example, consider the case where the aircraft is in its approach to landing. Engine at this point operates in the lower thrust rangezz

the times like a runway overshoot or a go-around landing case, the engine needs to regain its maximum thrust from the lower range in the minimum amount of time. It is at this particular case, the concept of flow control with reduced inlet pressure has a real-time application. Starting at the time of descent the flow control mechanism to reduce compressor inlet pressure is employed and the efficiency of the engine doesn't change much with this application. But the engine id operated at a 10% higher rpm than normal operation with 10% pressure drop across the inlet. If the engine needs to regain the maximum power for the cases as discussed, it could be achieved faster than the normal operation just by deploying the flow control mechanism.

With the reduction in the inlet pressure, the engine works at a higher rpm to produce the same thrust. This results with increase in the work output but decrease in the net work. Therefore, even with the increase in the compressor pressure ratio and turbine inlet temperature, the engine thermal efficiency goes down in a small proportion. With the higher exit jet velocities, propulsive efficiency of the engine also goes down in a very small proportion. SFC, Thermal and propulsive efficiencies are the major performance parameters for commercial engines. But for military engines, situations demand higher Specific Thrust.

Specific thrust for engine increases with reduced compressor inlet pressure. This is particularly important for the cases of shorter runways and higher climb rate. With increase in the specific thrust value, the frontal area of the engine could be decreased and it is extremely important for the military applications.

Thrust specific fuel consumption value increases with reduced inlet pressure. With increase in the specific fuel consumption value for an engine, the range value for the engine decreases. Thermal and Propulsive efficiencies are also decreasing with reduced inlet pressure. However, if the flow control mechanism is employed for certain time of flight such as landing or takeoff, performance decrease in these actors doesn't affect the engine operation. It is advantageous to employ the reduced compressor inlet pressure approach if the situation demands engine power to efficiency.

2.6 SUMMARY ;

The above papers studied detail to know about the performance analysis of engine and its various methods. So we are choosing a software analysis by using MATLAB. To input a constant performance parameters of jet engine to create a performance chart compared with the ideal cycle.

CHAPTER-III

FORMULAS

The performance of real cycles differs from that of ideal cycles for the following reasons.

(a) Because fluid velocities are high in turbo-machinery the change in kinetic energy between inlet and outlet of each component cannot necessarily be ignored. A further consequence is that the compression and expansion processes are irreversible adiabatics and therefore involve an increase in entropy.
(b) Fluid friction results in pressure losses in combustion chambers and heat-exchangers, and also in the inlet and exhaust ducts. (Losses in the ducts connecting components are often included in the associated component losses.)
(c) If a heat-exchanger is to be of economic size, terminal temperature differences are inevitable, i.e. the compressed air cannot be heated to the temperature of the gas leaving the· turbine.
(d) Slightly more work than that required for the compression process will be necessary to overcome bearing and 'windage' friction in the transmission between compressor and turbine, and to drive ancillary components such as fuel and oil pumps.
(e) The values of cPand y of the working fluid vary throughout the cycle due to changes of temperature and, with internal combustion, due to changes in chemical composition.
(f) The definition of the efficiency of an ideal cycle is unambiguous, but this is not the case for an open cycle with internal combustion.
Knowing the compressor delivery temperature, composition of the fuel, and turbine inlet temperature required, a straightforward combustion calculation yields the fuel/air ratio necessary; and a combustion efficiency can also be included to allow for incomplete combustion. Thus it will be possible to express the cycle performance unambiguously in terms of fuel consumption per unit net work output, i.e. in terms of the specific fuel consumption. To convert this t9 a cycle efficiency it is necessary to adopt some convention for expressing the heating value of the fuel.
(g) With internal combustion, the mass flow through the turbine might be thought to be greater than that through the compressor by virtue of the fuel added. In practice, about 1-2 per cent of the compressed air-is bled off for cooling turbine discs and blade roots, and we shall see later that the fuel/air ratio employed is in the region 0-01-0-02.
For many cycle calculations it is sufficiently accurate to assume that the fuel added merely compensates for this loss. We will assume in the numerical examples which follow that the mass flows through the compressor and turbine are equal. When turbine inlet temperatures higher than about 1350 K are used, the turbine blading must beinternally cooled as well as the disc and blade roots. We then have what is called an air-cooled turbine. Up to 15 per cent of the compressor delivery air might be bled for cooling purposes, and for an accurate estimate

of cycle performance it is necessary to account explicitly for the variation of mass flow through the engine.
So certain formulas are used to find the efficiency of an engine with losses. They are,

3.1 STAGNATION PROPERTIES:

The kinetic energy terms in the steady flow energy equation can be accounted for implicitly by making use of the concept of stagnation (or total) enthalpy.

$$(h_0-h)+1/2(0-c^2)=0$$

And thus h_0 is defined by

$$h_0=h+c^2/2$$

When the fluid is a perfect gas, CPT can be substituted for h, & the corresponding concept of stagnation temperature .T_0 is defined by

$$T_0=T+C^2/2\ C_P$$

$C^2/2C_P$ is called the dynamic temperature

T=static temperature

An idea of the order of magnitude of the difference between T_0& T is obtained by considering air at atmospheric temperature, for which c_p=1.005 KJ/Kg k, flowing at 100m/s .Then

$$T_0-T=100^2/(2*1.OO5*10^3)=5K$$

The stagnation pressure p_0 is defined in a similar way to T_0 but with the added restriction that the gas is imagined to be brought to rest not only adiabatically but also reversibly, ieisentropically. The stagnation pressure is thus defined by

$$P_0/P=(T_0/T)^{\gamma/(\gamma-1)}$$

3.2 Compressor and turbine efficiencies

A) ISENTROPIC EFFICIENCY

The efficiency of any machine, the object of which is the absorption or production of work is normally expressed in term of the ratio of actual and ideal work transfers . Because turbomachines are essentially adiabatic, the ideal process is isentropic and the efficiency is called an isentropic efficiency.

For compressor,

The isentropic efficiency for the compressor is

$$\eta_c=(T'_{02}-T_{01})/(T_{02}-T_{01})$$

for turbine,

The turbine isentropic efficiency is defined as

$$\eta_t=(T_{03}-T_{04})/(T_{03}-T'_{04})$$

B) POLYTROPIC EFFICIENCY:

When performing cycle calculation covering a range of pressure ratio, say to determine the optimum pressure ratio for a particular application, the question arises as to whether it is reasonable to assume fixed typical values of η_{c} & η_{t}.

These consideration have led to the concept of polytropic (or small stage) efficiency η_{∞}, which is defined as the isentropic efficiency of an elemental stage in the process such that it is constant throughout the whole process.

For a compression,

$$\eta_c=(P_2/P_1)^{(\gamma-1)/\gamma}-1/(P_2/P_1)^{(\gamma-1)/\eta\infty C}-1$$

For a turbine,

$$\eta_t=1-(1/(p_3/p_4))^{\eta\infty t(\gamma-1)/\gamma}/1-(1/(p_3/p_4)^{(\gamma-1)/\gamma})$$

$$T_{02}-T_{01}=T_{01}[(P_{02}/P_{01})^{(n-1)/n}-1]$$

Where $(n-1)/n=(\gamma-1)/\eta\infty c$, and

$$T_{03}-T_{04}=T_{03}[1-(1/P_{03}-P_{04})^{(n-1)/n}]$$

Where $(n-1)/n=\eta\infty t(\gamma-1)/\gamma$

3.3 PRESSURE LOSSES:

Pressure losses in the intake and exhaust ducting have been dealt with in the previous sub section. In the combustion chamber a loss in stagnation pressure(Δp_b)occurs due to the aerodynamic resistance of flame-stabilizing and mixing device and also due to momentum changes produced by the exothermic reaction.

$$P_{03}=P_{02}-\Delta p_b$$

$$P_{03}=P_{02}(1-((\Delta P_b/p_{02})$$

Heat-exchanger effictiveness:

$$\text{Effictiveness}=(T_{05}-T_{02})/(T_{04}-T_{02})$$

3.4 MECHANICAL LOSSES:

In all gas turbines, the power necessary to drive the compressor is transmitted directly from the turbine without any intermediate gearing. Any loss that occurs is therefore due only to bearing friction and windage.

$$W=(1/\eta_m)c_{p12}(T_{02}-T_{01})$$

We shall take η_m to be 99 percent for all numerical examples

3.5 VARIATION OF SPECIFIC HEAT:

The properties cp& γ play an important in the estimation of cycle performance, and it is necessary to take account of variations in values due to changing conditions through cycle. In general, for real gases over normal working ranges of pressure and temperature, $c_p$is a function of temperature alone. The same is true of γ because it is related to c_p by

$$\gamma-1/\gamma=\tilde{R}/Mc_p$$

3.6 SPECIFIC FUEL CONSUMPTION :

The performance of real cycles can be unambiguously expressed in terms of the specific fuel consumption

$$SFC = f/W_N$$

3.7 CYCLE EFFICIENCY :

$$\eta_t = W_N/fQ_{net,p}$$

The ratio of the maximum to minimum pressure in the cycle is 4.0 and the maximum cycle temperature is 1200 k. compressor and turbine isentropic efficiencies are 0.85. The compression pressure occurs in two stages, each having a pressure ratio of 2.0 with intercooling to 300 k in between.

CHAPTER-IV

SOFTWARE DESCRIPTION

4.1 MATLAB INTRODUCTION:

MATLAB is a multi paradigm numerical computing environment and proprietary programming language developed by math works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

As of 2018, MATLAB has more than 3 million users worldwide. MATLAB users come from various backgrounds of engineering, science, and economics.

4.2 LANGUAGE

This is a high-level matrix /array language with control flow statements. Function, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

4.3 HOW TO CREATE A GRAPH IN MATLAB

In the command window, define x as a vector of 50 linearly spaced values between 1 and 10. Define y as the sine function.

```
X=linespace(1,10,50);

Y=sin(x);
```

In the workspace panel in the MATLAB desktop, select the variables to plot. Use Ctrl+ click to select multiple variables.

Figure.no: 4.1 MATLAB desktop

Select the 2-d line plot from the gallery on the plot lab. For additional type click the arrow at the end of the gallery MATLAB creates the plot and displays the plotting commands at the command line.

Plot(x,y)

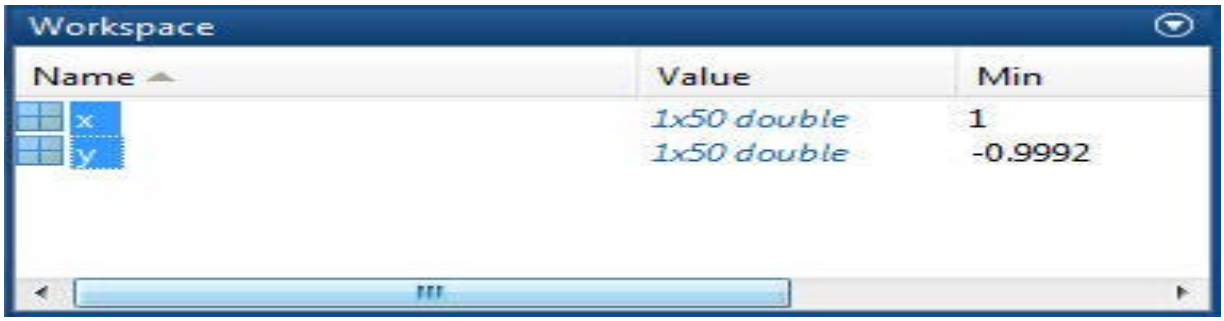


Figure.no: 4.2 MATLAB workspace

Functions

When creating a MATLAB function, the name of the file should match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores. Variables and functions are case sensitive.

Function handles

MATLAB supports elements of lambda calculus by introducing function handles,[27] or function references, which are implemented either in .m files or anonymous/nested functions.

4.4 INTERFACING WITH OTHER LANGUAGE:

MATLAB can call functions and subroutines written in the programming languages C or Fortran. A wrapper function is created allowing MATLAB data types to be passed and returned. MEX files (MATLAB executables) are the dynamically loadable object files created by compiling such functions. Since 2014 increasing two-way interfacing with Python was being added.

Libraries written in Perl, Java, ActiveX or .NET can be directly called from MATLAB, and many MATLAB libraries (for example XML or SQL support) are implemented as wrappers around Java or ActiveX libraries. Calling MATLAB from Java is more complicated, but can be done with a MATLAB toolboxwhich is sold separately by MathWorks, or using an undocumented mechanism called JMI (Java-to-MATLAB Interface), (which should not be confused with the unrelated Java Metadata Interface that is also called JMI). Official MATLAB API for Java was added in 2016

As alternatives to the MuPAD based Symbolic Math Toolbox available from MathWorks, MATLAB can be connected to Maple or Mathematica. The MATLAB working environment. This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

Handle Graphics.
This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

4.5 THE MATLAB MATHEMATICAL FUNCTION LIBRARY:

This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

4.6 The MATLAB Application Program Interface (API):

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.Libraries also exist to import and export MathML.

4.7 MATLAB APPLICATIONS IN AEROSPACE

- Developing the Apollo Lunar Module Digital Autopilot. ...
- Designing a High Angle of Attack Pitch Mode Control. ...
- Six Degrees of Freedom (6-DoF) Motion Platform. ...
- Aircraft Longitudinal Flight Control. ...
- Radar Tracking Using MATLAB Function Block. ...
- Optical Sensor Image Generation. ...
- Air Traffic Control Radar Design.

CHAPTER-V

RESEARCH METHODOLOGY

The analysis of engine performance, conceptual design and off-design performance of a small UAV turbojet engine is using a MATLAB code. Using design flow chart, MATLAB code is being developed for finding the performance parameters for different operating altitude and couple of operating Mach.No.

Performance of engine will be analysed for different operating altitude and operating Mach.No. Optimization of component performance will be done to achieve higher performance.

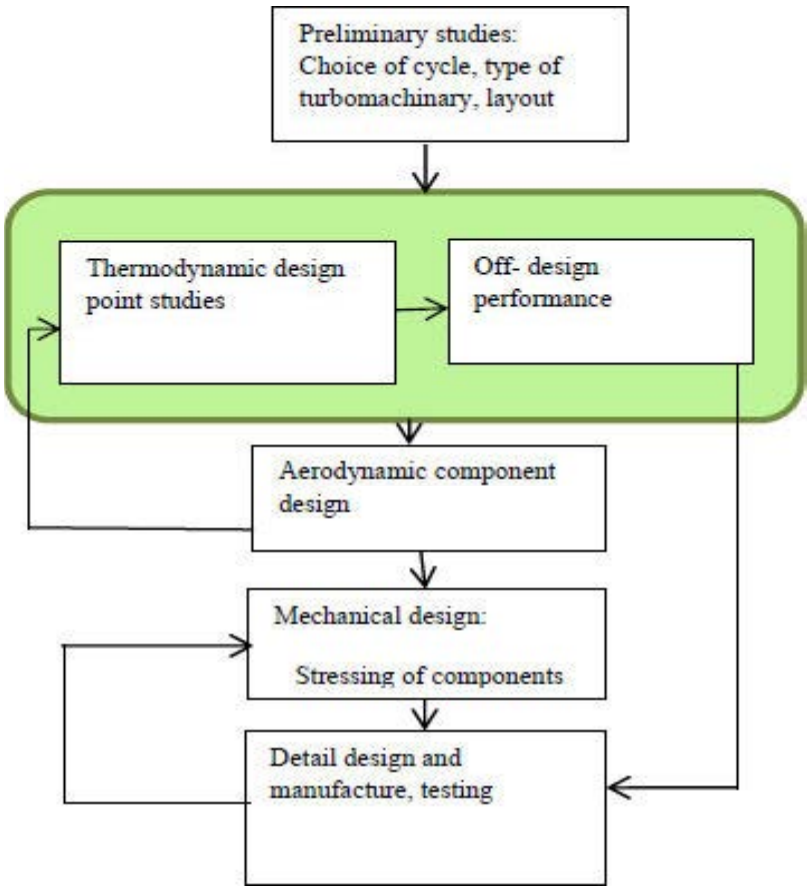


Figure.no: 5.1 Gas turbine design procedure adapted from Gas Turbine Theory by Cohen and Rogers.

5.1 Off-Design Performance of a Turbojet Engine

An engine is said to be running off-design if any of the following apply:

a) Change of throttle setting.
b) Change of altitude.
c) Change of flight speed.
d) Change of climate.
e) Change of installation.
f) Change in geometry.

Although each off-design point is effectively a design point calculation, the resulting cycle has the same turbine and nozzle geometry as that at the engine design point.

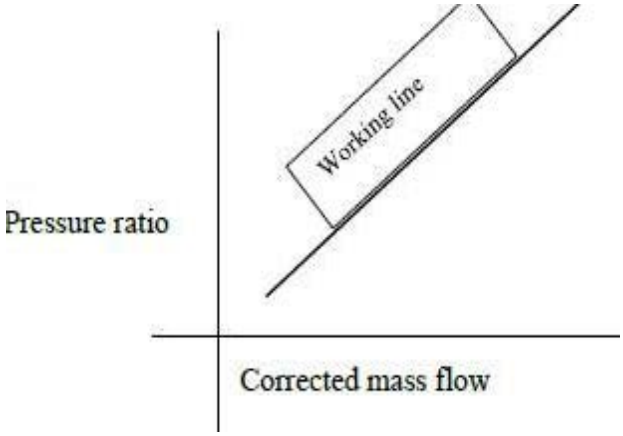


Figure.no: 5.2 Simple off-designs

Calculations of design points are usually carried out by a computer program. Such a program can also be used by adding an iterative loop to construct a quick, off-design model.
Thermodynamic point studies were used as the input for its off-design performance prediction. Other input values are atmospheric condition, isentropic efficiency, polytrophic efficiency, gas constant, mechanical transmission efficiency and combustion efficiency by using steady flow energy equation.

5.2 DESIGN DATA

PARAMETERS	**DATA**
Mach Number	0.8%
Altitude	1000%
Temperature	288%
Pressure	1%
Compressor Pressure Ratio	12%
Mechanical Transmission Efficiency	99%
Combustion Efficiency	97%
Combustion Chamber Pressure Loss	4%

Turbine Inlet Temperature	1200%
Specific Heat Ratio Of Air	1.4%
Specific Heat Ratio Of Hot Gases	1.33%
Specific Heat At Constant Pressure Of Air	1005%
Specific Heat At Constant Pressure Of Hot Gases	1173%
Gas constant	286%
Calorific value of the fuel	43100%

Table.no:5.1 Input Parameter for Engine Performance

5.2.1 Isentropic Efficiency**:** Isentropic efficiency is parameters to measure the degree of degradation of energy in steady-flow devices. It requires a contrast between the real performance of a system and the output it would achieve for the same inlet and exit states under idealized circumstances.

Intake	97%
Compressor	98%
Turbine	97%
Propelling nozzle	995

Table.no:5.2 Isentropic efficiency for Engine Performance

CHAPTER-VI

EXPERIMENTAL DATAS

6.1 AT SEA LEVEL:

MACH NO	TAS	CPR	T03	Specific Thrust	F	TSFC	Propulsive Efficiency
0	0	12	1200	1055.974	0.026746	0.091182	0
0.1	33.95809	12	1200	1040.747	0.026732	0.092467	10.27759
0.2	67.91618	12	1200	1023.203	0.02669	0.093905	19.525087
0.3	101.8743	12	1200	993.5248	0.02662	0.096456	27.890183
0.4	135.8324	12	1200	960.468	0.026522	0.099407	35.493756
0.5	169.7905	12	1200	926.7184	0.026395	0.102537	42.435691
0.6	203.7486	12	1200	892.8169	0.026241	0.105808	48.799248
0.7	237.7066	12	1200	858.8768	0.026059	0.109225	54.654382
0.8	271.6647	12	1200	824.9253	0.025848	0.112802	60.060301

Table.no: 6.1 Datas for various parameters at sea level.

6.2 AT ALTITUDE (H-1000):

MACH NO	TAS	CP R	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFICIENCY
0	0	12	1200	1055.974	0.0269	0.09170	0
0.1	33.5826	12	1200	1041.123	0.026887	0.092969	10.169799
0.2	67.16519	12	1200	1023.954	0.026845	0.094383	19.330323
0.3	100.7478	12	1200	994.651	0.026777	0.096915	27.624922
0.4	134.3304	12	1200	961.9698	0.026681	0.099848	35.171152
0.5	167.913	12	1200	928.5957	0.026557	0.102958	42.066331
0.6	201.4956	12	1200	895.0696	0.026406	0.106207	48.391708
0.7	235.0782	12	1200	861.5049	0.02622	0.1096	54.215656
0.8	268.6608	12	1200	827.929	0.026022	0.113149	54.215656

Table.no: 6.2 Datas for various parameters at altitude 1000.

6.3 AT ALTITUDE(H-2000)

MACH NO	TAS	CPR	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFFICIENCY
0	0	12	1200	1055.9734	0.027059	0.092248	0
0.1	33.192479	12	1200	1041.5125	0.027045	0.093483	10.057684
0.2	66.384957	12	1200	1024.7335	0.027005	0.094872	19.127535
0.3	99.577436	12	1200	995.91346	0.026935	0.097364	27.348475
0.4	132.76991	12	1200	963.52994	0.026844	0.100297	34.83466
0.5	165.96239	12	1200	930.54595	0.026724	0.103386	41.680774
0.6	199.15487	12	1200	897.40999	0.026576	0.106612	47.966001
0.7	232.34735	12	1200	864.23546	0.026402	0.109978	53.757079
0.8	265.53983	12	1200	831.04962	0.026201	0.113499	59.110649

Table.no: 6.3 Datas for various parameters at altitude 2000.

6.4 AT ALTITUDE(H-4000)

MACH NO	TAS	CPR	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFICIENCY
0	0	11	1200	1052..2797	0.027378	0.093665	0
0.1	32.400135	12	1200	1042.3043	0.027362	0.094506	9.829565
0.2	64.800269	12	1200	1026.3176	0.027324	0.095844	18.71426
0.3	97.200404	12	1200	998.19754	0.02726	0.098313	26.784279
0.4	129.60054	12	1200	966.69875	0.027171	0.101184	34.14702
0.5	162.00067	12	1200	934.5071	0.027056	0.104226	40.891927
0.6	194.40081	12	1200	902.16348	0.026915	0.107402	47.094058
0.7	226.80094	12	1200	869.78128	0.026749	0.110714	52.816876
0.8	259.20108	12	1200	837.38776	0.026558	0.114173	58.114402

Table.no: 6.4 Datas for various parameters at altitude 4000

6.5 AT ALTITUDE(H-7000)

MACH NO	TAS	CPR	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFICIENCY
0	0	12	1200	1055.9721	0.027849	0.094943	0
0.1	31.173881	12	1200	10435298	0.027837	0.096034	9.4775445
0.2	62.347761	12	1200	1028.7693	0.027802	0.097288	18.070965
0.3	93.521642	12	1200	1001.8755	0.027743	0.099687	25.903849
0.4	124.69552	12	1200	971.60293	0.02766	0.102487	33.071523
0.5	155.8694	12	1200	940.63752	0.027554	0.105453	39.655588
0.6	187.04328	12	1200	909.52013	0.0274242	0.108546	45.724904
0.7	218.21716	12	1200	878.36416	0.02727	0.111766	51.337984
0.8	249.39105	11	1200	847.1959	0.027096	0.115139	56.544835

Table.no: 6.5 Datas for various parameters at altitude 7000.

6.6 AT ALTITUDE(H-10000)

MACH NO	TAS	CPR	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFICIENCY
0	0	12	1200	1055.9713	0.028323	0.096559	0
0.1	29.898713	12	1200	1044.8042	0.028312	0.097553	9.1058
0.2	58.907747	12	1200	1032.2083	0.028441	0.099194	17.160916
0.3	89.696139	12	1200	1005.7001	0.028225	0.101035	24.97878
0.4	119.59485	12	1200	976.70276	0.028149	0.103754	31.93828
0.5	149.49356	12	1200	947.01251	0.028051	0.106634	38.349478
0.6	179.39228	12	1200	917.17027	0.027931	0.109634	44.275032
0.7	209.29099	12	1200	887.28945	0.02779	0.112753	49.768474
0.8	239.1897	12	1200	857.3973	0.027627	0.115999	54.875804

Table.no: 6.6 Datas for various parameters at altitude 10000.

6.7 AT ALTITUDE(H-12000)

MACH NO	TAS	CPR	T03	SPECIFIC THRUST	F	TSFC	PROPULSIVE EFFICIENCY
0	0	12	1200	1055.9711	0.028484	0.097106	0
0.1	29.453873	12	1200	1045.2487	0.028473	0.098066	8.976512
0.2	58.907747	12	1200	1032.2083	0.028441	0.099194	17.160916
0.3	88.36162	12	1200	1007.0344	0.028389	0.101485	24.653754
0.4	117.81549	12	1200	978.488184	0.028315	0.104175	31.539324
0.5	147.26937	12	1200	949.23641	0.02822	0.107024	37.88883
0.6	176.72324	12	1200	919.83901	0.028104	0.10999	43.762831
0.7	206.17711	12	1200	890.40302	0.027966	0.113072	49.213157
0.8	235.63099	12	1200	860.95571	0.027808	0.116277	54.284429

Table.no: 6.7 Datas for various parameters at altitude 12000

CHAPTER-VII

COMPARITIVE GRAPH

In mathematics, and more specifically in graph theory, a graph is a structure amounting to a set of objects in which some pairs of the objects are in some sense "related". Typically, a graph is depicted in diagrammatic form as a set of dots or circles for the vertices, joined by lines or curves for the edges.

7.1 MACH NO VS SPECIFIC THRUST

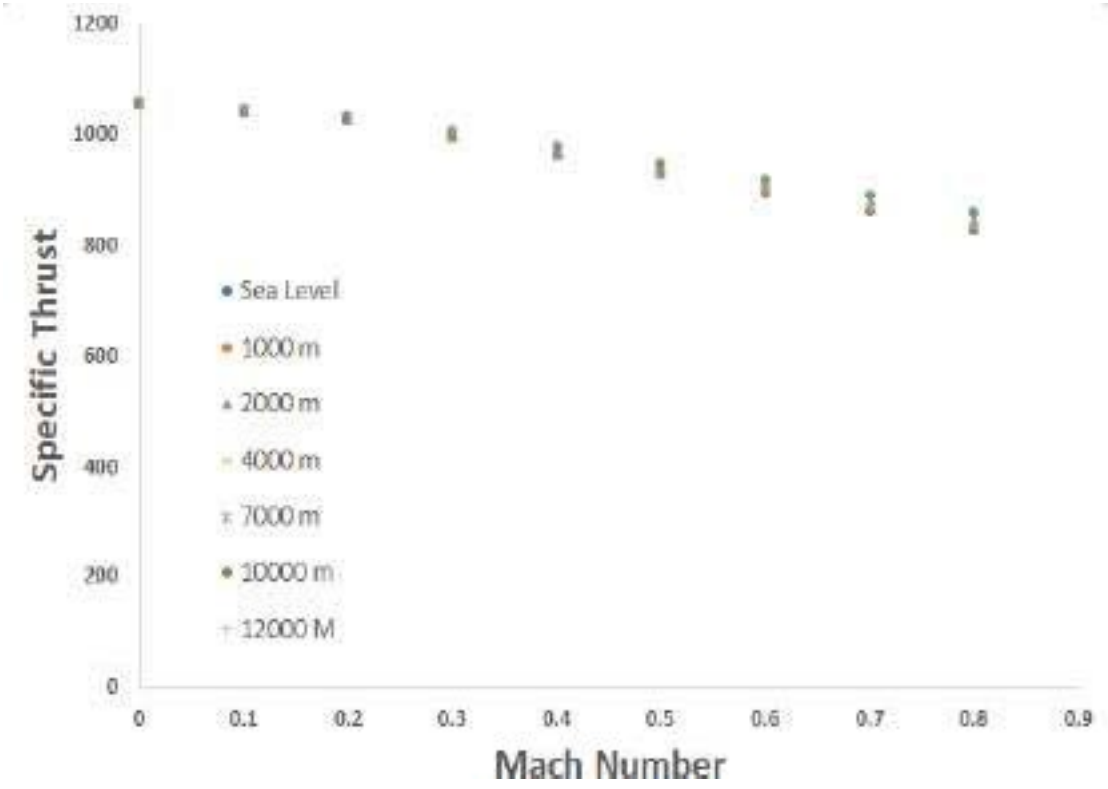


Figure.no:7.1 Mach number vs. Specific thrust

In this fig. 7.1 we compare Mach number vs specific thrust with various altitudes. The respective altitudes are 1000 m, 2000 m, 4000 m, 7000 m, 1000 m and 12000 m from the sea level and the Mach number varies from 0-0.8.The specific thrust slightly decrease from increase in altitude because of increase in momentum drag.

7.2 MACH NUMBER VS FUEL AIR RATIO

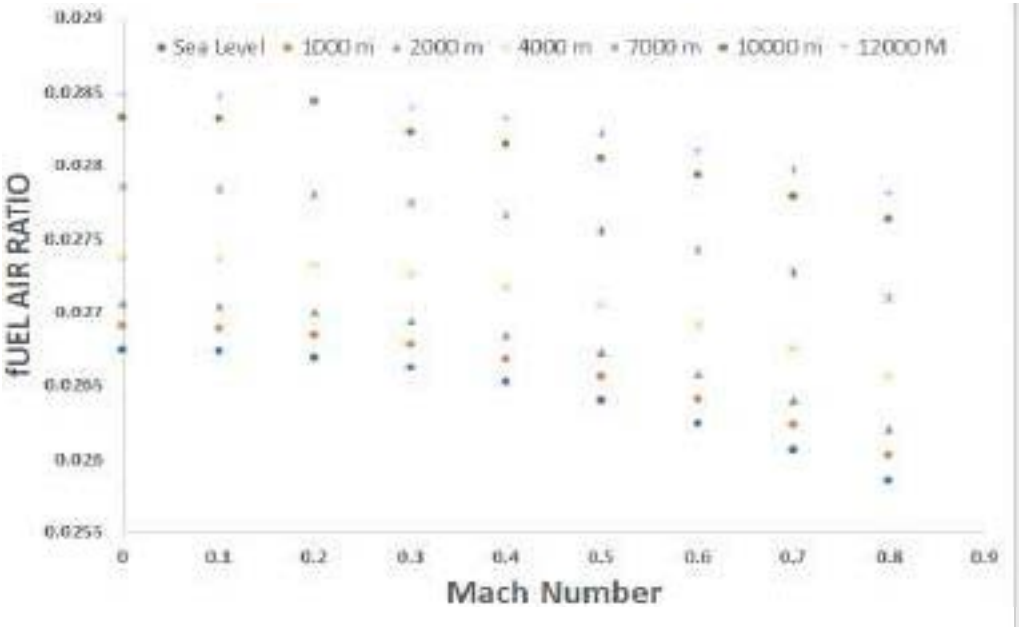


Figure.no:7.2 Mach number vs fuel air ratio

In this above fig.7.2 we compare both Mach number and fuel air ratio. The respective mach number is varies from 0.1,0.2,0.3,0.4,0.5,0.6,0.7 and 0.8. we are consider only subsonic speed. The consumption of fuel air ratio increases with increase in altitude. The graph explains the fuel air ratio slightly inversely proportional to the Mach number but directly proportional to the altitude.

7.3 MACH NO VS TSFC

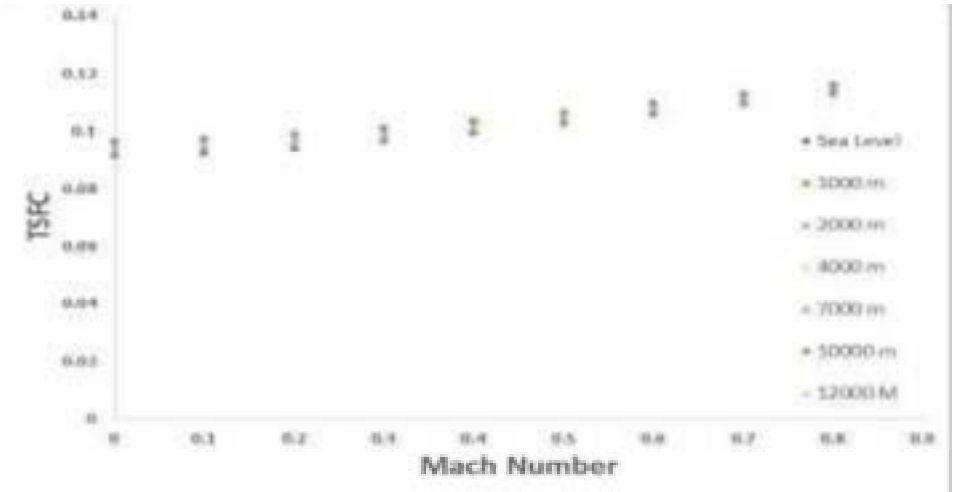


Figure.no:7.3 Mach number vs TSFC

In this fig.7.3 we compare both Mach number and thrust specific fuel consumption. The TSFC slightly increases with respect to the Mach number and different flight altitudes.

7.4 MACH NO VS PROPULSIVE EFFICIENCY

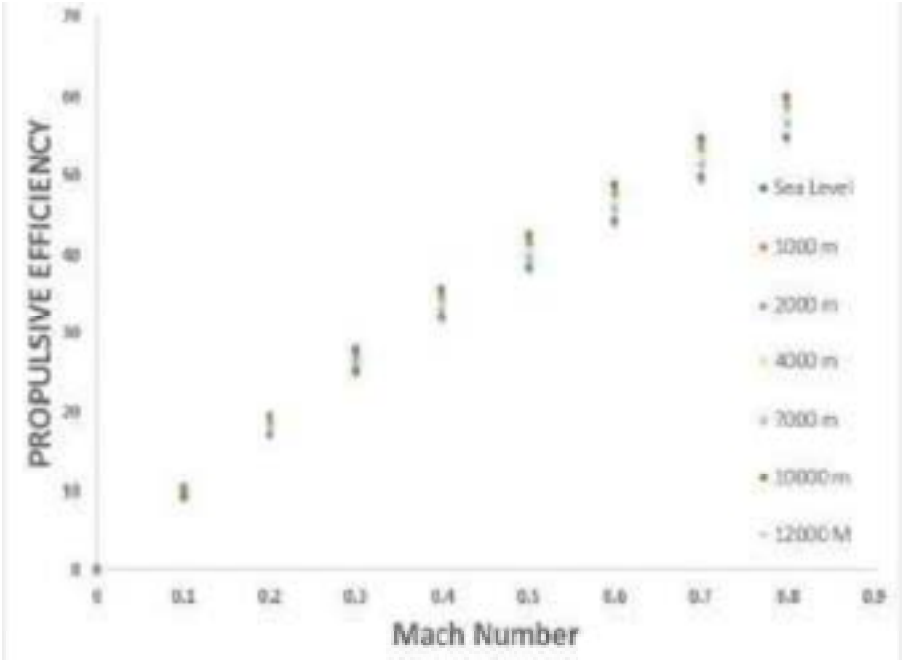


Figure.no:7.4 Mach number vs propulsive efficiency

In this fig. 7.4 we compare both Mach number and propulsive efficiency. It is also like a fig.11 Increases with respect to the both Mach number and different flight altitudes.

CHAPTER-VIII

CONCLUSION

The conceptual design of turbojet has been carried out using MATLAB code with the operating cycle assumptions of Brayton cycle with losses. Using the conceptual design approach, the performance parameters such as specific thrust, Propulsion efficiency, Thrust specific fuel consumption (TSFC) has been estimated through this cycle analysis for different operating mach number, compressor pressure ratio and the turbine inlet temperature. Fig illustrates the variation of specific thrust, propulsive efficiency and TSFC with operating mach number, the Compressor ratio and the turbine inlet temperature is constant. The variation of performance is taken for different altitudes from the sea level. The respective altitudes are 1000 m, 2000 m, 4000 m, 7000 m, 1000 m and 12000 m from the sea level. The mach number varies from 0 to 0.8. The Turbine inlet temperature is 1200 k and the compressor pressure ratio is 12.

At different flight conditions, the compressor ratio and the turbine inlet temperature is kept constant, the specific thrust and the fuel air mixture decreases slightly due to the decrease in the ambient pressure and density in the atmosphere.

Fig 7.1 shows that the increase of mach number at a fixed altitude also decreases the specific thrust because of the increase in the momentum drag. But the consumption of fuel-air mixture gets increased in increasing the altitude is shown in the fig 7.2.

The TSFC and Propulsive efficiency is not depending on the pressure and density of the air. They depend upon the temperature present in the engine. So the TSFC and the propulsive efficiency show improvement in their curves with respect to both mach number and the different flying altitudes is shown in the fig 7.4.

Hence the performance plot of the Turbojet engine is drawn for the above data.

REFERENCE

1. Sebastian Samuelsson, Konstantinos G.Kyprianidis, Tomas gronstedt.,'Consistent Conceptual Design and Performance Modeling of Aero Engines',ASME turbo expo ,Canada, June 2015.

2. Hsiao-wei D.chiang and chih-neng hsu.,' An Investigation of Steady and Dynamic Performance of a small turbojet engine', ASME turbo expo, Netherland, 2002.

3. X.zhao, S.sahoo, K.kyprianids, J.rantzer, M.sielemann.,'Off-design Performance analysis of hybridized aircraft gas turbine', Royal aeronautical society, Germany 2019.

4. Charles Lents, Larry Hardin, Jonathan rheaume.,'Parallel Hybrid Gas-Electric Geared Turbofan Engine Conceptual Design and Benefits Analysis', NASA Glenn research center, Hampton, 2016.

5. Y.G.Li.,'Performance Analysis- based gas turbine diagnostics', Journal of power and energy, 2002.

6. Anita Domitrovidr, E rnest Bazijanacr,V jekoslav Stojkoviiz.,' Mathematical Model For Rediction Of Single-Spool Turbojet Engine Off-Design Performance 'First symposium of explosive arterials, weapons and military technology. Horrid. September. 2002.

7. G.Jims john wessley.,' Design and Modeling of a Micro Turbojet Engine for UAV propulsion', International Journal of Engineering and Advanced Technology, 2019.

8. Swati Chauhan, G. Jims John Wessley.,' Thermodynamic Performance Analysis of a Micro Turbojet Engine for UAV and Drone Propulsion', International Journal of Recent Technology and Engineering, 2019.

9. Selcuk Ekici, Yasin Sohret, Kahraman Coban, Onder Altuntas and T. Hikmet Karakoc.,' Performance Evaluation of an Experimental Turbojet Engine', 2016.

10. Aly M. Elzahaby, Mohamed K. Khalil, Hesham E. Khalil.,' Theoretical and Experimental Analysis of a Micro Turbojet Engine's Performance', International Journal of Scientific & Engineering Research,2016.

11. HIH Saravanamuttoo, H.Cohen, GFC Rogers,'Gas Turbine Theory', 2011.

12. Aich, S & Ravichandran 2002, TiB Whisker Coating on Titanium Surfaces by Solid-State Diffusion: Synthesis, Microstructure, and Mechanical Properties', Metallurgical and Materials Transaction A, vol. 33A, pp. 2002-3489.

13. Alman, DE & Hawk, JA 1999, The abrasive wear of sintered titanium matrix – ceramic particle reinforced composites', Wear, vol. 225-229, pp. 629-39.

14. Atri, RR, Ravichandran, KS & Jha, SK 1999, Elastic properties of insitu processed Ti-TiB composites measured by impulse excitation of vibration', Materials Science and Engineering A, vol. 271, pp. 150-159.

15. Baker, H 1992, _Binary Alloy Phase Diagram', ASM Handbook, vol.3 pp. 2.85

16. Banerjee, R, Nag, S & Fraser, HL 2005, A novel combinatorial approach to the development of beta titanium alloys for orthopaedic implants', Materials Science and Engineering A, vol. C25, pp. 282- 289.

17. Bejjani R, Shi, B, Attia & Balazinski, M 2011, Laser assited turning of titanium Metal Matrix Composite', CIRP Annals-Manufacturing Technology, vol. 60, pp. 61-64.

18. Cezairliyan, A, McClure, JL & Taylor, R 1997, Thermophysical measurements on 90Ti-6Al-4V alloy above 1450K using a transient (subsecond) technique', Journal of Research of National bureau of standards- A physics and chemistry, vol. 81A, no. 2 & 3, pp. 251-256.

19. Chandrasekar, P, Balusamy, V, Ravi Chandran, KS & Harish kumar 2007, _ Laser surface hardening of titanium-titanium boride (Ti-TiB) metal matrix composites', Scripta Materialia, vol. 56, pp. 641-644.

20. Chandrasekar, P, Vijay, V, Balusamy, V & Chandramohan, P 2011, _Improving Corrosion Resistance of Ti–TiB Composite Using Gas 152 Tungsten Arc Heating', Materials and Manufacturing Processes, vol. 26, no. 4, pp. 654-657.

21. Chun Guo, Jiansong Zhou, Jierong Zhao, Bangang Guo, Youjun Yu, Huidi Zhou & Jianmin Chen 2011, _Microstructure and friction and wear behavior of laser boronizing composite coatings on titanium substrate', Applied Surface Science, vol. 257, pp. 4398-4405.

22. Courant, B, Hantzpergue, JJ, Avril, L & Benayoun, S 2005, _Structure and hardness of titanium surfaces carburized by pulsed laser melting with graphite addition', Journal of Materials Processing Technology, vol. 160, pp. 374-81.

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2	Conceptual Design And Performance Analysis Of Turbojet Engine.	International Journal Of Engineering Applied Sciences And Technology. (IJEAST)	Sep/Oct2020
3	Conceptual Design And Performance Analysis Of Turbojet Engine.	Journal of aerospace sciences and technologies	Sep2020

CONCEPTUAL DESIGN AND PRELIMINARY ANALYSIS OF TURBO JET ENGINE

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Abstract: The selection of aero-engine that can meet the design specifications of aircraft is the primary step to the overall design program of an aircraft. Global aviation traffic is expected to increase at an annual rate of 5% for the foreseeable future. However, the engine emissions such as CO, CO_2, UHC, and NO_X have greater adverse impact on the earth atmosphere and human health in addition to its performance degradation. Proper design of the aero-engine to the design requirements of the particular aircraft is essential for meeting the highly competitive airline market. Turbojet is an air-breathing engine which works under the basis of Brayton Cycle. The efficiency and thrust produced by the engine depend on the individual performance of the turbojet components such as Intake, Compressor, Combustion Chamber, Turbine, and Propelling Nozzle in addition to its various operating atmospheric conditions. Here, program has been developed to do a conceptual design of the aero-engine using MATLAB and also performance analysis chart will be developed for the aero-engine to meet the design requirements of the aircraft. Keywords: MATLAB, off-design, thermodynamic analysis.

Nomenclature

Δh()	Stagnation enthalpy change
h_{pol}	Polytrophic efficiency
AR	Axial Aspect Ratio
CO2	Carbon dioxide
UHC	unburned hydrocarbon
EINOx	Nitrogen Oxides Emissions Index
EIS	Entry into Service
FAR	Federal Aviation Regulations
FB	Fuel Burn
FL	Flight Level
HPC	High Pressure Compressor
HPT	High Pressure Turbine
ICAO	International Civil Aviation Organization
IPC	Intermediate Pressure Compressor
ISA	International Standard Atmosphere
IPT	Intermediate Pressure Turbine
LR	Long Range
MT	Medium Term
NOx	Nitrogen Oxides
OPR	Overall Pressure Ratio
PW	Power
RQL	Rich-burn/Quick-quench/Lean-burn
SFC	Specific Fuel Consumption
SLS	Sea Level Static
SR	Short Range
T4	Burner exit temperature
T/O	Take-Off
TEC	Turbine Exhaust Case
TET	Turbine Entry Temperature

Introduction: Since the introduction of the first operational jet engine, engine development has been on larger engines to meet the increasing demands of thrust, SFC, specific thrust etc., Now a days there are numerous ideas to design an engine to increase the performance but before starting the process we are undergoing the conceptual design to analyze the performance characteristic to check the design satisfies our mission requirements. Conceptual design is the first step of the multiphase process involved in creating a new product. The conceptual design phase is conducted next to the schematic design phase. In this process we are using multiple input parameters like operating altitude, Mach.No & component efficiency like compressor ratio, turbine inlet temperature and mechanical transmission efficiency. To determine the compressor stagnation properties from compressor pressure ratio, work done on the compressor and isentropic efficiency of compressor and also find the turbine

ANALYZING THE BEHAVIOUR OF NATURAL AND ARTIFICIAL COMPOSITES

A PROJECT REPORT

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in partial fulfilment for the award of the degree of

BACHELORE OF ENGINEERING

in

AERONAUTICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

MAY 2020

ABSTRACT

The composite materials are replacing the traditional materials, because of its superior properties such as high tensile strength, low thermal expansion, high strength to weight ratio. Natural fiber composites such as sisal and jute polymer composites became more attractive due to their high specific strength, lightweight and biodegradability. Artificial composites such as Glass Fiber Reinforced Polymer, Carbon Fiber Reinforced Polymer having high strength, durability and non-biodegradability.

In this study, both the Natural (Jute fiber) and Artificial Composites (GFRP) are developed and their mechanical properties such as tensile strength, compression strength, bending test, fatigue strength, shear strength and impact strength are evaluated. The interfacial properties, internal cracks and internal structure of the fractured surfaces are evaluated.

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INTRODUCTION

A composite is a structural material that consists of two or more combined constituents that are combined at a macroscopic level and are not soluble in each other. Composite materials are multiphase materials obtained through the artificial combination of different materials in order to attain properties that the individual components by themselves cannot attain.

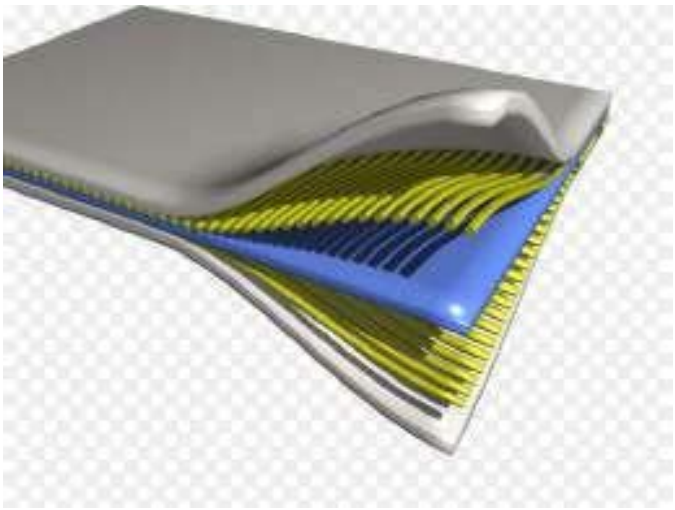


Fig No:1.1 Composite Material

One constituent is called the reinforcing phase and the one in which it is embedded is called the matrix. The reinforcing phase material may be in the form of fibers, particles, or flakes. The matrix phase materials are generally continuous. Examples of composite systems include concrete reinforced with steel and epoxy reinforced with graphite fibers, etc. If the composition occurs on a microscopic scale (molecular level), the new material is then called an alloy for metals or a polymer for plastics.

A composite material is composed of reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymers, metals, or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material.

1.1 HISTORY OF COMPOSITE MATERIALS

The first uses of composites date back to the 1500s B.C. when early Egyptians and Mesopotamian settlers used a mixture of mud and straw to create strong and durable buildings. Straw continued to provide reinforcement to ancient composite products including pottery and boats. Later, in 1200 AD, the Mongols invented the first composite bow. Using a combination of wood, bone, and "animal glue," bows were pressed and wrapped with birch bark. These bows were extremely powerful and extremely accurate. Composite Mongolian bows provided Genghis Khan with military dominance, and because of the composite technology, this weapon was the most powerful weapon on earth until the invention of gunpowder.

The modern era of composites did not begin until scientists developed plastics. Until then, natural resins derived from plants and animals were the only source of glues and binders. In the early 1900s, plastics such as vinyl, polystyrene, phenolic and polyester were developed. These new synthetic materials outperformed resins that were derived from nature. However, plastics alone could not provide enough strength for structural applications. Reinforcement was needed to provide the strength, and rigidity. In 1935, Owens Corning introduced the first glass fiber, fiberglass. It is combined with a plastic polymer creates an incredibly strong structure that is also lightweight. This is the beginning of the Fiber Reinforced Polymers (FRP) industry.

Many of the greatest advancements in composites were evolved during World War II. As the Mongols developed the composite bow, World War II also brought the FRP industry from the laboratory into actual production. Alternative materials were needed for lightweight applications in military aircraft. Engineers soon realized other benefits of composites beyond being lightweight and strong. It was discovered that fiberglass composites were transparent to radio frequencies, and the material was soon adapted for use in sheltering electronic radar equipment (Radomes).

By the end of the WWII, a small niche composites industry was in full swing. With lower demand for military products, the few composites innovators were now ambitiously trying to introduce composites into other markets. Boats were an obvious fit for composites, and the first commercial boat hull was introduced in 1946.At this time Brandt Goldsworthy, often referred to as the "grandfather of composites" developed new manufacturing processes and products. He is

credited with numerous advancements including being the first to fiberglass a surfboard, which revolutionized the sport. Goldsworthy also invented a manufacturing process known as pultrusion. Today, products manufactured from this process include ladder rails, tool handles, pipes, arrow shafts, armor, train floors, medical devices, and more.

In the 1970s the composites industry began to mature. Better plastic resins and improved reinforcing fibers were developed. DuPont developed an aramid fiber known as Kevlar, this fiber has become the standard in armor due to its high tenacity. Carbon fibers was also developed around this time since, it has been replacing metal as the new material of choice. The composite industry is still evolving, with much of the growth is now focused around Renewable energy.

Nowadays, Nanocomposites plays a vital role in composite industry. Nanocomposites refer to composites with nanometer-scale structure. This structure can relate to the grain size, the filler size, the pore size, etc. A small pore size helps to improve the mechanical strength of a porous material. A small grain size is attractive since it leads to a high yield strength in metals and a high toughness in ceramics. A small filler size provides a large filler–matrix interface area per unit volume. The idea behind Nanocomposites is to use building blocks with dimensions in nanometer range to design and create new materials with unprecedented flexibility and improvement in their physical and chemical properties.

1.2 TYPES OF COMPOSITE MATERIALS

Composite materials have undergone continuous development over the past 50 years, resulting in the evolution of a variety of new products. They may be broadly classified into two types, namely

- Natural Composites
- Artificial Composites

1.2.1 NATURAL COMPOSITES

Natural fiber composites are also claimed to offer environmental advantages such as reduced dependence on non-renewable energy/material sources, lower pollutant emissions, lower greenhouse gas emissions, enhanced energy recovery, and end of life biodegradability of components. Since, such superior environmental performance is an important driver of increased

future use of natural fiber composites, a thorough comprehensive analysis of the relative environmental impacts of natural fiber composites and conventional composites, covering the entire life cycle, is warranted.

Some of the examples for natural composites are listed below,

- Wood
- Bone
- Jute fiber
- Coconut fiber
- Cotton
- Bamboo

Fig no :1.2 Examples of Natural Composites

The natural composites are classified mainly in three biomaterial categories which are green composites, hybrid bio-composites, and textile bio-composites. In recent times, biological materials have become essential materials for the construction and automotive industry. Natural fibers and particles have been already used in various types of materials such as plastics, concrete, and textile products as strengthening part of the fiber/matrix combination. These composite materials have very good mechanical thermal and acoustical properties, hence they have been used in various engineering applications.

The wood-plastic composites (WPCs) have been used in many application areas as automobiles, constructions, marine, electronic and aerospace areas instead of fiber glass composites and steel materials. As a wood derivative, hemp fibers have been used in generating thermoplastic matrix composites. These composites can find its application area in the five sectors such as, the first area is to modify some parts of the internal and external automobile structures and electric cars. The second area is to obtain strong cementation in building construction. Another area is the production of durable clothes for army suppliers. The fourth one is to produce small electric hand tools and the last one is to build supercapacitors in carbon nanosheets which are as strong as graphene.

1.2.2 ARTIFICIAL COMPOSITES

Artificial composites are the structural material that consists of two or more combined constituents (including natural fibers sometimes) that are combined at a macroscopic level to obtain the new product. These Artificial Composites are more expensive than natural composites but, they offer high mechanical strength, less weight, more flexibility when compared to natural composites.

Some of the examples for Artificial composites are listed below,

- GFRP
- CFRP
- E-Glass
- S-Glass
- Aluminum Composites

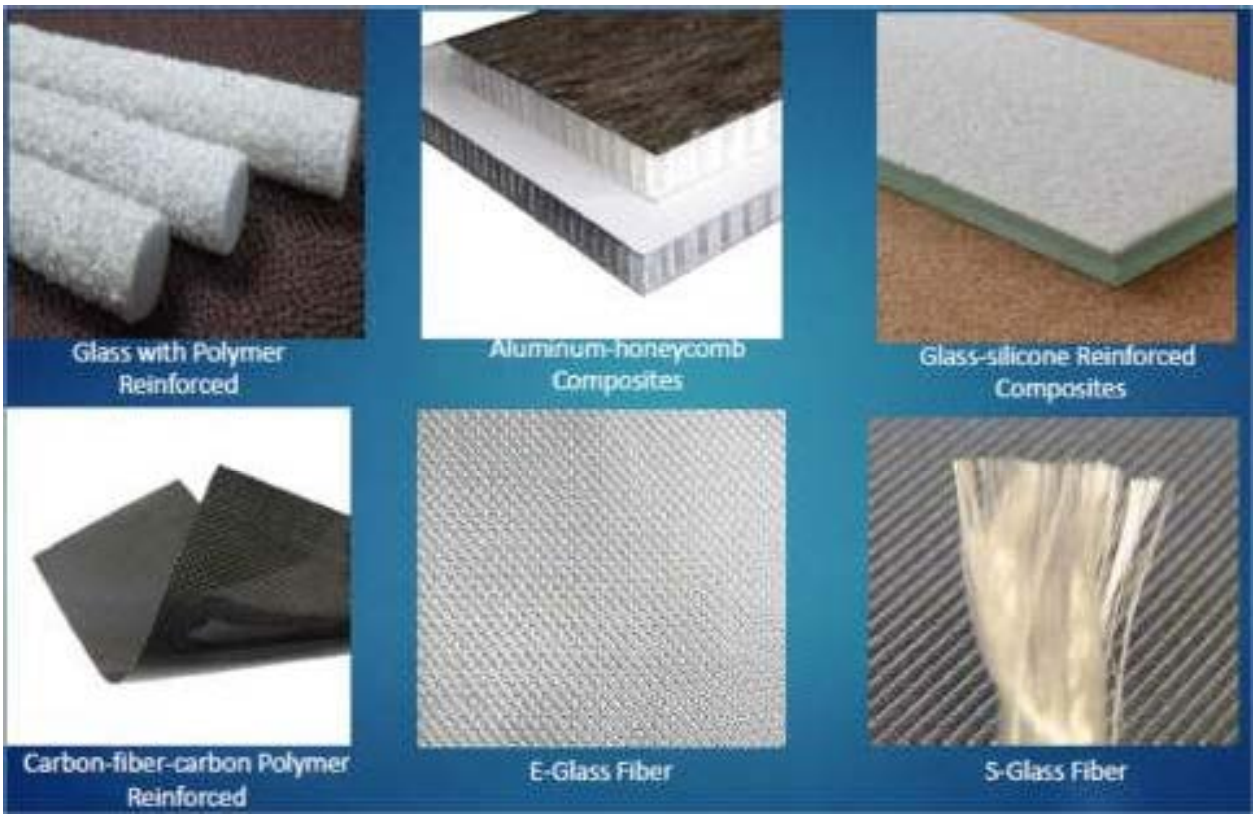


Fig no: 1.3 Examples of Artificial Composites

Carbon Fiber Reinforced Polymer (CFRP) is the most advanced among the above artificial composites.

1.3 CLASSIFICATION OF COMPOSITE MATERIALS

Composite Materials are classified into two different types based on their construction which are given below,

- Reinforcement Type
- Matrix Type

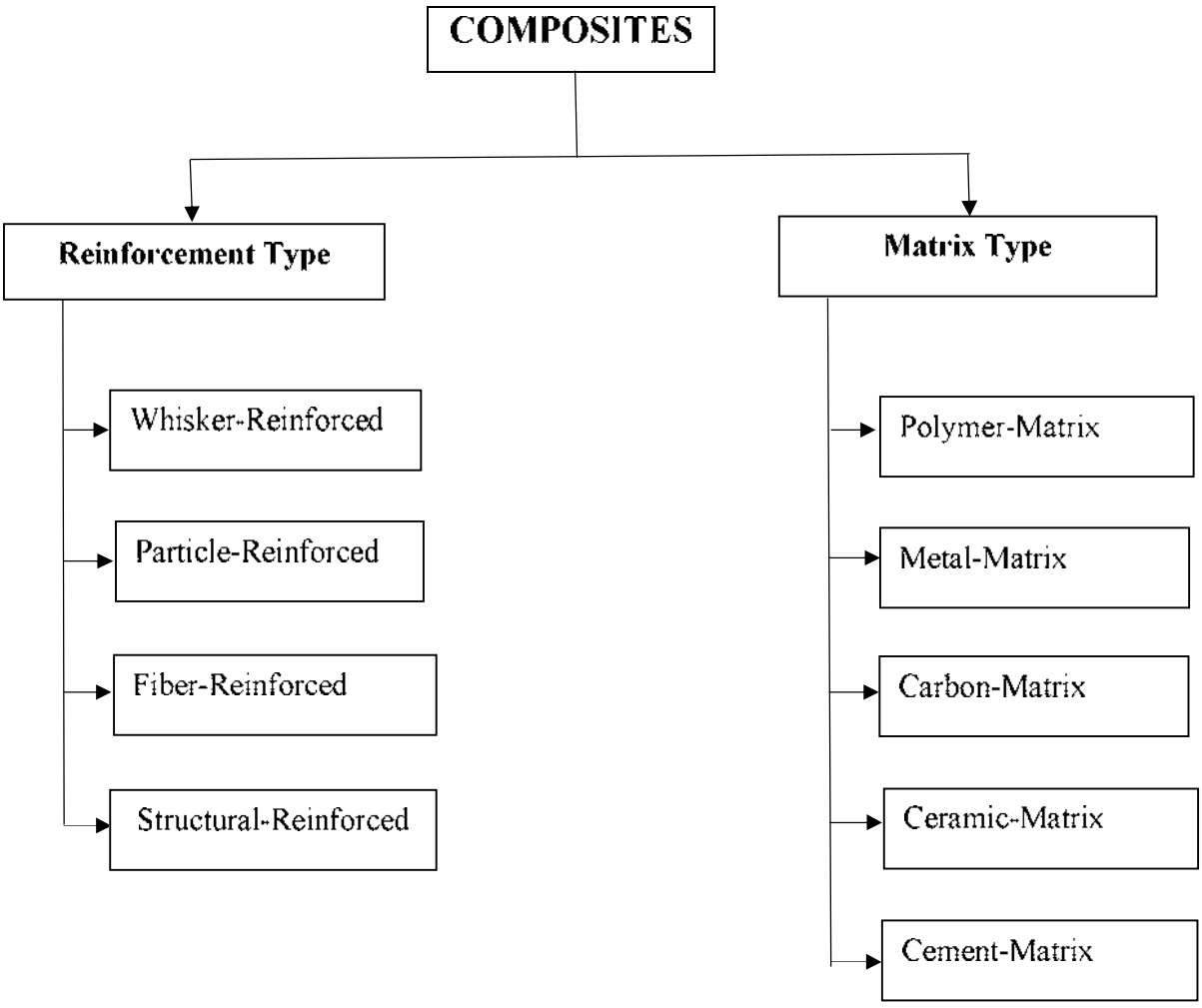


Fig no: 1.4 Classification of Composite Materials

1.3.1 REINFORCEMENT TYPE

Reinforced composites comprise a high-strength additive included with the virgin resin. The additive is usually glass, carbon, or Kevlar fiber. These fibers may be random, oriented, or in a mat format. In some cases, fine metal shavings are used. A common means of achieving this process is through spray up. A catalyst, resin, and chopped roving are all sprayed onto a mold. Filament winding is another reinforced composite method. In this process, a continuous fiber is wrapped repeatedly onto a mold to produce directional strength. A large portion of the filament

winding done in industry is custom manufacturing. Pultrusion is a third process by which reinforced composites are produced. This process allows for a composite of a constant profile to be continuously produced. The roving's or fibers are pulled through a resin, which impregnates the material. The part strengthens as the resin is allowed to cure.Composites reinforced with para-aramid fibers have low density, high strength and specific modulus, good tensile fatigue properties, but low compressive strength and interlaminar shear strength and difficulty in cutting process. It is generally difficult to obtain both good diametric tolerance and shredding-free surfaces for the composites reinforced with aramid fibers. To prevent shredding and surface de-laminations for a clean hole, this type of composite structure is preloaded by tensile stress and cut by shear force.

Composites fabrication is a largely specialized field. Thus, there are very few large companies that focus on composites fabrication to make the bulk of their income. These companies are usually self-managed as opposed to having a corporate office that oversees many smaller plants spread throughout the United States or the world. There are various types of Reinforced composites which are given as follows,

- Whisker-Reinforced Composites
- Particle- Reinforced Composites
- Fiber-Reinforced Composites
- Structural Composites

1.3.1.1 WHISKER-REINFORCED COMPOSITES

A whisker is a single crystal in the form of a fiber. Whiskers can be considered as a sub-group of fibers possessing shorter lengths compared to conventional fibers. They are among the strongest materials that we know of. Whiskers can be produced from materials like graphite, silicon carbide, aluminum oxide, iron, and alike as well as hydroxyapatite, dicalcium phosphate anhydrous, cellulose whiskers and other biomaterials. They are easily damaged, i.e. break to shorter lengths, during processing. They also tend to get oriented leading to unwanted anisotropy in composites. It is also very difficult to carry out large-scale manufacturing of whiskers that are

defect-free. Thus, they are very expensive. Whiskers also pose difficulty in packing compared to particulates; hence, it is not possible to achieve high reinforcement-to-matrix ratios.

1.3.1.2 PARTICLE- REINFORCED COMPOSITES

The particulate phase is harder and stiffer than the matrix. These reinforcing particles tend to restrain movement of the matrix phase in the vicinity of each particle. In essence, the matrix transfers some of the applied stress to the particles, which bear a fraction of the load. The degree of reinforcement or improvement of mechanical behavior depends on strong bonding at the matrix–particle interface. There are two subclassifications of particle-reinforced composites namely large-particle and dispersion-strengthened composites.

The term "large" is used to indicate that particle–matrix interactions cannot be treated on the atomic or molecular level in which continuous mechanics is used. The matrix transfers some of the applied stress to the particles, which bear a fraction of the load. Particles can have quite a variety of geometries, but they should be of approximately the same dimension in all directions (equiaxed). For effective reinforcement, the particles should be small and evenly distributed throughout the matrix. Furthermore, the volume fraction of the two phases influences the behavior; mechanical properties are enhanced with increasing particulate content

Dispersion-strengthened composites, particles are normally much smaller, with diameters between 0.01 and 0.1 m (10 and 100 nm). Particle–matrix interactions that lead to strengthening occur on the atomic or molecular level, whereas the matrix bears the major portion of an applied load, the small dispersed particles hinder or impede the motion of dislocations. Thus, plastic deformation is restricted such that yield and tensile strengths, as well as hardness, improve. Metals and metal alloys may be strengthened and hardened by the uniform dispersion of several volume percent of fine particles of a very hard and inert material. The dispersed phase may be metallic or nonmetallic sometimes, oxide materials are used.

Again, the strengthening mechanism involves interactions between the particles and dislocations within the matrix, as with precipitation hardening. The dispersion strengthening effect is not as pronounced as with precipitation hardening; however, the strengthening is

retained at elevated temperatures and for extended time periods because the dispersed particles are chosen to be unreactive with the matrix phase. For precipitation-hardened alloys, the increase in strength may disappear upon heat treatment as a consequence of precipitate growth or dissolution of the precipitate phase.

1.3.1.3 FIBER- REINFORCED COMPOSITES

The most important composites are those in which the dispersed phase is in the form of a fiber. Design goals of fiber-reinforced composites often include high strength and or stiffness on a weight basis. These characteristics are expressed in terms of specific strength and specific modulus parameters, which correspond, respectively, to the ratios of tensile strength to specific gravity and modulus of elasticity to specific gravity. Fiber-reinforced composites with exceptionally high specific strengths and moduli have been produced that utilize low-density fiber and matrix materials. The arrangement or orientation of the fibers relative to one another, the fiber concentration, and the distribution all have a significant influence on the strength and other properties of fiber-reinforced composites. With respect to orientation, two extremes are possible. They are, a parallel alignment of the longitudinal axis of the fibers in a single direction and a totally random alignment. Continuous fibers are normally aligned, whereas discontinuous fibers may be aligned, randomly oriented, or partially oriented. Better overall composite properties are realized when the fiber distribution is uniform.

Both inorganic and organic fibers are used in making structural composites. Inorganic fibers such as glass, boron, carbon, silicon carbide, silica, alumina, etc. are most commonly used. The structural grade organic fibers are comparatively very few in number. Aramid fibers are the most popular organic fibers. Another recent addition is a high strength polyethylene fiber which has a very low density and excellent impact resistant properties. The carbon fibers may also be grouped with organic fibers, although they are more often considered as ceramic (inorganic) fibers. Inorganic fibers in general are strong, stiff, thermally stable and insensitive to moisture. They exhibit good fatigue resistant properties, but low energy absorption characteristics. Organic fibers, on the other hand, are cheaper, lighter and more flexible. They possess high strength and better impact resistant properties.

1.3.1.4 STRUCTURAL COMPOSITES

A structural composite is normally composed of both homogeneous and composite materials, the properties of which depend not only on the properties of the constituent materials but also on the geometrical design of the various structural elements. Laminar composites and sandwich panels are two of the most common structural composites, only a relatively superficial examination is offered here for them.

A laminar composite is composed of two-dimensional sheets or panels that have a preferred high-strength direction such as is found in wood and continuous and aligned fiber-reinforced plastics. The layers are stacked and subsequently cemented together such that the orientation of the high-strength direction varies with each successive layer. For example, adjacent wood sheets in plywood are aligned with the grain direction at right angles to each other. Laminations may also be constructed using fabric material such as cotton, paper, or woven glass fibers embedded in a plastic matrix. Hence the laminar composite has relatively high strength in a number of directions in the two-dimensional plane.

Sandwich panels are considered to be a class of structural composites, are designed to be light-weight beams or panels having relatively high stiffnesses and strengths. A sandwich panel consists of two outer sheets, or faces, that are separated by and adhesively bonded to a thicker core. The outer sheets are made of a relatively stiff and strong material, typically aluminum alloys, fiber-reinforced plastics, titanium, steel, or plywood; they impart high stiffness and strength to the structure, and must be thick enough to withstand tensile and compressive stresses that result from loading. The core material is lightweight, and normally has a low modulus of elasticity.

Structurally, the core serves several functions. It provides continuous support for the faces. In addition, it must have sufficient shear strength to withstand transverse shear stresses, and also be thick enough to provide high shear stiffness. Another popular core consists of a "honeycomb" structure in which thin foils have been formed into interlocking hexagonal cells, with axes oriented perpendicular to face planes. The honeycomb material is normally either an aluminum alloy or aramid polymer. Strength and stiffness of honeycomb structures depend on cell size, cell wall thickness, and the material from which the honeycomb is made. Sandwich

panels are used in a wide variety of applications including roofs, floors, and walls of buildings; and, in aerospace and aircraft (i.e., for wings, fuselage, and tail plane skins).

1.3.2 MATRIX TYPE

The matrix is basically a homogeneous and monolithic material in which a fiber system of a composite is embedded. It is completely continuous. The matrix provides a medium for binding and holding reinforcements together into a solid. It offers protection to the reinforcements from environmental damage, serves to transfer load, and provides finish, texture, color, durability and functionality. There are various types of Reinforced composites which are given as follows,

- Polymer-Matrix Composites
- Metal-Matrix Composites
- Carbon-Matrix Composites
- Ceramic-Matrix Composites
- Cement-Matrix Composites

1.3.2.1 POLYMER-MATRIX COMPOSITES

Polymer-matrix composites are much easier to fabricate than metal-matrix, carbon-matrix, and ceramic-matrix composites, whether the polymer is a thermoset or a thermoplastic. This is because of the relatively low processing temperatures required to fabricate polymer-matrix composites. These matrices are prominent class of composites compared to other composite materials in commercial applications. Most of the PMCs use either carbon-graphite or aramid fibers, which are the main commercial fibers. Epoxy resin remains the most important matrix polymer.

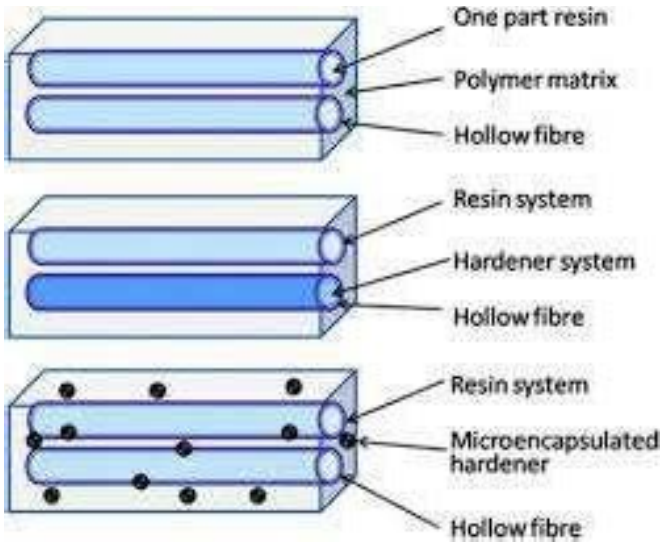


Fig no: 1.5 Polymer-Matrix Composites

1.3.2.2 METAL-MATRIX COMPOSITES

The processing of a metal-matrix composite tends to be much more expensive than that of a polymer-matrix composite due to the high processing temperature required. The fabrication of metal-matrix composites often involves the use of an intermediate, called a preform, in the form of sheets, wires, cylinders, or near-net shapes. A metal matrix composite (MMC) is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. An MMC is complementary to a cermet. In comparison with conventional polymer matrix composites, MMCs are resistant to fire, can operate in wider range of temperatures, do not absorb moisture, have better electrical and thermal conductivity, are resistant to radiation damage, and do not display outgassing. On the other hand, MMCs tend to be more expensive, the fiber reinforced materials may be difficult to fabricate, and the available experience in use is limited.

Fig no:1.6 Metal-Matrix Composites

1.3.2.3 CARBON-MATRIX COMPOSITES

Carbon-matrix composites are made by the carbonization of the matrix of a polymer-matrix composite. The process of carbonization (also known as pyrolysis) is akin to charring, which involves a chemical reaction that removes essentially all atoms that are not carbon from the polymer. Carbon matrix composites (CMCs) are a complex family of advanced materials that consist of carbon or graphite fibers embedded in a carbon or graphite matrix. The carbon fiber reinforcement of these materials makes them stronger, tougher, and more resistant to thermal shock than conventional graphite. The specific advantages of carbon–carbon are light weight and low density, high strength and stiffness, high thermal conductivity, low coefficient of thermal expansion, high fracture toughness, and good fatigue and creep resistance. The combination of low expansion and high thermal conductivity means that carbon–carbon materials also possess excellent thermal shock resistance. Moreover, almost uniquely among materials, the strength of these composites increases with increasing temperature.

Fig no:1.7 Carbon-Matrix Composites

1.3.2.4 CERAMIC-MATRIX COMPOSITES

A ceramic-matrix composite (abbreviated to CMC) is commonly made from a polymer matrix composite by converting the polymer matrix to a ceramic. The process often involves thermal composition and, in this case, it is known as pyrolysis. For example, Polycarbo-silane (a polymer that has both carbon and silicon atoms) is often used as the precursor of silicon carbide. The fibers can be short or continuous. In both cases, the composites can be formed by viscous glass consolidation, either hot pressing a mixture of fibers and glass powder, or winding glass-impregnated continuous fiber under tension above the annealing temperature of the glass. Short fiber borosilicate glass composites are prepared by hot pressing, in vacuum or argon, using an isopropyl alcohol slurry of fibers and Pyrex powder. Long fibers are more difficult to disperse in the slurry. The resulting composite has fibers that are randomized two-dimensionally, as some alignment occurs during pressing.

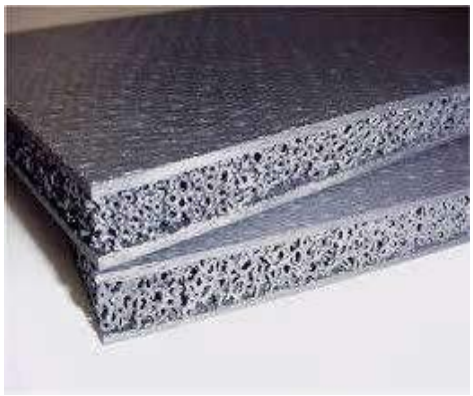


Fig no:1.8 Ceramic-Matrix Composites

1.3.2.5 CEMENT-MATRIX COMPOSITES

Cement is basically calcium silicate, where the SiO4 tetrahedron (with the silicon atom being *sp*3 hybridized and located at the body center of the tetrahedron, while the oxygen atoms are located at the four corners of the tetrahedron) is the fundamental building block. The realization of a cement-matrix composite does not require heat or pressure. Thus, the concrete processing can be performed in the field (as in road construction) rather than in a factory. The process involves mixing cement particles with water and allowing them to react.

This reaction is exothermic in which heat is released during the reaction and is known as hydration. Here, water enters the cement crystals and forms a gel that is a hydrate, particularly calcium silicate hydrate. Partly because of the difference in volume between the reaction products and the original material, shrinkage (commonly known as drying shrinkage) accompanies the hydration reaction.

In order to make sure that there is sufficient water available for the hydration reaction, the reaction is commonly conducted in a moisture chamber that has a high relative humidity. During the first 24h of the reaction, the originally fluid cement paste gradually becomes a rigid material that can thus be demolded if desired. This part of the hardening process is known as setting. However, the set material has not completed the hydration reaction, so the strength has not reached the desired high level. Therefore, setting is followed by curing for weeks.

While curing, the material is exposed to moisture for an extended period so as to allow the hydration reaction to approach completion.

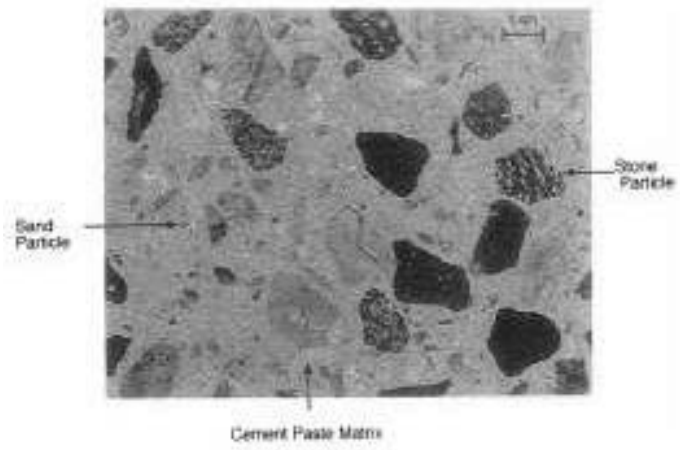


Fig no: 1.9Cement-Matrix Composites

1.4 FABRICATION OF COMPOSITE MATERIALS

Composite fabrication usually involves wetting, mixing or saturating the reinforcement with the matrix, and then causing the matrix to bind together (with heat or a chemical reaction) into a rigid structure. The operation is usually done in an open or closed forming mold, but the order and ways of introducing the ingredients varies considerably. Some of the methods involved in the fabrication process are listed below,

- Hand Lay-Up
- Automated Tape Lay-up
- Compression Molding
- Resin Transfer Molding
- Filament Winding
- Pultrusion Process
- Injection Molding
- Centrifugal Casting
- Continuous Laminating

1.4.1 HAND LAY-UP

Hand lay-up is a molding process where fiber reinforcements are placed by hand then wet with resin. The manual nature of this process allows for almost any reinforcing material to be considered, chopped strand or mat. Similarly, the resin and catalyst blend can be manipulated to allow for ideal processing conditions. Single sided, typically composite tools are used for this process.

Gel coat is first applied to the mold using a spray gun for a quality surface. When the gel coat has cured sufficiently, roll stock fiberglass reinforcement is manually placed on the mold. The laminating resin is applied by pouring, brushing, spraying, or using a paint roller. FRP rollers, paint rollers, or squeegees are used to consolidate the laminate, thoroughly wetting the reinforcement and removing entrapped air. Subsequent layers of fiberglass reinforcement are

added to build laminate thickness. Low density core materials such as end-grain balsa, foam, and honeycomb, are commonly used to stiffen the laminate.

Simple, single cavity molds of fiberglass composites construction are generally used. Molds can range from small to very large and are low cost in the spectrum of composites molds.

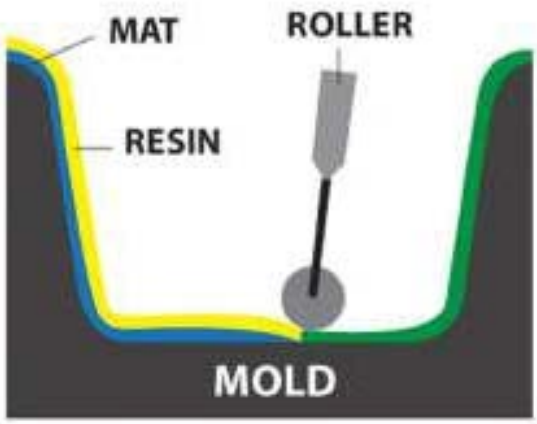


Fig no:1.10 Hand lay Up Method

1.4.2 AUTOMATED TAPE LAY-UP

Automated tape laying (ATL) is one of the most well-established automated manufacturing techniques for composites. Wide unidirectional tapes are laid onto a part mold using a loaded roller system with varying degrees of articulation, depending on the complexity of the part being manufactured. ATL essentially replicates the manual deposition of UD tape but can do so at higher speeds, on larger parts, with greater process control. Although not necessarily a fiber placement technique, modern ATL systems have precise control of tape start, cut, and orientation, allowing them to add more complex reinforcement than simply adding additional plies to the laminate.

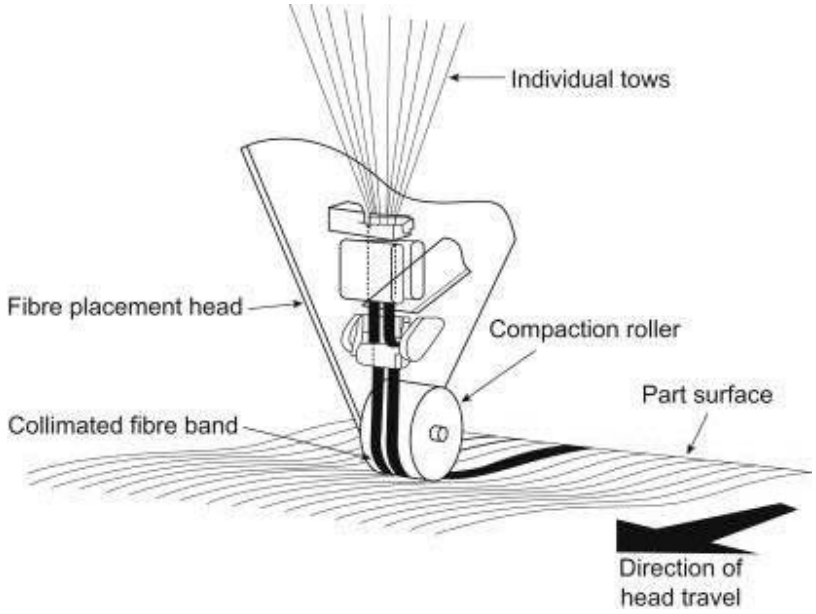


Fig no:1.11 Automated Tape Lay-Up

1.4.3 COMPRESSION MOLDING

Compression Molding is a method of molding in which the molding material, generally preheated, is first placed in an open, heated mold cavity. The mold is closed with a top force or plug member, pressure is applied to force the material into contact with all mold areas, while heat and pressure are maintained until the molding material has cured. The process employs thermosetting resins in a partially cured stage, either in the form of granules, putty-like masses, or preforms.

Compression molding is a high-volume, high-pressure method suitable for molding complex, high-strength fiberglass reinforcements. Advanced composite thermoplastics can also be compression molded with unidirectional tapes, woven fabrics, randomly oriented fiber mat or chopped strand. The advantage of compression molding is its ability to mold large, fairly intricate parts. Also, it is one of the lowest cost molding methods compared with other methods moreover it wastes relatively little material, giving it an advantage when working with expensive compounds.

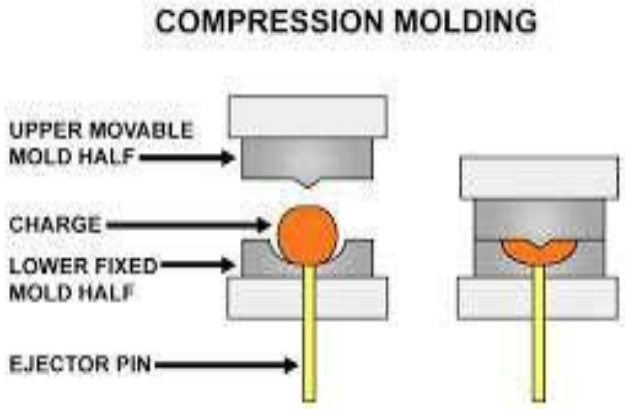


Fig no:1.12 Compression Molding

1.4.4 RESIN TRANSFER MOLDING

Resin transfer molding (RTM) is an intermediate volume molding process for producing composites. In RTM, resin is injected under pressure into a mold cavity. This process produces parts with two finished surfaces. By laying up reinforcement material dry inside the mold, any combination of material and orientation can be used, including 3-D reinforcements. Part thickness is determined by the tool cavity. Fast cycle times can be achieved in temperature-controlled tooling and the process can range from simple to highly automated. RTM can use a wide variety of tooling, ranging from low-cost composite molds to temperature-controlled metal tooling. Vacuum assist can be used to enhance resin flow in the mold cavity.

The mold is gel coated conventionally, if required. The reinforcement (and core material) is positioned in the mold and the mold is closed and clamped. The resin is injected under pressure, using mix/meter injection equipment, and the part is cured in the mold. The reinforcement can be either a preform or a pattern cut roll stock material. A preform is a reinforcement that is formed to a specific shape in a separate process and can be quickly positioned in the mold. RTM can be done at room temperature; however, heated molds are required to achieve fast cycle times and product consistency. Clamping can be accomplished with perimeter clamping or press clamping.

RTM can utilize either hard or soft tooling depending upon the expected duration of the run. Soft tooling would be either polyester or epoxy molds, while hard tooling may consist of cast machined aluminum, electroformed nickel shell, or machined steel molds. RTM can take advantage of the broadest range of tooling of any composites process. Tooling can range from very low-cost to high-cost, life-long molds.

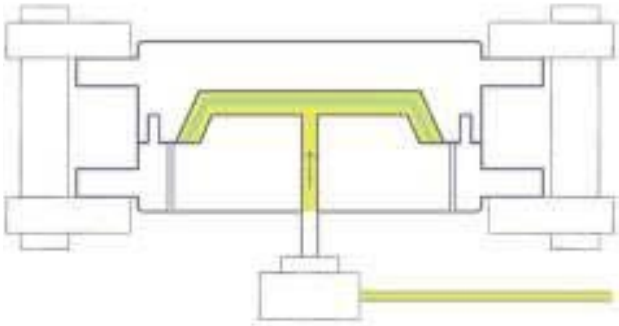


Fig no:1.13 Resin Transfer Molding

1.4.5 FILAMENT WINDING

Filament winding is a fabrication technique mainly used for manufacturing open (cylinders) or closed end structures (pressure vessels or tanks). This process involves winding filaments under tension over a rotating mandrel. The mandrel rotates around the spindle, while a delivery eye on a carriage traverses horizontally in line with the axis of the rotating mandrel, laying down fibers in the desired pattern or angle. The most common filaments are glass or carbon and are impregnated in a bath with resin as they are wound onto the mandrel. Once the mandrel is completely covered to the desired thickness, the resin is cured. Depending on the resin system and its cure characteristics, often the rotating mandrel is placed in an oven or placed under radiant heaters until the part is cured. Once the resin has cured, the mandrel is removed or extracted, leaving the hollow final product. For some products such as gas bottles, the 'mandrel' is a permanent part of the finished product forming a liner to prevent gas leakage or as a barrier to protect the composite from the fluid to be stored.

Filament winding is well suited to automation, and there are many applications, such as pipe and small pressure vessel that are wound and cured without any human intervention. The

controlled variables for winding are fiber type, resin content, wind angle, tow or bandwidth and thickness of the fiber bundle.

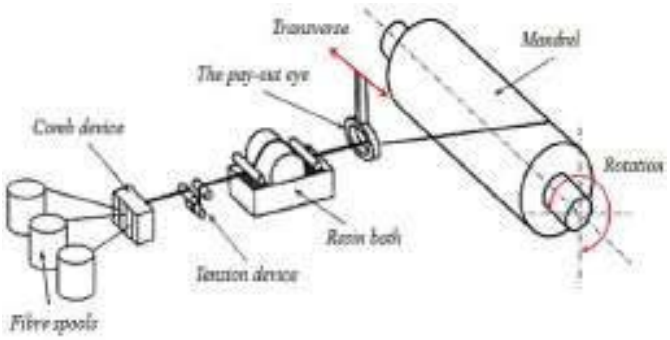


Fig no:1.14 Filament Winding

1.4.6 PULTRUSION PROCESS

Pultrusion is a continuous process for manufacture of splendorous materials with constant cross-section.

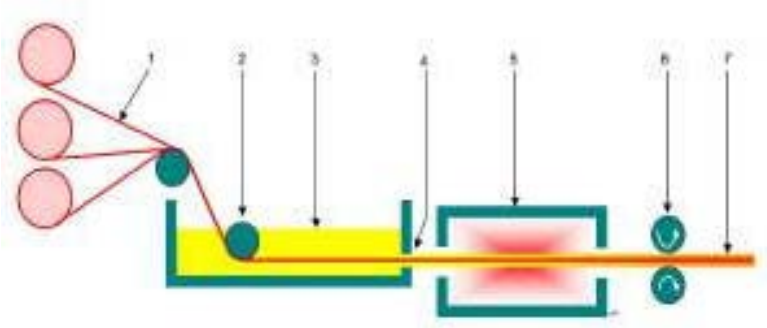


Fig no: 1.15 Pultrusion Process

1 – Continuous roll of reinforced fibers/woven fiber mat

2 – Tension roller

3 – Resin Impregnator

4 – Resin soaked fiber

5 – Die and heat source

6 – Pull mechanism

7 – Finished hardened fiber reinforced polymer

The process starts with the support of the reinforcements. These can be glass, carbon or aramid and in a roving/tow, mat, woven or stitched format. The material is pulled into the infeed area where it is accurately formed to the required shape and impregnated with a resin matrix. The resin matrix can be polyester, vinyl ester, epoxy or phenolic. From the infeed area the impregnated reinforcement is pulled into the heated pultrusion die.

The resin matrix is such that it solidifies and cures within the die. The cured profile exiting the die is allowed to cool before being clamped and pulled by the reciprocating puller units. The puller units reciprocate in a hand over hand motion, with the return stroke being faster than the pulling stroke to give a smooth continuous pull at a constant speed irrespective of the pulling force required. From the puller units the profile passes into the flying cut off saw where it is cut to the required length.

1.4.7 INJECTION MOLDING

Injection molding is a manufacturing process for producing parts by injecting molten material into a mold, or mold. Injection molding can be performed with a host of materials mainly including metals, glasses, commonly thermoplastic and thermosetting polymers. Material for the part is fed into a heated barrel, mixed, and injected into a mold cavity, where it cools and hardens to the configuration of the cavity. It is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection molding, which vary greatly in their size, complexity, and application. The injection molding process requires the use of an injection molding machine, raw plastic material, and a mold. The plastic is melted in the injection molding machine and then injected into the mold, where it cools and solidifies into the final part. The steps in this process are described in greater detail in the next section.

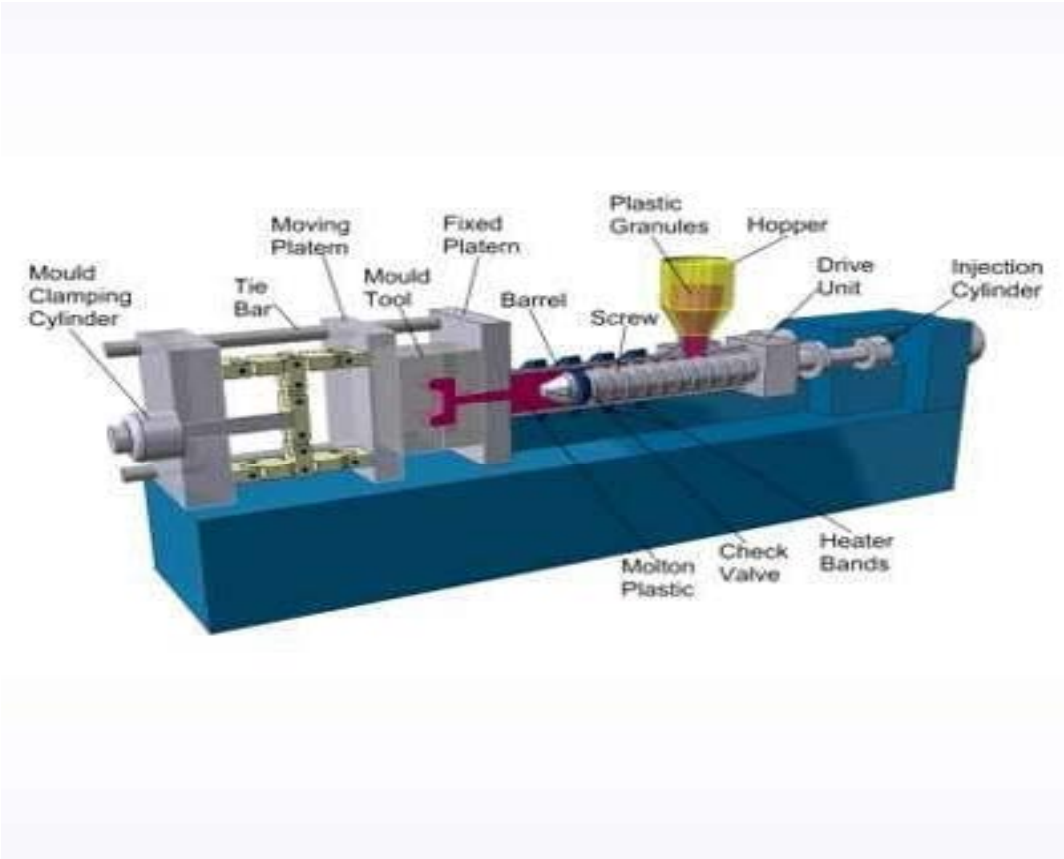


Fig no: 1.16 Injection Molding

1.4.8 CENTRIFUGAL CASTING

It is a process that delivers castings of very high material soundness, and thus is the technology of choice for applications like jet engine compressor cases, petrochemical furnace tubes, many military products, and other high-reliability applications.

In the centrifugal casting process, molten metal is poured into a spinning die. The die can be spinning either on a vertical or horizontal axis depending on the configuration of the desired part. Ring and cylinder type shapes are cast vertically; tubular shapes are made with the horizontal centrifugal process. Either process may be used to produce multiple parts from a single casting.

External structures and shaping can be cast in place to significantly reduce post-processing including machining or fabrication. Because of the high g-forces applied to the molten metal in the spinning die, less dense material, including impurities are subsequently

removed by machining. Typical materials that can be cast with this process are iron, steel, stainless steels and alloys of aluminum, copper and nickel. Two materials can be cast by introducing a second material during the process. Typical parts made by this process are pipes, boilers, pressure vessels, flywheels, cylinder liners and other parts that are axis-symmetric.

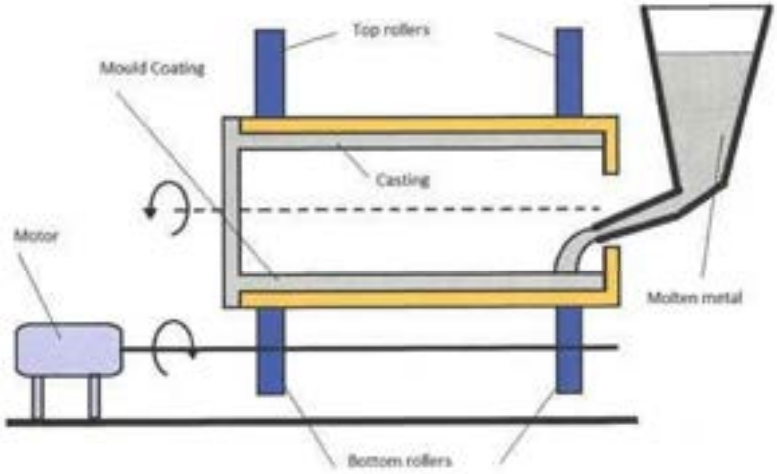


Fig no:1.17 Centrifugal Casting

1.4.9 CONTINUOUS LAMINATING

Continuous lamination is a highly automated process in which reinforcements are impregnated with resin and guided through a conveyor process of forming rolls to control thickness and resin content consistent with the desired end product. As the material on the conveyor is passed through a heating zone the resin is cured to form the composite panel. Panels and sheets manufactured in this process are used to produce truck trailer and RV sidewalls, skylights, building panels, and other construction industry applications.

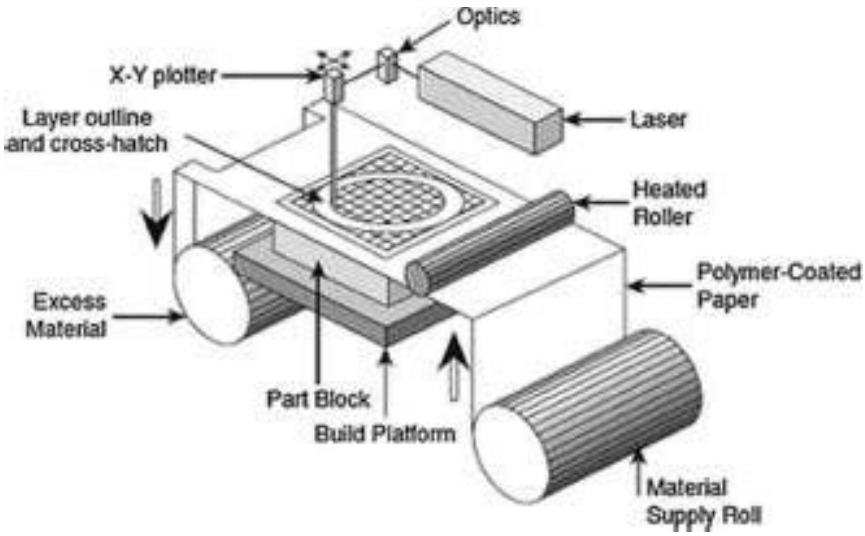


Fig no: 1.18 Continuous Lamination

1.5 CHARACTERISTICS OF COMPOSITE MATERIALS

The characteristic features of the composite materials are as listed below,

- High strength (as strong as high-strength steels).
- Low density (lower than aluminum).
- High stiffness (stiffer than titanium, yet much lower in density).
- Good creep resistance.
- Good fatigue resistance.
- Low friction coefficient and good wear resistance.
- Toughness and damage tolerance (as enabled by using appropriate fiber orientations).
- Chemical resistance (chemical resistance controlled by the polymer matrix).
- High thermal conductivity.
- Corrosion resistance.
- Dimensional stability.
- Vibration damping ability.
- Low electrical resistivity.
- High electromagnetic interference (EMI) shielding effectiveness.

1.6 ADVANTAGES OF COMPOSITE MATERIALS

The advantages of composite materials are as follows,

- **Design Flexibility** – Thermoset Composites give designers nearly unlimited flexibility in designing shapes and forms. They be molded into the most intricate components and can be made a wide range of densities and chemical formulations to have precise performance properties.
- **Low cost per cubic inch** – When comparing costs based on volume, thermoset composites have lower material costs than traditional materials such as wood, engineered thermoplastics and metals. In addition, because thermoset composites have a low petroleum-based content, they are not subjected to the price fluctuations experienced in petroleum-based products.
- **Lower material costs** – Because thermoset composites can be precisely molded, there is little waste and therefore significantly lower overall material costs than metals products.
- **Improved productivity** – Industrial Designers and Engineers are able to reduce assembly costs by combining several previously assembles parts into a single component. Also, inserts can be molded directly into the part during the molding process thereby eliminating the need for a post-process. In addition, composites do not usually require additional machining, thereby reducing work-in-process and time to market.

1.7 DISADVANTAGES OF COMPOSITE MATERIALS

The disadvantages of composite materials are as follows,

- **Delamination** - Since composites are often constructed of different ply layers into a laminate structure, they can "delaminate" between layers where they are weaker.
- **High Cost** - They are a relatively new material, and as such have a high cost.
- **Complex Fabrication** - The fabrication process is usually labor intensive and complex, which further increases cost.

- **Damage inspection** - Delamination and cracks in composites are mostly internal and hence require complicated inspection techniques for detection.

- **Composite to metal joining** - Metals expand and contract more on variations in temperature as compared to composites. This may cause an imbalance at joinery and may lead to failure.

Barring for the few disadvantages, composite materials are an almost perfect material for aircraft and fulfill most of the structural requirements. With further research progress in composite material damage control, the existing problems could also be controlled.

1.8 APPLICATIONS OF COMPOSITE MATERIALS

Some of the applications of composite materials are listed below,

- **Space craft**- Antenna structures, Solar reflectors, Satellite structures, Radar, Rocket engines, etc.
- **Aircraft**- Jet engines, Turbine blades, Turbine shafts, Compressor blades, Airfoil surfaces, Wing box structures, Fan blades, Flywheels, Engine bay doors, Rotor shafts in helicopters, Helicopter transmission structures, etc.
- **Industry**- Bearing materials, Pressure vessels, Abrasive materials, Electrical machinery, Truss members, Cutting tools, Electrical brushes, etc.
- **Automobiles**- Engines, bodies, Piston, cylinder, connecting rod, crankshafts, bearing materials, etc.

CHAPTER 2

LITERATURE SURVEY

Rahul Reddy Nagavally et al [1] "Composite Materials - History, Types, Fabrication Techniques, Advantages, and Applications" This paper presents a brief introduction of composite materials followed by history, fabrication techniques, advantages and applications. The individual components in the composite remains separate and distinct characteristics within the finished structure. The new material may be preferred for many reasons in which they are stronger, lighter, or less expensive when compared to traditional materials. More recently, researchers have also begun to actively include sensing, actuation, computation and communication into composites, which are known as Robotic Materials.

M.Ramesh et al [2] "Mechanical property evaluation of sisal–jute–glass fiber reinforced polyester composites" This paper reveals that the evaluation of mechanical properties by the reinforcement of Natural Composites (sisal–jute) with Artificial Composites (Glass fiber reinforced polyester) to determine that the jute-sisal mixture composite sample is capable of having maximum flexural strength, maximum impact strength, maximum tensile strength than the individual artificial composite GFRP by using Scanning Electron Microscope. The result indicates that the incorporation of sisal–jute fiber with GFRP can improve the properties and used as an alternate material for glass fiber reinforced polymer composites.

Jiayu Xiao et al [3] "Study on Processing and Properties of Jute Fiber Reinforced Polymer Matrix Composites" The fundamental performance, processing, mechanical properties and potential applications of jute fiber are discussed. The wettability between jute fiber and the three kinds of general resin matrices are quite good. The count of twisting jute fiber and thickness of jute fabric determines the tensile strength and bio-degradability factors are also included in this study.

S. Kandwal et al [4] "Processing and Characterization of Natural Fiber Reinforced Polymer Composites" The investigation of mechanical properties of Grewia Optiva (Bhimal) and jute fiber with epoxy resin matrix-based polymer composites indicates that the tensile, bending and abrasion behavior of composites material made by grewia optiva and jute into epoxy

resin have better tensile strength and flexural strength compared with the Gypsum-paper composites.

Hari Jana Raju et al [5] "Physical and Mechanical Characteristics of the Jute Fiber Reinforced Polymer Composites" Fabrication of unidirectional jute fiber reinforced epoxy-based composites have different fiber loading, density, void content and water absorption coefficients increases invariably with respect to its weight ratio. The mechanical properties of the composites are improved by adding the jute fiber as reinforcement in polymer matrix has been proved.

Sivasaravanan.S et al [6] "Mechanical Characterization of GFRP/CFRP/Natural Fiber Laminated in Epoxy Resin Composites" The composite consisting of an epoxy resin matrix reinforce with E-type glass fiber, Carbon fiber, Natural Fiber are used due to their high strength, light weight and free from corrosion. This research work will describe the fabrication of nano composite materials by hand layup technique and also gives the detailed report about the characteristic properties such as Mechanical properties and Morphological properties of Epoxy/GFRP/CFRP/Natural Fiber.

Ajith Gopinath et al [7] "Experimental Investigations on Mechanical Properties of Jute Fiber Reinforced Composites with Polyester and Epoxy Resin Matrices" is carried out to reveal that the jute epoxy exhibited better tensile and flexural properties. The processing time required for the jute polyester composite is very less compared to jute-epoxy composite. The results of this research indicate better mechanical properties for jute-epoxy, which makes it better suited for the automotive applications rather than jute-polyester composites.

Mubarak Ahmed Khan et al [8] "Study on the Mechanical Properties of Jute/Glass Fiber-reinforced Unsaturated Polyester Hybrid Composites and the effect of Surface Modification by Ultraviolet Radiation" The changes in tensile and flexural properties as a function of fiber content and as a consequence of UV radiation were investigated. Glass/jute was successfully reinforced in Unsaturated Polyester Hybrid (USP) resin and the mechanical performance was maximum at fiber loading. Different weight fractions of glass were added to the jute/USP composites and better mechanical properties, such as tensile and bending moduli were found at a jute to glass ratio. Due to the use of low-cost UV treatment as a surface modification technique and good balance of mechanical properties with proper hybridization, this type of composite can primarily be used for low-cost housing and automotive interior component applications.

Hazizan Md Akil et al [9] "Water absorption study on pultruded jute fiber reinforced unsaturated polyester composites" Comparative study of water absorption on the mechanical properties of jute fiber reinforced unsaturated polyester composite has been studied following different aqueous environments such as distilled water, sea water and acidic solutions at room temperature. The water absorption pattern is found to follow pseudo-Fickian behavior and therefore is predictable over a period of time.

Sgriccia.N et al [10] "Characterization of natural fiber surfaces and natural fiber composites" using FTIR, XPS, and ESEM. Water absorption experiments were also conducted to determine saturation mass gain. Alkali treated fiber composites absorbed more water than silane treated or untreated composites. The natural fiber composites absorbed more water than the glass fiber composites.

Joshi.S.V et al [11] "Natural fiber composites are environmentally superior to glass fiber reinforced composites" This studyCompares the life cycle and environmental performance of natural fiber composites with glass fiber reinforced composites find that the natural fiber composites are environmentally superior in the specific applications such as lower environmental impacts, fuel efficiency, pollution free and low cost.

Satheesh Raja. R et al [12] "Study on mechanical properties of fly ash impregnated glass fiber reinforced polymer composites using mixture design analysis" The study of fiber reinforced polymer and the fly ash impregnated fiber reinforced polymer composites are carried out to evaluate the mechanical properties such as tensile strength, compressive strength, hardness and impact strength and also the morphological properties of the fractured surfaces examined using SEM have revealed that the fly ash has better interaction with matrix which leads to better stress transfer and also to avoid the formation of cracks are discussed in this paper.

C. Santulli et al [13] "Impact damage characterization on Jute reinforced composites" These observations highlighted the characteristic patterns of impact damage and post-impact fatigue damage in jute reinforced laminates. On a set of specimens removed from the same plate, the impact-damaged area was also measured from low magnification micrographs. The dimension of impact-damaged area with the degradation of mechanical properties in jute reinforced composites are categorized.

Prabhuram.T et al [14] "Hybrid Composite Materials" deals with the analysis of hybrid composite materials. Hybridization is a process of incorporating synthetic fibers with that of

natural and metallic fibers in order to yield better strength, stiffness, high strength to weight ratio and other mechanical properties. This paper concerns with the development of new hybrid composite materials using Wood Powder, Groundnut Husk and Cashew nut Husk. Based on the physical, chemical and mechanical properties of the selected materials the required resins, catalysts and other accelerators are chosen and fabricated accordingly. The paper will present the Mechanical properties of the above mentioned eco-friendly and bio-degradable composites and the best possible applications of this composite materials.

M. S. Johari et al [15] "An experimental study on mechanical properties of GFRP braid-pultruded composite rods" The influence of over braiding on mechanical properties of pultruded rods, unidirectional (UD) rods, without braided fabric, were produced and those rod types were subjected to tensile, bending and torsion tests. The experimental results showed that BP rods have considerably higher shear modulus, but lower tensile modulus and flexural rigidity than those of UD pultruded rods, when fiber volume fraction is kept constant. Moreover, rods produced with higher braid roving linear densities had better torsional, but lower tensile and flexural properties. The highest shear modulus was observed in BP rods with braid angle of 45°.

Habib Tabatabai et al [16] "Tensile Strength and Bond Properties of GFRP Bars after Exposure to Elevated Temperatures" This paper reports residual tensile strength, modulus of elasticity, and bond strength of GFRP bars after exposure to elevated temperatures of up to 400 deg C and subsequent cooling to an ambient temperature. The results showed that the residual strength generally decreases with increasing temperature exposure. It concludes that the residual bond strength is a critical parameter in strength assessments of GFRP reinforced concrete members.

A. Adetiloye et al [17] "Mechanical Properties of Glass Fiber Reinforced Polymer Based on Resin from Recycled Plastic". It presents the mechanical performance properties of glass fiber reinforced plastic GFRP, based on resin recovered from recycled plastic waste. GFRP had a fiber content varied by weight, while the thicknesses of the laminate were minimum. The mechanical tests, conducted at room temperature, included tests for density, tensile strength, Izod impact energy, Brinell hardness number and tensile creep behavior. The results obtained in this study are in close agreement with the trend of variation of these parameters in GFRP, based on virgin resins. This confirms the applicability of GFRP based on recycled resin for structural uses. The successful application of plastic wastes in construction practice will generate multiple benefits of

turning waste into wealth, preservation of environment, job creation as well as opening up opportunity for designing smart materials with predetermined mechanical properties.

Paulo Pecas et al [18] "Natural Fiber Composites and Their Applications" A bibliometric study regarding applications of natural fibers composites and the prospective analysis about the future trends of natural fibers applications and the required developments to broaden their applications is also presented. The recycling, social influence and changing cognitive values in the composition of natural fibers are discussed in this paper.

Jena Pandey et al [19] "Comparison of jute fiber over glass fiber and carbon fiber reinforced plastic material composites used for civil structure". In this paper Jute textile reinforced polymer composite system was developed and its tensile, flexural behaviour was characterized and compared with that of carbon textile (CFRP) and glass textile (GFRP) reinforced polymer composite. In the present work the efficacy of jute textile reinforced polymer composite (JFRP) as compared to CFRP and GFRP for the flexural strengthening of reinforced concrete beams. The work carries out the study of failure modes, flexural strengthening effect on ultimate load and load deflection behaviour as well as the deflection ductility study of RC beams bonded externally with JFRP, CFRP and GFRP, wrapped in U configuration in single layer, along the entire length of the beam in full wrapping and strip wrapping technique.

J. Gassan et al [20] "Composites reinforced with cellulose based fibers". This article concerning natural and man-made cellulose fiber reinforced plastics, introduces possible applications and having physical properties that are mainly determined by the chemical and physical composition, such as the structure of fibers, cellulose content, angle of fibrils, cross-section, and by the degree of polymerization. The specific mechanical properties, can reach comparable values of traditional reinforcing fibers and it can be modified by using alkali treatment and acetylation processes.

Satish Pujari et al [21] "Comparison of Jute and Banana Fiber Composites". The present review explores the potentiality of jute and banana fiber composites, emphasizes both mechanical and physical properties and their chemical composition. Combining the useful properties of two different materials, cheaper manufacturing cost, versatility, availability makes them useful in various fields of engineering and high-performance applications.

Tara Sen et al [22] "Pretreatment of Woven Jute FRP Composite and Its Use in Strengthening of Reinforced Concrete Beams in Flexure" Evaluating the mechanical characteristics of natural woven jute fiber reinforced polymer (FRP) composite subjected to three different pretreatments, alkali, benzyl chloride, and heat treatment. It concludes that heat treatment is one of the most suitable treatment methods for enhancing mechanical properties of jute FRP such as high tensile strength, ultimate flexural strength and good ageing characteristics.

J Naveen et al [23] "A review of GFRP composites". The mechanical, tribological, thermal, water absorption, vibrational properties, strength, flexibility, stiffness, resistance to chemical harm and applications of various glass fiber reinforced polymer composites were reported.

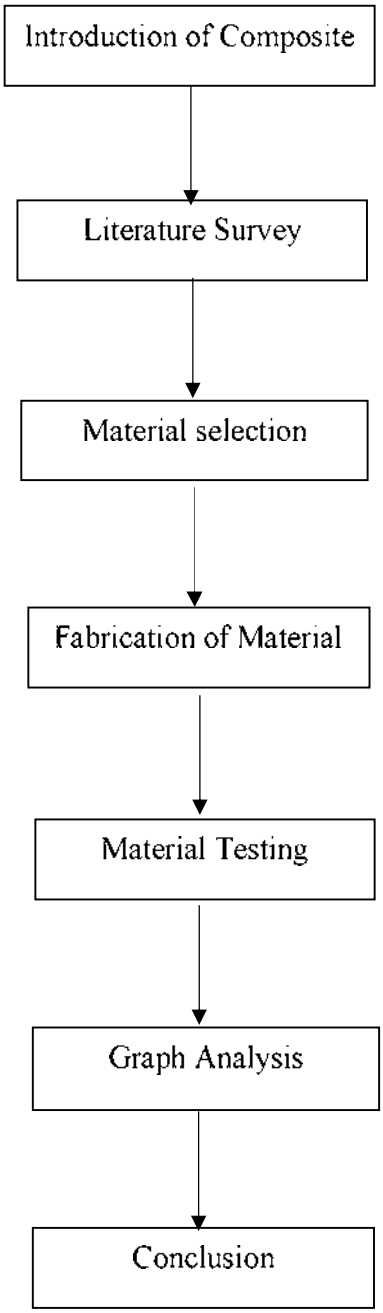
I.S.N.V.R.Prasanth et al [24] "Experimental investigation on comparison of the surface quality on various GFRP composites during end milling by control process parameters". The effect of process parameters on the dimensional accuracy, surface finish and damages of the slots produced by end milling on GFRP composite laminate needs machining to obtain close dimensional accuracy with minimized surface damages towards the selection of best milling processes parameters such as spindle speed, feed rate and depth of cut. The investigation results pertaining to resultant force, surface roughness and delamination aspects of uni- directional (UD) and bi-directional (BD) glass fiber reinforced composite laminates are the important aspect in production industries such as automobile, aerospace and other industrial applications were discussed.

J. Sahari et al [25] "Natural Fiber Reinforced Bio-Degradable Polymer Composites" The production and properties of bio composites are the polymer matrices derived from renewable resources such as poly lactide (PLA), thermoplastic starch (TPS), cellulose and poly hydroxy alkenoates (PHAs). This review is carried out to evaluate the development and properties of natural fiber reinforced biodegradable polymer composites having the capability to fully degrade and compatible it with the environment.

Sreenivasulu Reddy et al [26] "Aero Space Applications of GFRP Composites". The surface quality and dimensional precision greatly affect the parts during their useful life, especially in cases where the components come in contact with other elements or materials.

CHAPTER 3

METHODOLOGY



CHAPTER 4

SELECTION OF MATERIALS AND FABRICATION

We have selected **Jute fiber reinforced polymer** material as a **natural composite** and **Glass fiber reinforced polymer** material as an **artificial composite**. For material testing we have fabricated the material for certain dimensions to gain accuracy.

4.1 SPECIMEN SIZE

- Tensile test

  JFRP – 250 mm **X** 25 mm **X**3 mm

  GFRP - 250 mm **X** 25 mm **X**3 mm

- Bending test

  JFRP - 150 mm **X** 25 mm **X**3 mm

  GFRP - 150 mm **X** 25 mm **X**3 mm

- Fatigue test

  JFRP - 250 mm **X** 25 mm **X**3 mm

  GFRP - 250 mm **X** 25 mm **X**3 mm

- Shear test

  JFRP - 250 mm **X** 25 mm **X**3 mm

  GFRP - 250 mm **X** 25 mm **X**3 mm

4.2 FABRICATION PROCEDURE

Vacuum assisted resin infusion molding technique was used for manufacturing specimens. Fiber reinforced composite materials are orthotropic materials which generally show different characteristics in fiber, matrix and through thickness direction.

These characteristics may depend on fiber material, matrix material, fiber orientation etc.Different apparatus configurations were used for shear, tension and compression strength values.

The various steps involved in the vacuum assisted resin infusion molding panel fabrication technique are as listed below,

STEP 1

Prepare the required flat surface as necessary.

Fig No: 4.1 Flat Surface

STEP 2

Bonding surfaces must be free of any contaminants such as grease, oil, wax or mold release. Clean contaminated surfaces with lacquer thinner, acetone or other appropriate solvent. Wipe the surface with paper towels before the solvent dries. Clean surfaces before sanding to

avoid sanding the contaminant into the surface. Follow all safety precautions when working with solvents.

Fig No: 4.2 Wrapping Sheet

STEP 3

Prepare the vacuum bagging materials such as Cut carbon fabric, perforated releasing film, bagging film, peel ply and breather slightly larger than the fabric area. Cut the vacuum bag several inches larger on all sides than the working area. Apply sealant of 1/2 inches outside the perimeter of the working area.

Fig No: 4.3 Sealant Tape Pasting

STEP 4

Mix required resin/hardener as you can apply during the open time of the mixture. Pour the mixture into a roller pan as soon as it is mixed thoroughly.

Fig No: 4.4 Resin Application

STEP 5

Wet out the fabric area with a resin/hardener mixture. Apply a thin layer of thickened phenolic resin mixture to the fabric area to fill voids or unevenness and removing air bubbles and excess resin. Surface finishing is a broad range of industrial processes that alter the surface of a manufactured item to achieve a certain property.

Finishing processes may be employed to improve appearance, adhesion or wettability, solderability, corrosion resistance, tarnish resistance, chemical resistance, wear resistance, hardness, modify electrical conductivity, remove burrs and other surface flaws, and control the surface friction. In limited cases some of these techniques can be used to restore original dimensions to salvage or repair an item. An unfinished surface is often called mill finish.

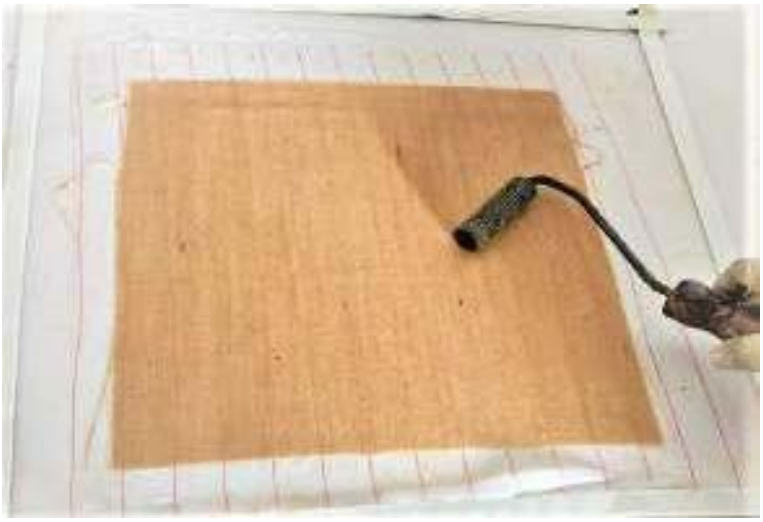


Fig No: 4.5 Jute Fabric Cloth

STEP 6

Squeegee the layer of release fabric over the layers of cloth to remove any trapped air and excess Phenolic. Place the peel ply, perforated film and breather material over the lay-up and seal the vacuum bag to the sealant tape.

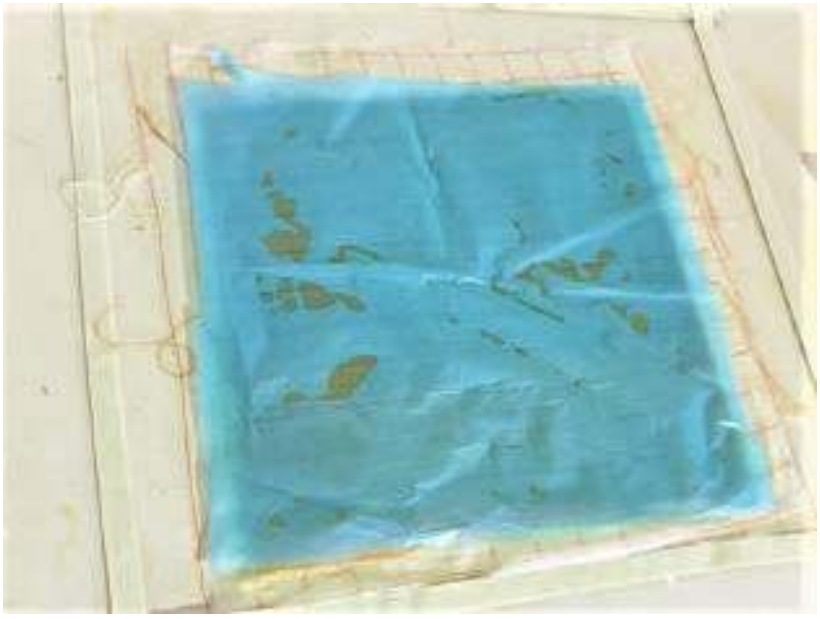


Fig No: 4.6 Perforated Film

STEP 7

Attach the vacuum port off to the side of the working area if possible, to avoid dimpling the fabric with the vacuum port.

Fig No: 4.7 Sponge for curing

STEP 8

Turn on the vacuum pump and attach the vacuum gauge. After the vacuum has stabilized, moderate heat from a heat lamp or portable heater may be applied to the lay-up to speed the cure. Allow the lay-up to cure thoroughly and remove the bag, breather, perforated film and release fabric.

There are various methods of curing. The adoption of a particular method will depend upon the nature of work and the climatic conditions. The following methods of curing of concrete are generally adopted.

Fig No 4.8 Vacuum resin molding

STEP 9

Finally, the material had been cut down by using water jet method to avoid delamination for our own desired sizes. Thus, the material had been fabricated.

Fig No: 4.9 Specimen for Testing

CHAPTER 5

TESTING OF MATERIALS

Structural applications are applications that require mechanical performance (e.g., strength, stiffness and vibration damping ability) in the material, which may or may not bear the load in the structure. The material does bear the load, the mechanical property requirements are particularly stringent. In addition to mechanical properties, a structural material may be required to have other properties, such as low density (i.e., be lightweight) for to save fuel in the case of aircraft and automobiles, to facilitate high speed in the case of race bicycles, and for easier handling in the case of wheelchairs and armor.

Another property that is often required is corrosion resistance, which is desirable for the durability of all structures, particularly automobiles and bridges. Yet another property that may be required is the ability to withstand high temperatures and/or thermal cycling, as heat may be encountered by the structure during operation, maintenance or repair.

In this project, we have performed various testing of both Jute and GFRP materials to determine its mechanical behaviour. There are four testing that we have performed namely,

- Tensile Testing
- Fatigue Testing
- Shear Testing
- Bending Testing

5.1 TENSILE TESTING

Tensile testing is also known as tension testing. It is a fundamental materials science and engineering test in which a sample is subjected to a controlled tension until failure. Properties that are directly measured via a tensile test are ultimate tensile strength, breaking strength, maximum elongation and reduction in area.

From the above measurements various properties canbe determined namely Young's modulus, Poisson's ratio, yield strength, and strainhardening characteristics. Uniaxial tensile

testing is the most commonly used for obtaining the mechanical characteristics of isotropic materials. Some materials use biaxial tensile testing.Tensile testing might have a variety of purposes which are as follows,

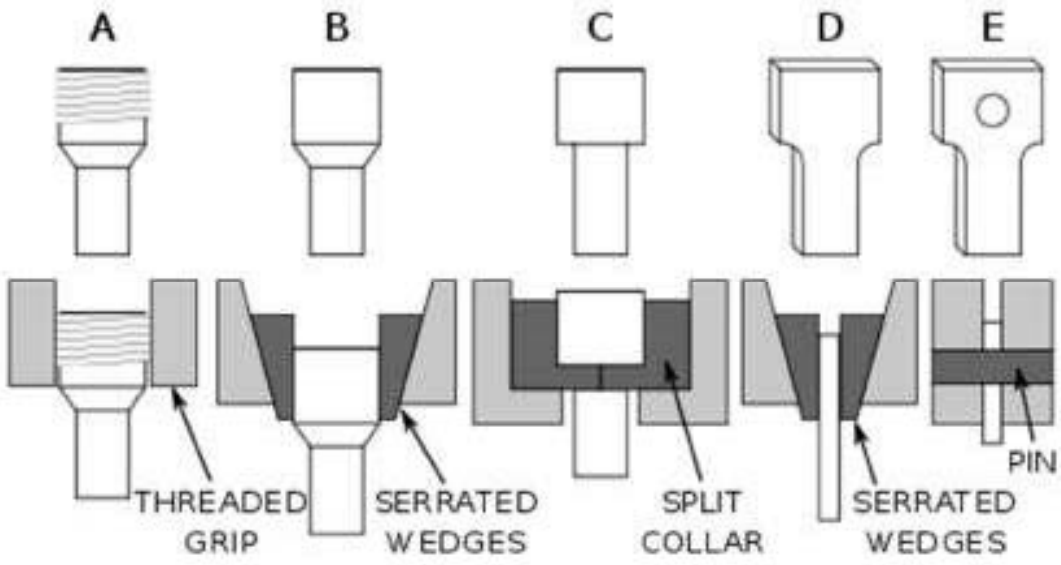
- Select a material or item for an application.
- Predict how a material will perform under normal and extreme forces.
- Determine or verify the requirements of a specification, regulation, or contraction in that specimen.
- Decide if a new product development program is on track.
- Demonstrate proof of concept.
- Demonstrate the utility of a proposed patent.
- Provide standard data for other scientific, engineering ,and quality assurance functions
- Provide a basis for Technical communication
- Provide a technical means of comparison of several options
- Provide evidence in legal proceedings

The preparation of test specimens depends on the purposes of testing and on the governing test method or specification. A tensile specimen is usually a standardized sample cross-section. It has two shoulders and a gage in between.

The shoulders are large so they can be readily gripped, whereas the gauge section has a smaller cross-section so that the deformation and failure can occur in this area.

The shoulders of the test specimen can be manufactured in various ways to mate to various grips in the testing machine. Each system has advantages and disadvantages; for example, shoulders designed for serrated grips are easy and cheap to manufacture, but the alignment of the specimen is dependent on the skill of the technician. On the other hand, a pinned grip assures good alignment.

Threaded shoulders and grips also assure good alignment, b ut the technician must know to thread each shoulder into the grip at least one diameter's length, otherwise the threads can strip before the specimen fractures.



Where,

A	Threaded shoulder for use with a thread
B	Round shoulder for use with serrated grips
C	Butt end shoulder for use with a split collar
D	Flat shoulder for used with serrated grips
E	Flat shoulder with a through hole for a pinned grip

Fig No 5.1 Various shoulder styles for tensile specimens.

The most common testing machine used in tensile testing is the universal testing machine. This type of machine has two crossheads; one is adjusted for the length of the specimen and the other is driven to apply tension to the test specimen. There are two types: hydraulic powered and electromagnetically powered machines.

The machine must have the proper capabilities for the test specimen being tested. There are four main parameters: force capacity, speed, precision and accuracy. Force capacity refers to the fact that the machine must be able to generate enough force to fracture the specimen. The machine must be able to apply the force quickly or slowly enough to properly mimic the actual

application. Finally, the machine must be able to accurately and precisely measure the gauge length and forces applied; for instance, a large machine that is designed to measure long elongations may not work with a brittle material that experiences short elongations prior to fracturing.

Alignment of the test specimen in the testing machine is critical, because if the specimen is misaligned, either at an angle or offset to one side, the machine will exert a bending force on the specimen. This is especially bad for brittle materials, because it will dramatically skew the results. This situation can be minimized by using spherical seats or U-joints between the grips and the test machine. If the initial portion of the stress–strain curve is curved and not linear, it indicates the specimen is misaligned in the testing machine. The strain measurements are most commonly measured with an extensometer, but strain gauges are also frequently used on small test specimen or when Poisson's ratio is being measured.

Fig No: 5.2 Tensile Test

The test process involves placing the test specimen in the testing machine and slowly extending it until it fractures. During this process, the elongation of the gauge section is recorded against the applied force.

5.2 FATIGUE TESTING

Fatigue testing is a specialized form of mechanical testing that is performed by applying cyclic loading to a coupon or structure. These tests are used either to generate fatigue life and crack growth data, identify critical locations or demonstrate the safety of a structure that may be susceptible to fatigue. Fatigue tests are used on a range components from coupons through to full size test articles such as automobiles and aircraft.

Fatigue tests on coupons are typically conducted using servo hydraulic test machines which are capable of applying large variable amplitude cyclic loads. Constant amplitude testing can also be applied by simpler oscillating machines.

The fatigue life of a coupon is the number of cycles it takes to break the coupon. This data can be used for creating stress-life or strain-life curves. The rate of crack growth in a coupon can also be measured, either during the test or afterward using fractography. Testing of coupons can also be carried out inside environmental chambers where the temperature, humidity and environment that may affect the rate of crack growth can be controlled.

Because of the size and unique shape of full size test articles, special test rigs are built to apply loads through a series of hydraulic or electric actuators. Actuators aim to reproduce the significant loads experienced by a structure, which in the case of aircraft, may consist of maneuver, gust, buffet and ground-air-ground (GAG) loading.

A representative sample or block of loading is applied repeatedly until the safe life of the structure has been demonstrated or failures occur which need to be repaired. Instrumentation such as load cells, strain gauges and displacement gauges are installed on the structure to ensure the correct loading has been applied. Periodic inspections of the structure around critical stress concentrations such as holes and fittings are made to determine the time detectable cracks were found and to ensure any cracking that does occur, does not affect other areas of the test article. Because not all loads can be applied, any unbalanced structural loads are typically reacted out to the test floor through non-critical structure such as the undercarriage.

Fatigue tests are used to obtain material data such as the rate of growth of a fatigue crack that can be used with crack growth equations to predict the fatigue life. These tests usually determine the rate of crack growth per cycle versus the stress intensity factor range .

Standardized tests have been developed to ensure repeatability and to allow the stress intensity factor to be easily determined . Strain gauges are used to monitor the applied loading or stress fields around the crack tip. They may be placed beneath the path of the crack or on the back face of a compact tension coupon.

- An extensometer or displacement gauge can be used to measure the crack tip opening displacement at the mouth of a crack. This value can be used to determine the stress intensity factor which will change with the length of the crack. Displacement gauges can also be used to measure the compliance of a coupon and the position during the loading cycle when contact between the opposite crack faces occurs in order to measure crack closure.
- Applied test loads are usually monitored on the test machine with a load cell.
- A travelling optical microscope can be used for measurement of the position of the crack tip. In order to apply the correct loads to various parts of the structure, a mechanism known as a whiffle tree is used to distribute the loads from a loading actuator to the test article. Loads applied to a central point are distributed through a series of pin jointed connected beams to produce known loads at the end connections. Each end connection is typically attached to a pad which is bonded onto the structure such as an aircraft wing. Hundreds of pads are usually applied to reproduce the aerodynamic and inertial loads seen on wing. Because the whiffle tree consists of tension linkages, they are unable to apply compressive loads and therefore, independent whiffle trees are typically used on the upper and lower sides of wing fatigue tests.
- Hydraulic, electromagnetic or pneumatic actuators are used to apply loads to the structure, either directly or through the use of a whiffle tree to distribute the loads. A load cell is placed in line with the actuator and is used by the load controller to control the loads into the actuator. When many actuators are used on a flexible test structure, there may be cross-interaction between the different actuators. The load controller must ensure that spurious loading cycles are not applied to the structure as a result of this interaction.

- Many of the loads such as aerodynamic and internal forces are re-acted by internal forces which are not present during a fatigue test. Hence, the loads are reacted out of the structure at non-critical points such as the undercarriage or through restraints on the fuselage.
- Linear variable differential transformer can be used to measure the displacement of critical locations on the structure. Limits on these displacements can be used to signal when a structure has failed and to automatically shut down the test.
- Some test structure may be expensive or unavailable and are typically replaced on the test structure with an equivalent structure. Structure that is close to actuator attachment points may see an unrealistic load that makes these areas non-representative.

Fig No: 5.3 Fatigue Test

5.3 SHEAR TEST

A shear test is designed to apply stress to a test sample so that it experiences a sliding failure along a plane that is parallel to the forces applied. Generally, shear forces cause one surface of a material to move in one direction and the other surface to move in the opposite direction so that the material is stressed in a sliding motion. Shear tests differ from tension and compression tests in that the forces applied are parallel to the two-contact surface, whereas, in tension and compression they are perpendicular to the contact surfaces.

The most common use of a shear test is to determine the shear strength, which is the maximum shear stress that the material can withstand before failure occurs, of a material. This is a very important design characteristic of many types of fasteners such as bolts and screws. For example, when a bolt is used to secure two plates together it will experience a shear forces if the plates themselves experience any forces parallel to their plane that attempt to separate them. If the small fastener fails in shear it may lead to a chain of failures that could lead to the entire destruction of a much larger structure.

Generally, there are two common types of shear tests. The first requires that the sample be setup in a modified three-point flexure or four-point bend fixture. The purpose of this test is to load the sample so that it experiences double shear or so that the sample has two locations where the forces are applied. Each end of the sample is anchored and the force is applied over the middle of the sample in an attempt to remove the middle section so that both ends are left behind. The second test requires that the sample have tapered ends that are each placed into grip fixtures that have been offset from the vertical axis of the sample. The sample is then pulled so that the opposite faces are pulled in opposing directions.

Three materials are commonly tested in shear such as rigid substrates, adhesives, and layered composites. Rigid substrates may be composed of metals, plastics, ceramics, composites or woods but usually come in a solid form and are used as building materials or fasteners. Adhesives are used to bond two materials together and experience shear stress when the materials are pulled in opposing directions in an attempt to slide them apart. Layered composites experience shear stress in a similar manner to adhesives as the shear forces are applied to the glue or laminate used to hold the layers together.

Shear tests are generally carried out to measure the ability of an adhesive tape to resist creep under a constant load, applied parallel to the surface of the tape and substrate. The purpose of this test is to compare the performance of an adhesive in a joint and to determine its mechanical response.

Fig No: 5.4 Shear Test

5.4 BENDING TESTING

The bend test is a simple and inexpensive qualitative test that can be used to evaluate both the ductility and soundness of a material. It is often used as a quality control test for butt-welded joints, having the advantage of simplicity of both test piece and equipment.

No expensive test equipment is needed, test specimens are easily prepared and the test can be carried out on the shop floor as a quality control test to ensure consistency in

production.The bend test uses a coupon that is bent in three-point bending to a specified angle.The outside of the bend is extensively plastically deformed so that any defects in, or embrittlement of, the material will be revealed by the premature failure of the coupon.The bend test may be free formed or guided.The guided bend test is where the coupon is wrapped around a former of a specified diameter and is the type of test specified in the welding procedure and welder qualification specifications.For butt weld procedure and welder qualification testing the bend coupons may be oriented transverse or parallel to the welding direction.

Where the material thickness is too great to permit the full section to be bent the specifications allow a number of narrower specimens to be taken provided that the full material thickness is tested. Conventionally, most welding specifications require two root and two face bend coupons or four side bends to be taken from each butt -welded test piece.

Fig No: 5.5 Bending Test

The transverse face bend specimen will reveal any defects on the face such as excessive undercut or lack of sidewall fusion close to the cap. The transverse root bend is also excellent at revealing lack of root fusion or penetration. The transverse side bend tests the full weld thickness and is particularly good at revealing lack of side-wall fusion and lack of root fusion in double-V butt joints. This specimen orientation is also useful for testing weld cladding where any brittle regions close to the fusion line are readily revealed.

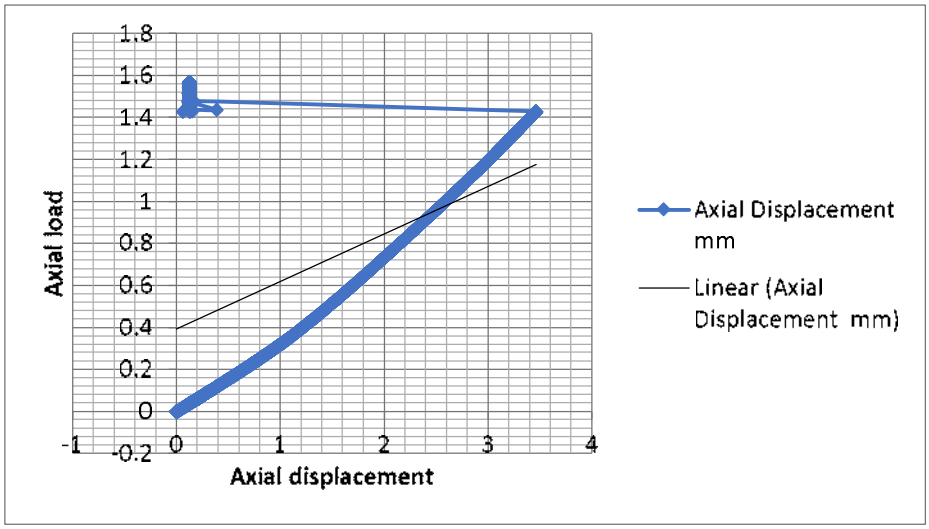
Weld joints with non-uniform properties such as dissimilar metal joints or where the weld and parent metal strengths are substantially different can result in 'peaking' of the bend coupon. This is when most of the deformation takes place in the weaker of the two materials which therefore experiences excessive localized deformation that may result in premature failure.A dissimilar metal joint where one of the parent metals is very high strength is a good example of where this may occur and similar peaking can be seen in fully hard welded aluminium alloy joints.

CHAPTER 6

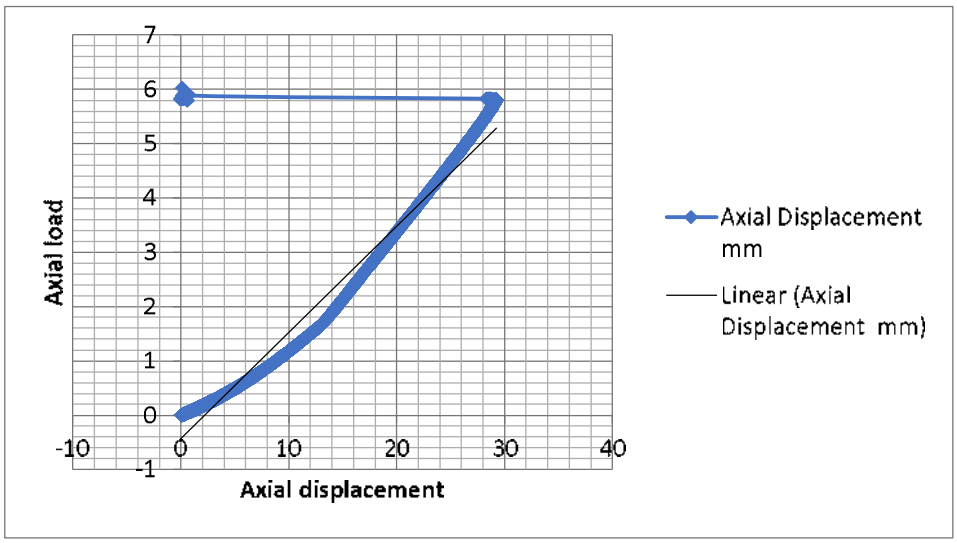
RESULT AND GRAPH ANALYSIS

The result and analysis of graph for both Jute and GFRP composite materials are discussed in this chapter.

6.1 GRAPH FOR TENSILE TEST

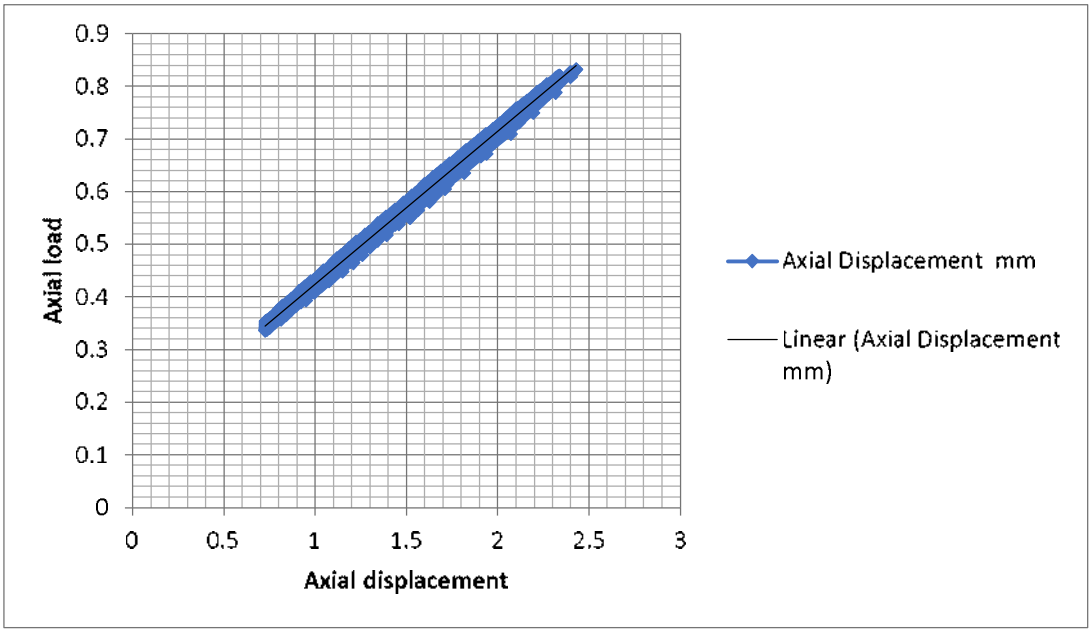


Graph 6.1 Tensile Testing for Jute

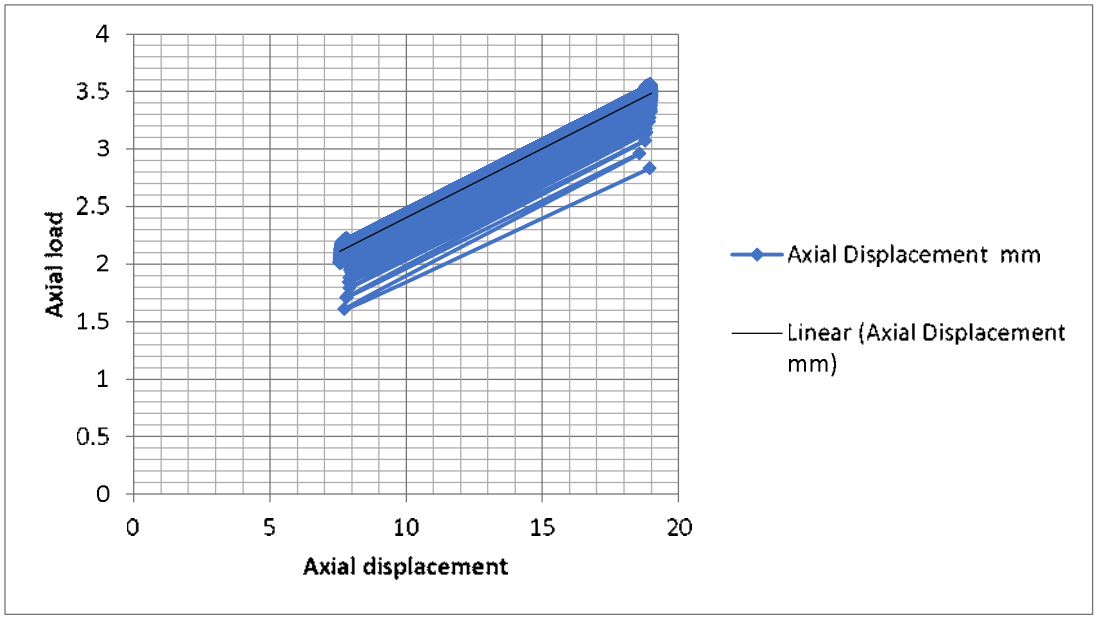


Graph 6.2 Tensile Testing for GFRP

6.2 GRAPH FOR FATIGUE TEST

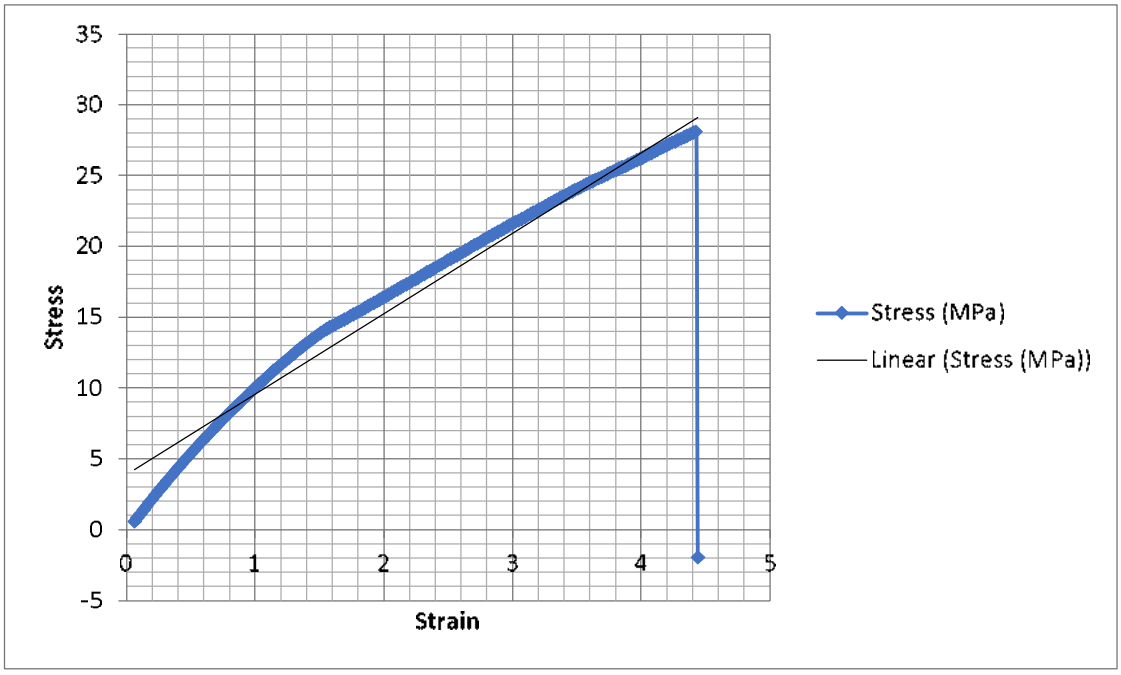


Graph 6.3 Fatigue Testing for Jute

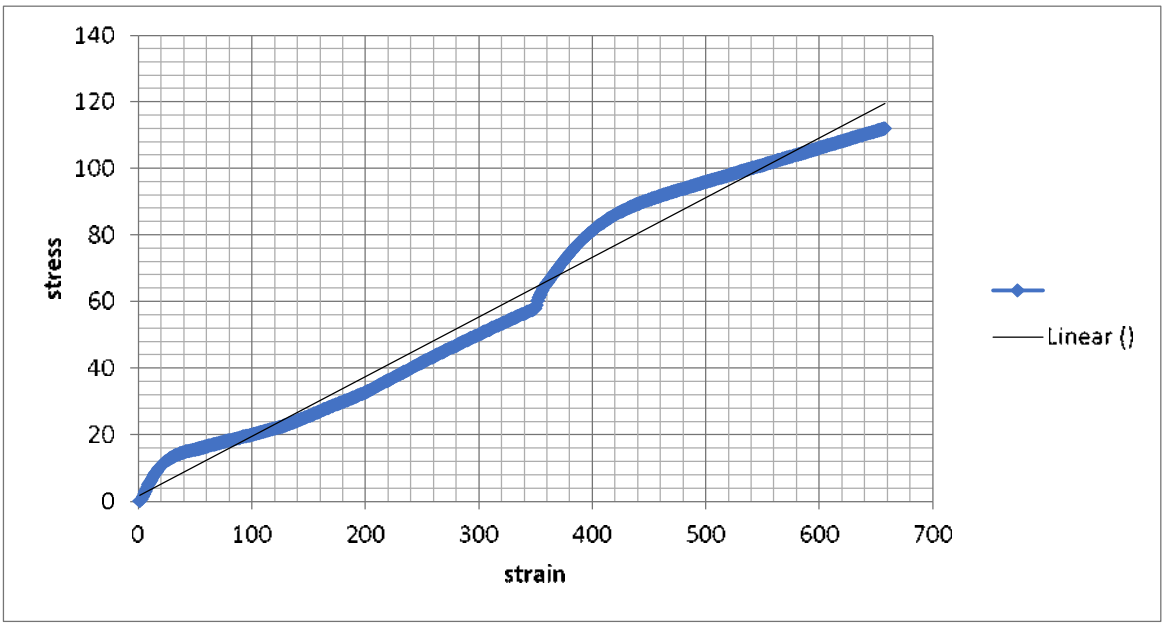


Graph 6.4 Fatigue Testing for GFRP

6.3 GRAPH FOR SHEAR TEST

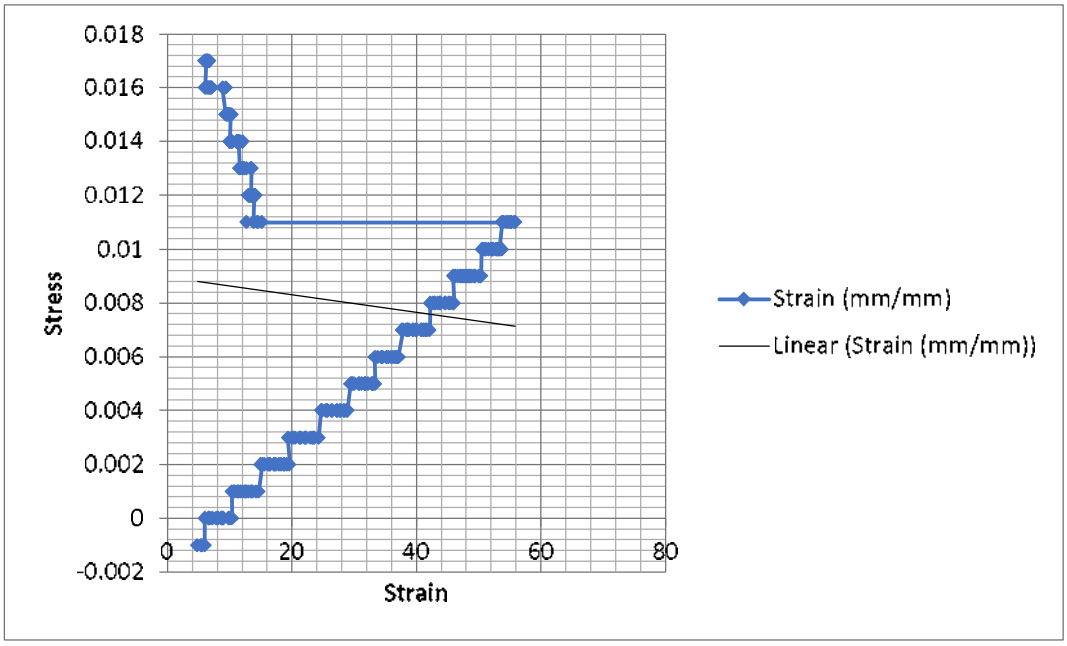


Graph 6.5 Shear Testing for Jute

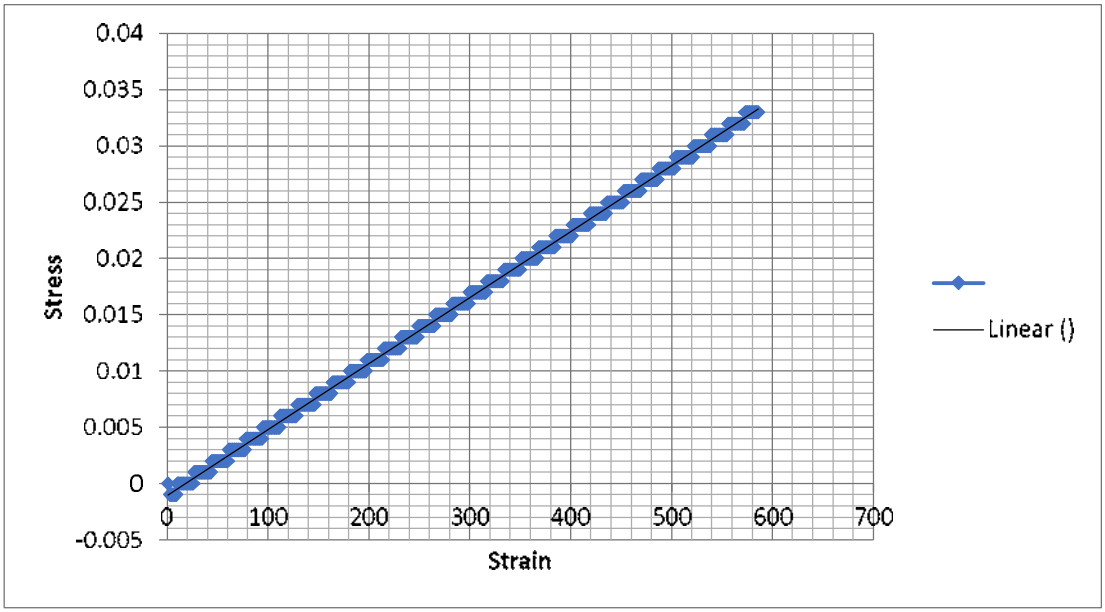


Graph 6.6 Shear Testing for GFRP

6.4 GRAPH FOR BENDING TEST



Graph 6.7 Bending Test for Jute



Graph 6.8 Bending Test for GFRP

CHAPTER 7

CONCLUSION

The Jute and GFRP composites are successfully fabricated under specific dimensions by using Vacuum assisted epoxy resin infusion manufacturing technique and subjected to Tensile, Fatigue, Shear and Bending tests respectively. On following the results of testing, comparative graphs are drawn to analyse the material behaviour of composites easily

In this research, the mechanical characterization and behavioral analysis of both Natural (JUTE) and Artificial (GFRP) fiber laminated in epoxy resin composites are studied.

The load carrying capacity of these composites are very less. In future, reinforcement of composite materials can be done to increase the load carrying capacity. The work may be extended by analyzing the corrosion and thermal resistant of this material so that, it may find more applications. By changing the type of resin, the application may be extended to prepare bio-degradable and eco-friendly composite materials for different applications. These samples are further treated for Compressive test, Fracture toughness test, Creep test, Water absorption test etc.,

One of the major problems associated with the use of natural fibers in composites is their high moisture sensitivity leading to severe reduction of mechanical properties and delamination. The reduction in mechanical properties may be due to poor interfacial bonding between resin matrices and fibers. It is therefore necessary to modify the fiber surface to render it more hydrophobic and also more compatible with resin matrices. An effective method of chemical modification of natural fibers is graft copolymerization. The resulting co-polymer displays the characteristic properties of both fibrous cellulose and grafted polymer. It will enrich the mechanical properties of both natural (Jute) and artificial (GFRP) composites.

REFERENCES

1. Daniel Gay "Composite Materials: Design and Applications, Third Edition".
2. Clyne.T.Wand Hull.D 1996, "An Introduction to Composite Material", 2nd Edition, Cambridge University Press, Cambridge.
3. Chung, Deborah D. L, Composite Materials: Science and Applications.
4. Lee.S.M 1990, "International Encyclopedia of Composites-Vol.2", VCH, New York.
5. Lee.S.M 1996, "International Encyclopedia of Composites-Vol.4", VCH, New York.
6. Roger M.Powell 1994, "Utilization of Natural Fibers in Plastic Composites" in Lignocellulosic: Plastic Composites, Vol. 4(27).
7. Krishan K.Chawla. Composite Materials: Science and Engineering (Materials Research and Engineering) 3rd Edition.
8. Ramesh Chandra Yadaw, and Sachin Chaturvedi. An Investigation of Mechanical and Sliding Wear Behavior of Glass Fiber ReinforcedPolymer Composite with or without Addition of Silica (SiO2). International Conference on PFAM XXI, IIT Guwahati, (2012).
9. Mukul Kant Paliwal and Sachin Kumar Chaturvedi. An Experimental Investigation of Tensile Strength of Glass Composite Materials with Calcium Carbonate (CaCO3) Filler. Int. J. Emerg. trends in Eng. and Dev. 2012; 6 (2): 303-309.
10. Cantwell WJ and Morton J. The impact resistance of composite materials - A review. Composites Part A 1991; 22: 347–362.
11. Alemdar and M.sain, composite science and technology 68(2008) 557.
12. Elie Awwad, Mounir Mabsout, Bilal Hamad and Helmi Khatib, Preliminary Studies on the use of natural fibers in sustainable concrete, Lebansese science journal,Vol. 12, No. 1,2011.
13. U.S. Bongrade, V.D.Shinde, Review on natural fiber reinforcement polymer composites, international journal of Engineering Science and innovative technology (IJESIT) Volume 3, Issue 2, March 2014.
14. D. Chandramohan, K.Marimuthu. A review on natural Fibers, IJRRAS 8 (2), August 2011.
15. M.R.Sanjay, G.R.Arpitha, L.Laxman Naik. K,Gopalakrishna, B.Yogesha.Application of natural fibers and its composites, An Overview, 2016,7, 108-114.
16. M. Ramesh,K.Palani Kumar, K.Hemachandra Reddy, Comparative Evaluation on Properties of Hybrid Glass Fiber- sisal/jute Reinforced Epoxy composites, Elsevier, 51 (2013) 745-750.

17. Ajith Gopinath, Senthil kumar.M, Elayaperumal. AnExperimental investigation on mechanical properties of jute fiber Reinforced composites with polyester and epoxy resin matrices, ScienceDirect, 97 (2014) 2052-2063.
18. Velmurugan R, Manikandan V. Mechanical properties of palmyra/glass fiber hybrid composites. Compos: Part A 2007; 38:2216–26.
19. Munikenche Gowda T, Naidu ACB, Chaya Rajput. Some mechanical properties of untreated jute fabric-reinforced polyester composites. Compos: Part A 1999; 30:277–84.
20. Dash B, Rana AK, Mishra HK, Nayak SK, Mishra SC, Tripathy SS. Novel, low cost jute-polyester composites: Part 1: processing, mechanical properties, and SEM analysis. Polymer Composites 1999; 20:1.
21. Callister Jr William D. Materials science, engineering: an introduction. 6th ed. John Wiley & Sons, Inc.; 2003.
22. Herrera-Franco.P.J, valadez-Gonzalez.A 2005, "A study of mechanical properties of short natural fibers reinforced composites", Center of Investigation in Materials, Mexico.
23. Prof. Dr. Ryszard Kozlowski 2000, "Potential and Diversified Uses of Green Fibers", in 3rd International Wood and Natural Fiber Composites Symposium held in Germany.
24. Saheb. D.N, Jog. J.P. Natural fiber polymer composites: A review. Polymer Technologies 1999, 18, 351–363.
25. Biagiotti. J, Puglia. D, Kenny. J.M. A Review on Natural Fiber-Based Composites, Part I. J. Nat. Fibers 2004, 1, 37–68.
26. Puglia. D, Biagiotti. J, Kenny. J.M. A Review on Natural Fiber-Based Composites, Part II. J. Nat. Fibers 2005,1, 23–65.
27. Summerscales. J, Dissanayake. N, Virk. A, Hall. W. A review offibers and their composites. Part 2, Composites. Compos. Part A Appl. Sci. Manuf. 2010, 41, 1336–1344.
28. La Mantia. F.P,Morreale. M, Green composites: A brief review. Compos. Part A Appl. Sci. Manuf. 2011, 42,579–588.
29. Yan. L,Chouw. N, Jayaraman. K Flax fiber and its composites. A review. Compos. Part B Eng. 2014, 56,296–317.
30. Guru Nathan. T, Mohanty. S, Nayak, S.K. A review of the recent developments in bio-composites based on natural fibers and their application perspectives. Part A 2015, 77, 1–25.

LIST OF PUBLICATIONS

1. P.Karthikeyan, P.Gokulraj, T.Kaviarasu, K.Nishanth, P.Vishnu . Analysing the behaviour of Natural and Artificial Composites. Journal of Aerospace Sciences and Technologies. (Applied on 21.09.2020. Awaiting for Reviewers Comment).

ANALYSING THE BEHAVIOUR OF NATURAL AND ARTIFICIAL COMPOSITES

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ABSTRACT: The composite materials are replacing the traditional materials, because of its superior properties such as high tensile strength, low thermal expansion, high strength to weight ratio. Natural fiber composites such as sisal and jute polymer composites became more attractive due to their high specific strength, lightweight and biodegradability. Artificial composites such as Glass Fiber Reinforced Polymer, Carbon Fiber Reinforced Polymer having high strength, durability and non-biodegradability.

In this study, both the Natural (Jute fiber) and Artificial Composites (GFRP) are developed and their mechanical properties such as tensile strength, compression strength, bending test, fatigue strength, shear strength and impact strength are evaluated. The interfacial properties, internal cracks and internal structure of the fractured surfaces are evaluated.

INTRODUCTION: A composite is a structural material that consists of two or more combined constituents that are combined at a macroscopic level and are not soluble in each other. Composite materials are multiphase materials obtained through the artificial combination of different materials in order to attain properties that the individual components by themselves cannot attain. One constituent is called the reinforcing phase and the one in which it is embedded is called the matrix. The reinforcing phase material may be in the form of fibers, particles, or flakes. The matrix phase materials are generally continuous. Examples of composite systems include concrete reinforced with steel and epoxy reinforced with graphite fibers, etc. If the composition occurs on a microscopic scale (molecular level), the new material is then called an alloy for metals or a polymer for plastics.

ANALYSIS AND EFFECT OF SHIM USED IN A COMPOSITED AND METAL BOLTED JOINT

A PROJECT REPORT

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In partial fulfilment for the award of the degrees of

BACHELOR OF ENGINEERING

in

AERONAUTICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

MAY 2020

ABSTRACT

This paper about the behaviour of joints, that most of the composites can't be riveted. Mostly bonding (adhesives) technique is used to join the two different materials, like metal to composites and composites-composites. Our work is to address the behaviour (strength and life time) of different composite and metal joints using FEA analysis. Which will reduce the time and cost of the testing. There are different techniques (from literature) which have been considered and by using different thickness layer of shim with bolted joints in the composite material and compare the results with the test results.

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NOMENCLATURE

UTS	-	Ultimate Tensile Strength
E	-	Elastic Modulus
YTS	-	Yield Tensile Strength
KDF	-	Knock Down Factor
D	-	Diameter Of Bolt
T	-	Thickness Of One Plate
P	-	Applied Load,N
T	-	Thickness Of Top Plate
Ttotal	-	Thickness Of Total Specimen

CHAPTER 1

INTRODUCTION

Composite materials are being extensively used in an aircraft manufacturing industry. The property of weight reduction is the main driving force which benefits fatigue and corrosion resistance properties. A clear trend in composites is being increasing with in heavily loaded primary structures. The increasing use of Composite materials and its popularity has prompted significant changes in the field of research and developing for reliable design methods. Designing useful structures requires several parts to be joined together. This can be done only by adhesive, mechanical or hybrid joins which is a combination of the first two techniques. With low weight and good sealing properties the adhesive joints have advantage over the mechanical joints. The adhesive joints are sensitive to environmental conditions and adhesive structures cannot be easily replaced when few parts get damaged. Mechanical joining, i.e. using fasteners, is the most common method in an aerospace industry. Although it's most preferred in most of the cases it's associated with difficulties. The presence of a hole in the laminate disturbs the stress field because stresses are concentrated at the vicinity of the hole. This makes the bolted joint as a weak link in the composite structure, which materials

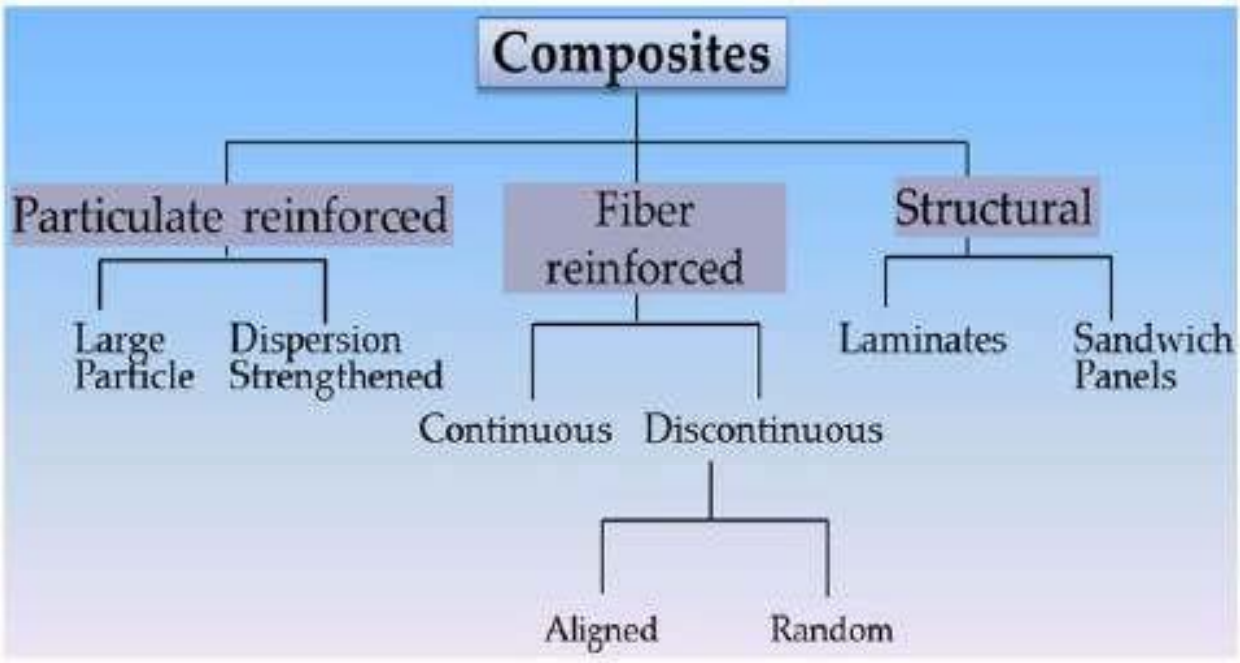


Fig 1.1 Classification of composites

1.1 CLASSIFICATION

Most composite materials developed thus far have been fabricated to improve mechanical properties such as strength, stiffness, toughness, and hightemperature performance. It is natural to study together the composites that have a common strengthening mechanism. The strengthening mechanism strongly depends on the geometry of the reinforcement. Therefore, it is quite convenknt to classify composite materials on the basis of the geometry of a representative unit of reinforcement.

1.2 PARTICULATE COMPOSITES

A composite whose reinforcement may be classified as particles is called a particulate composite. A particle, by definition, is nonfibrous and generally has no long dimension, with the exception of platelets. The dimensions of the reinforcement determine its capability of contributing its properties to the composite. Also, a reinforcement having a long dimension discourages the growth of incipient crack normal to the reinforcement that otherwise might lead to failure, particularly with brittle matrices. Therefore, fibers are very effective in improving the fracture resistance of the matrix. In general, particles are not very effective in improving fracture resistance. However, particles of rubberlike substances in brittle polymer matrices improve fracture resistance by promoting and then arresting crazing in the brittle matrices.

Other types of particles, such as ceramic, metal, or inorganic particles, produce reinforcing effects in metallic matrices by different strengthening mechanisms The particles in a particulate composite place constraints on the plastic deformation of the matrix material between them because of their inherent hardness relative to the matrix. The particles also share the load, but to a much smaller extent than those fibers in fibrous composites that lie parallel to the direction of load. Thus the particles are effective in enhancing the stiffness of the composites but do not offer the potential for much strengthening.

For example, hard particles placed in brittle matrices reduce the strength due to stress concentrations in the adjacent matrix material. Particle fillers, however, are used widely to improve the properties of matrix materials, such as to modify the thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface hardness, and reduce shrinkage. In many cases they are used simply to reduce cost. The particles and matrix material in a particulate composite can be any combination of metallic and nonmetallic materials. The choice of a particular combination depends on the desired end properties. Particles of lead are mixed with copper alloys and steel to improve their machinability. In addition, lead is .a natural lubricant in bearings made of copper alloys. Particles of many brittle metals such as tungsten, chromium, and molybdenum .are incorporated into' ductile metals to improve their elevated temperature performance while maintaining ductile characteristics at room temperature. Composites with parttticles of tungsten, molybdenum, or their carbides in silver and copper matrice are used widely for electrical-contact applications. These applications requil materials with properties such as high thermal and electrical conductivitie: high melting point, and low friction and wetting characteristics. These m, terials are also used for electrodes and related applications in the weldin industry.

It is well known that the measured strengths of most materials are found to be much smaller (by a couple of orders of magnitude) than their theoretical strengths. The discrepancy in strength values is believed to be due to the presence of imperfections or inherent flaws in the material. An attempt to minimize or eliminate flaws enhances the strength of a material. Flaws in the form of cracks that lie perpendicular to the direction of applied loads are particularly detrimental to strength. Therefore, compared with the strength of the bulk material, man-made filaments or fibers of non polymeric materials exhibit much

higher strengths along their lengths because large flaws that may be present in the bulk material are minimized owing to the small cross sectional dimensions of the fiber. In the case of polymeric materials, orientation of the molecular structure is responsible for high strength and stiffness.

Properties of some common types of fibers as well as some conventional materials are given in, which clearly shows the importance of fibers in achieving higher strengths. The high strength of glass fibers is attributed to a defect-free surface, whereas graphite and aramid fibers attain their strength as a result of improved orientation of their atomic or molecular structure. The most important reinforcement fiber is E-glass because of its relative low cost. However, boron, graphite, and the aramid polymer fibers (Kevlar49) are most exceptional because of their high stiffness values. Of these, thegraphite fibers offer the greatest variety because of the ability to control their structure. Fibers, because of their small cross-sectional dimensions, are not directly usable in engineering applications. They are, therefore, embedded in matrix materials to form fibrous composites. The matrix serves to bind the fibers together, transfer loads to the fibers, and protect them against environmental attack and damage due to handling. In discontinuous fiber-reinforced composites, the load-transfer function of the matrix is more critical than in continuous-fiber composites. The fibrous composites have become the most important class of composite materials because they are capable of achieving high strengths.

APPLICATIONS OF FIBER COMPOSITES

The two outstanding features of oriented-fiber composites are their high strength-weight ratio and contrQlled anisotropy. The strength and modulus of commonly used bidirectional composites are compared with those of conventional structural materials strengths and moduli approximately one-half of those of unidirectional laminates. They have equal properties in two principal directions and show smaller property. variation with direction. Fiber composites generally are superior to metals with respect to specific strength and modulus. However, glass-fiber composites are inferior to both steel and aluminum with respect to specific modulus. In applications where the structure's weight is a factor in the design, comparisons should be made on the basis of specific properties of the materials.

Controlled anisotropy means that the ratio of property values in different directions can be varied or controlled. For example, in a unidirectional composite, l >P. longitudinal strength-transverse strength ratio can be changed easily by changing the fiber volume fraction. Similarly, other properties can be altered by altering the material and manufacturing variables. Further, laminates are designed and constructed from unidirectional composites to obtain desired directional properties to match requirements of specific applications.

These two features, high specific strength and controlled anisotropy, make fiber composites very attractive structural materials. Their other advantages include ease of manufacture and structural forms that are otherwise inconvenient or impossible to manufacture. Their use, therefore, in aerospace and transportation industries is increasing continuously. Fiber-reinforced polymer matrix composites are the most widely used fiber composites. The U.S. polymer composite industry has grown at an average rate of 6.5% since 1960, which is approximately twice the growth rate of the U.S. economy. U.S. growth in composites is compared with that of steel.

ADVANCED FIBERS

A great majority of materials are stronger and stiffer in the fibrous form than as a bulk material. A high fiber aspect ratio (length-diameter ratio) permits very effective transfer of load via matrix materials to the fibers, thus taking advantage of their excellent properties. Therefore, fibers are very effective and

attractive reinforcement materials. Reinforcing fibers used in advanced composites are discussed in this section.

Glass fibers are the most common of all the reinforcing fibers for polymer matrix composites. The principal advantages of glass fibers are the low cost and high strength. However, glass fibers have poor abrasion resistance, which reduces their usable strength. They also exhibit poor adhesion to some polymer matrix resins, particularly in the presence of moisture. To improve adhesion, the glass fiber surface often is treated with chemicals called coupling agents (mostly silanes).

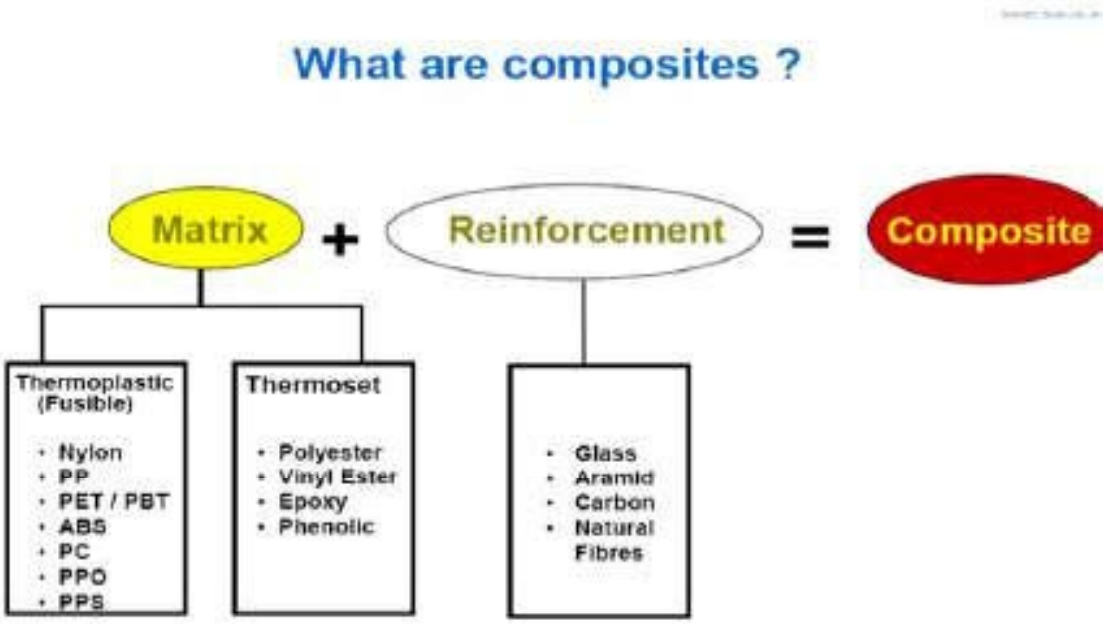


Fig 1.2 properties of composites

Two forms of fiberglass can be produced- continuous fiber and staple (discontinuous) fiber. Both forms are made by the same production method up to the fiber-drawing stage. Ingredients such as sand, limestone, and alumina are dry-mixed and melted in a refractory furnace. The temperature of the melt varies for each glass composition but generally is about 1260°C. The molten glass flows directly.

Into the fiber-drawing furnace in the direct-melt process or flows into a marble-making machine in the. marble process. The marbles are subsequently remelted and drawn into fibers. Most fiberglass is currently produced by the direct-melt process, illustrated schematically.

Continuous fibers are produced by introducing molten glass into a platinum bushing, where the molten glass is gravity-fed through a multiplicity of holes in the base of the bushing. The molten glass exits from each orifice and is gathered together and attenuated mechanically to the proper dimensions, passed through a light water spray (quench), and then traversed over a belt that applie's a protective and lubricating binder or size to the individual fibers. These fibers then are gathered together into a bundle of fibers called a strand or end. The fiberglass strand, typically consisting of 204 filaments, is then wound onto a receiving package (spool) at speeds of up to 50 mis. This "cake" is then conditioned or dried prior to further processing into other textile forms.

Glass fibers are amorphous solids. Chemically, glass is composed primarily of a silica (Si02) backbone in the form of (-Si04-)n tetrahedra. Modifier ions are added for their contribution to glass properties and manufacturing capability. For structural composites, the two commonly used types of glass fiber are E-glass and S-glass. Compositions of these are given and some important properties. At present, E-glass constitutes the majorityof glass-fiber production.

Sizes and Coupling Agents The chemical treatments applied during the forming of glass fibers are called sizes.These are of two general types: temporary sizes and compatible sizes.The temporary sizes are applied to minimize the degradation of strength resulting from abrasion of fibers against one another and to bind the fibers together for easy handling in forming woven (twisting and weaving) glassfiber products. These sizes are often starch-oil sizes. Ingredients of starch-oil sizes interfere with good bonding between the fibers and impregnating resin. Oil, emulsifying agent, and lubricant prevent good fiber wetting by the resin, and the starch, gelatin, and polyvinyl alcohol result in high water absorption and poor fiber-resin adhesion in the presence of moisture. Sizes of this type must be removed and replaced by a finish (coupling agent) before the fibers can be impregnated with resin. The sizes are easily removed by heating the fibers in an air-circulating oven at 340°C or higher temperatures for 15-20 h. Forms of Glass Fiber Glass fibers are commercially available in various forms suitable for different applications. Some of them are described in the following paragraphs and are illustrated in the photographs .

Fiberglass roving is a collection of parallel continuous ends of filaments. Conventional rovings are produced by winding together the number of single strands necessary to achieve the desired yiekl (number ofmeters of roving per kilogram of weight). Generally, rovings are made with fibers of diameter 9 or 13 μm. Roving yields vary from about %00 to 450 m/kg and typically have 20 strands. Rovings are used directly in pultrusion, filament winding, and prepreg manufacture.

Carbon/ graphite fibers are the predominant high-strength, high-modulus reinforcement used in th fabrication of high-performance polymer-matrix composites. Their use is growing rapidly owing to a significant reduction in their price in the 1990s and an increase in their availability. Besides aerospace applications, they are now being u,sed in sporting goods, automotive, civil infrastructure, offshore oil, and mahy other consumer applications.

In the graphite structure, the carbon atoms are arranged in the form of hexagonal layers with a very dense packing in the layer planes. The highstrength bond between carbon atoms in the layer plane results in an extremely high modulus, whereas the weak van der Waals-type bond between the neighboring

Layers results in a lower modulus in that direction. Strictly speaking, the term "graphite fibers" is a misnomer because there is no true graphite crystal structure in the fibers. The term "graphite fiber" is used to describe fibers that have a carbon content in excess of 99%, whereas the term "carbon fiber" describes fibers that have a carbon content of 80-95%. The carbon content is a function of the heat-treatment temperature. The current technology for producing carbon fibers generally centers on the thermal decomposition of various organic precursors. However, currently available carbon fibers are made using one of the three precursor materials: polyacrylonitrile (PAN), pitch, and rayon. Candidate organic materials for pyrolysis into carbon fibers having good properties should satisfy four criteria. First, the precursor should possess the appropriate strength and handling characteristics needed "to hold the fibers together" during all stages of the conversion process to carbon. Second, the precursor should not melt during any stage of the conversion process. This can be accomplished by either selecting infusible precursor material or by stabilizing a thermoplastic precursor prior to the conversion process. Third, the precursor material must not volatilize completely during the pyrolysis process: that is, the carbon yield of the precursor fiber after pyrolysis shouldbe appreciable enough to justify its use on an economic basis. Furthermore, in order to obtain optimal properties, the carbon atoms should tend to array themselves in an aligned graphite structure during pyrolysis. In general, the more highly graphitic and oriented the fibers, the better are the mechanical properties. Finally, the, precursor material should be as inexpensive as possible. One of the production methods for graphite fiber production is described below.

Graphite Fibers from PAN

The process by which PAN* is converted to carbon fibers involves five steps :
1. Spinning the PAN into a precursor fiber.
2. Stretching the precursor.
3. Stabilization by holding the prestretched polymer under tension at a. temperature of 205-240°C for uto 24 h in •an oxidizing atmosphere (air).
4. Carbonization at approximately 1500°C in an inert atmosphere. Carbonization is the process of pyrolizing stabilized PAN fibers to drive out most (if not all) noncarbon elements of the precursor fibers until they are essentially transformed into carbon1fibers. It is during this stage that the high mechanical properties found in most commercially available carbon fibers are developed.
5. Graphitization at approximately 3000°C in inert atmosphere. Graphitization heat treatments are carried out at temperatures in excess of 1800°C in order to improve the tensile modulus of elasticity of the fiber by improving the crystallite structure and preferred orientation of the graphitelike crystallite within each individual fiber.

Model nesting is the most commonly applied and traditional method of linking numerical and physical models. A global or regional numerical model provides the external boundary conditions for a smaller area, more detailed model. Model nesting is a common way to downscale numerical model results from the global to the local level or to drive a more detailed regional model from a less detailed, larger scale model. However, here we are interested in how to drive a physical model covering a small, specific area, from a numerical model of a wider area.

Carbon fibers produced from each precursor have distinct advantages and drawbacks in terms of both cost and properties. The PAN-based carbon fibers are lower in cost and have good properties. They are the dominant class of structural carbon fibers and are used widely in military aircraft, missiles, and spacecraft structures. Pitch-based carbon fibers generally have higher stiffness and thermal conductivities, which make them useful in satellite structures and thermal-management applications, such as space radiators and electronic enclosures. Rayon-based carbon fibers are not used for structural applications, but their low thermal conductivity makes them useful for insulating and ab~lative applications such as rocket nozzles, missile reentry vehicle nosecones, and heat shields. Typical property ranges of each class of carbon fibers. Carbon fibers are available in a great variety of property combinations because their properties can be altered easily by controlling their structure through manufacturing process (e.g., by heat-treatment temperature). Fiber properties change from batch to batch and also as manufacturers improveiber technology. The latest dat from the manufacturer should be consulte for specific fibers and their actual properties. Carbon fibers are available in various forms: continuous, chopped, wovel fabric, 01/ mat. Tows, yarn, rovings, and tape are the most common foons o conti'nuot4's-graphite fibers sold today. A tow consists of numerotrS rilament in a straight-laid bundle and is /specified by their number. Depending on th1 organic precursor and manufacturer, typical filament counts vary from 400- 10,000 or as high as 160,000. A ·yiim is a twisted tow, whereas a roving is : number of ends or strands collected in a parallel bundle with little or no twis and is specifiea by the number of ends. Finally, a tape consists of numerous tows or yarns' (e.g., 300) side by side on a backing or stitched together.

Various types of polymer fibers (e.g., nylon, polyester, rayon) have been i1 use for many years as reinforeements in automobile tires, large balloons am dirigibles, body armor, and rubber-coated fabrics.Polymer-aramid fibers (Kevlar) were first introduced in 1971. The aramil fiber-forming polymers, that is, the aromatic polyamides, are believed to b made by solution-polycondensation of diamines and diacid halides at lo, temperatures. The polymers are spun from strong acid solutions (e.g., concentrated H2S04) by a dry-jet wet spinning process. The polymers are madeby rapidly adding a diacid chloride to a cool (5-10°C) amine solution while stirring. The polymer thus formed is recovered from the crumbs or gel bypulverizing, washing, and drying. To form filaments, the clean polymer, mixed with strong acid, is extruded from spinne.rets at an elevated temperature (51-100°C) through a 0.5-1.9-cm layer of air into cold water (0-4°C). The fibers are then washed thoroughly in water and dried on bobbins. Fiber properties can be altered by using solvent additives, varying the spinning conditions, and using postspinning heat treatments. Kevlar fibers possess unique properties. Tensile strength and modulus are substantially higher and fiber elongation is significantly lower for Kevlar fibersthan for other organic fibers. Kevlar fibers have poor characteristics incompression, with compressive strength being only one-eighth the tensilestrength. This results from their anisotropic structure, which permits rather

easy local yielding, buckling, and kinking of the fiber in compression. They are not as brittle as glass or graphite fibers and can be readily woven on conventional fabric looms. Representative properties of Kevlar fibers.

Boron filaments are produced by chemical vapor deposftion (CVD) from the reduction of boron trichloride (BC13) with hydrogen on a tungsten or carbon monofilament substrate. The substrate is resistively heated to a temperature of 1260°C and pulled continuously through a reactor to obtain the desired boron coating thickness. Currently, boron filaments are produced with diameters of 100, 140, and 200 μm (4, 5.6, and 8 mils), in descending order ofproduction quantity; however, both smaller- and larger-diameter fibers havebeen produced in experimental quantities.The tensile strength of boron-tungsten filaments has improved steadilyover the past decade from an average of under 2750 MPa to over 3445 MPa.

The need for high-temperature reinforcing fibers has led to the development of ceramic fibers. The ceramic fibers combine high strength and elastic modulus with high-temperature capability and a general freedom from environmental attack. Alumina fibers and silicon carbide fibers are among the importan ceramic fibers. Alumina fibers marketed by Du Pont (E.I. Du Pont de Nemours & Co.) with the trade name "Fiber FP" are a continuous aalumina yarn with a 98% theoretical density. These fibers are made by spinning of an aqueous slurry and a two-step firing. As-produced Fiber FP surface is very rough. A thin silica coating enhances tensile strength by about 50%. An excellent feature of Fiber FP is its strength retention at high temperatures. They retain strength up to about 1370°C. Properties of Fiber FP . Silicon carbide (SiC) fibers are produced by a chemical vapor deposition (CVD) process (AVCO Specialty Materials Co.), as well as by controlled pyrolysis of a polymeric precursor (Nippon Carbon Co.-Nicalon fibers). Properties of SiC fibers . Silicon carbide fibers retain tensile strength well above 650°C. Alumina and SiC fibers are suitable for reinforcing meta matrices, in which carbon and boron fibers exhibit adverse reactivities. In addition, alumina has an inherent resistance to oxidation that is desirable in applications such as gas-turbine blades.

For different applicatiqns. The range of properties of the HPPE fibers, as reported by manufacturers. The reported properties often are influenced by the testing method, and actual usable properties of fibers may b~ lower than the reported values.

HPPE fibers have a density of only 0.97 g/cm3

Their modulus and strength are slightly lower than those of K5Ylar fibers but on a per-unit-weight basis, HPPE fibers have 30-40% higher strength and modulus than Kevlar fibers. High-energy absorption of HPPE fibers makes them suitable for use in ballistic protection applications. HPPE fiber-based composites perform exceptionally well against high~velocity impacts such as the ones produced by rifle rounds and shock waves from an explosion. This is so because the highvelocit impact produces a high strain-rate loading on the composite, and the strength and stiffness of the PE fibers increase at high strain rate. Highperformance body armors (concealed ballistic vests) made from these fibers provide comfort and maneuverability. They also find use in vehicles for se· curity and law enforcement blaSt-:dmtainment applications, and reinforce cockpit doors on commercial airliners. Major limitations in the application of HPPE fibers come from their lo"' melting point of I 50°C, an inert surface that makes it difficult to bond to othei polymers, and poor creep characteristics.

Fibers, because of their small cross-sectional dimensions, cannot be loaded directly. Further, fibers, acting alone, cannot transmit loads from one to an· other to be able to share a load. This severely limits their direct use in load· bearing engineering applications. This limitation is overcome by embeddini

Them in a matrix material to form a composite. The matrix binds the fiber: together, transfers loads between them, and protects them against environ· mental attack and damage due to handling. The matrix has a strong influenet on several mechanical properties of the composite, such as transverse modulw and strength, shear properties, and· properties ir1 compression. The matrb material frequently limits composite's service -femperature. Temperatunranges at which composites with different types of matriee can be use. Physical and chemical characteristics of the matrix, sudas· melting or curing temperatures, viscosity, and reactivity with fibers, influ. ence the choice of fabrication process. The matpx material for a compositesystem is selected keeping in view all these factors. Commonly used matrb materials are described in this section.

According to their structure and behavior, polymers can be classified as thermoplastics or thermosets. The polymers that soften or melt on heating, called thennoplastic polymers, consist of linear or branched-chain molecules having strong intramolecular bonds but weak intermolecular bonds. Melting and solidification of these polymers are reversible, and they can be reshaped by application of heat and pressure. They are either semicrystalline or amorphous in structure.

Examples include polyethylene, polystyrene, nylons, polycarbonate, polyacetals, polyamide-imide, polyether-ether ketone (PEEK), polysulfone, polyphenylene sulfide (PPS), and polyether imide. Thermosetting plastics have cross-linked or network structures with covalent bonds between all molecules. They do not melt but decompose on heating. Once solidified by a crosslinking (curing) process, they cannot be reshaped. Common examples of thermosetting polymers include epoxide~ polyesters, phenolics, ureas, melamine, silicone, and polyimides.

These transition temperatures are illustrated as measured by specific volume changes with temperature. Transition temperatures (Tg and Tm) of some polymers are given in Table 2-9. The temperature for processing of thermoplastics is governed by either the melt temperature or glass transition temperature. For example, an amorphous thermoplastic must be molded well above its Tg in order to reduce its melt viscosity sufficiently.

An understanding of the effect of these temperatures on the mechanical behavior of polymers is best seen by the behavior of modulus of elasticity (E) with temperature An amorphous thermoplastic (e.g., polystyrene, polycarbonate, or polymethylmethaerylate) has a significant change of mechanical properties at the glass transition temperature. Hence maximum use temperatures must be less than the glass transition temperatures. A thermoset (e.g .. epoxy, polyester, or phenolic) has a much reduced change in properties at the glass transition temperature because of its high degree of cross-linking. However, their maximum use temperatures should not exceed Tg. Semicrystalline thermoplastlics alsohave a modest change in properties at the glass transition temperature owing to the presence of the crystalline regions. Their maximum use temperatures are more dictated by the melting

These general shapes are applicable for crystalline or amorphous materials. It is important to recognize that these large variations in behavior can occurover a temperature range of only 100-200°C for some materials. Further, the rate of strain has a comparable effect, although much greater rate changes must occur to alter the behavior substantially. Thermosets also are not as affected by temperature and strain rate, the range of behavior being limited to approximately the higher three curves . Environmental influences (e.g., moisture absorption) also have a significant effect on the behavior of polymers, particularly relative to metals and ceramics For example, epoxy or polyester resins can absorb up to 4-5% by weight of water if exposed to 100% relative humidity or immersed in water. The mechanical properties of nylon thermoplastics are influenced significantly by their moisture contents. Polymers are also susceptible to deterioration as a result of exposure to ultraviolet radiation.

Polyester and epoxy resins are the most common polymeric matrix materials used with highperformance reinforcing fibers. Both are thermosetting polymers. Easy processibility and good chemical resistance are their chief advantages.

A polyester resin is an unsaturated (reactive) polyester solid dissolved in a polymerizable monomer. Unsaturated polyesters are long-chain linear polymers containing a number of carbon double bonds. They are made by a condensation reaction between a glycol (ethylene, propylene, or diethylene glycol) and an unsaturated dibasic acid (maleic or fumaric). A typical polyester resin made from reaction of maleic acid and diethylene glycol is shown below:

The length of the molecule or degree of polymerization n may vary. The resin generally will be a solid. It is dissolved in a polymerizable (reactive) monomer such as styrene, which also contains carbon double bonds and acts as a crosslinking agent by bridging adjacent polyester molecules at their unsaturation points. The monomer also acts as a diluent, reducing the viscosity of the polyester, and makes it easier to process. The curing or cross-linking process is initiated by adding a small quantity of a free-radical initiator/curing agent such as an organic peroxide (e.g., benzoyl peroxide) or an aliphatic azo compound. The styrene monomer cross-links or reacts with the double bond in the polyester backbone above to form a network polymer, as shown below:

Vinyl esters, polyimides, and phenolics are among the other thermosetting polymers that are used as matrix materials for composites. Vinyl esters are closely related to the unsaturated polyesters. Like unsaturated polyesters, they possess low viscosity and cure fast but are slightly more expensive. They possess exceptional mechanical and chemical performance characteristics and thus provide a transition in mechanical properties and cost between polyesters and the high-performance epoxy resins. Vinyl esters often are used because of their ease and speed of processing and their good resistance to wet environments. Their applications include high performance gel coats, pipes, and reaction vessels.
Polyimides have a relatively high service temperature range (250-300"C). They also possess excellent chemical and solvent resistance. Bismaleimide (BMIs) are the most widely used thermosetting polyimides for composites employed at high temperatures. However, these materials are inherently very brittle, and thus they are often combined with polysulfone, polyetherimide, or other thermoplastics. The handling and processing techniques for BMI resins are similar to those for epoxy resins. Their applications include aerospace wing-skin ribs, helicopter firewalls, and printed wiring boards. Phenolic resins have low flammability, low smoke production, good dimensional stability under temperature fluctuations, and good adhesive properties. Phenolics are attractive for aircraft and mass-transit vehicles and as interior construction materials where outgassing due to fire must be extremelylow.

Phenolics also are used for rocket nozzle ablative and insulation liners. Chopped-fiber molding compounds of phenolic resin are used mostly in the automotive, appliance, and electrical component markets.

Fillers Fillers are used widely in polymeric composites primarily to reduce cost with some sacrifice in physical properties. They also are used to reduce shrinkage, control viscosity, and improve part stiffness. Commonly used fillers include calcium carbonate, kaolin (china clay), silica (sand), feldspar,talc, and glass microspheres. Fillers are not as common in highperformance composites because they may adversely affect the fiber-resinload transfer and decrease the toughness of the resin at high filler content.Calcium carbonate (CaC03) is a widely used filler for both economic and performance considerations.Glass-fiber-reinforced polyesters from sheetmolding compounds or bulk-molding compounds may contain substantial amounts of CaC03 for cost reduction and shrinkage control. High surface smoothness may be achieved and sink marks eliminated. Kaolin is used to increase resin viscosity to prevent fibers from extruding from molded surfaces. It also improves the fire resistance of the compound.Natural silicas are used in thermoset resins for dimensional stability, good electrical insulation, and improved thermal conductivity. Talc (hydrated magnesium silicate), in the form of finely ground thin platelets,

Is added to resins to improve stiffness and creep resistance. Some natural organic materials such as wood flour, shell fibers (e.g., shell of almond, coconut, peanut, walnut, etc.), and cotton and vegetable fibers (e.g., hemp, jute, ramie, and sisal) are also used as fillers. Hollow microspheres made from glass or polymers can be used to reduce thedensity of the resin significantly. Additives used for fire resistance (e.g., antimony oxide), chemical thickening (e.g, magnesium oxide and calcium hydroxide), and for lowering shrinkage (e.g ., fine-powdered polyethylene) are also common. For more detailed information on fillers and additives, the reader shouldrefer to the books suggested at the end of this chapter.

Metals are by far the most versatile engineering materials. The properties that are particularly important for their use as matrix materials in composites include high strength, high modulus, high toughness and impact resistance, and relative insensitivity to temperature changes.

1.3 Summary

Here the introductory part about the analysis and effect of shim used in a composite and metal bolted joints.

CHAPTER 2

LITERATURE REVIEW

The report explains his works that consists on a new experimental methodology for testing metal-composite bolted joints. Single-lap titanium-composite structure joints attached by monel fasteners were investigated. Finite element analysis was carried out in order to predict the mechanical behaviour of the joints up to the first failure, as well as to aid test setup. The experimental tests were carried out by using geometry specifications for composite-composite joints, and procedures established by the Secondary-Modulus Method for metal-metal joints. Based on the experimental tests, using the proposed methodology it was possible to observe the mechanical behaviour of the metal-composite joints, mainly to determine the stiffness and strength of the structures. Therefore, the proposed methodology can contribute for designing metal-composite bolted joints, estimating not only the compliance but also allowable stress values for those structures .

This thesis deals with composite joints with single shear tensile loading for a single piece specimen. The bearing response data from single shear test using a single piece specimen has been extensively used in the development of design allowable data. The first objective of the work was to test three different displacement gauge position configurations for determining the bearing chord modulus and the 2% offset strength of composite coupons. Testing was done according to ASTM D5961: Procedure 'C' - the standard test procedure for the bearing response of a single shear one-piece polymer matrix composite laminate. The Procedure 'C' testing method is not yet standardized by the ASTM and there is a great deal of confusion in the extensometer position. Hence, an attempt has been made to study the variability in the chord modulus, and more importantly the 2% offset bearing strength depending on the different reference positions of the displacement gage placement. The other aim of thesis was to build a finite element (FE) model for a quasi-isotropic material, to justify the FE results with experimental results, and then to conduct a set of parametric studies to study the stiffness behaviour in all the three positions. The statistical analysis using Design of Experiments (DOE) of the parametric study data, identified significant factors affecting the results .

In this study, analytical models with different material and geometry for both single and double- lap bolted joints were reviewed for better understanding on how to select the proper model for a particular application. The survey indicates that the analytic models selected for the adhesively

single or double bolted lap joints, as well as T, scarf, and stepped joints, with linear material properties are mostly two dimensional and the studies on stress distribution and/or failure of the joints are performed experimentally, analytically or by finite element method. The results seem to be generally accurate and adequate. Additionally, it was shown that any increase in the bolt-hole clearance leads to an increase in bolt rotation, as well as a decrease in bolt-hole contact area. Hence, there is a reduction in joint stiffness. Moreover, studies on hybrid joints have revealed that the proper choice of adhesive material in conjunction with bolts or rivets in a joint, allows for significant increase in the static and fatigue strength compared to similar pure bonded joints. Additionally, the results on hybrid scarf joints showed that it is vital to place fasteners closer to the ends of the overlap to suppress the peak peeling stresses and hence, delay the effects of early crack initiation in the adhesive layer. Experimental studies on fatigue behaviour and strength of bolted joints have shown that compared to clearance fit specimens, clamping force increases the fatigue life of a bolted joint. Moreover, higher tightening torque, in general, results in higher fatigue lives in bolted joints .

The formation of micro-cracks and crack propagation is still an acute problem in polymer and polymer composites. These micro-cracks usually occur while the materials are manufactured or serviced. The development and coalescence of these cracks reduces the lifespan and brings about a catastrophic failure of the materials. Novel scientific research on polymeric self-healing is emphasised in a number of publications, which consist of contributions from many of the prominent researchers in this area. Progress in this field can eventually enable scientist to construct new flexible materials that both monitor the material's integrity and repair the deformed material prior to the occurrence of any fatal failures. This report describes recent trends that have been used in material science and computational methods to mitigate the development of micro-cracks and crack propagation in polymer composites.

Prepregs are fibre-reinforced resins that cure under heat and pressure to form exceptionally strong yet lightweight components. Hexcel is a world leader in prepreg technology and this guide has been written to provide a greater understanding of prepregs, how they are manufactured, processed their properties and varied applications. Information is provided to guide you through the choice of the most suitable prepreg and processing method for an application. To assist with product selection Hexcel has produced PREPREG MATRIX SELECTOR GUIDES for Aerospace and Industrial applications which are available on request. For more information on our product range, prepreg selection or processing techniques please contact Hexcel .

2.1 Summary

Based on the above research is considered as a foundation for our project for composite and bolted joints.

CHAPTER 3

MODELLING

The specimen is modelled using CATIA V5. Initially the parts such as top and bottom plate, shim, nut and bolt are designed using part design feature. Then these parts are assembled to model the specimen using assembly design feature. Fig.3. 1 shows the CAD models of the different parts and also the assembled model.

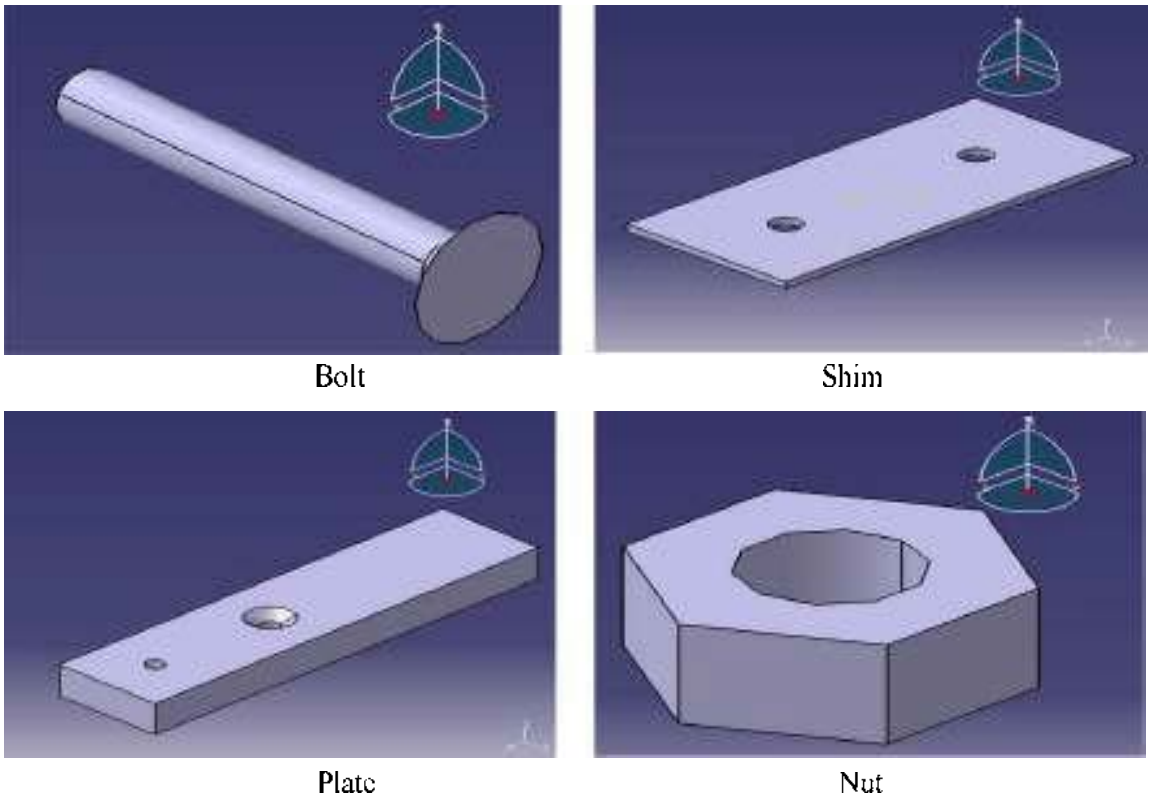


Fig 3.1 : Modelling of bolt, nut, shim and plate

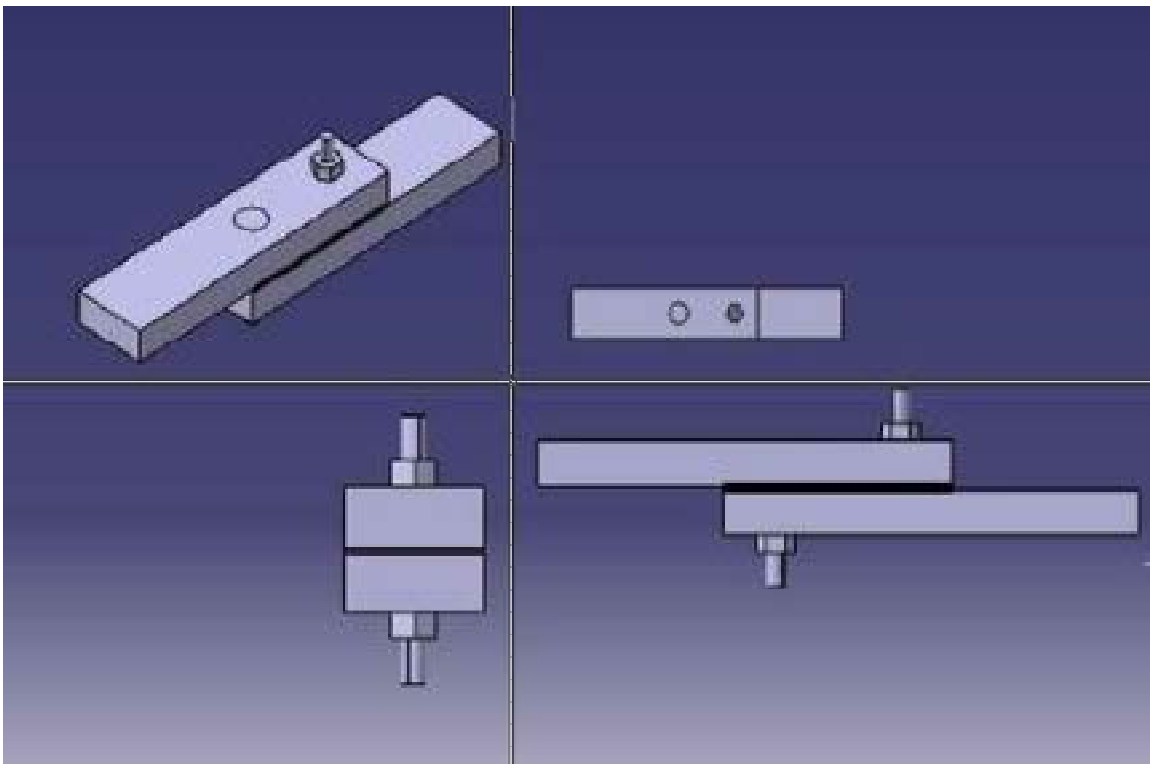


Fig. 3.2 : CAD models of the specimen

An unusual extension of this composite modeling approach involved the physical and numerical models covering the same domains (van den Boogaard et al, 2009, summarized in Gerritsen et al, 2009, Gerritsen and Sutherland, 2011). Here wave propagation over a nearshore bar was modeled using a physical and a numerical model to determine the worst cases wave conditions at the toe of a seawall. The worst case was determined by the geometry of the nearshore bar and intertidal terrace, so several geometries had to be modeled for each wave condition. In general terms, physical wave experiments for near-shore problems are accurate but expensive and time consuming, while numerical wave modelling for these problems is flexible, relatively fast and cheap, but still much less accurate. An error correction technique was devised to use the results of the physical model to correct the results of the numerical model. The error correction procedure was based on an artificial neural network model of type Multilayer Perceptron. A priori knowledge and analysis were used to reduce the dimensionality of the problem to acceptable limits.

In this way the speed and flexibility of the numerical model was combined with the accuracy of the physical model so that the worst case of nearshore bathymetry could be determined. Moreover, the above combination of both models significantly reduced the number of flume experiments needed to derive the most critical bed geometry for the defined problem.

While individual length-scale and time-scale computational approaches provide extremely useful information, there is a need for an integrated multi-scale simulation approach to investigate existing and novel composite materials. Based on the current research efforts, we are hoping to see the development of multi-scale simulation approaches to examine composites in the near future.

One example of this involves the design of lock filling and emptying (F/E) systems. A numerical model with 1D pressure flow and 1D open channel flow was used to model the F/E system. The head loss of each component must be represented in such a system, but this is difficult to estimate for a complex culvert. Therefore the numerical model was used to model the system with standard textbook head losses. A physical model of a culvert was constructed and run. Pressure gradients were measured and flow patterns were observed (as an even flow distribution is desired). The culvert design was optimized based on the physical model results. The head losses derived from measurements on the physical model were then incorporated into the numerical model so that the overall design could be optimized (Bousmar, 2010, personal communication).

Both of these examples are similar to the composite modeling approach advocated by Oumeraci (1999) for whom the principle of Composite Modelling consists in subdividing a very complex and complicated problem into several simple and more easily tractable processes which can be described by the most appropriate methods in order to get the most reliable process models, including physical and validated numerical and analytical models. These models should then be combined using a hydro-informatics approach. As the hydro-informatics approach taken commonly consists of the development of a numerical model including behavioral (parameterized) elements, this can be seen as a typical means of numerical model development. However, in these cases the physical model tests were designed to produce sit-specific and conditions-specific results, which were not intended to be generalized for use in a numerical model of other similar cases.

In a coastal area where a breakwater is being built, for example, it may be necessary to construct a physical model to test armour stability, scour, overtopping or any other nonlinear phenomenon that cannot accurately be represented in a numerical model. In this case an offshore wave condition would typically be obtained and a regional wave model used to propagate the desired wave conditions inshore, modelling processes such as shoaling, refraction and possibly diffraction. The modelled wave condition is output at typically one location in relatively deep water at the offshore edge of the physical model. A characteristic wave height and wave period (often the significant wave height and peak wave period) is extracted from the numerical model, even if it is a spectral model with wave-wave interactions that contains much more information than simply height and period. A wavemaker will then generate an irregular but normally longcrested sea state with a standard spectral shape.

3.1 Summary

The above modelling is designed in CATIA V5 software. And it's designed in upper and lower plate, nut, bold and shim.

CHAPTER 4

MESHING

Meshing is done using NFX. The plates, bolts and the shim are meshed separately to maintain the quality of mesh. Fig. 4.1 shows the mesh files of the individual parts.

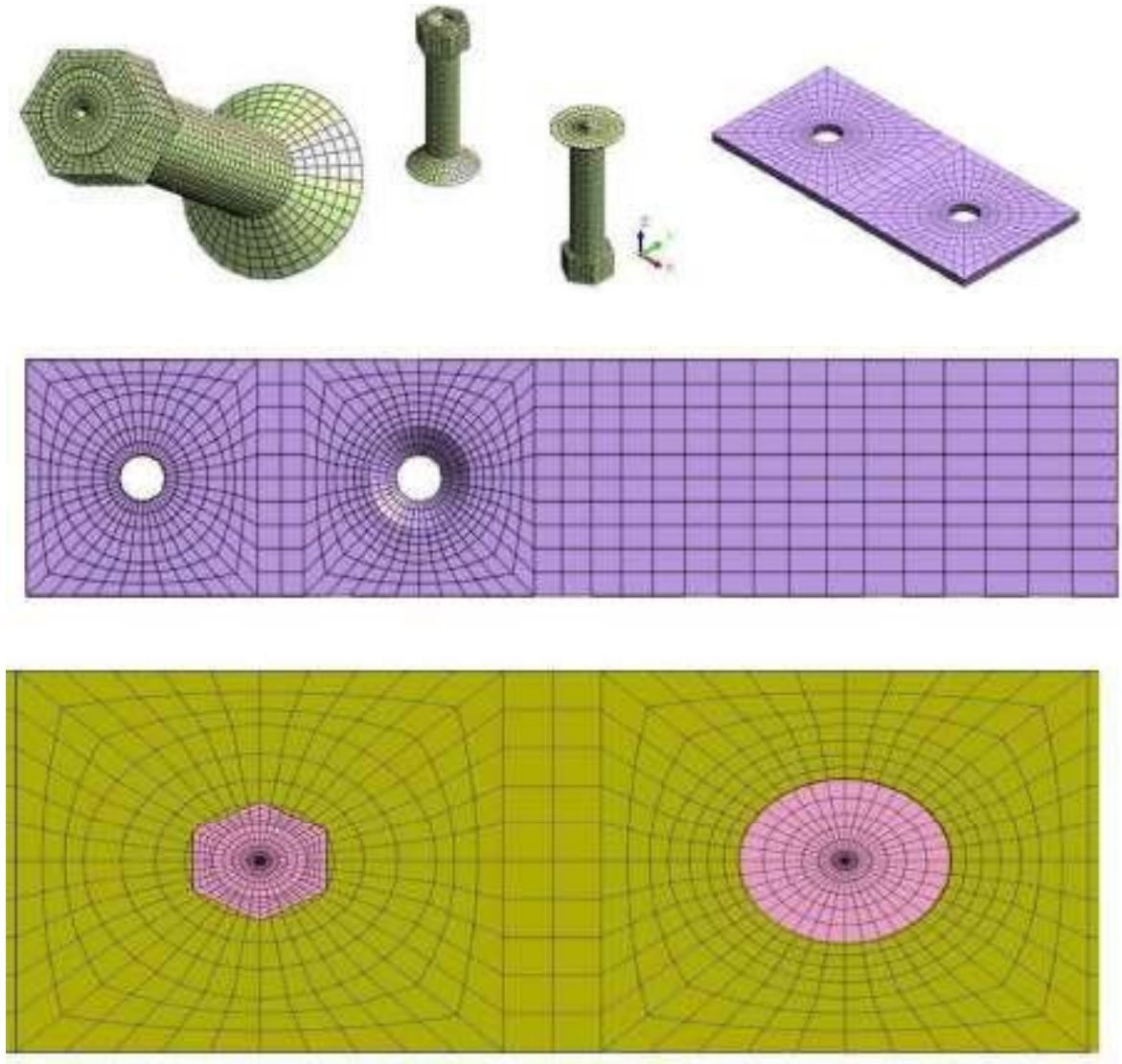


Fig. 4.1: Mesh of individual parts

4.1 Finite Element Analysis:

The tensile test is carried out in MIDAS NFX 2019. The right end of the top plate is made as a rigid body to apply load. The entire model is constrained in Y and Z direction to prevent movement in y and z directions. The left end of the bottom plate is fixed and the load is applied on the rigid body on the right end of the top plate. Fig. 4.2 shows the specimen with boundary condition and applied load. FEA is done for specimens with three different thickness and with varying the dimensions of the shim. Displacement and von Mises stress distribution is obtained for all specimens.

Fig. 4.2: Specimen with constraints and applied load

4.2 Summary

The meshing and finite element analysis run in MIDAS NFX software. To distribute the weight in each and every parts in the upper and lower plate

CHAPTER 5

MATERIALS AND PROPERTIES

The top and bottom plates are made with hexcel prepreg made with carbon IM7 as fibre and epoxy 8552 as resin. The bolt is considered as titanium and the shim is made up of epoxy resin. The stacking sequence of 3 different specimens are $[45/-45/90/0/45/-45/90/0/45/-45/90/0]_s$, $[45/-45/90/0/45/-45/90/0/45/-45/90/0/45/-45/90/0]_s$ and $[45/-45/90/0/45/-45/90/0/45/-45/90/0/45/-45/90/0/45/-45/90/0/45/-45/90/0]_s$ respectively. The shim thickness is varied from 0 mm to 2 mm with an interval of 0.5 mm. Here the composite laminate is assumed as 3D anisotropic material whereas the shim and bolts are assumed as 3D isotropic materials. The material properties for the prepreg is given in Table 1. Also the material properties of titanium and epoxy resin is given in Table 5.1

5.1. Material Property matrix (G_{ij}) of Hexcel IM7/8552 prepreg (MPa)

88886	51246	51246	0	0	0
	100249	61362	0	0	0
		100249	0	0	0
			21405	0	0
				19443	0
					21405

5.2. Properties of epoxy and titanium

Material	E (MPa)	V
Titanium	110000	0.3
Epoxy	6000	0.35

5.1 Contact Pairs:

Contact pairs are created in MIDAS NFX to create contact between the individual parts. Three contact pairs are created (between plates and bolt head, between plate and shim and between plates and bolt middle portion). Welded contact is provided for plates and bolts whereas sliding contact is provided between plates and shim. Fig. 3 shows the master and slave of the contact pairs.

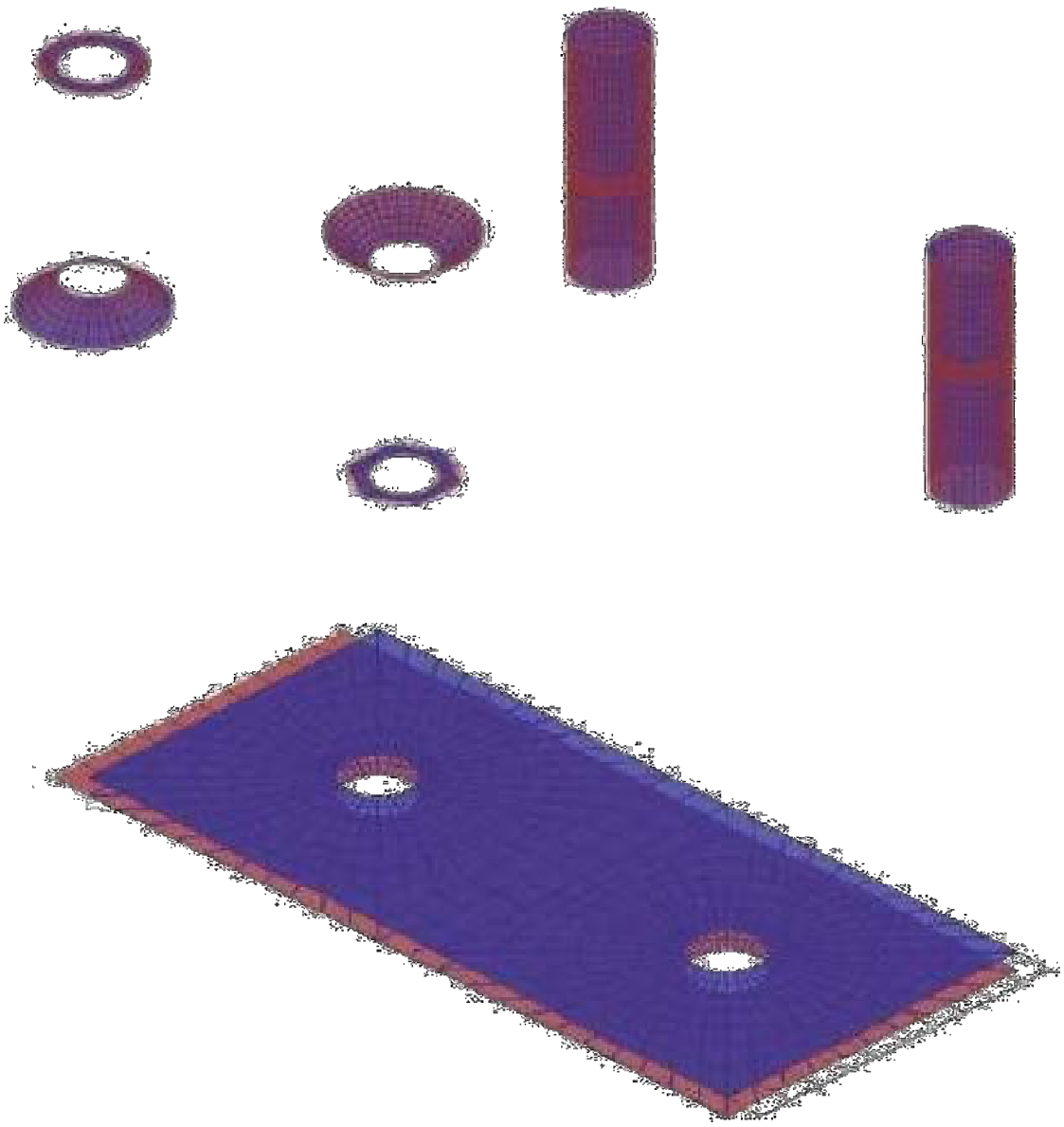


Fig. 5.1: Contact Pairs

5.2 Summary

The above materials and properties are choosing based upon the quality and strong materials. Contact pairs meshed in MIDAX NFX Software in individual parts of nut and bolt heads and plate and bolt mid span.

CHAPTER 6

CALCULATIONS

The top and bottom plate is made with three different kinds of thickness such as 12.7, 8.48 and 6.36 mm respectively. The diameter of the bolt is fixed as 6.35 mm. The bearing allowable stress is considered as 758 MPa. The applied load for tensile test is obtained using the bearing allowable stress. is used to calculate the applied load.

For t=12.7 mm and d=6.35 mm, P=758*12.7*6.35 =61129 N

For t= 8.48 mm and d= 6.35mm, P= 758*8.48*6.35 = 40817 N

For t= 6.36 mm and d= 6.35mm, P= 758*6.36*6.35 = 30613 N

Table 6.1 shows the thickness of top and bottom plates, thickness of shim, total thickness of the specimen and diameter of the bolt. Table 4 shows the applied load calculated for three different specimen thickness.

Table: 6.1 Specimen dimensions

Specimen ID	t_u (mm)	t_l (mm)	t_s (mm)	t_{total} (mm)	d (mm)
A0	12.7	12.700	0	25.400	6.35
B0	8.480	8.480	0	16.960	6.35
C0	6.360	6.360	0	12.720	6.35
A1	12.7	12.700	0.5	25.900	6.35
B1	8.480	8.480	0.5	17.460	6.35
C1	6.360	6.360	0.5	13.220	6.35
A2	12.7	12.700	1	26.400	6.35
B2	8.480	8.480	1	17.960	6.35
C2	6.360	6.360	1	13.720	6.35
A3	12.7	12.700	1.5	26.900	6.35
B3	8.480	8.480	1.5	18.460	6.35
C3	6.360	6.360	1.5	14.220	6.35
A4	12.7	12.700	2	27.400	6.35
B4	8.480	8.480	2	18.960	6.35
C4	6.360	6.360	2	14.720	6.35

Table: 6.2 Applied load for specimens of different thickness

t (mm)	d (mm)	P (N)
12.7	6.35	61129
8.48	6.35	40817
6.36	6.35	30613

6.1 Knock Down Factor

Knock Down Factor is the ratio of stress developed without shim to stress developed with shim is used to find the KDF values. KDF of specimen with and without thickness. Table 6.3 gives the KDF values for specimens of different thickness.

Table 6.3. KDF values

Specimen ID	t_s/t_{total} (%)	KDF	
		Top plate bottom face	Bolt
A0	0.00	1.000	1.000
B0	0.00	1.000	1.000
C0	0.00	1.000	1.000
A1	3.94	0.923	0.833
B1	5.90	0.902	0.779
C1	7.86	1.193	1.353
A2	7.87	0.964	0.826
B2	11.79	0.978	0.869
C2	15.72	1.290	0.868
A3	11.81	1.050	0.676
B3	17.69	1.053	0.685
C3	23.58	1.306	0.931
A4	15.75	0.908	0.649
B4	23.58	0.930	0.685
C4	31.45	1.316	0.860

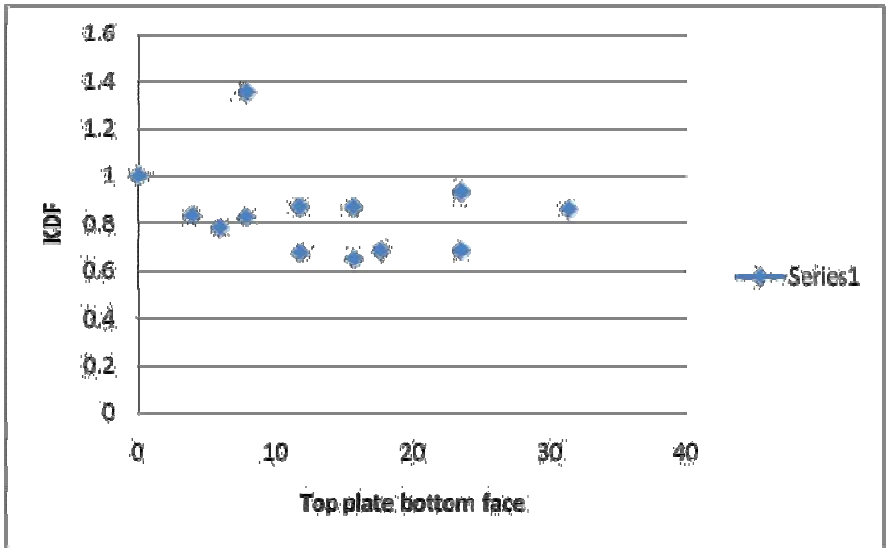


Fig. 6.1: KDF vs. t_s/t_{total} (%) of top plate bottom face

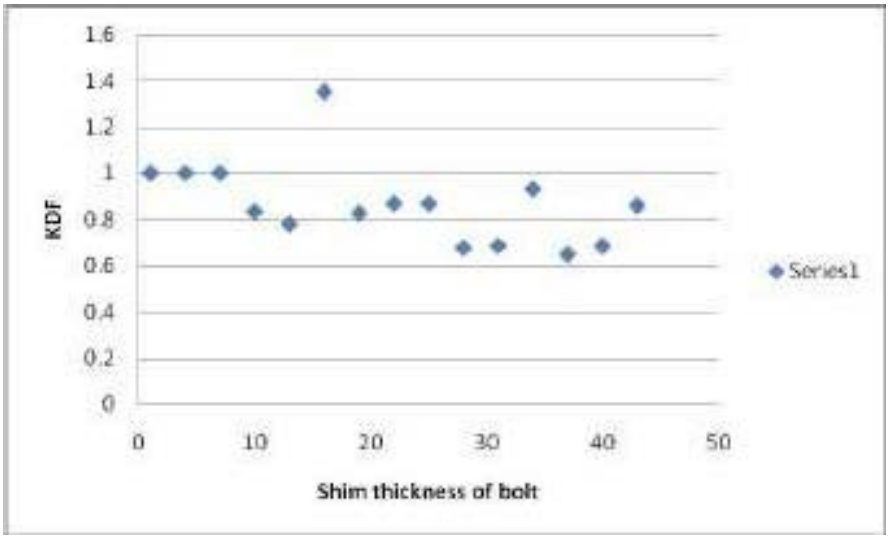


Fig.6.2: KDF vs. shim thickness of bolt

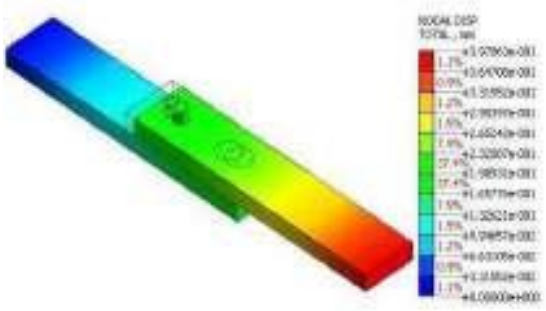
6.2 Summary

The above calculations are calculated in different models and different thickness of shim. Calculated applied load in different specimen thickness.

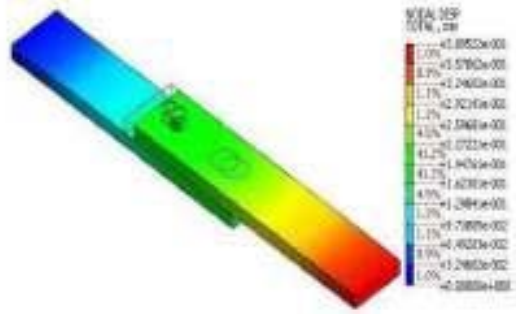
CHAPTER 7

RESULT

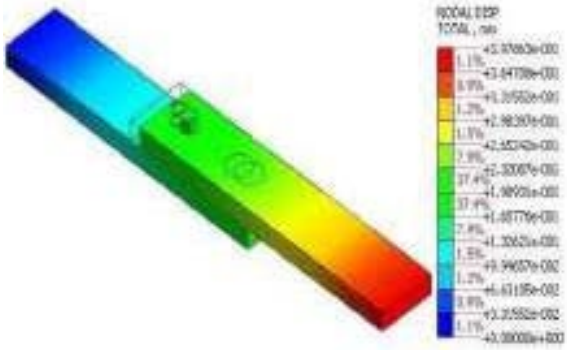
Displacements and maximum von Mises stress are obtained for all the specimens. Also the maximum stress obtained by the bolt and the bottom face of the top plate is also noted. Table 7.1 gives the displacements and von Mises stress obtained for different specimens. Fig. 7.1 shows the displacement variation in specimen without shim and with shim of thickness 2mm. Fig. 7.2 shows the displacement variation in bolts compared to undeformed shape using no shim and shim with thickness of 2 mm. Fig. 7.3 shows the von Mises stress plots of bolts with different thickness and shim thickness. Fig. 7.4 shows the von Mises stress distribution of the 3 different thickness of top plate bottom face



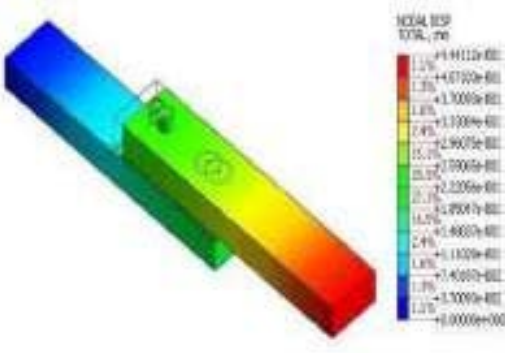
t = 12.7mm t_s = 0 mm



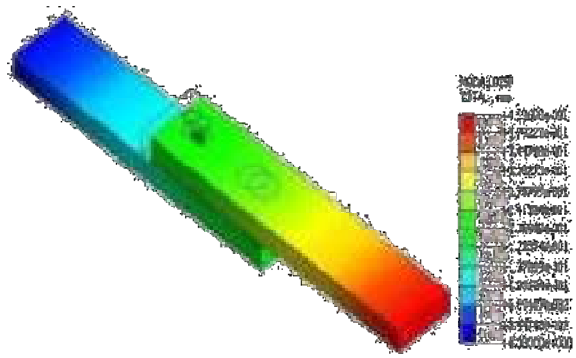
t = 6.37 mm t_s = 0 mm



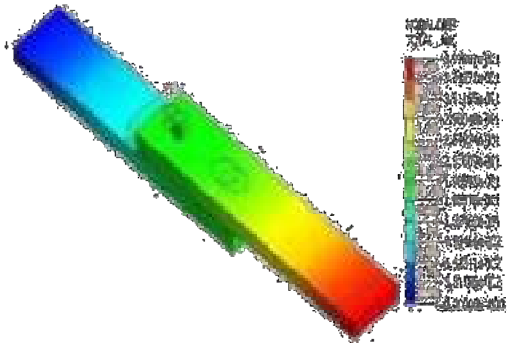
t = 8.48 mm t_s = 0 mm



t = 12.7mm t_s = 2 mm

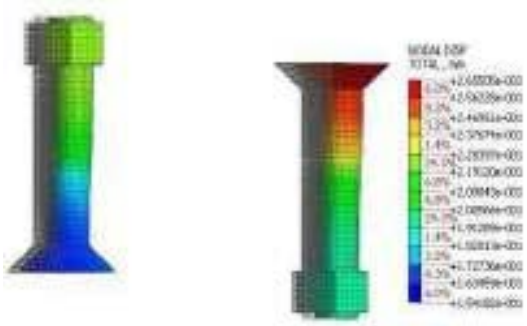


t = 8.48 mm t_s = 2 mm

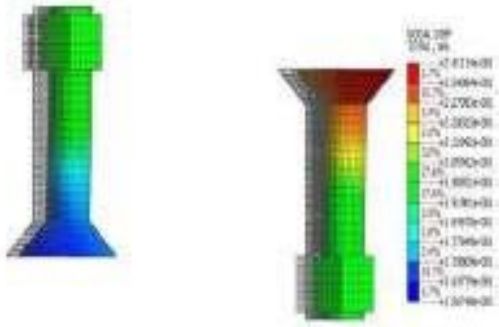


t = 6.37mm t_s = 2 mm

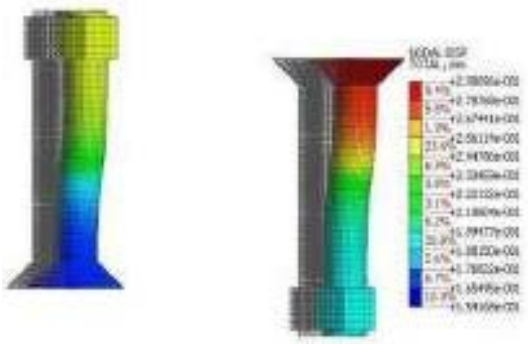
Fig. 7.1: Dispacement variation in specimen without shim and with shim of thickness 2 mm



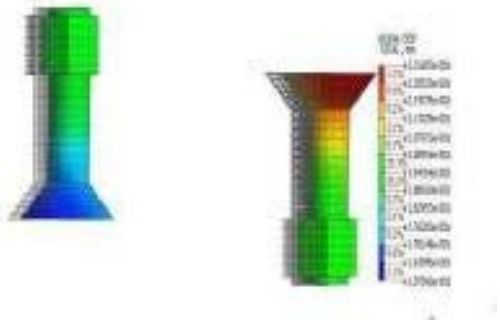
t = 12.7mm t_s = 0 mm



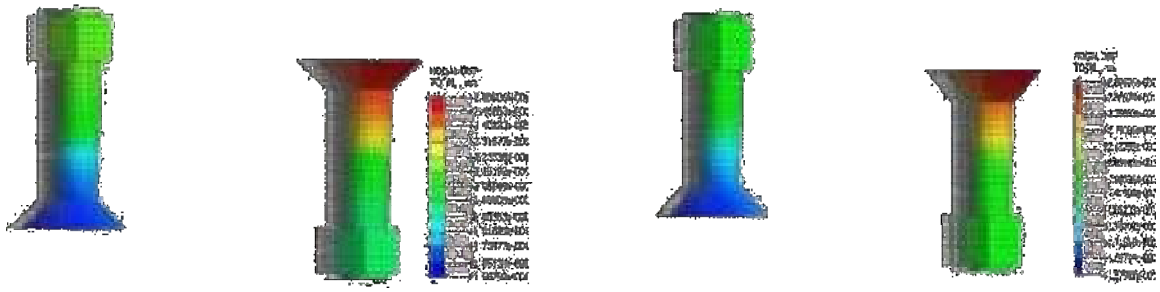
t = 8.48 mm t_s = 0 mm



t = 12.7mm t_s = 2 mm



t = 6.37 mm t_s = 0 mm

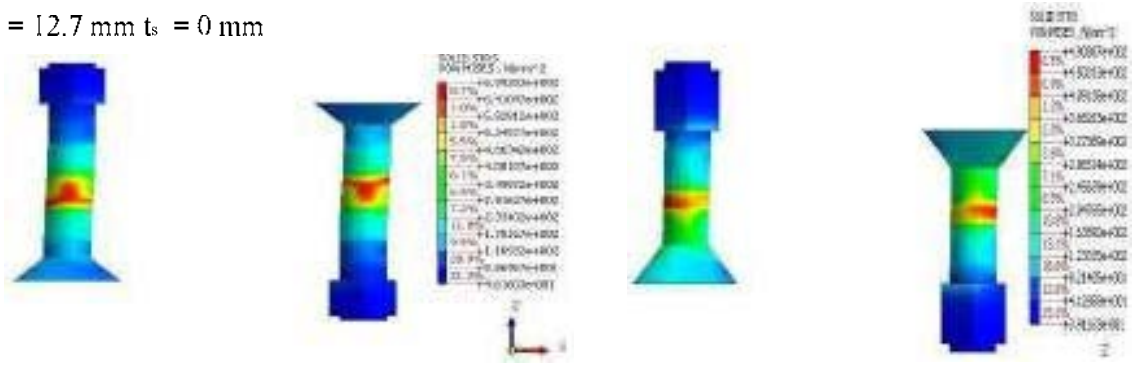


t = 8.48 mm t_s = 2 mm

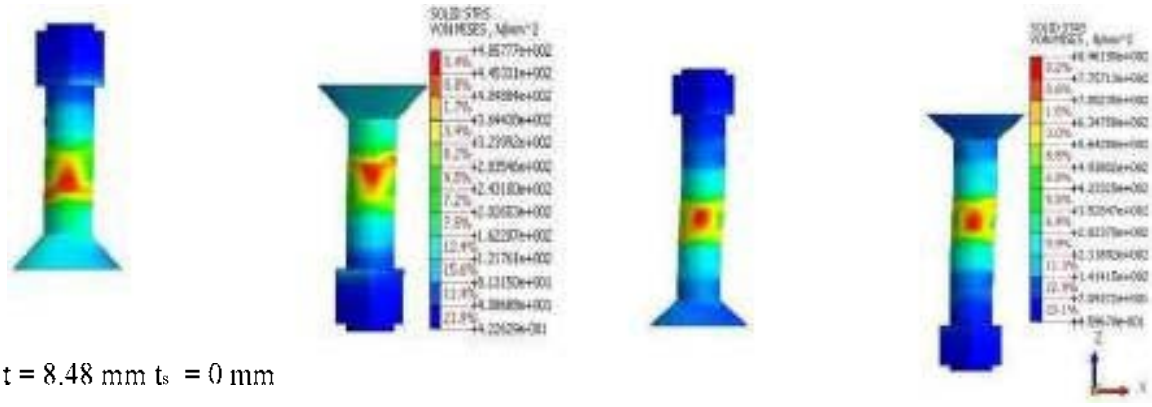
t = 6.37 mm t_s = 2 mm

Fig. 7.2: Displacement variation without shim and with shim of thickness 2 mm in bolts

t = 12.7 mm t_s = 0 mm

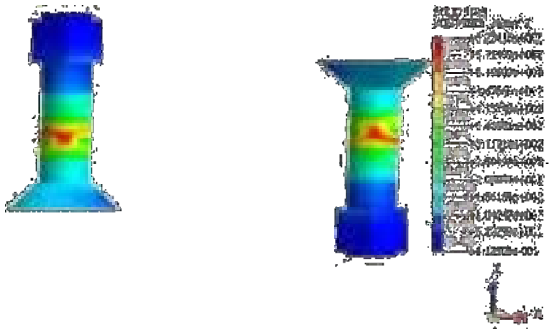


t = 6.37 mm t_s = 0 mm

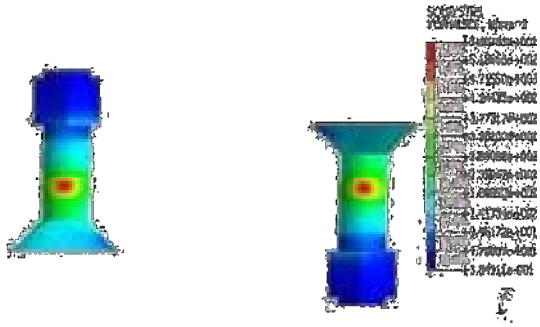


t = 8.48 mm t_s = 0 mm

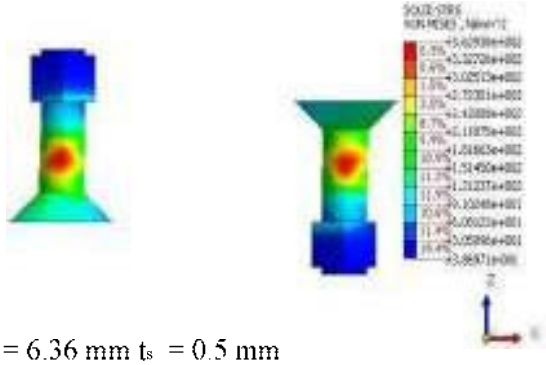
t = 12.7 mm t_s = 0.5 mm



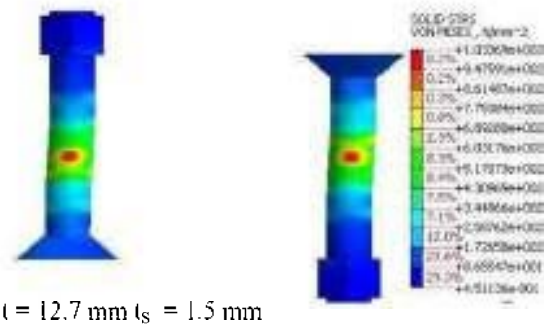
t = 8.48 mm t_s = 0.5 mm



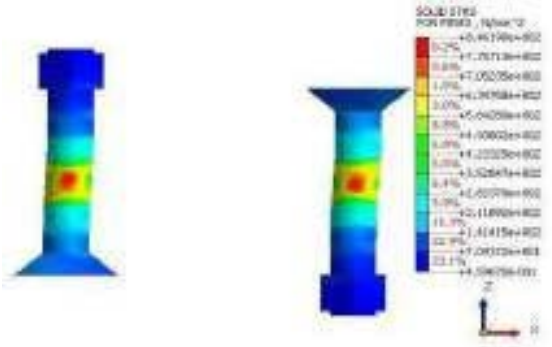
t = 6.36 mm t_s = 1 mm



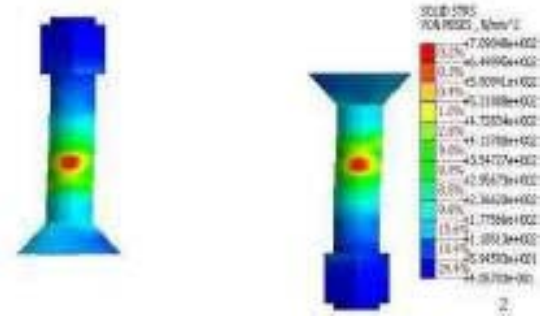
t = 6.36 mm t_s = 0.5 mm



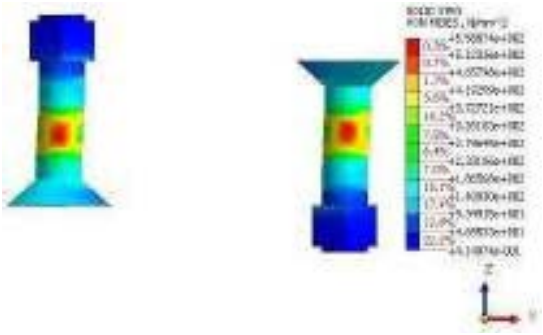
t = 12.7 mm t_s = 1.5 mm



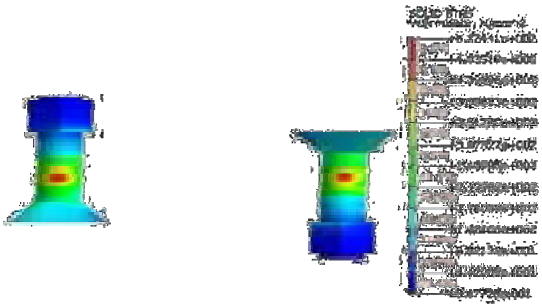
t = 12.7 mm t_s = 1 mm



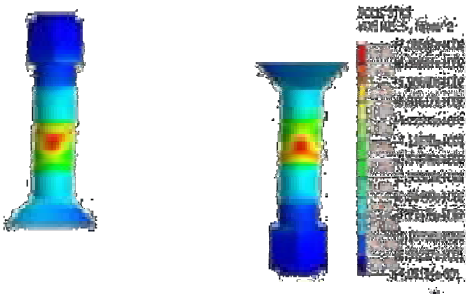
t = 8.48 mm t_s = 1.5 mm



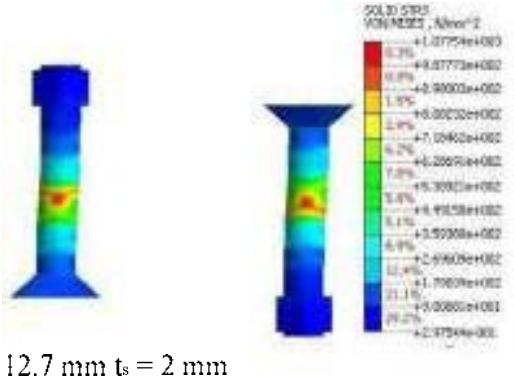
t = 8.48 mm t_s = 1 mm



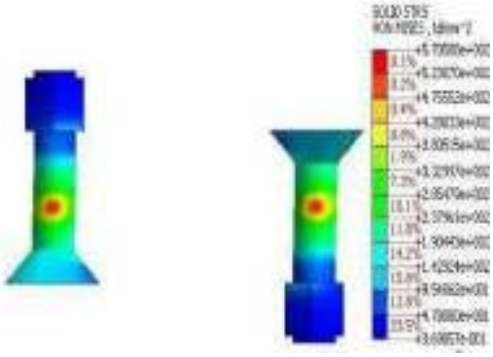
t = 6.37 mm t_s = 1.5 mm



t = 8.38 mm t_s = 2 mm

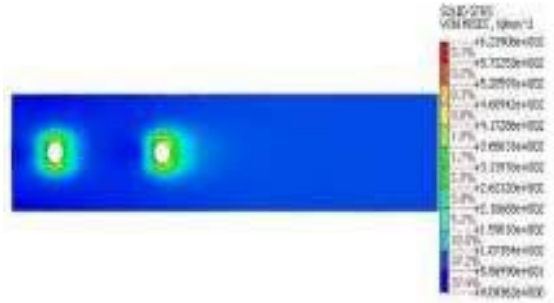


t = 12.7 mm t_s = 2 mm



t = 6.36 mm t_s = 2 mm

Fig. 7.3 von Mises stress distribution of bolt



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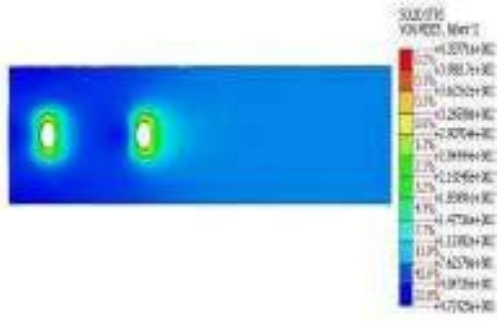
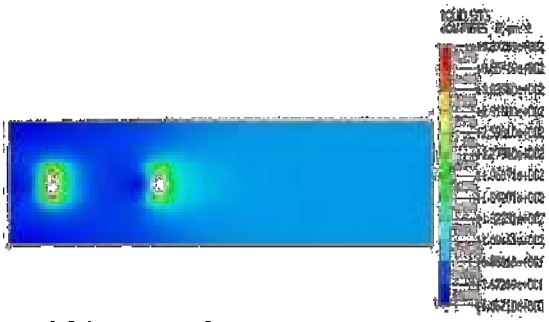


t = 8.38 mm t_s = 0 mm



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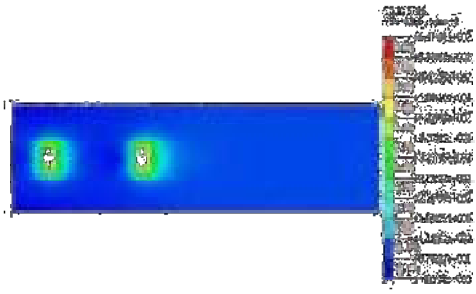
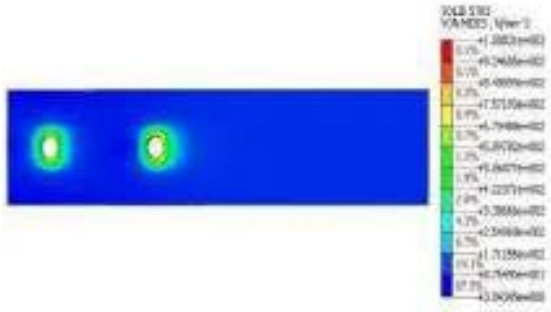


t = 12.7 mm t_s = 1 mm



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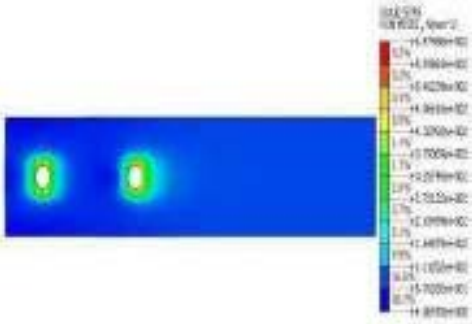
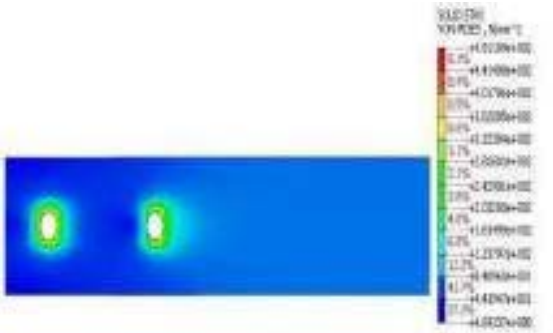


t = 8.38 mm t_s = 1 mm



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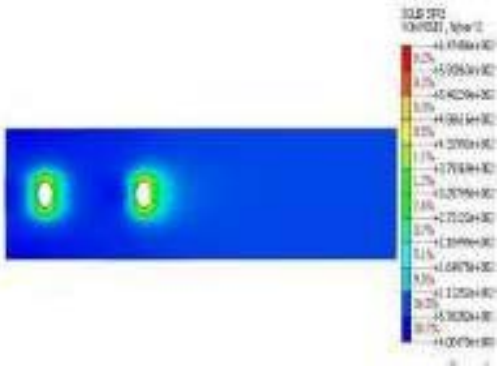
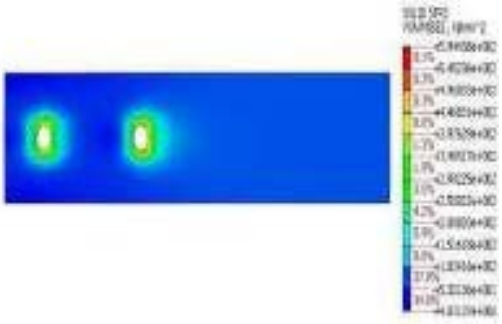


t = 6.36 mm t_s = 1 mm

t = 6.36 mm t_s = 0.5 mm



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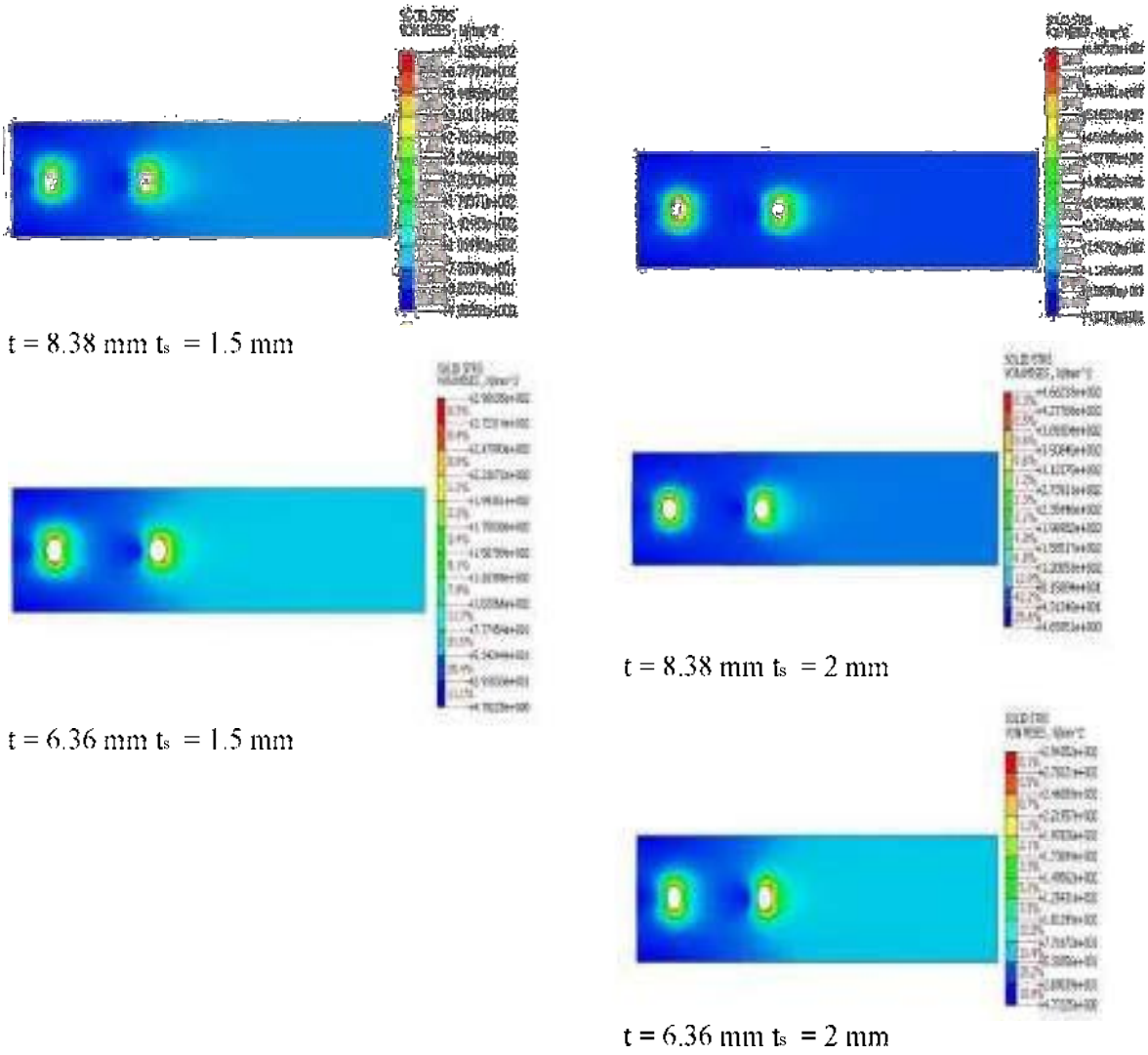

Fig.7.4: von Mises stress distribution on the bottom face of the top plate

Table 7.1: Displacement and von Mises stress for different specimen

Specimen ID	t_s/t_{total} (%)	P (N)	Displacement(mm)	Max. von Mises stress (MPa)		
				Overall model	Top plate bottom face	Bolt
A0	0.00	61129	0.4196	699.27	623.91	699.27
B0	0.00	40817	0.3979	485.78	433.77	485.78
C0	0.00	30613	0.3895	490.89	387.29	490.89
A1	3.94	61129	0.4249	839.87	676.18	839.87
B1	5.90	40817	0.4033	623.42	481.11	623.42
C1	7.86	30613	0.3896	362.94	324.71	362.94

A2	7.87	61129	0.4305	846.19	647.49	846.19
B2	11.79	40817	0.4048	558.87	443.61	558.87
C2	15.72	30613	0.3927	565.78	300.20	565.78
A3	11.81	61129	0.4350	1033.69	594.44	1033.69
B3	17.69	40817	0.4076	709.05	411.93	709.05
C3	23.58	30613	0.3953	527.44	296.64	527.44
A4	15.75	61129	0.4441	1077.54	687.04	1077.54
B4	23.58	40817	0.4137	708.69	466.23	708.69
C4	31.45	30613	0.3974	570.59	294.35	570.59

Different graphs were plotted to understand the displacement and stress variations with respect to shim to total thickness ratio as shown in Fig. 7.5 and fig 7.6

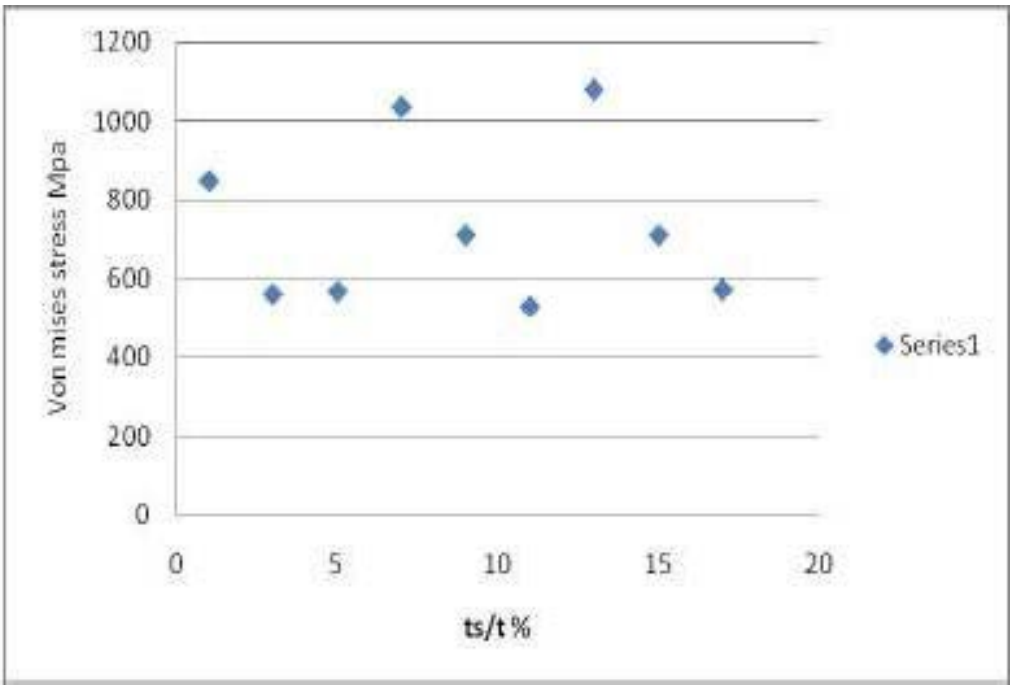

Fig. 7.5: von Mises stress vs. t_s/t_{total} (%) of bolt

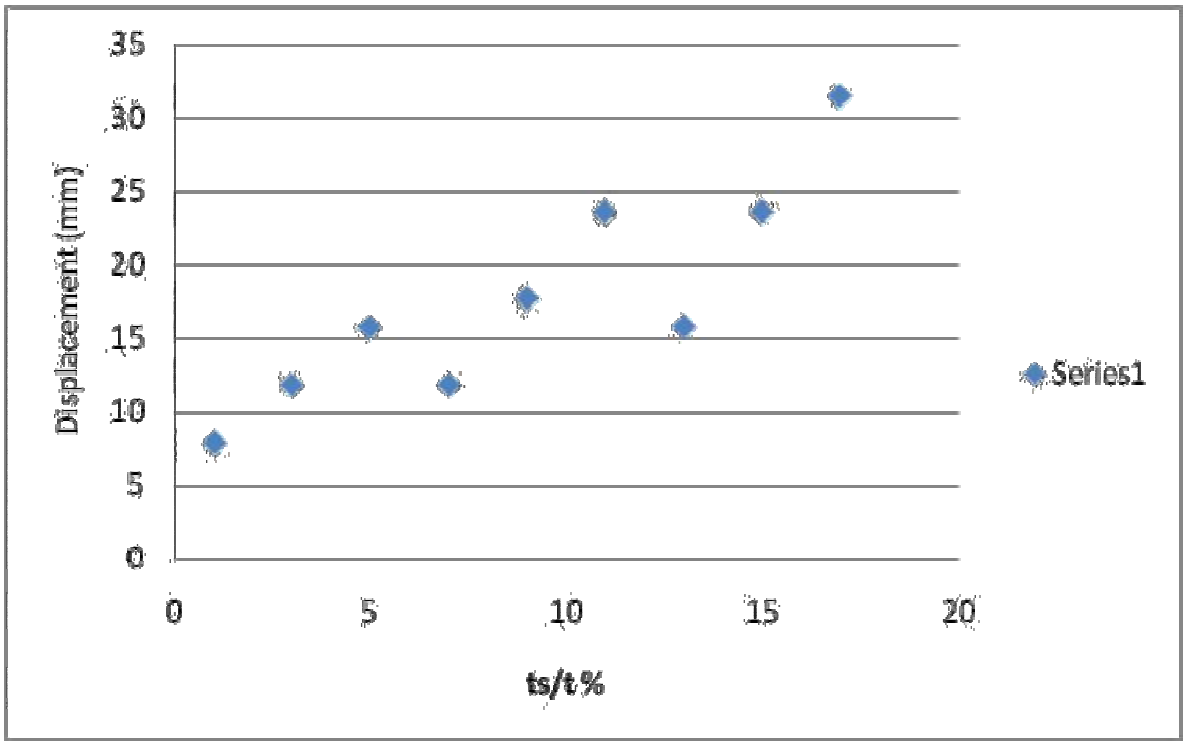

Fig. 7.6: Displacement vs. t_s/t_{total} (%) of specimen

7.1 Summary

The result is compared to the with shim and without shim in five different shim thicknesses. The shim thickness in 2 mm is sustained more stress in other shim thicknesses.

CHAPTER 8

CONCLUSIONS

Finite element simulations play a vital role in the design validation of concepts at the early stages of any validation of engineering substance. In this work, the design and analysis of an effect in shims in a composite and metal bolted joint has been validated through the use of finite element simulations in which the simulation depicted the true deformation iterations and the stress levels observed for various shimmy joints will be coincided with the engineering judgement. The following conclusions are observed after the tensile test of specimens with varying thickness of top and bottom plates and shim of varying thickness. From the graphs we came to know that more stress is obtained in bolts than the plates. Also it clearly showed that the stress increases with the shim thickness but it decreases when we reduce the thickness of the thickness of the top and bottom plates. After observing the displacement plots, we came to know that the displacement increases when there is an increase in the shim thickness and also it decreases when we reduce the thickness.

REFERENCES

[1] ISO 13232-8, Motorcycles - Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles, 2nd Edition, 2005-12-15.

[2] Hybrid-III 10Year-Old Child Dummy, 420-0000-H Parts Catalogue, Humanetics Innovative Solutions, USA.

[3] M. Shishesaz and M. Hosseini. 2018. A review on stress distribution, strength and failure of bolted composite joints, JCAMECH.

[4] K. Mphahlele, S.S. Ray and A. Kolesnikov. 2017. Self-Healing Polymeric Composite Material Design, Failure Analysis and Future Outlook: A Review, Polymers.

[5] Hexply Prepreg Technology handbook, Hexcel

[6] Anita Domitrovidr, E rnest Bazijanacr,V jekoslav Stojkoviiz.,' Mathematical Model For Rediction Of Single-Spool Turbojet Engine Off-Design Performance 'First symposium of explosive arterials, weapons and military technology. Horrid. September. 2002.

[7] G.Jims john wessley.,' Design and Modeling of a Micro Turbojet Engine for UAV propulsion',

[8] Swati Chauhan, G. Jims John Wessley.,' Thermodynamic Performance Analysis of a Micro Turbojet Engine for UAV and Drone Propulsion', International Journal of Recent Technology and Engineering, 2019.

[9] Selcuk Ekici, Yasin Sohret, Kahraman Coban, Onder Altuntas and T. Hikmet Karakoc.,' Performance Evaluation of an Experimental Turbojet Engine', 2016.

[10] Aly M. Elzahaby, Mohamed K. Khalil, Hesham E. Khalil.,' Theoretical and Experimental Analysis of a Micro Turbojet Engine's Performance', International Journal of Scientific & Engineering Research,2016.

[11] HIH Saravanamuttoo, H.Cohen, GFC Rogers,'Gas Turbine Theory', 2011.

[12] Aich, S & Ravichandran 2002, TiB Whisker Coating on Titanium Surfaces by Solid-State Diffusion: Synthesis, Microstructure, and Mechanical Properties', Metallurgical and Materials Transaction A, vol. 33A, pp. 2002-3489.

[13] Alman, DE & Hawk, JA 1999, The abrasive wear of sintered titanium matrix – ceramic particle reinforced composites', Wear, vol. 225-229, pp. 629-39.

[14] Atri, RR, Ravichandran, KS & Jha, SK 1999, Elastic properties of insitu processed Ti-TiB composites measured by impulse excitation of vibration', Materials Science and Engineering A, vol. 271, pp. 150-159.

[15] Baker, H 1992, _Binary Alloy Phase Diagram', ASM Handbook, vol.3.pp. 2.85

[16] Banerjee, R, Nag, S & Fraser, HL 2005, A novel combinatorial approach to the development of beta titanium alloys for orthopaedic implants', Materials Science and Engineering A, vol. C25, pp. 282-289.

[17] Bejjani R, Shi, B, Attia & Balazinski, M 2011, Laser assited turning of titanium Metal Matrix

[18] Cezairliyan, A, McClure, JL & Taylor, R 1997, Thermophysical measurements on 90Ti-6Al-4V alloy above 1450K using a transient (subsecond) technique', Journal of Research of National bureau of standards- A physics and chemistry, vol. 81A, no. 2 & 3, pp. 251-256.

[19] Chandrasekar, P, Balusamy, V, Ravi Chandran, KS & Harish kumar 2007, _Laser surface hardening of titanium-titanium boride (Ti-TiB) metal matrix composites', Scripta Materialia, vol. 56, pp. 641-644.

[20] Chandrasekar, P, Vijay, V, Balusamy, V & Chandramohan, P 2011, _Improving Corrosion Resistance of Ti–TiB Composite Using Gas 152 Tungsten Arc Heating', Materials and Manufacturing Processes, vol. 26, no. 4, pp. 654-657.

[21] Chun Guo, Jiansong Zhou, Jierong Zhao, Bangang Guo, Youjun Yu, Huidi Zhou & Jianmin Chen 2011, _Microstructure and friction and wear behavior of laser boronizing composite coatings on titanium substrate', Applied Surface Science, vol. 257, pp. 4398-4405.

[22] Courant, B, Hantzpergue, JJ, Avril, L & Benayoun, S 2005, _Structure and hardness of titanium surfaces carburized by pulsed laser melting with graphite addition', Journal of Materials Processing Technology, vol. 160, pp. 374-81.

LIST OF PUBLICATIONS

1. Prasanna P, Mohan R, Parthiban S & Raja G 2020, Analysis and Effect of shim used in a composite and metal bolted joints. Journal of ADRA conference. (Applied on 21.09.2020 |Awaiting for Reviewers Comment).

ANALYSIS AND EFFECT OF SHIM USED IN A COMPOSITE AND METAL BOLTED JOINT

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ABSTRACT; This paper study the behaviour of joints, that most of the composites can't be riveted. Mostly bonding (adhesives) technique is used to join the two different materials, like metal to composites and composites-composites. Our work is to address the behaviour (strength and life time) of different composite and metal joints using FEA analysis. Which will reduce the time and cost of the testing. There are different techniques (from literature) which have been considered and by using different thickness layer of shim with bolted joints in the composite material and compare the results with the test results.

1. INTRODUCTION

Composite materials are being extensively used in an aircraft manufacturing industries. The property of weight saving is the main driving force which benefits fatigue and corrosion resistance properties. A clear trend in composites is being increasing with in heavily loaded primary structures. The increasing use of Composite materials and its popularity has prompted significant changes in the field of research and developing for reliable design methods. Designing useful structures that means several parts must be joined together. This can be done only by adhesive, mechanical or hybrid joins which is mainly combination of the first two techniques. With low weight and good sealing properties the adhesive joints have advantage over the mechanical joints. Also mean while the adhesive joints are sensitive to environmental conditions and adhesive structures cannot be easily replaced while some parts get damage. Mechanical joining, i.e. using fasteners, is the most common method in an aerospace industry.

EFFECTS OF ORGANIC LIQUID FERTILIZERS ON SOIL PROPERTIES AND GROWTH OF BRINJAL

A PROJECT REPORT

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(AUTONOMOUS)

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ABSTRACT

Nowadays, the synthetic fertilizers are used in agriculture when compared with organic fertilizer. But the continuous use of chemical fertilizers are diminishing soil fertility, health threads to human, livestock and also microbial community present in the soil. Applying liquid fertilizers directly to the root zone will provide an immediate effect on plant growth because the solution of fertilizer acts quickly to make the nutrients available to plants. The treatment of liquid fertilizer is prepared from waste materials. The different liquid organic fertilizers are Banana peel, Cow dung, Coconut cake, Groundnut cake and Vegetable waste.

The main intention of this project to compare the performance of different organic liquid fertilizers and to find out the nutrients present in the soil. With the help of parameters like pH, electrical conductivity (EC), nutrients of soil like nitrogen, phosphorous, potassium, organic carbon and plant growth.

KEY WORDS:

Organic liquid fertilizer, pH, Electrical conductivity, nutrients.

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LIST OF ABBREVATIONS AND SYMBOLS

ha	-	Hectare
Fig.	-	Figure
g	-	Gram
g/cm3	-	Gram per Cubic centimetre
cm	-	Centimetre
cm2	-	Square centimetre
cm3	-	Cubic centimetre
dia.	-	Diameter
et al.	-	*Et alibi*
i. e.	-	That is
kg	-	Kilogram
kg/cm2	-	Kilogram per square centimetre
kg/ha	-	Kilogram per hectare
m2	-	Square meter
mm	-	Millimetre
No.	-	Number
Rs	-	Rupees
pH	-	Power of hydrogen ions
EC	-	Electrical Conductivity
FYM	-	Farm Yard Manure
DAP	-	Days After Planting
N	-	Nitrogen
P	-	Phosphorous
K	-	Potassium
Ca	-	Calcium

CHAPTER 1

INTRODUCTION

1.1. GENERAL

Organic liquid fertilizer is natural or artificial substance containing all macro and micro essential nutrients that improve the growth and productiveness of plants, enhance the natural fertility of the soil or replace the chemical elements taken from the soil by previous crops or other factors and improve the essential micro-organisms in the soil. Liquid concentrates are rich in nitrogen and defined as fertilizers containing organic elements including sulphur and trace metal elements used in agricultural applications. Liquid concentrate provides features such as organic form of nitrogen and adds positive value, compared to typical industrial fertilizers. The fertilizer, available to be used for plants are produced from completely natural raw materials without causing damage to the environment. After making necessary specifications these fertilizers can be sold through the agency of retail or fertilizer producers. Fertilizers are simply plant nutrients applied to agricultural fields to supplement required elements found naturally in the soil.

Liquid organic fertilizers consist of essential plant nutrients and beneficial microorganisms, which recycle organic matter. Microorganisms have an important role on the degradation of substrates in the fermentation process. However, it is a rich source of nutrients (nitrogen, phosphorus and potassium). Liquid organic fertilizers are generally having low concentration of chemical compounds with fairly good nutrient content to fulfil the plant requirement. If there is an excessive amount of the fertilizer in the soil, the plants can easily control its absorption. Liquid fertilizers are concentrated liquids that are added to water and applied to the soil and foliage. These types of fertilizers contain a synthetic chemical mix of the plant's essential nutrients, including nitrogen, phosphorus, potassium and iron. Organic liquid fertilizers are generally better for edible plants that produce fruit and veggies, because they are made from purely organic materials, whilst still releasing the nutrients they need. The great thing about liquid fertilizers is that they feed your plants the nutrients they need quickly, as well as adding beneficial bacteria, fungi and organic matter that improves your soil or potting mix. Organic fertilizer inputs in agricultural fields in the present scenario has significant environmental benefits over the use of chemical fertilizers and the practice has gained much importance. One of the advantages of using liquid organic

fertilizers into plants is the easily absorbed nutrients in the fertilizers by the soil that can readily be utilized by the plants.

The application of organic liquid fertilizers is using foliage, fertigation and direct spray to the soil. The fertigation organic liquid fertilizer especially, Nitrogen and phosphorus are the two primary nutrients injected through fertigation systems. Liquid fertilizer can offer opportunities for more efficient nitrogen use when they are applied through a drip irrigation system such an application is called fertigation. Any nutrient in a water - soluble form is readily available for plant uptake just after application, leading to a more efficient use of fertilizers. When nutrients are applied shortly before they are needed, growers can reduce loss of nutrients from the root zone. These liquid fertilizers may be applied on a regular basis, depending on the nutrient need of the crop. This allows the growers greater control over nutrient availability to their crop. Fertigation can provide supplemental doses of these nutrients, especially at critical periods during the growing season such as vegetative growth, flowering and fruit filling or blooming. The organic liquid fertilizers used for fertigation such as N, P, K and micro-nutrients to increase vegetable production per area or plant through improving soil fertility. Their ease of handling, low labour requirement, and the possibility of mixing with herbicides have made liquid fertilizers more acceptable to farmers. And the farmers were interested on the soluble organic fertilizers using drip irrigation.

1.2 BENEFITS OF USING ORGANIC LIQUID FERTILIZER

Liquid fertilizers offer a quick response and are applied to plants and lawn using spray bottles or sprinkler attachments. Because they are absorbed through the water directly into the roots of the plants, liquid fertilizers provide an immediate effect.

FAST ACTING:

The plant's root systems absorb most of the nutrients and provide a rapid green-up of your garden at a lower cost A small amount of these nutrients are taken through the leaves as well. One of the benefits of liquid fertilizers that because the liquid penetrates the soil immediately, plants are given faster access to the nutrients. Some plants will see results from this application almost immediately.

EASIER TO HANDLE:

No clean up, easily mixed into your daily watering and offers a uniform application. It is an easy process to apply the liquid fertilizer, and it is worked into the soil in more uniform ways.

UNIFORM APPLICATION:

When granular fertilizers are applied, they can be dropped in patterns throughout fields that are not necessarily uniform, which simply is a matter of it being a solid rather than a liquid. Liquid fertilizers can seep into the soil and spread more uniformly, thus giving your fields an even consistent coating so that all plants receive the same nutrients regardless of location.

COMBINED FERTILIZER AND PESTICIDES:

To apply on one pass over the lawn and garden, saving time and money. This better coverage also helps to combat weeds too.

1.3 OBJECTIVES

- ✓ To improve soil fertility.
- ✓ To prevent the soil from chemical pollution and toxic residues.
- ✓ To reduce salinity.
- ✓ To restore the ecological balance.

CHAPTER 2

REVIEW OF LITERATURE

Abhishek Raj, Manoj Kumar Jhariya, Pratap Toppo (2019) entitled as **"COW DUNG FOR ECOFRIENDLY AND SUSTAINABLE PRODUCTIVE FARMING"** said Cow dung is a most important source of bio-fertilizer. It is very effective's alternatives to chemical fertilizers by enhancing productivity in long term with maintaining the soil health and enhances the microbial population. Cow dung manure and vermicompost increases soil organic matter content, and this leads to improved water infiltration and water holding capacity as well as an increased cation exchange capacity. As per Fulhage (2000) manure contains the three major plant nutrients, nitrogen, phosphorus and potassium (NPK), as well as many essential nutrients such as Ca, Mg, S, Zn, B, Cu, Mn etc. That, in addition to supplying plant nutrients, manure generally improves soil tilth, aeration, and water holding capacity of the soil and promotes growth of beneficial soil organisms.in addition to supplying plant nutrients, manure generally improves soil tilth, aeration and promotes growth of beneficial soil organisms. Cow dung and cow's urine products, which can be used as fertilizers and pest repellent in agricultural practice. It showed positive response in suppress the growth of plant pathogenic fungi like *Fusarium solani, F. oxysporum.* Similarly, as per Mary *et al.* (1986) cow dung extract spray was also reported to be effective for the control of bacterial blight disease of rice and was as effective as penicillin, paushamycin and streptomycin. As per Pammel (1889) cow dung as organic manure increase vigour of plant and reduce the disease incidence of root rots in cotton caused by *Phymatotrichum omnivorum*.

From this literature, we conclude that the Application of cow dung in a sustainable way can enhance not only productivity of yield but also minimizing the chances of bacterial and fungal pathogenic disease. Due to increasing prices of chemical fertilizer and non-efficient role in long term to sustainable production, there is a need of application of organic manure including cow dung for enhancing maximum productivity in sustainable way with better soil health. It is an effective tool to improves physio - chemical and biological properties of the soil with higher yield of plants in sustained basis without deleting the fertility of soil. It can be also productively used for basic energy, biogas, electricity and fertilizer and has a strong socioeconomic dimension. The effective use of dung would contribute to increase energy security and reduce environmental degradation and greenhouse

S. Ginandjar, B. Frasetya, W. Nugraha and M. Subandi (2019) entitled as **"THE EFFECT OF LIQUID ORGANIC FERTILIZER OF VEGETABLE WASTE AND PLANTING MEDIA ON GROWTH AND YIELD OF STRAWBERRY"** said Increasing growth and yield of strawberry plant can be achieved by applying liquid organic fertilizer (LOF) of vegetable waste and planting media. This research was conducted to study interaction between Liquid organic fertilizer and planting medium and to inquire about the best dosage of Liquid organic fertilizer and planting medium for the growth and yield of strawberry. The first factor was vegetable waste of LOF with four treatments level respectively: p0: without LOF application, p1:250 ml, p2: 500 ml, and p3: 750 ml. The second factor was planting media with three treatments level respectively: m0: without husk charcoal, m1: (1:1) soil and husk charcoal, m2: (1:2) soil and husk charcoal. LOF vegetable waste preparation of liquid organic fertilizer for vegetable waste is done for 2 weeks according to the method of making LOF for vegetable waste. The application of liquid organic fertilizer is very good against the growth of plant height in each observation is indicated by there is a significant influence on the dosing of 500 ml and 750 ml. The highest rate of plant growth was demonstrated at 60 DAP at treatment of p3 with dose of 750 ml with a very significant effect on this matter. Liquid organic fertilizer waste can increase the availability of nutrients Ca, Mg and K surrounding soil and the presence of growth regulators such as auxin, spur leaf formation. Application of liquid organic fertilizer, vegetable waste done on 7 days before planting on planting medium and 21 DAP. The amount of leaf and plant height depends on the availability of nutrients absorbed. Liquid organic fertilizer of vegetable waste plays a role in the provision of nutrients and nutrients for plants.

From this literature, we know that the Organic fertilizers can provide ingredients of amino acids, proteins and contain substances that grow the auxin that plays a role in spurring root growth and ready to build a network of plant growth. Increased root growth and the formation of tissues on and leaves in large and large quantities can support the increase in fresh weight of plants. The advantages of liquid organic fertilizer are to provide nutrients in accordance with the needs of plants. Organic material is now promoted by farmers to support the application of organic farming. The number of microorganism population at soil used as an indicator for soil degradation. The natural pesticide was proven to be better and more profitable, biological control of pest will avoid ecology contamination with chemical pesticides, and be compatible with other methods of pest control.

Papa Malick Sall, Hani Antoun, Francois-P. Chalifour & Chantal J. Beauchamp (2019) entitled as **"POTENTIAL USE OF LEACHATE FROM COMPOSTED FRUIT AND VEGETABLE WASTE AS FERTILIZER FOR CORN"** said Composting fruit and vegetable waste from grocery stores on farms is a challenge due to the large quantity of liquid that leaches out. This leachate needs to be characterized for its effects on plant growth and soil. It was acidic with high conductivity, the plant mineral nutrient contents derived from the leachate (in decreasing order) were K, N mainly as ammonium-N, Ca, Mg, Na, and P; the trace elements were quite low. These results demonstrate the opportunity of recycling plant nutrients from compost leachate of fruit and vegetable waste as composting 6000 kg of fruit and vegetable waste generated about 400 L of leachate per day. After harvesting, soil samples were taken at depths of 0–20 and 20–40 cm, air-dried, and sieved at 2 mm before pH (1:1 soil:water (w:v)) and electrical conductivity (1:5 soil:water (w:v)) determinations. For total N, soil samples were ground at 100 mesh and analyzed as previously described. The leachate obtained was brown with an unpleasant odor that could be attributed to the organic acids and volatile fatty acids produced from composting food waste. Therefore, the physicochemical composition and effects of the leachate produced by fruit and vegetable waste compost were investigated. First, the plant mineral nutrients, including the trace elements, were determined. Then, under controlled environmental conditions, the phytotoxicity of leachate for cress and corn germination, and corn grown in pots were studied. Finally, the effects of leachate on corn yield and soil accumulation of plant nutrients were investigated in small field plots. At the end of the growing season, soil samples at depths of 0–20 and 20–40 cm were analyzed.

From this literature, we know that the germination and rootlet growth of cress and corn increased with the dilution of the compost leachate. In a field study on sandy loam, corn yields and plant uptake of P and K were similar among the mineral fertilized control and split application leachate treatments applied to meet the P or K requirements of corn. After harvest, the soil pH, conductivity, and total N, P, and K contents were not affected by the leachate treatments. No significant differences among the treatments and controls were measured in terms of soil pH, electrical conductivity, total N, and available P and K. In this study, the sandy loam and rainy weather could have prevented K accumulation in the soil. Lastly, the acidic property of the compost leachate could have prevented the buildup of soil K. Within these limits, the leachate-fertilized treatment could be used to substitute most mineral fertilizers for corn .

Lalnunpuia, Arun Alfred David, Syed H Mahzar, Tarence Thomas and Smriti Rao (2018) **"EFFECT OF DIFFERENT LEVELS OF FERTILIZERS AND NEEM CAKE ON SOIL HEALTH GROWTH AND YIELD OF POTATO (*SOLANUM TUBEROSUM* L.) CV. KUFRI JYOTI"** said that the field experiment was conducted to study the effect of different levels of fertilizers and Neem cake on soil health, growth and yield of Potato. The experiment was carried out in RBD (Randomised Block Design) with three replications for each treatment. The treatment combination was laid out as T0- Control, T1-NPK 0% Recommended Dose of Fertilizer (RDF)+ Neem cake 50 kg ha-1 T2- NPK 0% RDF+ Neem cake 100 kg ha-1, T3-NPK 50% RDF+ Neem cake 0 kg ha-1, T4-NPK 50% RDF+ Neem cake 50 kg ha-1, T5-NPK 50% RDF+ Neem cake 100 kg ha- 1, T6-NPK 100% RDF+ Neem cake 0 kg ha-1, T7-NPK 100% RDF+ Neem cake 50 kg ha-1, T8-NPK 100% RDF+ Neem cake 100 kg ha-1 respectively. Soil samples were taken from 0-15cm depth of soil randomly prior to tillage operations, air dried and passed through 2 mm sieve. Then the composite sample was taken for mechanical and chemical analysis. The findings of the experiment concluded that the application of NPK (@ 120 kg ha-1, 100 kg ha-1, 120 kg ha-1 and Neem cake @ 1250 kg ha-1 had significant effects on the soil, growth and yield of Potato which makes the combined application of NPK and Neem cake a beneficial approach towards an important source of plant nutrients. From economical point of view, the treatment T8 (NPK 100% RDF+ Neem cake 100 kg ha-1) was found to be economically viable in terms of gross return (Rs 325120.00 ha-1). It has been recorded that the maximum number of yield of 40.64 t ha-1was found in treatment T8 (NPK 100% RDF+ Neem cake 100 kg ha-1), followed by treatment T7 (NPK 100% RDF+ Neem cake 50 kg ha-1) with 33.03 t ha-1. And the minimum tuber yield was found in treatment T0 (Control) with 12.25 t ha-1. Application of both NPK and Neem cake resulted in significantly higher tuber yield as compared to Control.

From this, NPK and neem cake showed significant response in plant growth and neem cake manure protects plant roots from nematodes, soil grubs and white ants probably due to its residual limonoid content. It also acts as a natural fertilizer with pesticidal properties. Neem cake also reduces alkalinity in soil, as it produces organic acids on decomposition. Being totally natural, it is compatible with soil microbes, improves and rhizosphere micro flora and also enhances the fertility of the soil. Neem cake improves the organic matter of the soil, helping improve soil texture, water holding capacity, and soil aeration for better root development.

Rajesh and Arun Alfred David (2017) entitled as "**RESPONSE OF NEEM CAKE RHIZOBIUM AND INORGANIC FERTILIZER ON SOIL HEALTH GROWTH AND YIELD OF GREEN GRAM (*VIGNA RADIATA* L.) VAR. SAMRAT"** said that it was concluded from trial that the various level of N P K + Neem cake and *Rhizobium* used from in the experiment, the treatment combination T11(I2+N2+R1) @100% N P K ha-1 + @ 100% Neem cake 0.5 t ha-1 + @ 100% *Rhizobium* 20 g/ Kg seed was found to be the best treatment gave highest benefit of 58651with highest cost benefit ratio 1:2.73 for Green gram it could be recommended for profitable production of Green gram (*Vigna radiata* L.*)* var. The use of biofertilizers are more eco-friendly in nature. They can play a significant role in fixing atmospheric nitrogen; biofertilizers enrich soil fertility and improves soil fertility. Samrat, it improves soil physical and chemical properties. Integrated nutrient management is better for soil health and Green gram production. The composition of Neem cake is 5.2 % N, 1.0 % P, 1.4 % K. Neem cake act as a nitrogen inhibitor means reduce the nitrification. It supplies the available nitrogen for a long time in the soil (Katyayan, 2012). If we compare the pH of pre sowing soil sample which was 7.44 with that of after crop harvest soil, there was decrease in pH after crop harvest. Increasing dose of N P K and Neem cake lightly decrease pH of the post-harvest soil. The decrease in pH might be due to higher growth of crops as respiration is more. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil.

From this, we concluded that the Neem cake is a potential source of organic manure. Neem has demonstrated considerable potential as a fertilizer. Our Neem cake also reduce alkalinity in soil, as it produce organic acid on decomposition, being totally natural, the Neem cake we offer hence ensure fertility of the soil, it also improve the organic matter contain of the soil, helping improvement in soil texture, water holding capacity, soil aeration for batter root development. The addition of Neem cake also positively affected the available soil organic carbon, N P K and Mn content of soil resulting better growth and grain yield of mung bean (*Vigna radiata* L.) besides suppressing soil borne pathogens. Organic carbon (%), available nitrogen, phosphorus and potassium (kg ha-1) were increased in soil after crop harvests. The chemical properties were significantly affected by different treatment combination of N P K, Neem cake and *Rhizobium*.

Hiral J. Jariwala, Huma S. Syed (2016) entitled as **"STUDY ON USE OF FRUIT PEELS POWDER AS A FERTILIZER"** said that Fruits contain a high amount of antioxidants that are beneficial to our health in many ways. The present study deals with the utilization of fruit peels for the effective growth of plants and higher yield, by mainly focusing on Nitrogen, Phosphorous and Potassium. Different fruit peels such as Pomegranate, Orange, Sweet lime and Banana were used. Generally, fruit peels are thrown in garbage and it goes to solid waste dumping site. That causes odor problem due to degradation of peel content in dumping site. These fruit peels have nutrients like potash, iron, zinc, calcium, citrate content etc. Fruit peel powders are used as natural fertilizer in the present study. Different formulation of fruit peel powder was used to compare the plant growth. Fruit peels were collected from fruit juice vendors were segregated first. So different fruit peels can be used on field as per requirements of pH and nutrients. Each formulation was mixed with water in different quantities. Each formulation was mixed with water in different quantities. 1g of fruit peel powder of citrate peels like pomegranate, orange, sweet lime were taken in 100 ml of distilled water and mixed thoroughly for the preparation of extract. This mixture was stirred for 3 days by using magnetic Stirrer. Same procedures are also done by Alkaline Banana peel powder and make solution. There are two types of fruit peel powder like a) citrate peel powder which consists of orange, sweet lime and pomegranate peel and b) alkaline peel powder consisting of banana peel. Both type of peel powder has different pH, generally alkaline peel powder is used for reducing acidity content present in soil. Similarly, acidic peel reduces salinity of soil. The final results of the study showed that Citric Peel powder has higher Nitrogen content(9.1 mg/g), whereas alkaline peel powder has higher quantity of Phosphorous(4.2 mg/g) and Potassium(2.1 mg/g).

This proves that the powder can be feasibly used as a Soil Fertilizer, pH regulator (for improving soil morphology) as micronutrient supplement (zinc, iron, calcium) and also for horticultural purposes. Both different peels are used for control pH of soil. Where citrate peel powder is used to decrease pH of soil and alkaline peel powder is used to increase pH of soil. By mixing of both citrate and alkaline peel powder we can reach up to maximum nutrient content. The use of fruit peel powder is pH regulator for soil, improve soil morphology, fulfils requirements of micronutrient, best use for Horticulture. These are cheapest and harmless materials are used for plant growth. The present study deals with the utilization of fruit peels for the effective growth of plants and higher yield.

A A Kadir, N A Rahman and N W Azhari (2016) entitled as *"***THE UTILIZATION OF BANANA PEEL IN THE FERMENTATION LIQUID IN FOOD WASTE COMPOSTING"** said the preparation for fermentation liquid is by using banana peel to replace fermented food and coconut candy to replace sugary water. Banana peel is an organic waste that highly rich in nutrient especially K, that could support the microbial growth in fermentation phase. Using banana peel as fermentation liquid or waste in composting is considered as good as it stimulates soil microbial growth and activity with the subsequent mineralization of plant nutrients. As replacement of brown sugar in common fermentation liquid, uses of candy which serves as food source for the microbes. Three litres of water was mixed with 250gram candy and 250gram banana peel from Makanan Ringan Mas. Fermentation was occurred when bubbles starts to form, which normally occurs on the second day. Ideally, fermentation should take no longer than 7 days. Fermentation liquid was completed when the banana peel floats and the liquid settles at the bottom. During the fermentation process, the lid of the bottle should be loosened once a day to remove the gas that trapped in the bottle. The sweet and sour smell produced indicates that the fermentation liquid is successfully conducted. The goal of this study was to compost the food waste generated at Makanan Ringan Mas and determine the physical parameters which are temperature, pH and chemical parameters which are Nitrogen (N), Phosphorous (P) and Potassium (K). The parameters which include temperature, pH value, NPK values has been examined. Banana peel is being used as the fermentation liquid whilst soil and coconut husk were used as the composting medium. Based on the results during the composting process, most of the pH value in each reactor is above 5 and approximately at neutral. As for NPK content Nitrogen value range is 35325 mg/L to 78775 mg/L, Phosphorus, 195.83 mg/L to 471 mg/L and potassium is 422.3 mg/L to 2046 mg/L which is sufficient to use for agricultural purpose.

This study also used to compare between NPK concentration produce from the composting process using banana peel as fermentation liquid with the chemical fertilizers. Reactor B showed the most effective composting process in this composting study. Reactor B which consists of banana peel waste is easily decomposed and the nutrient produced in compost is much faster and higher than others. This is probably due to the oxygen and supplementary nutrient supply that could promote specific growth of microorganism essential for mineralization of organic substance. High K and N content in banana peel compost reactor is to assist in obtaining high potential K and N nutrient source in the soil.

Monisha. J. N. and Dr. G. N. Rameshaiah (2016) entitled as "**PRODUCTION AND COMPARSION OF SOLID-LIQUID FERTILIZER FROM VEGETABLE WASTE"** said Vegetable wastes are produced in large quantities in the markets across the world, to make use of this waste and to reduce the pollution they can be used to produce Biofertilizers. The collected five vegetables were produced in large quantity because they are daily used in everyday life; they are subjected to decomposition (1month) for producing solid and liquid fertilizers. Since Biofertilizers are one of the best tools that is used in the agricultural field, which is applied as a replacement of conventional fertilizers. The nutrients present in the fertilizers were determined and comparative study was undertaken to evaluate Vegetable waste make an extraordinary measure of contamination which contain high part of natural matter that causes genuine ecological and wellbeing issues. Predetermined samples were taken to estimate the components like pH, moisture content, organic content, particle size followed by major components like nitrogen, potassium and phosphate, minor components like calcium and magnesium, sulfur and micro components like boron, manganese were also estimated. A different type of waste was collected and they were separated according to the requirement. The types of vegetable waste that are collected from market are varieties of green leaves, potato, tomato, beans and carrot as they are used in large quantities in day to day life. The collected samples were finely chopped and grounded with the help of mixer and they were kept in separate bins for solid and liquid fertilizer. For solid fertilizer the 500grams of each sample were added containing ½ kg of soil in it and allowed for decomposition. For liquid fertilizer 500grams of each sample were added and approximately 3litres of water was added depending upon the requirement and they were subjected to aerobic decomposition process for 1month. The liquid fertilizer sample was filtered and centrifuged at 10,000 rpm for 10 minutes and stored for further analysis. The fertilizer sample is of its suitable characteristics which should be sealed tightly and then stored at room or cold temperature. Samples are stored in tightly sealed containers.

The present work is carried out to explain the uses of Biofertilizers that are produced naturally from the vegetable waste which are produced in two different ways and its comparison to select the better source for further application. Hence forth using natural composts or Bio fertilizers will help in retaining the soil properties and produce organic food crops which does not have any side effects.

Dr. Asha V. Pillai, Aswathy, K. K., Preethy, T. T. and Renisha, Mannambeth (2016) entitled as **"EFFECT OF ORGANIC LIQUID MANURES ON CROP GROWTH AND PRODUCTIVITY"** said Unscientific use of chemicals in agriculture leads to several health hazards and environmental problems. India has vast potential of organic resources and the extract prepared from these resources can be effectively utilized to sustain yield, improve physical, chemical and biological properties of soil and to maintain soil health. Commonly used liquid manures are compost tea, vermiwash, biogas slurry and cow's urine along with the extracts of oil cakes like groundnut cake, poultry manure and neem cake. The nutrient content of cow's urine was reported to be 0.9 - 1.2% N, 0.2 – 0.5% P and 0.5-1% K. The combined use of neem cake (0.5 t ha-1) as soil application and foliar application of vermiwash (1:1 ratio) increased the crop vigour and fruit yield of chilli (George, 2006). Ingham (2003) observed that compost tea contained soluble nutrients that enhanced crop yield. The beneficial organisms present in the EM solution increased the yield of crops (Yamada *et al*., 2003). Sayre (2010) reported that application of compost tea at fort nightly interval increased the marketable yield of potato by 18 to 19 %.Compost tea could reduce the severity of diseases like powdery mildew and downy mildew of grape, grey mould of strawberries and late blight of potato (Elad *et al.,* 1994); butter cup infestation and tomato blight (Touart, 2000). Scheuerell *et al.* (2002) observed that compost tea as foliar spray reduced the incidence of pests and diseases in crops by competition with disease causing microbes and degradation of toxic pesticides. The effectiveness of compost tea in controlling the bacterial spot of tomato was reported by (Al-Dahmaniel *et al*., 2003). According to Sayre (2003), compost tea had the capacity to manage many pests and diseases of crop plants. Ingham (2005) reported that the compost tea contained populations of several beneficial microorganisms and also the well made compost tea will be dominated by beneficial bacteria or fungi.

From this, it can be concluded to protect our crops and the environment we have to follow sustainable and eco-friendly agriculture. Among the several methods of ecofriendly agriculture, liquid nutrition occupies an important position. Foliar nutrition with organic compounds in vegetables is especially important as they provide quality foods, which are very important for providing health security to people. And the observation shows that greater the amount of soluble material in the compost tea, the more food resources would be there for the growth of beneficial bacteria and fungi, and microbial activity will be improved.

Mercy S, Mubsira Banu S, Jenifer (2015) entitled as **"APPLICATION OF DIFFERENT FRUIT PEELS FORMULATIONS AS A NATURAL FERTILIZER FOR PLANT GROWTH"** said that Fruit peels of Banana, Pomegranate, Sweet lime and Orange are highly rich in potash, ion, zinc etc. Three different formulations were applied for plant growth in two methods such as fruit peel powder, fruit peel powder extract as a natural fertilizer. Fenugreek seeds were used to test the utilization of fruit peel powder as a natural growth enhancer. After 45 days of application of fertilizer, plant growth was measured and the yield of fenugreek vegetables was counted. Among the three formulations of fruit peel powder and fruit peel extract, formulation 1 was found more suitable for plant growth. Control soil, fruit peel fertilized- both powder and extract applied soil samples were analyzed for the nutritive values of soil. Nitrogen, Phosphorous, Potassium were mainly observed. After the application of three different formulations in soil, soil fertility is increased. The soil was fertilized with different formulation of fruit peel powder. After 15days of application of fruit peel powder. The seeds of fenugreek (*Trigonella foenum graecum*) were sown in fertilized soil which was already fertilized by formulation of fruit peel. Control was maintained without formulation. After 45 days of seedling the plant length was measured for control and test. Control was maintained without formulation. Length of the plant was very less in control than the fruit peel powder applied soils. The collected soil was taken separately and filled with many pots. Each pot contains 4 kg of soil. The soil samples were air-dried and the dried soil was packed in sterile polythene bags and sent to soil quality centre, collected fruit peels were washed thoroughly with tap water to remove the unwanted material including seeds. The washed peels were cut into small pieces [1-5 cm] and air dried in sunlight for 20 days. The dried fruit peels were powdered individually, sieved and stored at room temperature. Different formulation of fruit peel powder was used to compare the plant growth. Each formulation was mixed with water in different quantities. 1g of fruit peel powder of pomegranate, orange, sweet lime, banana was taken in 100 ml of distilled water and mixed thoroughly for the preparation of extract. This mixture was stirred for 3 days by using magnetic stirrer.

From this, we concluded that the fruit peel powder extract increased the growth of plants and yield and the leaves of the plants were remaining green till harvesting. Additionally, growth of microorganisms was also increased by the application of fruit peel powder and extract. And the chemical fertilizers can be replaced by the fruit peel powder and extract to protect the soil from the infertility.

Asha V. Pillai and Sheela K. R (2015) entitled as **"ORGANIC LIQUID MANURES AS FOLIAR NUTRIENT SUPPLEMENT IN AMARANTHUS"** said the liquid manures were prepared by soaking composite organic manures in water (1:5 ratio), collecting the extract seven days after soaking and enriching the same with PGPR addition. Among the combinations, the extracts of composite manure prepared by mixing groundnut cake, neem cake and poultry manure (in 1:0.5:0.5 ratio), groundnut cake, vermicompost and poultry manure (in 1:0.5:0.5 ratio), and groundnut cake and poultry manure (in 1:1 ratio) recorded high nitrogen content (0.56-0.78%). Foliar application of these liquid manures as substitute to nitrogen for top dressing in amaranthus enhanced plant height, number of leaves per plant, crop yield and vitamin C content. The basal application of farmyard manure along with full P and K and half nitrogen was applied uniformly for all treatments. Organic liquid manures (T1 to T3) were prepared by mixing composite manures with five times water and the liquid extract was collected after seven days. After each harvest a foliar spray was given. Four harvests could be obtained from the crop. Observation on growth characters like plant height, number of leaves, total dry matter production and yield and quality attribute like Vitamin C were recorded. Use of foliar formulations is gaining importance in crop production owing to its quick response in plant growth. It is proved to be the fastest way of curing nutrient deficiencies and boosting plant performances at specific physiological stages. The result revealed that the use of (groundnut cake + neem cake + poultry manure) can be used as a substitute to top dressing of nitrogen in Amaranthus. The significance of organic N nutrition in enhancing the vitamin C content of amaranthus. Though the N content of the best liquid manure T3 is lesser than 2% foliar applied urea, the presence of invitro beneficial microorganisms might have enhanced the biological efficiency of the crop plants resulting in improved crop quality.

From this literature, we conclude that the organic liquid manures contain several beneficial microbes which help to increase yield, impart resistance to diseases, insects, pests, improve drought tolerance and enhance crop quality. Organic liquid fertilizer is considered as a viable means for enhancing crop production both in conventional and modern production system. Organic manures play a key role in sustaining crop growth and productivity and this is very important in vegetable cultivation. Among the organic manures, groundnut cake, vermicompost, neem cake, poultry manure and compost are considered to be viable choice in crop production on account of their high nutrient content.

CHAPTER 3

METHODOLOGY

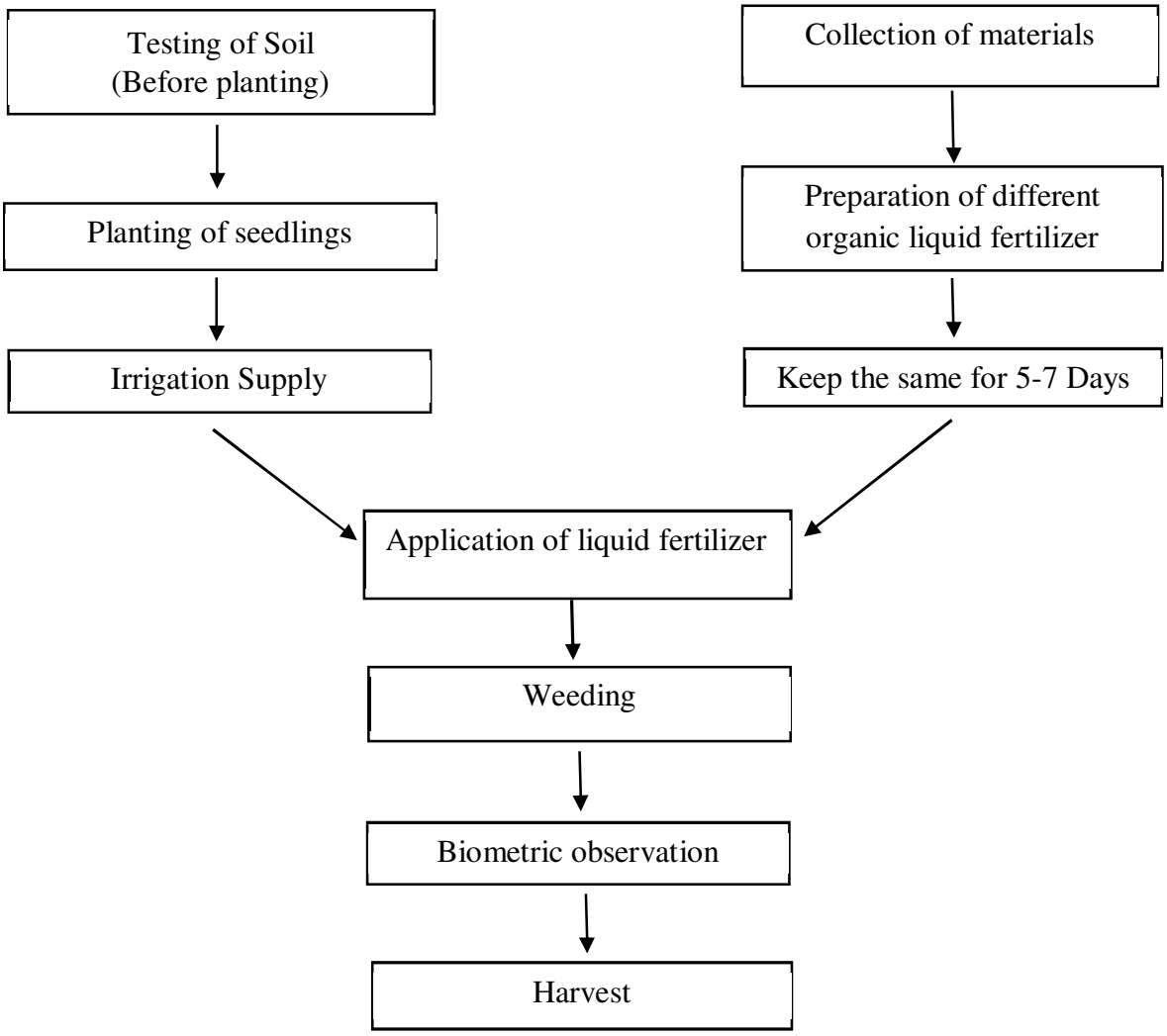

FIGURE 3.1 METHODOLOGY FLOW CHART

3.1 TESTING OF SOIL

Before planting the seedlings, the soil sample was collected at the field of Paavai Engineering College at Namakkal located on latitude 11.2195158 and longitude 78.1677931. The parameters like soil pH, Electrical conductivity (EC), Organic Carbon, Nitrogen, Phosphorus and Potassium (soil nutrients) were tested in the laboratory.

3.2 PLANTING THE SEEDLINGS

Planting two seedlings per hill in the polybag and then thin one plants per hill after 10 days. It consists of 5 treatments with two replications. Planting can be done during November - December. The optimum time of seed sowing varies greatly depending upon climate, varieties and their temperature requirement for growth.

FIGURE 3.2 AT THE TIME OF PLANTING THE SEEDLING

FIGURE 3.3 AT 30 DAP

3.3 IRRIGATION SUPPLY

Irrigation is done at weekly intervals. A pre-sowing irrigation 3-4 days before sowing is beneficial. Give pre-sowing irrigation, if the soil is not moist enough. During summer, irrigate the crop at intervals of 2 to 3 days.

3.4 COLLECTION OF MATERIALS

The different materials are Banana peel, Tea powder waste, Cow dung, Coconut cake, Neem cake, Groundnut cake, Vegetable waste. The materials were collected for preparing the liquid fertilizer and these are easily available waste materials.

3.5 PREPARATION OF LIQUID FERTILIZERS

The liquid fertilizers were prepared with different ratios of organic materials and the preparation details are explained below.

3.6 APPLICATION OF LIQUID FERTILIZER

Liquid fertilizers can be applied at every 30 days intervals (i.e. 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP) and the observation of plant growth can be recorded.

3.7 WEEDING

Weeding is the process to remove out the weeds. Weeds are unwanted plants which grows along the useful crops. Weeding is required because weeds are competitive plants as they reduce the useful crop yield by acquiring space, fertilizers and nutrients from the soil. Hand weeding can be done at every 15 days interval.

3.8 BIOMETRIC OBSERVATION

3.8.1 GROWTH ATTRIBUTES

Different parameters of growth attributes such as plant height, leaf length, leaf breadth and number of leaves present in the plant was recorded at 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP.

3.8.2 YIELD

Production in each treatment was recorded and expressed in gram. It requires good amount of fertilizers for high yield. The fertilizer dose depends upon the fertility of soil.

3.9 HARVEST

FIGURE 3.4 AT HARVESTING STAGE OF BRINJAL

Harvesting can be done at 70 to 85 days from transplanting. Brinjals are ready for harvest when the fruit is glossy, firm, full-coloured. Usually picking can be done once in each week; twice each week at the peak of the season. Frequent picking promotes fruit development and prevents the pods from growing too large.After harvesting of brinjal, the performance of organic liquid fertilizers was analyzed through the observation of plant growth and also based on the soil testing parameters like pH, EC, NPK and organic carbon.

CHAPTER 4

MATERIALS AND ITS PROPERTIES

4.1 BANANA PEEL

FIGURE 4.1 BANANA PEEL

It is the outer covering of banana fruit. A banana peel is also called as banana husk or banana skin. Banana peels contain nutrients that are essential for healthy potted plants. Bananas are a great source of potassium and phosphorus. Their peels also contain the same elements which work wonders for plants. These peels actually decompose quickly and provide necessary nutrient to the plants.

4.1.1 PROPERTIES

- Banana peel as a growth booster for plants.
- Banana peel has a fantastic source of potassium which is about 42%.
- It contains potassium, phosphorus, calcium, magnesium, sodium, manganese and sulphur.
- Using banana peels in the garden provides nutrients that plants need to thrive, and it acts also as a pest repellent.
- Banana peels also contain calcium, which helps plants take up more nitrogen, which some potassium loving plants need.

4.1.2 TREATMENT PROCESS (BANANA PEEL FERTILIZER)

- Take the banana peels and Chop the peels.
- Take some amount of tea powder waste.
- Add 1 litre of water and cover the container or bottle.

- Keep the same for 7 days. Stir the mixture once every three days.
- Mix with same amount of water and apply to the plants.
- Working cut up banana peels into the soil surrounding your plants not only feeds the plants, it also will help naturally deter green aphids and other pests. You can also spray your banana peels compost tea directly onto plants to help repel aphids.

4.2 TEA POWDER

FIGURE 4.2 TEA POWDER WASTE

Tea powder can be a great source of biodegradable garbage but it can make a good source of compost as well. By using this compost, the plants grow very rapidly and there is increment in the leaf area, leaf density, height, and germination period and germination frequency of the plant. It acts as a fertilizer and help to improve the plants growth, overall health and vigour.

4.2.1 PROPERTIES

- Tea waste powder is a good fertilizer for plant growth.
- It contains nutrients and trace minerals that promote healthy growth in plants.
- The evidence dried leaves contain about 4.4% nitrogen,0.24% phosphorus and 0.25% potassium.
- Create a more fertile environment for the plants.
- It increases the nutrient levels and improve the soil quality as they decompose.

4.3 COW DUNG

Cow dung is the undigested residue of plant matter which has passed through the animal's gut. The resultant faecal matter is rich in minerals. Cow dung contains a substance similar to penicillin, which has a disinfecting effect and reduces bacteria that cause disease.

FIGURE 4.3 COWDUNG

Cow dung is high in organic materials and rich in nutrients. It contains about 3 percent nitrogen, 2 percent phosphorus, and 1 percent potassium (3-2-1 NPK). In addition, cow manure contains high levels of ammonia and potentially dangerous pathogens.

4.3.1 PROPERTIES

- Cow manure is rich in minerals, especially nitrogen, phosphorus, and potassium.
- It can support the growth of beneficial microorganisms when it's mixed with soil.
- Manure can also improve the texture of the soil and help it to maintain moisture.
- It contains about 3% Nitrogen, 2% phosphorus and 1% potassium (3-2-1 NPK).
- In addition, cow manure contains high level of ammonia and potentially dangerous pathogens. For this reason, it is usually recommended that it be aged or composted prior to its use as cow manure fertilizer.

4.3.2 TREATMENT PROCESS (COWDUNG FERTILIZER)

- Place the cow dung into the bucket and add 1 lit of water, stir the mixture once for first 3 days and apply to the plants.
- Use a drum, bucket, or other suitable container. It must have a lid or a makeshift lid.
- Place the dried-out cow manure into the container. Place in to about one-third of the container's height.
- Fill the rest of the container with water.
- Cover the container. This keeps out the flies and other pests.
- Stir the mixture once every three days. Or, stir once a day for the first three days and then only stir weekly.

- Leave until the smell dissipates. Once it doesn't smell anymore, it is ready for use. The odor may be smelly over the container itself but the ammonium odor should be completely gone. If not, leave longer until it has gone.

4.4 COCONUT CAKE

FIGURE 4.4 COCONUT CAKE

Coconut Oil Cake is the by-product of Oil Extraction. Coconut Oil Cake is the residue left after the extraction of oil from copra which is mainly used as manure for plants and also as cattle feed. You have to use with Neem Cake or any other natural insect repellent. Coconut Oil Cake contains 4-5 per cent oil which is extracted by solvent extraction process.

4.4.1 PROPERTIES

- Oil cake is one of the natural fertilizer with high nitrogen content, which is the residues of coconut.
- It is mainly used as a manure for plants.
- It is very effective when it can be use with neem cake or any other natural insect repellent.

4.4.2 TREATMENT PROCESS (COCONUT CAKE FERTILIZER)

- Take 200gms of coconut cake and 100gms neem cake into the bucket.
- Add 1 litre of water and cover the bucket perfectly.
- Keep the same for 2-3 days or leave it until the smell dissipates.
- Filter the liquid from the mixture.
- Now mix the liquid with 1-2 times of water.
- Apply the liquid fertilizer to the plants at every 30 days interval.

4.5 GROUNDNUT CAKE

FIGURE 4.5 GROUNDNUT CAKE

Groundnut Oil Cake is made by extracting the oil completely from the groundnut seeds. The left over is then processed to produce high quality Groundnut Oil Cake. Oilseed cakes are the by-products generated from edible oil processing. The oilseed cakes are generally used as animal feed, plant fertilizer or soil compost due to their high protein, carbohydrate, mineral and nitrogen contents.

4.5.1 PROPERTIES

- Groundnut cake is rich in nitrogen (7.3%) and facilitates better growth of plants.
- Also, it contains phosphorus (1.5%) and potash (1.3%) enables flowering and higher yield in plants.
- Peanut cake is a very effective way to grow your veggies organically.
- This helps in improving the health of plants and thus enhance the crop yield.
- It is often used to boost the growth of fruit, flower and vegetable crops.
- Groundnut cake increase the water holding capacity of soil and soil structure.
- Don't apply directly into soil, mix with neem cake fertilizer it to prevent from ant and neem also good biofertilizer, bioinsecticide.

4.5.2 TREATMENT PROCESS (GROUNDNUT CAKE FERTILIZER)

- Take 200gms of ground nut cake and 100gms neem cake and put it in 1 lit of water, 100ml of curd.
- Add jaggery and it acts as a good promoter to increase the absorption of nutrients by plants.
- Keep the same for 2-3 days.
- After 2-3 days you can take that and mix with 1-2 times of water and apply to the plants.

4.6 NEEM CAKE

FIGURE 4.6 NEEM CAKE

Neem cake organic manure is the by-product obtained in the process of cold pressing of neem tree fruits and kernels, and the solvent extraction process for neem oil cake. It is a potential source of organic manure. Neem cake organic manure protects plant roots from nematodes, soil grubs and white ants probably due to its residual limonoid content. It also acts as a natural fertilizer with pesticidal properties.

4.6.1 PROPERTIES

- Neem Cake is used as an organic fertilizer because of the various micro and macro nutrients which it is composed of.
- It will provide a better crop yield because it will provide the nutrients that crops need.
- It helps to cure diseases and will control the growth of nematodes and harmful plant pathogens.
- The crop yield is15-25% higher when using Neem Cakes than with any other fertilizer.
- It will also inhibit nitrification of the soil plus enhance the efficiency of nitrogen providing fertilizer.
- The use of Neem Cakes will increase the water holding capability of the soil and improve soil structure.

4.7 VEGETABLE WASTE

Vegetable wastes include the rotten, peels, shells, and scraped portions of vegetables or slurries. These wastes can be treated for biofuel production through fermentation under controlled conditions or else used for composting. The natural decomposition of wastes by microbes generates products with high humus content.

FIGURE 4.7 VEGETABLE WASTE

4.7.1 PROPERTIES

- Vegetable waste provides good amount of nutrients for during harvesting.
- It contains major nutrients like NPK and also provides micronutrients to the plant.
- The microorganisms and the nutrients present in the raw materials are very helpful in improving soil health.
- Vegetable waste compost can increase water and nutrient holding capacity of sandy soils, increase aeration and internal drainage of clay soils, add nutrients, increase soil microorganisms, and suppress some plant diseases.
- The vegetable waste containing lettuce and onion waste has high amounts of sulphur 0.2% and 0.7% respectively, their moisture content is of 96.2% and 91.1% respectively.

4.7.2 TREATMENT PROCESS (VEGETABLE WASTE FERTILIZER)

- Put the vegetable waste into the bucket, add certain amount of sugar.
- Cover the bucket.
- After 2-3 weeks, discharge the brown liquid.
- Then mix the brown liquid with 1-2 times of water and apply to the plants.

CHAPTER 5
RESULT AND DISCUSSION

5.1 GROWTH ATTRIBUTES

5.1.1 PLANT HEIGHT

The average height of plants from each replication was measured with a measuring scale and results were expressed in centimetres. The plant height of selected plants was recorded at 30 days interval in each replication of different treatments. The plant height was recorded from the bottom of the plant to the highest leaf of the individual plant. The plant height recorded at 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP. From this observation, maximum plant height was observed in groundnut cake treatment (89cm) followed by coconut cake (85cm) and the minimum plant height (74cm) in control treatment.

S. No	TREATMENTS	30 DAP (cm)	60 DAP (cm)	90 DAP (cm)	120DAP (cm)	150DAP (cm)
1.	Banana peel	16	31	51	71	77
2.	Cow dung	17	32	54	73	79
3.	Coconut cake	16	34	53	75	85
4.	Groundnut cake	17	36	56	78	89
5.	Vegetable waste	16	32	53	73	82
6.	Control	15	28	49	67	74

TABLE 5.1 PLANT HEIGHT VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP &150 DAP

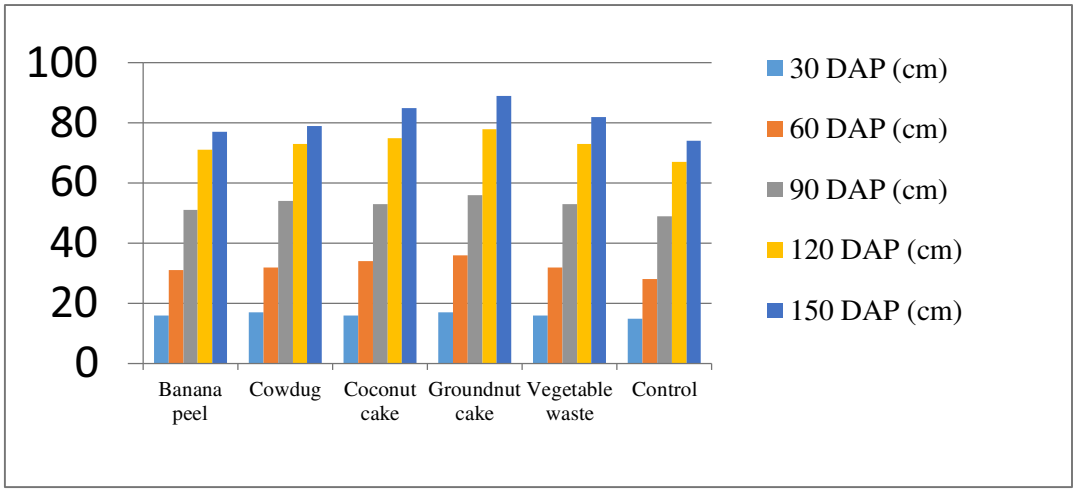

CHART 5.1 PLANT HEIGHT VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP &150 DAP

5.1.2 LEAF LENGTH

The average length of randomly selected leaves from each replication was measured in cm. The leaf length of the plant was recorded at 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP. From this observation, maximum leaf length was observed in groundnut cake fertilizer (16.5cm) and the minimum leaf length (14 cm) in control treatment.

S. No	TREATMENTS	30 DAP (cm)	60 DAP (cm)	90 DAP (cm)	120DAP (cm)	150DAP (cm)
1.	Banana peel	9	11	12	13	15
2.	Cow dung	10	11	12	13	14.5
3.	Coconut cake	10	11	13	15	16
4.	Groundnut cake	10	12	14	16	16.5
5.	Vegetable waste	10	11	13	14	15
6.	Control	9	11	12	13	14

TABLE 5.2 LEAF LENGTH VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

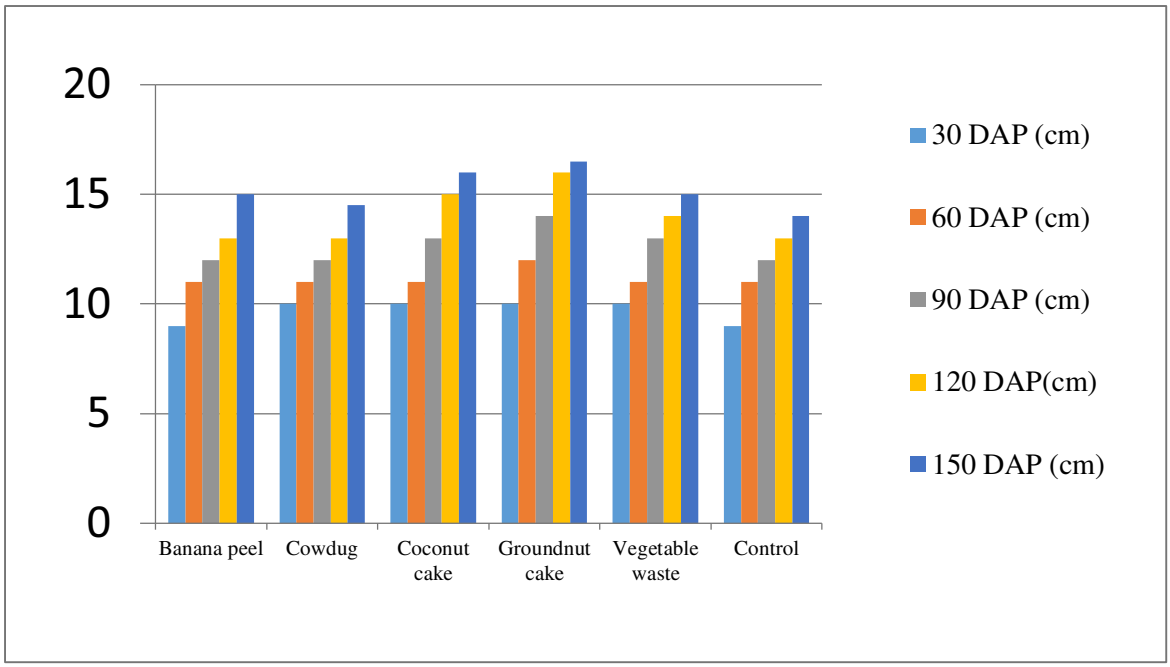

CHART 5.2 LEAF LENGTH VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

5.1.3 LEAF BREADTH

The average breadth of randomly selected leaves from each replication was measured in centimetre and the measurements are recorded at 30 days interval. The maximum breadth (12 cm) was measured under groundnut cake fertilizer whereas the lowest (10 cm) was scored under control treatment and the measurements of leaf breadth in each treatments were showed below.

S. No	TREATMENTS	30 DAP (cm)	60 DAP (cm)	90 DAP (cm)	120DAP (cm)	150DAP (cm)
1.	Banana peel	6	7	8	10	11.5
2.	Cow dung	6	7	8	10	11
3.	Coconut cake	6	7.5	9	10	11.5
4.	Groundnut cake	6.5	8	10	11	12
5.	Vegetable waste	6	7	8.5	9.5	11
6.	Control	6	7	8	9	10

TABLE 5.3 LEAF BREADTH VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

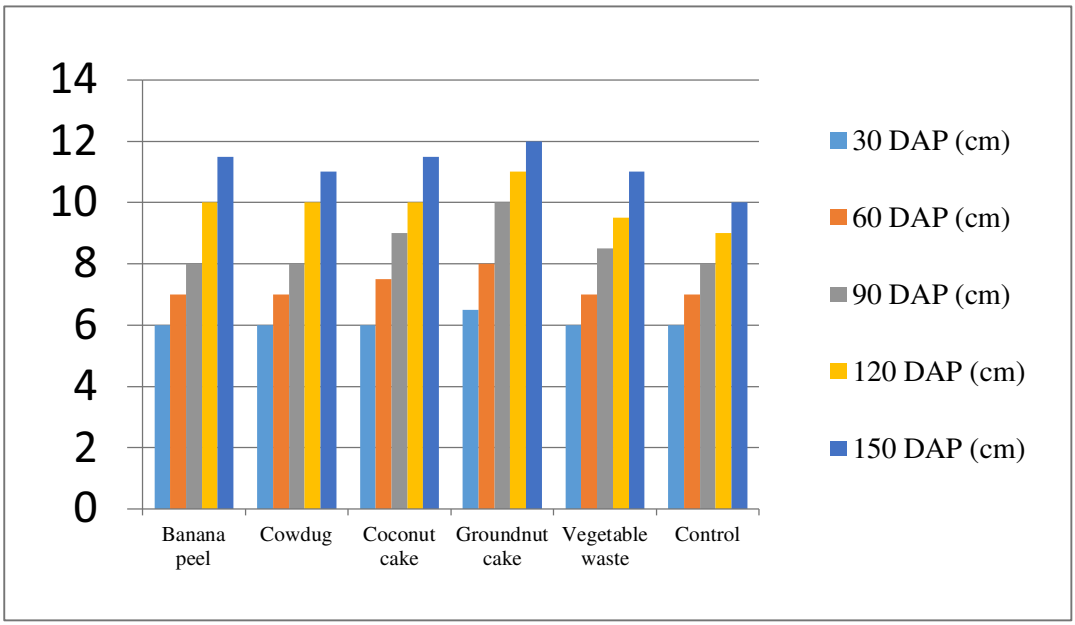

CHART 5.3 LEAF BREADTH VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

5.1.4 LEAF COUNT

The average number of leaves were recorded in each treatment and results were expressed as leaf number per plant. Leaf count was observed at 30 DAP, 60 DAP, 90 DAP, 120 DAP and 150 DAP. More number of leaves formed under groundnut cake, coconut cake and control treatment were 180, 176 and 168 respectively.

S. No	TREATMENTS	30 DAP	60 DAP	90 DAP	120DAP	150DAP
1.	Banana peel	5	37	83	141	173
2.	Cow dung	6	37	84	142	171
3.	Coconut cake	5	42	87	148	176
4.	Groundnut cake	6	43	91	152	180
5.	Vegetable waste	6	39	85	145	174
6.	Control	5	33	78	138	168

TABLE 5.4 LEAF COUNT VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

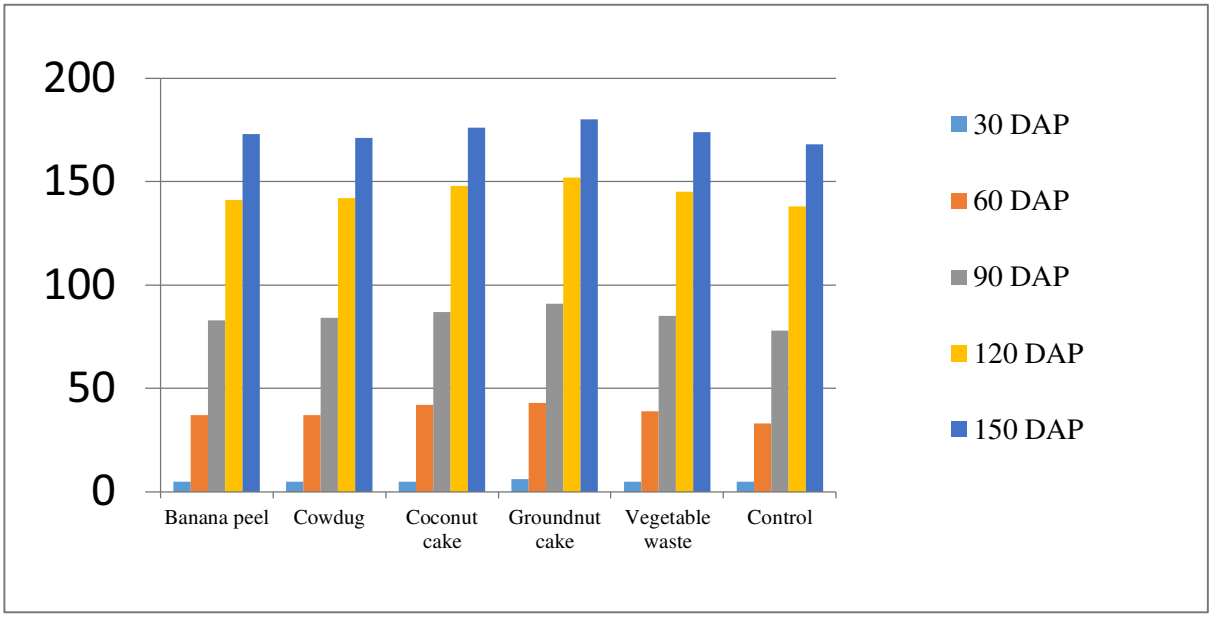

CHART 5.4 LEAF COUNT VARIATION IN 30 DAP, 60 DAP, 90 DAP, 120 DAP & 150 DAP

5.1.5 YIELD

The total fruit production in each treatment was recorded and yield was expressed in kilogram. It has been recorded that the higher yield of 2.10 kg was found at groundnut cake treatment, whereas lower yield 1.50 kg was recorded at control treatment. Application of different organic liquid fertilizer had resulted significantly higher yield as compare to control treatment.

Treatments	Banana peel	Cow dung	Coconut cake	Groundnut cake	Vegetable waste	Control
YIELD (kg)	1.80	1.90	2.00	2.10	1.90	1.50

TABLE 5.5 YIELD VARIATION IN DIFFERENT TREATMENTS

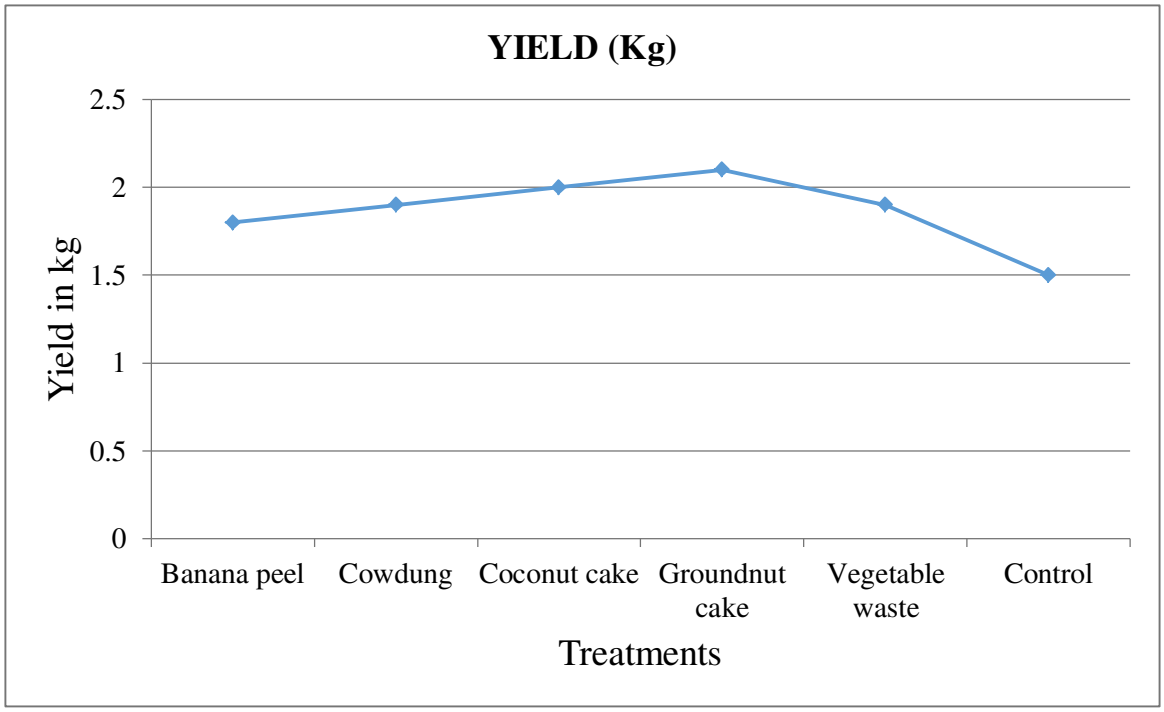

CHART 5.5 YIELD VARIATION IN DIFFERENT TREATMENTS

5.1.6 SOIL TESTING ANALYSIS

S.NO	TREATMENTS	Soil Ph	EC (dS m^{-1})	OC (%)	N (Kg ha^{-1})	P (Kg ha^{-1})	K (Kg ha^{-1})
1.	Control	7.7	0.0033	0.38	258	15.9	106
2.	Banana Peel	7.10	0.30	0.41	259	23.5	114
3.	Cow dung	7.06	0.32	0.39	265	25.7	129
4.	Coconut cake	6.91	0.31	0.45	278	27.7	134
5.	Groundnut cake	6.82	0.58	0.58	284	29.6	163
6.	Vegetable waste	7.20	0.35	0.40	269	20.3	129

TABLE 5.6 ANALYSIS OF SOIL PROPERTIES AFTER HARVEST OF BRINJAL

Soil pH

Soil pH is a measure of the acidity or basicity of a soil. The normal pH suitable for plant growth ranges from 6.5 – 7.5. The result shows that the highest pH (7.7) was recorded with control treatment followed by vegetable waste treatment (7.20) whereas the lowest value was observed with groundnut cake treatment(6.82).

Electrical Conductivity (dSm^{-1})

Soil Electrical conductivity is a measurement that correlates with soil properties which includes soil texture, cation exchange, drainage conditions, organic matter level, salinity and subsoil characteristics. Too low EC levels indicate low available nutrients, and too high EC levels indicate an excess of nutrients.

The maximum Electrical conductivity (EC) value 0.58 dSm^{-1} was found at groundnut cake treatment and the minimum electrical conductivity value 0.0033 dSm^{-1} was recorded in control treatment. The application of various fertilizers raised the EC of the soils and the highest was recorded at treatment receiving the dose of organic fertilizers.

Organic Carbon (%)

The result shows that maximum soil organic carbon (OC) of 0.58 % was observed in groundnut cake treatment and the minimum soil organic carbon of 0.38 % was recorded in control treatment.

Available Nitrogen (kg ha-1)

The maximum available Nitrogen of 284.00 kg ha^{-1} was recorded at groundnut cake fertilizer treatment and the minimum available Nitrogen was recorded at control treatment with 258.00 kg ha^{-1}.

Available Phosphorus (kg ha-1)

The maximum available Phosphorus of 29.6 kg ha^{-1} was recorded at groundnut cake fertilizer treatment and the minimum available Phosphorus was recorded at control treatment with 15.9 kg ha^{-1}.

Available Potassium (kg ha-1)

The maximum available Potassium of 163 kg ha^{-1} was recorded at groundnut cake fertilizer treatment and the minimum available Potassium was recorded at control treatment with 106 kg ha^{-1}.

CHAPTER 6

CONCLUSION

From the result, it can be concluded that the application of fertilizer showed that the plant height, leaf length, leaf breadth, leaf count and yield was higher in groundnut cake and followed by coconut cake treatment whereas the minimum growth was observed in control treatment . The application of fertilizer treatment had significant effects on the soil, growth and yield of brinjal and it makes a beneficial approach towards an important source of plant nutrients in the soil.

Observations on plant growth showed that the Brinjal plants in groundnut and coconut cake treatments were generally tall, more vigorous and reached 50% flowering earlier than in the control treatment. And the use of these cakes reduces the alkaline content in the soil because when they decompose, this produces organic acids. It is very low cost process to convert waste resources into organic liquid fertilizer.

These fertilizer treatments make a good addition to the soil and it makes the soil rich and ideal for plant growth. The utilization of organic liquid fertilizer in proper way not only useful in increasing soil fertility but also decrease pollution load and increase greenery, it is proving to be beneficial for human being as well as for nature. And it is an effective tool to improve the physio - chemical and biological properties of the soil with higher yield of plants in a sustained way without affecting the fertility of soil.

REFERENCE

1. Abhishek Raj, Manoj kumar Jhariya, Pratap Toppo., Cow dung for ecofriendly and sustainable productive farming International Journal of Scientific Research vol. 3, issue 10, October 2014 – ISSN No 2277 – 8179.
2. Monisha. J. N. and Dr. G. N. Rameshaiah., Production and comparison of solid – liquid fertilizer from vegetable waste, International journal of innovations in engineering research and technology [ijiert] ISSN: 2394-3696, volume 3, issue 7, july-2016
3. S. Ginandjar, B. Frasetya, W. Nugraha and M. Subandi.,"The effect of liquid organic fertilizer of vegetable waste and planting media on growth and yield of strawberry" 2019 IOP Conference Series: Earth and Environmental Science 334 012033
4. Papa Malick Sall, Hani Antoun, François-P. Chalifour & Chantal J. BeauchampB| (2019) Potential use of leachate from composted fruit and vegetable waste as fertilizer for corn, Cogent Food & Agriculture, 5:1, 1580180
5. Rajesh and Arun Alfred David. 2017. Response of Neem Cake Rhizobium and Inorganic Fertilizer on Soil Health Growth and Yield of Green gram (Vigna radiata L.) var. Samrat. Int.J.Curr.Microbiol.App.Sci. 6(7): 815-821.
6. A A Kadir, N A Rahman and N W Azhari (2016) "The utilization of banana peel in the fermentation liquid in food waste composting" IOP Conference Series: Materials Science and Engineering 136 012055
7. Dr. Asha V. Pillai, Aswathy, K. K., Preethy, T. T. and Renisha, Mannambeth, 2016. "Effect of organic liquid manures on crop growth and productivity", International Journal of Current Research , 8, (04), 29023-29029.
8. Mercy S, Mubsira Banu S, Jenifer (2015) entitled as "Application of different fruit peels formulations as a natural fertilizer for plant growth" International journal of scientific & technology research volume 3, issue 1, January 2014 ISSN 2277-8616
9. Asha V. Pillai and Sheela K. R., Organic Liquid Manures as Foliar Nutrient Supplement in Amaranthus International Journal of Recent Scientific Research Vol. 6, Issue, 6, pp.4788-4790, June, 2015
10. Gudugi I.A.S. (2013)., "Effect of cow dung and variety on the growth and yield of okra (abelmoschus esculentus (l.)" European Journal of Experimental Biology, 2013, 3(2):495-498 . ISSN: 2248 –9215

11. Murugan, R., Apillai, S.C., Niemsdorff, P.F. and Nanjappan, K. (2011) Effects of combined application of biofertilizers with neem cake on soil fertility, grain yield and protein content of black gram (Vigna mungo (L.) Hepper). World journal of Agricultural sciences 7 (5): 583-590.
12. Kalemelawa F., Nishihara E., Endo T., Ahmad Z., Yeasmin R., Tenywa M. M., and Yamamoto S. (2012), An evaluation of aerobic and anaerobic composting of banana peels treated with different inoculums for soil nutrient replenishment. Bioresour. Technol., 126(375–82).
13. Mercy S, Muchira Banu S, Jenifer I "Application of different fruit peel formulation as a natural fertilizer for plant growth" IJSTR journal page 301-302, Volume 3, ISSUE 1, January 2014 ISSN 2277-8616
14. Jayasundara, J. M. N. P., Jayasekara, R. and Ratnayake, R. M. C. S. (2016). Liquid organic fertilizers for growth enhancement of Abelmoschus esculentus (L.) Moench and Alternanthera sessilis (L.) DC. Tropical Plant Research 3 (2):334–340.
15. Neha Panwar., "Studies on Physicochemical Characteristics and Fertility of Soil by Addition of Banana Peels – Waste Management" *IJSRD - International Journal for Scientific Research & Development, Vol. 3, Issue 01, 2015 ISSN (online): 2321-0613.*
16. Esawy M, Kader N, Robin P, Corfini N, Rahman L. Effects of Different Organic and Inorganic Fertilizers on Cucumber Yield and Some Soil Properties. World Journal of Agricultural Sciences. 2009; 5(4):408-414.
17. Mercy S, Muchira Banu S, Jenifer I "Application of different fruit peel formulation as a natural fertilizer for plant growth" IJSTR journal page 301-302, Volume 3, ISSUE 1, JANUARY 2014.ISSN 2277-8616
18. Tewari HK, Marwaha SS & Rupal K (1986) Ethanol from Banana peels, Agric Wastes 16: 135-146.
19. Diacono MA, Montemurro F. Review effectiveness of organic wastes as Fertilizers and Amendments in Salt-Affected Soils. Agriculture 2015,5,221-230;
20. BaladiE, Toselli M, Eiseenstat DM, Marangoni B. Organic fertilization leads to increase peach root production and lifespan. Tree physiol.2010;30:1373-1382.doi;10.1093/treephys/tpq078.pmid:20921024.
21. Ibrahim MH, Jaafar HZE, Karimi E, Ghasemzadeh A. Impact of organic and inorganic fertilizer applications on the phytochemical and antioxidant activity of kacip Fatimah(Labisia pumila benth).Molecules 2013;18:10973-10988.doi:10.3390?molecules 180910973.pmid:24013410.

22. Martinez-Alcantara B, Martinez-Cuenca MR, Fernandez C, Legaz F, Quinones A, Production of 15N-Labelled liquid organic fertilizers based on manure and crop residue for use in fertigation studies. Plos one ,2016.
23. Diacono M, Montemurro F. Long-term effects of organic amendments on soil fertility. A review Agron Sustain Dev.2010;30(2):401-422.
24. Baldi E, Marcolini G, QuartieriQ, Sorrenti G, Toselli M. Effect of organic fertilization on nutrient concentration and accumulation in nectarine (Prunns persica var. nucipersica)trees: The effect of rate application .Sci Hort.2014;179:174-179.

PLATES

PLATE: 1 BANANA PEEL FERTILIZER

PLATE: 2 COW DUNG FERTILIZER

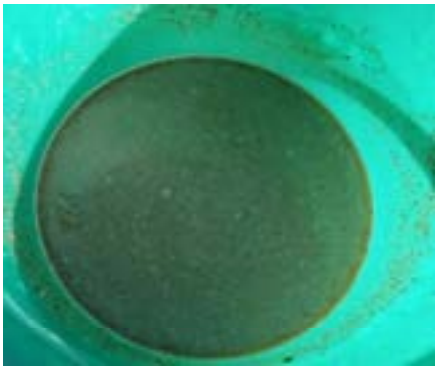

PLATE: 3 COCONUT CAKE FERTILIZER

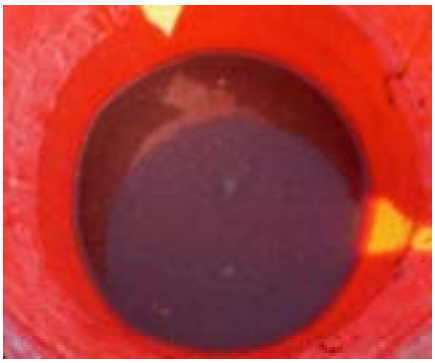

PLATE: 4 GROUNDNUT CAKE FFERTILIZER

PLATE: 5 VEGETABLE WASTE FERTILIZER

AUTOMATED DAIRY FARM IN SMALL SCALE

A PROJECT REPORT

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in

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PAAVAI ENGINEERING COLLEGE, NAMAKKAL.

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

Dairy farming is the important allied sector of agriculture and it has been a major sources of food, nutrition, income and livelihoods for hundreds of millions of people around the world. In the recent years with advancement in monitoring and automation technology, research in cattle rearing has resulted in development of production technologies that improved the quality and quantity of the milk, thus leading to improvement and increasing of milk production. India is a subcontinent hence it experiences a varied change in the temperature. Thus it creates an unfavourable condition for the dairy cattle. It leads to a problem called heat stress. It reduce their feed intake, then affect the fertility rate and finally lead to the decrease in the milk production. Hence we use a temperature sensor to find the surrounding temperature of the stanchion barn, when the temperature level is above to the fixed level it will trigger the relay to switch ON, the water will be sprayed in the form of mist. The mist form of the water will mixed with the surrounding air and tend to reduce the temperature. When the temperature reaches below the fixed level the will switch OFF the pump. The ambient temperature for the cattle growth is 19 – 21^{o} C. Cleaning the shed by pressurized water and water feeding to the cattle in regular intervals by coding on Arduino board. This system can be implemented at any small size dairy barn at low cost. It can be solution for the problems in the Indian dairy farms.

Key Words: *Heat Stress, Temperature, Automation.*

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LIST OF ABBREVATIONS AND SYMBOLS

SYMBOLS

h	-	Hour
ha	-	Hectare
Fig.	-	Figure
cm	-	Centimetre
cm2	-	Square centimetre
cm3	-	Cubic centimetre
dia.	-	Diameter
i. e.	-	That is
kg	-	Kilogram
m2	-	Square meter
mm	-	Millimetre
°C	-	Degree centigrade
m.c.	-	Moisture content
No.	-	Number
Rs	-	Rupees
S	-	Second
%	-	Percentage
Vin	-	Voltage Input
V	-	Volts
VCC	-	Voltage Collector to Collector
GND	-	Ground
°C	–	Degree Celsius

μA	-	Micro Ampere
K Ohms	-	Kilo Ohms
TX	-	Transmit FROM
RX	-	Receive TO
°F	-	Degree Fahrenheit
%	-	Percentage
Kg	-	Kilogram

ABBREVIATIONS

UNO	-	One
AC	-	Alternating Current
DC	-	Direct Current
LED	-	Light Emitting Diode
DHT	-	Digital Temperature and Humidity
OTP	-	One Time Password
PCB	-	Printed Circuit Board
NTC	-	Negative Temperature Coefficient

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Agriculture is said to be the backbone of Indian economy. However, every Indian farmer own a cow in order to earn an additional income and meet the nutritional requirements of the family. In India farmers did not do any special arrangements for the cow rearing, mostly the stanchion barn will be the part of their house wall. Hence, it can be stated that dairy cows are the part of their family and even it considered the part of their spiritual belief. India has the tremendous milk production in the last 40 years and has become the largest milk-producing nation among the world countries due to its liberalisation in this field. India is known as the 'Oyster' in the global milk industry.

India has 37 pure cattle breeds, out of this Sahiwal, Gir, Red Sindhi, Tharparker, Rathi are known for their milking powers. In addition, few others such as Kankerj, Ongole and Hariana are known as dual breeds they are both the milking and draught qualities. Under good management conditions, the Red Sindhi averages over 1700 kg of milk after suckling their calves but under optimum conditions there have been milk yields of over 3400 kg per lactation. Hence, India is a sub-continent it experience a varying temperature all through the year, it leads to result in heat stress in the cattle. An automated system was developed to monitor the temperature change and to reduce it to normal.

1.2 OBJECTIVE

The main objective is to develop the cost-efficient automated system, which requires less maintenance work. The dairy farm i.e., cattle rearing is done in India as an additional income work. The feeds to the cattle is given the fodder that grown in the field and the residual remain in the field after the harvest of the crop. India is the sub continental country where it experiences a high temperature every year. At the time of the high temperature, the dairy cows get affected. As the global warming increases, there will be constant increase in the temperature day by day. Indian farmers won't have enough time to look into the matter.

- Due to the increase in the temperature, the cows are prone to the heat stress. The heat stress affect the feed intake of the cow then soon reduces the

milking rate and affect the fertility of the cows. This system can help in the monitoring temperature and control it by an automated system. It is a pre-programmed microcontroller, which senses the temperature with the help of the temperature sensor and guides the fogger system to switch ON automatically and automatically switched OFF when the temperature is normal.

- Cleaning the shed by pressurized water with submerged pump automatically with the help of Arduino IDE program. It has the relay to control the fluctuations and the water has pumped 2hrs interval the cow dung was converted into liquid by pressurized manner. It leads to keep clean shed.
- Water feeding is necessary for cows to stabilize the body temperature and producing the milk. Water feeding for cows should be in time and perfect interval for that we made the automation system for water feeding to the cows in the interval of 4hrs, 4hrs and 16hrs automatically the water cup has filled in 3minutes. By this method, the water has feed interval is perfect and there is no human to work.

1.3 DAIRY FARM AND DAIRY FARMING

1.3.1 Dairy Farming

Dairy farming is a class of agriculture for long-term production of milk, which is processed (either on the farm or at a dairy plant, either of which may be called a dairy) for eventual sale of a dairy product. While cattle were domesticated as early as 11,000 years ago as a food source and as beasts of burden, the earliest evidence of using domesticated cows for dairy production is the seventh millennium BC - the early Neolithic era - in north western Anatolia. Dairy farming developed elsewhere in the world in subsequent centuries: the sixth millennium BC in east Europe, the fifth millennium BC in Africa, and the fourth millennium BC in Britain and Northern Europe.

Dairy cattle housing systems vary greatly throughout the world depending on the climate, dairy size, and feeding strategies. Housing must provide access to feed, water and protection from relevant environmental conditions. One obvious issue for humanely housing cattle is temperature extremes. Heat stress can decrease fertility and milk production in cattle. Providing shade is a very common method for reducing heat stress. Barns may also incorporate fans or tunnel ventilation

into the architecture of the barn structure. Overly cold conditions, while rarely deadly for cattle, cause increases in maintenance energy requirements, thus increased feed intake, and decreased milk production.

During the winter months, where temperatures are low enough, dairy cattle are often kept inside barns, which are warmed by their collective body heat. Feed provision is also an important feature of dairy housing. Free stall barns and open lots are intensive housing options where feed is brought to the cattle at all times of year. Free stall barns are designed to allow the cows freedom to choose when they feed, rest, drink, or stand. They can be either fully enclosed or open-air barns again depending on the climate. The resting areas, called free stalls, are divided beds lined with anything from mattresses to sand. In the lanes between rows of stalls, the floor is often make of grooved concrete. Most barns open onto uncovered corrals, which the cattle are free to enjoy as the weather allows. Open lots are dirt lots with constructed shade structures and a concrete pad where feed is delivered.

1.3.2 Dairy Cattle

Cows

Dairy cattle (also called dairy cows) are cattle cows bred for the ability to produce large quantities of milk, from which products are made. Dairy cows generally are of the species *Bos taurus*. Historically, there was little distinction between dairy cattle and beef cattle, with the same stock often being used for both meat and milk production. Today, the bovine industry is more specialized and most dairy cattle have been bred to produce large volumes of milk. Either dairy cows may be found in herds or dairy farms where dairy farmers own, manage, care for, and collect milk from them, or on commercial farms. Herd sizes vary around the world depending on landholding culture and social structure. The United States has 9 million cows in 75,000 dairy herds, with an average herd size of 120 cows. The number of small herds is falling rapidly with the 3,100 herds with over 500 cows producing 51% of U.S. milk in 2007. The United Kingdom dairy herd overall has nearly 1.5 million cows, with about 100 head reported on an average farm. In New Zealand, the average herd has more than 375 cows, while in Australia, there are approximately 220 cows in the average herd.

FIGURE. 1.1. COWS AT STANCHION BARN

The United States dairy herd produced 84.2 billion kilograms (185.7 billion pounds) of milk in 2007, up from 52.9 billion kilograms (116.6 billion pounds) in 1950, yet there were only about 9 million cows on U.S. dairy farms—about 13 million fewer than there were in 1950. The top breed of dairy cow within Canada's national herd category is Holstein, taking up 93% of the dairy cow population, have an annual production rate of 10,257 kilograms (22,613 pounds) of milk per cow that contains 3.9% butter fat and 3.2% protein. Dairy farming, like many other livestock raring, can be split into intensive and extensive management systems.

Intensive systems focus towards maximum production per cow in the herd. This involve formulating their diet to provide ideal nutrition and housing the cows in a confinement system such as free stall or tie stall. These cows are housed indoors throughout their lactation and may be put to pasture during their 60-day dry period before ideally calving again. Free stall style barns involve cattle loosely housed where they can have free access to feed, water, and stalls but are moved to another part of the barn to be milked multiple times a day. In a tie stall system, the milking units are brought to the cows during each milking. These cattle are tethered within their stalls with free access to water and feed are provided. In extensive systems, cattle are mainly outside on pasture for most of their lives. These cattle are generally lower in milk production and are herded multiple times daily to be milked. The systems used greatly depends on the climate and available land of the region of which the farm is situated.

To maintain lactation, a dairy cow must be bred and produce calves. Depending on market conditions, the cow may be bred with a "dairy bull" or a "beef bull." Female calves (heifers) with dairy breeding may be kept as replacement cows for the dairy herd. If a

replacement cow turns out to be a substandard producer of milk, she then goes to market and can be slaughtered for beef. Male calves can either be used later as a breeding bull or sold and used for veal or beef. Dairy farmers usually begin breeding or artificially inseminating heifers around 13 months of age. A cow's gestation period is approximately nine months. New born calves are removed from their mothers quickly, usually within three days, as the mother/calf bond intensifies over time and delayed separation can cause extreme stress on both cow and calf.

Domestic cows can live to 20 years; however, those raised for dairy rarely live that long, as the average cow is removed from the dairy herd around age six and marketed for beef. In 2014, approximately 9.5% of the cattle slaughtered in the U.S. were culled dairy cows: cows that can no longer be seen as an economic asset to the dairy farm. These animals may be sold due to reproductive problems or common diseases of milk cows such as mastitis and lameness.

Calf

Most heifers (female calves) are kept on farm to be raised as a replacement heifer, a female that is bred and enters the production cycle. Market calves are generally sold at two weeks of age and bull calves may fetch a premium over heifers due to their size, either current or potential. Calves may be sold for veal, or for one of several types of beef production, depending on available local crops and markets. Such bull calves may be castrated if turnout onto pastures is envisaged, to make them less aggressive. Purebred bulls from elite cows may be put into progeny testing schemes to find out whether they might become superior sires for breeding. Such animals can become extremely valuable.

Most dairy farms separate calves from their mothers within a day of birth to reduce transmission of disease and simplify management of milking cows. Studies have been done allowing calves to remain with their mothers for 1, 4, 7 or 14 days after birth. Cows whose calves were removed longer than one day after birth showed increased searching, sniffing and vocalizations. However, calves allowed to remain with their mothers for longer periods showed weight gains at three times the rate of early removals as well as more searching behaviour and better social relationships with other calves. After separation, some young dairy calves subsist on commercial milk replacer, a feed based on dried milk powder. Milk replacer is an economical alternative to feeding whole milk

because it is cheaper, can be bought at varying fat and protein percentages, and is typically less contaminated than whole milk when handled properly. Some farms pasteurize and feed calves milk from the cows in the herd instead of using replacer. A day-old calf consumes around 5 litres of milk per day.

FIGURE. 1.2. CALF

Cattle are social animals; their ancestors tended to live in matriarchal groups of mothers and offspring. The formation of "friendships" between two cows is common and long lasting. Traditionally individual housing systems were used in calf rearing, to reduce the risk of disease spread and provide specific care. However, due to their social behaviour the grouping of offspring may be better for the calves' overall welfare. Social interaction between the calves can have a positive effect on their growth. It has been seen that calves housed in grouped penning were found to eat more feed than those in single pens, suggesting social facilitation of feeding behaviour in the calves. Play behaviour in pre-weaned dairy calves has also been suggested to help build social skills for later in life. It has been seen that those reared in grouped housing are more likely to become the dominant cattle in a new combination of animals. These dominant animals have a priority choice of feed or lying areas and are generally stronger animals. Due to these reasons, it has become common practice to group or pair calves in their housing. It has become common within Canada to see paired or grouped housing in outdoor hutches or within an indoor pack penning.

Bull

A bull calf with high genetic potential may be reared for breeding purposes. It may be kept by a dairy farm as a herd bull, to provide natural breeding for the herd of cows. A bull may service up to 50 or 60 cows during a breeding season. Anymore and the sperm count declines, leading to cows "returning to service" (to be bred again). A herd bull may only stay for one season, as when most bulls reach over two years old their temperament becomes too unpredictable. Bull calves intended for breeding commonly are bred on specialized dairy breeding farms, not production farms. These farms are the major source of stocks for artificial insemination.

FIGURE. 1.3. BULLS

Goat Farming

Goat farming is the raising and breeding of domestic goats (*Capra aegagrus hircus*). It is a branch of animal husbandry. Goats are raised principally for their meat, milk, fibre and skin. Goat farming can be very suited to production with other livestock such as sheep and cattle on low-quality grazing land. Goats efficiently convert sub-quality grazing matter that is less desirable for other livestock into quality lean meat. Furthermore, goats can be farmed with a relatively small area of pasture and limited resources

Meat

Three-quarters of the global population eat goat meat. It comprises 10% of worldwide meat consumption and 60% of red meat. Goat meat contains low amounts of saturated fatty acids and cholesterol. It is considered to be a healthier alternative to other types of red meat. The taste of goat kid meat has been reported as similar to that of spring

lamb meat. In some localities (e.g. the Caribbean, Bangladesh, Pakistan and India) the word "mutton" is used to describe both goat and lamb meat. However, some compare the taste of goat meat to veal or venison, depending on the age and condition of the goat.

The flavour is primarily linked to the presence of 4-methyloctanoic and 4-methylnonanoic acid. Goat meat can be prepared in a variety of ways, including stewing, baking, grilling, barbecuing, canning, and frying; it can be minced, curried, or made into sausage. Because of its low fat content, the meat can toughen at high temperatures if cooked without additional moisture. One of the most popular goats farmed for meat is the South African Boer, introduced into the United States in the early 1990s. The New Zealand Kiko is also considered a meat breed, as is the myotonic or "fainting goat"

Offal

When slaughtered, none of the animal need be wasted – so, all of the eviscerate can be used. This includes heart, liver, kidneys, spleen, lungs, stomach and intestines. The stomach can be eaten as tripe or stuffed like a haggis. The intestines make good sausage casings but have to be processed whilst still warm, otherwise the digestive enzymes start to digest the gut itself *post mortem*. Once cleaned out and cut into convenient lengths they can be turned inside out so that the internal lining can be scraped away with a knife. They can then be left in an isotopic cool solution (salty water) which keeps them supple until needed. This is traditionally done in autumn/fall when the temperature drops to below 55 degree Fahrenheit to avoid the meat within rotting -which can lead to botulism poisoning. Likewise, the skins need to be pricked so that air can ingress, as botulism needs an anaerobic medium in order to multiply. Goat sausages dry cured in this way, require no refrigeration. Modern curing methods include nitre to inhibit botulism but it is best not to wean a baby on sausages as it could induce *infantile botulism* from any spores present. It is considered by some that such dry cured sausages of goat, take on a rancid taste quite quickly and develop a *strong taste* so are not popular today. Yet, for those that like a goat taste it only adds to their appeal. In the case of billy goats, the testicles sliced and fried are considered a delicacy.

FIGURE. 1.4. GOAT

1.3.3 Milk, Butter and Cheese

Goats produce about 2% of the world's total annual milk supply. Some goats are bred specifically for milk. Unprocessed goat milk has small, well-emulsified fat globules, which means the cream remains suspended in the milk instead of rising to the top, as in unprocessed cow milk; therefore, it does not need to be homogenized. Indeed, if goat milk is to be used to make cheese, homogenization is not recommended, as this changes the structure of the milk, affecting the culture's ability to coagulate the milk and the final quality and yield of cheese. Dairy goats in their peak milk production (generally around the third or fourth lactation cycle) average 2.7 to 3.6 kg of milk production dairy roughly 2.8 to 3.8 l (3 to 4 U.S. qt) during a ten-month lactation, producing more just after freshening and gradually dropping in production toward the end of their lactation. The milk generally averages 3.5% butterfat.

Goat milk is commonly processed into cheese, butter, ice cream, yogurt, *cajeta* and other products. Goat cheese is known as *fromage de chèvre* ("goat cheese") in France. Some varieties include Rocamadour and Montrachet. Goat butter is white because goats produce milk with the yellow beta-carotene converted to a colourless form of vitamin A. Male goats are generally not required for the dairy-goat industry and are usually slaughtered for meat soon after birth. In the UK, approximately 30,000 billy goats from the dairy industry are slaughtered each year.

Fibre

Most goats have soft insulating hairs near the skin and longer guard hairs on the surface. The desirable fibre for the textile industry is the former; it has several names

including "down", "cashmere" and "pashmina". The guard hairs are of little value as they are too coarse, difficult to spin and difficult to dye. Goats are typically shorn twice a year, with an average yield of about 4.5 kg. In South Asia, cashmere is called "pashmina" (from Persian *pashmina*, "fine wool"). In the 18th and early 19th centuries, Kashmir (then called Cashmere by the British), had a thriving industry producing shawls from goat-hair imported from Tibet and Tartary through Ladakh. The shawls were introduced into Western Europe when the General in Chief of the French campaign in Egypt (1799–1802) sent one to Paris. Since these shawls were produced in the upper Kashmir and Ladakh region, the wool came to be known as "cashmere".

The Cashmere goat produces a commercial quantity of cashmere wool, which is one of the most expensive natural fibres commercially produced; cashmere is very fine and soft. The Cashmere goat fibre is harvested once a year, yielding around 260gm of down. Angora goats produce long, curling, lustrous locks of mohair. Their entire body is covered with mohair and there are no guard hairs. The locks constantly grow to 9 cm or more in length. Angora crossbreeds, such as the pygora and the nigora, have been selected to produce mohair and/or cashgora on a smaller, easier-to-manage animal.

The skin of goats is a valuable by product of goat farming. Up until 1849 all Rolls of Parliament were written upon parchment usually made from goat skin. Another populer use is for drum skins. Parchment is prepared by liming (in a solution of quick lime) to loosen the hair follicles.

CHAPTER 2

LITERATURE REVIEW

B.PRAVEEN KUMAR, S.RAJAGOPAL (2015) entitled as **"DAIRY AUTOMATION USING CONTROLLED AREA NETWORK PROTOCOL"** said, In these days automation in industry's increases rapidly. For safety purpose and to reduce man power requirement automation is adapted by industries. Some automation is fully automatic and some require human driver some control on automation. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic sensors, usually in combination. Complicated systems, such as, Milk Diaries, modern factories, airplanes and ships typically use all these combined techniques. These various sensor produced data collected by the vehicle data acquisition system by interactive communication through an intelligent information network called as Controlled area network.

It is a serial bus protocol to connect control system to sensors as an alternative to conventional multi- wire looms. They currently use PLC based system in Milk industries of southern India which is costly and a lot of noise is induced in the system as the distance between the control room and the area of work is large. And for the flushing of milk containers they use manually operated system which is quite time consuming and always increases the man power. This paper analyses an Architecture of control system and deals with its application using the controlled area network protocol. The benefits of this system over the system they currently employ is that noise reduction takes place as CAN is used and it is much cost effective than the PLC's and the man power is reduced. This prototype system hardware circuits mainly consist of LPC2129 32-bit Microcontroller, MCP 2551 CAN standalone Controller, MCP 2515 Transceiver. LPC 2129 32 -bit Microcontroller which based on ARM 7 Advanced RISC Architecture CPU serially interfaced with MCP 2515 and CAN Controller Rx and Tx pin connected to Tx and Rx pin of MPC 2551 transceiver.

From this literature we conclude that all the modern technologies are combined in the form of dairy system and also increase the milk production by using sensorized automotive controllers. Then analyse the farm area through CAN protocol.

AJINKYA S KADATE , ASHWINI R KANADE , ITI RASTOGI(2015) entitled as **"POLYHOUSE AUTOMATION USING PLC"** observed that, Poly-house is basically naturally ventilated climate controlled system. In poly-house various crops are grown under their favourable environmental conditions. Environmental conditions such as temperature within the poly-house, humidity of soil and atmosphere etc. Every crop needs different climatic conditions and to provide that condition farmers need manpower to do labour work. The system we designed and implemented on small working model of poly-house reduces labour and manpower. The various agricultural universities and agricultural experts provide the info about favourable condition and need of plant. Today we have cheap sensors and more precise and programmable controllers such as PLC available in the market. With the help of temperature, light intensity, humidity sensors and PLC automation of poly-house can be done. With the help of automation, minimum and effective use of valuable resources can lead to achieve maximum crop.

From this literature we conclude that the temperature, humidity and light intensity are kept as parameters for the automation of dairy farm and to reduce the work of labour in a cheap rate of materials.

NADER BARSOUM & ADRIAN PETER (2014) entitled as **"GSM GREENHOUSE MONITORING AND CONTROL OF TEMPERATURE AND SOIL MOISTURE"** observed that, Monitor and control of greenhouse environment play an important role in greenhouse production and management. To monitor the greenhouse environment parameters effectively and to match the crops needs is very challenging to a farmer as it needs 24hour of monitoring to the crops. Thus, it is necessary to design a control system to assist the farmer to boost up the production with reduction in human labour and assist in the greenhouse management. This paper presents basic monitoring and control method using mobile phone .GSM modem is used to control wirelessly the output variables of the greenhouse having the ability to monitor the parameters such as temperature and soil moisture in the greenhouse. This system is developed to bring convenience to the farmer to control and monitor the climate inside the greenhouse anywhere using SMS application.

Siemens TC35i Modem is used as SMS receiver while MCU PIC16F877A is connected to process the data by reading the content of the SMS. The MCU control the whole system and to enable the water pump and fan to operate by following the user

instruction through SMS. Moreover, the MCU can collect the climate data through the Temperature sensor and Soil moisture sensor and using TC35i modem to send it to the mobile phone whenever the farmer request for it. This paper describes the design of fully automated and manually greenhouse management system. From the experiment it is seen that the system is working properly which full fill the entire requirement related in greenhouse management. Thus, by using GSM technology the farmer can use mobile phone to control the fan and the water pump. The initial cost to implement this project may be costly but the cost can be cut when using low cost water pump and using low cost GSM modem which is the function is for messaging only.

From this literature we conclude that the process of monitoring and control of the dairy farm at regular intervals the monitoring process can also be done by mobile phones and monitoring the climate inside the green house using SMS from any location.

ROBERT J H DUNN, NAOMI E MEAD, KATE M WILLETT AND DAVID E PARKER (2014) entitled as ***"ANALYSIS OF HEAT STRESS IN UK DAIRY CATTLE AND IMPACT ON MILK YIELDS"*** said, Much as humans suffer from heat-stress during periods of high temperature and humidity, so do dairy cattle. Using a temperature-humidity index (THI), we investigate the effect of past heat waves in the UK on heat-stress in dairy herds. Daily THI data derived from routine meteorological observations show that during the summer, there has been an average of typically 1 day per year per station over the past 40 years when the THI has exceeded the threshold for the onset of mild heat-stress in dairy cattle. However, during the heat waves of 2003 and 2006, this threshold was exceeded on typically 5 days on average in the Midlands, south and east of England. Most dairy cattle are in the west and north of the country and so did not experience the severest heat. Milk yield data in the south-west of England show that a few herds experienced decreases in yields during 2003 and 2006. We used the 11-member regional climate model ensemble with the A1B scenario from UKCP09 to investigate the possible future change in days exceeding the THI threshold for the onset of mild heat-stress. The number of days where the THI exceeds this threshold could increase to over 20 day yr^{-1} in southern parts of England by the end of the century.

From this literature we conclude that the THI observation can be taken to determine the heat produced in the dairy farm and to maintain optimum temperature in the dairy farm.

CARIG THOMAS (2010) entitled as **"HEAT STRESS IN DAIRY CATTLE"** observed that, Thermal comfort for workers is very important factor to increase their performance, as well as the comfort level of dairy cattle will influence in milk productivity. The purposes of the paper is to measure the level of heat stress and then use the information to design the dairy cattle house for increasing thermal comfort. The research is started with literature review of heat stress and early survey of environment condition e.g. temperature, wind speed and relative humidity. The next step is using the information to determine the temperature humidity index (THI) level for dairy cattle with maximum THI = 86 and 84 (moderate stress). The 3D Computer Aided Designing model and Computational Fluid Dynamic simulation are employed to looking for solution for reducing the discomfort thermal of dairy cattle. A scenario (fan) air conditioning to get better condition of thermal comfort have been successfully presented with final THI index = 76 and 78 (mild stress). Finally, the paper shows how to reduce heat stress of cattle house by installation 3 exhaust fans in tropical climate.

From this literature we conclude that the heat stress in the cattle shed is determined and based on it the temperature is altered to the determined rate.

MRS.REENA P. SHINDE1 , MR.YOGESH (2010) entitled as **"AN SMART GREENHOUSE AUTOMATION SYSTEM APPLYING MOVING AVERAGE ALGORITHM"** observed that, Automation of greenhouses has proved to be extremely helpful in maximizing crop yields and minimizing labour costs. The optimum conditions for cultivating plants are regularly maintained by the use of programmed sensors and actuators with constant monitoring of the system. In this paper, we have designed a prototype of a smart greenhouse using Arduino microcontroller, simple yet improved in feedbacks and algorithms. Only three important microclimatic parameters namely moisture level, temperature and light are taken into consideration for the design of the system. Signals acquired from the sensors are first isolated and filtered to reduce noise before Arduino processes it. With the help of Lab view program, Time domain analysis and Fast Fourier Transform of the acquired signals are done to analyse the waveform.

Especially, for smoothing the outlying data digitally, Moving average algorithm is designed. With the implement of this algorithm, variations in the sensed data, which could occur from rapidly changing environment or imprecise sensors, could be largely smoothed and stable output could be created. In addition, actuators are controlled with constant feedbacks to ensure desired conditions are always met. Lastly, data is constantly acquired

by the use of Data Acquisition Hardware and can be viewed through Computer or Smart devices for monitoring purposes.

From this literature we conclude that the moving average algorithm is observed to sense the variations in the data due to rapidly changing environment or imprecise sensors.

G.ANDRÉ, B.ENGEL, P.B.M.BERENTSEN, TH.V.VELLINGA, AND A.G. J. M. OUDE LANSINK (2005) entitled as **"QUANTIFYING THE EFFECT OF HEAT STRESS ON DAILY MILK YIELD AND MONITORING DYNAMIC CHANGES USING AN ADAPTIVE DYNAMIC MODEL"** said, Automation and use of robots are increasingly being used within dairy farming and result in large amounts of real time data. This information provides a base for the new management concept of precision livestock farming. From 2003 to 2006, time series of herd mean daily milk yield were collected on 6 experimental research farms in the Netherlands. These time series were analysed with an adaptive dynamic model following a Bayesian method to quantify the effect of heat stress. The effect of heat stress was quantified in terms of critical temperature above which heat stress occurred, duration of heat stress periods, and resulting loss in milk yield. In addition, dynamic changes in level and trend were monitored, including the estimation of a weekly pattern. Monitoring comprised detection of potential outliers and other deteriorations.

The adaptive dynamic model fitted the data well; the root mean squared error of the forecasts ranged from 0.55 to 0.99 kg of milk/d. The percentages of potential outliers and signals for deteriorations ranged from 5.5 to 9.7%. The Bayesian procedure for time series analysis and monitoring provided a useful tool for process control. Online estimates (based on past and present only) and retrospective estimates (determined afterward from all data) of level and trend in daily milk yield showed an almost yearly cycle that was in agreement with the calving pattern: most cows calved in winter and early spring versus summer and autumn. Estimated weekly patterns in terms of weekday effects could be related to specific management actions, such as change of pasture during grazing. For the effect of heat stress, the mean estimated critical temperature above which heat stress was expected was 17.8 ± 0.56°C. The estimated duration of the heat stress periods was 5.5 ± 1.03 d, and the estimated loss was 31.4 ± 12.2 kg of milk/cow per year. Farm-specific estimates are helpful to identify management factors like grazing, housing and feeding,

that affect the impact of heat stress. The effect of heat stress can be decreased by modifying these factors.

The adaptive dynamic model is appropriate for quantification of the effect of heat stress for each farm in its specific situation in terms of critical temperature, duration, and effect on milk production. The critical temperature can be used as an indicator for the risk on heat stress based on daily weather forecasts. The duration can be used to evaluate and improve management regarding grazing, feeding, and housing during warm periods. The adaptive dynamic model is appropriate for evaluation and monitoring level and trend of herd mean daily milk yield, including the estimation of weekday effects. The online estimates provide useful information to the farmer to evaluate the actual situation and the retrospective estimates provide a good insight after- ward.

From this literature we conclude that the adaptive dynamic model is taken for quantification of the effect of heat stress in the dairy farm.

PERDIGONES, L. GARCIA , A. ROMERO , A. RODRIGUEZ , L. LUNA , C. RAPOSO , S. DE LA PLAZA(2004) entitled as **"COOLING STRATEGIES FOR GREENHOUSES IN SUMMER: CONTROL OF FOGGING BY PULSE WIDTH MODULATION"** observed that, The possibilities for improving the control of greenhouse fogging systems, were studied by comparing several combinations of ventilation cooling techniques, shade screening and low-pressure fogging. The study was divided into three parts: experiments, modelling and simulations. In the first part of the paper, ten combinations of five cooling techniques were tested during the summers of 2002 and 2003 in a 132-m^2 greenhouse with a steel structure and a single-layer methacrylate cover located in Madrid, Spain. An analysis of variance of the climatic parameters was carried out to determine which combinations produced significant differences in inside temperature or relative humidity. Comparing the values for the inside to outside temperature difference, the combination of a shade screen and above-screen fogging achieved a difference in temperature almost the same as that for under-screen fogging, but the relative humidity was significantly lower. In the second part of the study, a dynamic model was developed (2002) and validated (2003). The mean absolute error obtained for inside temperature was similar in the fit and the validation and it was less than 1.5 °C in both cases. The model was used to simulate the inside air temperature for a fog system working without shading, and above and under a shade screen. Control

algorithms were developed for reducing system water consumption. In the three cases a simple on/off control with a fixed fogging cycle was compared with a pulse width modulation (PWM) strategy, in which the duration of the fogging pulse was increased as a function of inside temperature.

The strategies with PWM applied to the fog system were able to reduce water consumption by 8-15% with respect to the strategies with a fixed fogging cycle. Combination of ventilation with shade screening and low-pressure fogging above the screen, but did not produce high humidity levels around the plant (mean relative humidity lower than 50%). It is therefore a suitable combination of equipment for crops that require cooling and relative humidity values far from saturation. A simple in situ calibration climate model has been used to evaluate the energy fluxes involved. This model can be easily used for control simulations. The absolute mean error for the calculation of the inside temperature was under 1.5 °C. The control of fogging using the PWM technique, regulating the fogging rate applied as a function of the inside temperature error yielded an estimated water saving of between 8% and 15% as compared with on/off control with fixed fogging cycles.

From this literature we conclude that the cooling strategies during summer and the method of fogging is been adopted to overcome the excess heat produced in the dairy farm.

J. W. WEST (2004) entitled as **"EFFECTS OF HEAT-STRESS ON PRODUCTION IN DAIRY CATTLE"** said, The south eastern United States is characterized as humid subtropical and is subject to extended periods of high ambient temperature and relative humidity. Because the primary non evaporative means of cooling for the cow (radiation, conduction, convection) become less effective with rising ambient temperature, the cow becomes increasingly reliant upon evaporative cooling in the form of sweating and panting. High relative humidity compromises evaporative cooling, so that under hot, humid conditions common to the Southeast in summer the dairy cow cannot dissipate sufficient body heat to prevent a rise in body temperature. Increasing air temperature, temperature-humidity index and rising rectal temperature above critical thresholds are related to decreased dry matter intake and milk yield and to reduced efficiency of milk yield.

Modifications including shade, barns which enhance passive ventilation, and the addition of fans and sprinklers increase body heat loss, lowering body temperature and improving DMI. New technologies including tunnel ventilation are being investigated to determine if they offer cooling advantages. Genetic selection for heat tolerance may be possible, but continued selection for greater performance in the absence of consideration of heat tolerance will result in greater susceptibility to heat stress. The nutritional needs of the cow change during heat stress, and ration reformulation to account for decreased dry matter intake, the need to increase nutrient density, changing nutrient requirements, avoiding nutrient excesses and maintenance of normal rumen function is necessary. Maintaining cow performance in hot, humid climatic conditions in the future will likely require improved cooling capability, continued advances in nutritional formulation, and the need for genetic advancement, which includes selection for heat tolerance or the identification of genetic traits which enhance heat tolerance. Extended periods of high ambient temperature coupled with high relative humidity compromise the ability of the lactating dairy cow to dissipate excess body heat. Cows with elevated body temperature exhibit lower DMI and milk yield and produce milk with lower efficiency, reducing profitability for dairy farms in hot, humid climates. Although adequate cooling systems exist their efficiency in humid climates is less than in arid climates and these systems often lack the ability to maintain normal body temperature.

From this literature we conclude that the effects of heat stress in the farm is reduced and the respective adaptive method is followed.

A.A.DIJKHUIZEN, M.A.TOMASZEWSKI (1996) entitled as **"ADAPTATION TO HOT CLIMATE AND STRATEGIES TO ALLEVIATE HEAT STRESS IN LIVESTOCK PRODUCTION"** observed that, Despite many challenges faced by animal producers, including environmental problems, diseases, economic pressure, and feed availability, it is still predicted that animal production in developing countries will continue to sustain the future growth of the world's meat production. In these areas, livestock performance is generally lower than those obtained in Western Europe and North America. Although many factors can be involved, climatic factors are among the first and crucial limiting factors of the development of animal production in warm regions. In addition, global warming will further accentuate heat stress-related problems. The objective of this paper was to review the effective strategies to alleviate heat stress in the

context of tropical livestock production systems. These strategies can be classified into three groups: those increasing feed intake or decreasing metabolic heat production, those enhancing heat-loss capacities, and those involving genetic selection for heat tolerance. Under heat stress, improved production should be possible through modifications of diet composition that either promotes a higher intake or compensates the low feed consumption. In addition, altering feeding management such as a change in feeding time and/or frequency, are efficient tools to avoid excessive heat load and improve survival rate, especially in poultry. Methods to enhance heat exchange between the environment and the animal and those changing the environment to prevent or limit heat stress can be used to improve performance under hot climatic conditions.

Although differences in thermal tolerance exist between livestock species (ruminants > monogastrics), there are also large differences between breeds of a species and within each breed. Consequently, the opportunity may exist to improve thermal tolerance of the animals using genetic tools. However, further research is required to quantify the genetic antagonism between adaptation and production traits to evaluate the potential selection response. With the development of molecular biotechnologies, new opportunities are available to characterize gene expression and identify key cellular responses to heat stress. These new tools will enable scientists to improve the accuracy and the efficiency of selection for heat tolerance. Epigenetic regulation of gene expression and thermal imprinting of the genome could also be an efficient method to improve thermal tolerance. Such techniques (e.g. perinatal heat acclimation) are currently being experimented in chicken.

From this literature we conclude that the tolerance of the cattle towards heat is determined and the optimum heat will provided to the cattle.

JEFFREY F. KEOWN AND RICHARD J. GRAN (1993) entitled as **"HEAT STRESS IN DAIRY CATTLE"** observed that, With an increase in herds than are housed or partially-house all-year-round there has been an increased awareness of the problems associated with heat stress in dairy cattle. High humidity and temperature levels in large buildings combined with poor air flow has been blamed for a 5-15% decrease in milk production and lowered conception rates, due to high cortisol (stress hormone) levels depressing intakes.As with any chronic forms of stress, cows can experience metabolic changes which can result in stress-related illnesses and depressed immunity. This can lead to a lowering of the cow's defences against

mastitis-causing pathogens. This, coupled with conditions in cattle housing that may favour the spread of bacteria can lead to an increase in clinical mastitis and raised Somatic Cell Counts.

The most visible symptoms of heat stress tend to be elevated breathing rates in a significant proportion of the herd. The first step in improving conditions for heat-stressed cows is to identify means of improving air flow and ventilation in buildings replacing doors with gates, or taking out alternate boards on spaced boarding are obvious suggestions. As a last resort, fans can be installed where other improvements cannot be made. Drinking water supply is another essential area in which conditions can be improved for heat-stressed cows; water intakes can increase by up to 10-20% in hot weather, particularly in high-yielders, which are more prone to suffering the effects of heat stress. Overcrowding should be avoided and cows allowed larger than normal space requirements by reducing stocking densities in buildings, if possible. It may also be wise to buffer feed cows either earlier in the morning or later in the evening when temperatures are lower. Rations should be balanced so that the ingredients most likely to degrade due to the heat are fed as efficiently as possible or replaced by other more suitable products. The mineral content of rations should also be reviewed so that the minerals lost in sweat in hot weather are replaced.

From this literature we conclude that the heat stress in the cattle is reduced by providing the optimum temperature for the cattle to survive the environmental conditions.

CHAPTER 3

METHODOLOGY

3.1 FLOWCHART

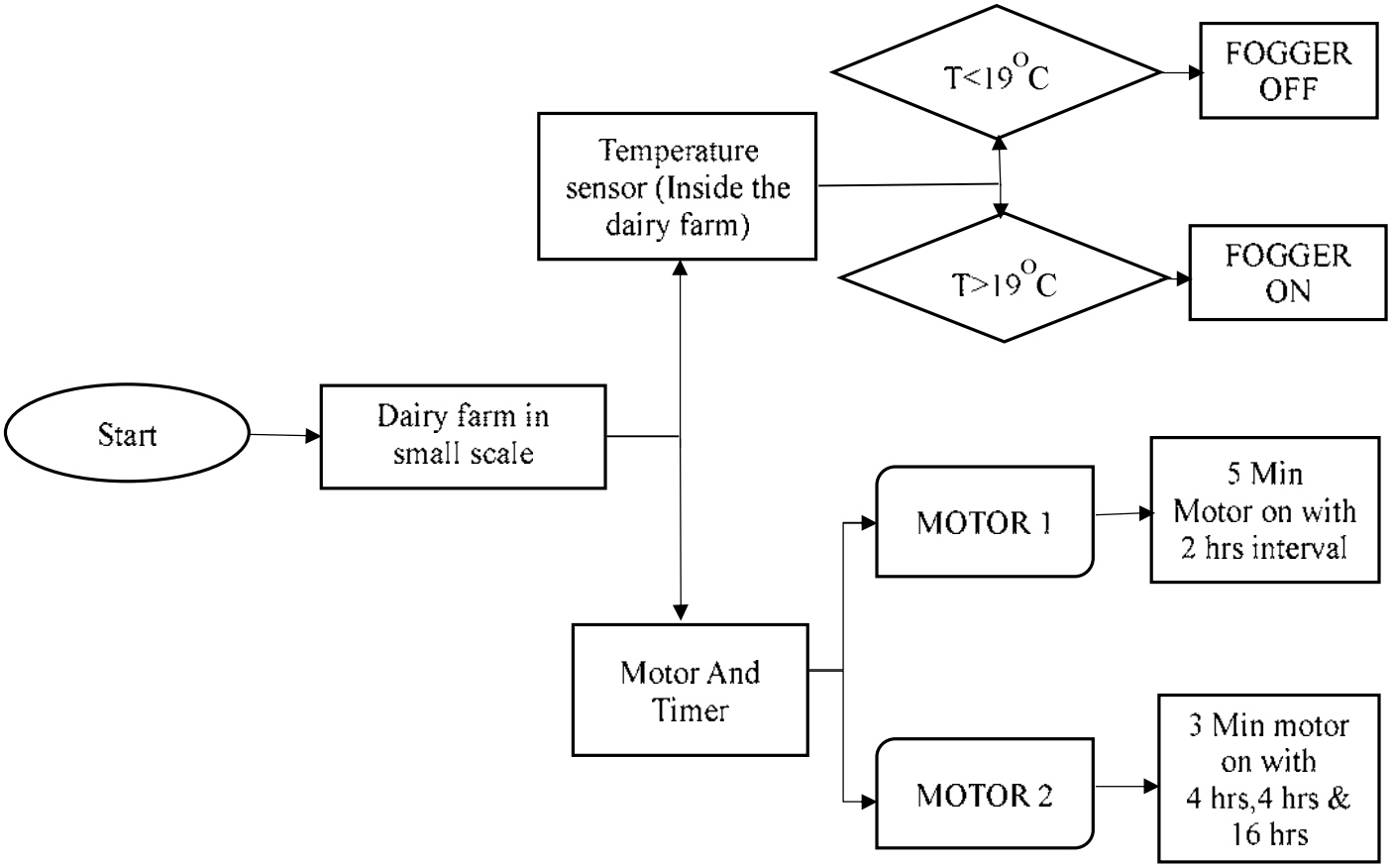

FIGURE. 3.1. FLOWCHART OF METHODOLOGY.

3.1.1 START: To give power of all components and check all components are worked well condition.

3.1.2 TEMPERATURE SENSOR: Temperature sensor is measured temperature range in outside greenhouse and signals are send to Arduino UNO.

3.1.3 T<19ºC: When a temperature range inside the shed are less than 19º C, the fogger is OFF.

3.1.4 T>19ºC: When a temperature range in inside the shed are greater than 19º C, the fogger is ON.

3.1.5 MOTOR (SUBMERSIBLE PUMP) : It was used for water feeding and cow dung was cleaned in between the duration by pressurized pump automatically with the help of Arduino IDE program

CHAPTER 4

MATERIALS AND ITS PROPERTIES

4.1. HARDWARE REQUIREMENT

- Arduino-UNO.
- Temperature sensor.
- Submerged pump.
- LCD display 16*2
- IC2 module
- Relay
- RTC Timer
- Fogger
- Piping system

SOFTWARE REQUIREMENT

- Arduino IDE.

HARDWARE ANALYSIS

4.1.1. ARDUINO - UNO

The Arduino UNO is an open-source microcontroller board based on the MicrochipATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by the USB cable or by an external 9-voltbattery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

4.1.1.1 Properties of Arduino-UNO

- Microcontroller: Microchip AT mega328P.
- Operating Voltage: 5Volts.
- Input Voltage: 7 to 20Volts.
- Digital I/O Pins: 14 (of which 6 provide PWM output).
- Analog Input Pins: 6.
- DC Current per I/O Pin: 20mA.
- DC Current for 3.3V Pin: 50mA.
- Flash Memory: 32 KB of which 0.5 KB used by boot loader.
- SRAM: 2KB.
- EEPROM: 1KB.
- Clock Speed: 16MHz
- Length: 68.6mm
- Width: 53.4mm
- Weight: 25g

FIGURE. 4.1. ARDUINO UNO BOARD

4.1.2 TEMPERATURE SENSOR

The DS18B20 Stainless Steel Temperature Sensor is a pre-wired and waterproofed version of the DS18B20 sensor. Its unique 1-wire interface makes it easy to communicate with devices. It can converts temperature to a 12-bit digital word in 750ms(max). Besides, it can measures temperatures from -55°C to +125°C (-67F to +257F). In addition, this thermo probe doesn't require any external power supply since it draws power from data line. Its stainless steel probe head makes it suitable for any wet or harsh environment. The working principle of DS18B20 Stainless Steel Temperature Sensor and DS18B20 Temperature Sensor is same but the only difference is that the temperature sensor is placed inside the stainless steel probe.

4.1.2.1 Features

- Power supply range: 3.0V to 5.5V
- Operating temperature range:-55°C to +125°C (-67F to +257F)
- Temperature-limit alarm system
- ±0.5°C Accuracy from -10°C to +85°C
- 9 to 12 bit selectable resolution
- Uses 1-Wire interface- requires only one digital pin for communication

FIGURE. 4.2. TEMPERATURE SENSOR

4.1.3 SUBMERSIBLE PUMP

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surfaces. Submersible pumps push fluid to the

surface as opposed to jet pumps which create a vacuum and rely upon atmospheric pressure. Submersibles are more efficient than jet pumps. Hydraulic submersible pumps (HSP's) use pressurised fluid from the surface to drive a hydraulic motor downhole, rather than an electric motor, and are used in heavy oil applications with heated water as the motive fluid.

4.1.3.1 Working principle

Electric submersible pumps are multistage centrifugal pumps operating in a vertical position. Liquids, accelerated by the impeller, lose their kinetic energy in the diffuser where a conversion of kinetic to pressure energy takes place. This is the main operational mechanism of radial and mixed flow pumps. In the HSP, the motor is a hydraulic motor rather than an electrical motor, and may be closed cycle (keeping the power fluid separate from the produced fluid) or open cycle (mingling the power fluid with produced fluid downhole, with surface separation). The pump shaft is connected to the gas separator or the protector by a mechanical coupling at the bottom of the pump. Fluids enter the pump through an intake screen and are lifted by the pump stages. There are also screw-type submersible pumps, there is a steel screw which is used as a working element in them. The screw allows the pump to work in water with a high sand content and other mechanical impurities.

FIGURE. 4.3. SUBMERSIBLE PUMP

4.1.4 LCD DISPLAY 16*2

The liquid-crystal display has the distinct advantage of having a low power consumption than the LED. It is typically of the order of microwatts for the display in comparison to the some order of milliwatts for LEDs. Low power consumption requirement has made it compatible with MOS integrated logic circuit. Its other advantages are its low cost, and good contrast. The main drawbacks of LCDs are additional requirement of light source, a limited temperature range of operation (between 0 and 60° C), low reliability, short operating life, poor visibility in low ambient lighting, slow speed and the need for an ac drive.

4.1.4.1 Structure of an LCD

A liquid crystal cell consists of a thin layer (about 10 u m) of a liquid crystal sandwiched between two glass sheets with transparent electrodes deposited on their inside faces. With both glass sheets transparent, the cell is known as transitive type cell. When one glass is transparent and the other has a reflective coating, the cell is called reflective type. The LCD does not produce any illumination of its own. It, in fact, depends entirely on illumination falling on it from an external source for its visual effect.

4.1.5 RELAY

The main usage of the Relay was seen in the history for transmitting and receiving the information, that was called as Morse code where the input signals used to be either 1 or 0, these change in signals were mechanically noted in terms of ON and OFF of a light bulb or a beep sound, it means those pulses of 1s and 0s are converted as mechanical ON and OFF using electromagnets. Later this was improvised and used in various applications. Let's see how this electromagnet acts as a switch and why it is named as RELAY.

4.1.5.1 Design of a Relay

An electromechanical relay is basically designed using few mechanical parts like Electromagnet, a movable armature, contacts, yoke, and a spring/frame/stand, these parts are showing in the internal pictures of Relay below. All these are arranged logically to form into a relay.

4.1.5.2 Construction of Relay and its operation:

Metal contact connected to another side, all these arrangements are placed over the core such that, when the coil is energized, it attracts the armature. The movable armature is generally considered as a common terminal which is to be connected to the external The following figure shows how a Relay looks internally and how it can be constructed,

4.1.5.3 Applications of Relay:

The applications of the relay are limitless, its main function is to control the high voltage circuit (230V circuit AC) with the low voltage power supply (a DC voltage).

- ❖ Relays are not only used in the large electrical circuits but also used in the computer circuits in order to perform the arithmetic and mathematical operations in it.
- ❖ Used to control the electric motor switches. To turn ON an electric motor we need 230V AC supply but in few cases/applications, there may be a situation to switch ON the motor with a DC supply voltage. In those cases, a relay can be used.
- ❖ Automatic stabilizers are one of its applications where a relay is used. When the supply voltage is other than the rated voltage, set of relays sense the voltage variations and controls the load circuit with the help of circuit breakers.
- ❖ Used for the circuit selection if there exists more than one circuit in a system.

4.1.6 FOGGER

The ELECTRO-GEN UNIT is a dual purpose chemical application device: A THERMAL FOGGER which produces a very small size droplet particle and an optional electric sprayer which produces a cold mist spray similar to that produced by an aerosol can.

4.1.6.1 Cold spraying mode

At the touch of the trigger, an electric pump draws solution from the solution reservoir. The solution is pressurized and forced through a specially restricted orifice where the solution is atomized into a cold mist. In the cold spraying mode the operator has a choice of utilizing water based or solvent based formulations, such as fabric protectors, deodor-ants, flame retardants, spotters, insecticides, etc. Special Advisory The use of resinous materials such as duct sealants, etc. may clog and damage the unit and are to be avoided.

4.1.6.2 Thermal fogging mode

At the touch of the trigger, an electric pump forces solution drawn from the solution reservoir through an atomizing nozzle and into a thermostatically controlled heating chamber in the barrel. The solution is vaporized instantly and a cloud of smoke like fog surges out of the end of the barrel. For odour removal applications always utilize ODORx® Thermo 55™. ODORx Application Advisory is Thermo 55 is ready-to-use and should not be diluted with water. For pest control applications be sure insecticide label permits

4.1.6.3 Thermal fogging.

For best results dry fog is recommended. The dryer the fog the smaller the droplets, resulting in improved penetration and economical treatment. Dryness of the fog is controlled by the rate of solution passing through the heating chamber. This flow rate is controlled by turning the adjustment knob clockwise for a dryer fog, and counter clockwise for a damper fog.

4.1.6.4 Specifications:

- MOTOR: Electro-Mechanical (vibrator)
- 7,200 strokes per minute
- Rating - refer to rating on plate
- PUMP: Displacement Type
- Output-Spraying: 1 ounce (30ml) per minute
- Fogging: 1,000 cubic feet (28 cubic meters) per minute

4.1.6.5 Particle Size

- Cold Spraying: 115 microns in diameter
- Fogging: 13.5 microns in diameter
- Heating element: Thermostatically Controlled
- Operating Temperature: 450° - 525°F (232°C - 274°C)
- Current: 115v = 8 amps Wattage: 900 Watts, 230v = 4 amps
- Solution reservoir: Spun Aluminium 3 quart (2.8 Litre) capacity

4.1.7 IC2 MODULE PROPERTIES

- Only 2 Arduino pins are occupied (Use I2C interface).
- Supports standard I2C mode (100Kbit/s) and fast I2C mode (400Kbit/s).
- Compatible with multiple communication logic levels: 2.8~5VDC.
- Arduino library supported, use a line of code to complete the display.
- Integrate 7 sizes of ASCll fonts, 5 graphics functions.
- Provide dedicated picture data convert software (Bitmap Converter).
- Most of the complex operation is processed by I2C_LCD independent controller, saving user controller resources.
- Supports cursor function, can set up 16 cursor flicker frequency.
- Supports 128 level backlight lightness adjustment.
- Support 64 level screen contrast adjustment.
- Support device address modification.
- Supports 127 I2C_LCD work in parallel.
- When debugging code, it can take the place of the serial monitor to monitor the program running state.
- Two abnormal recovery methods are provided: reset and restore the factory settings.
- Compatible with Grove interface and 4Pin-100mil interface (under the Grove socket).
- 4 symmetrical fixed hole design for easy user installation and China style unique appearance.

4.1.8 REAL TIME CLOCKS (RTC)

Real time clocks (RTC), as the name recommends are clock modules. The DS1307 real time clock (RTC) IC is an 8 pin device using an I2C interface. The DS1307 is a low-power clock/calendar with 56 bytes of battery backup SRAM. The clock/calendar provides seconds, minutes, hours, day, date, month and year qualified data. The end date of each month is automatically adjusted, especially for months with less than 31 days. They are available as integrated circuits (ICs) and supervise timing like a clock and also operate date like a calendar. The main advantage of RTC is that they have an arrangement of battery backup which keeps the clock/calendar running even if there is power failure.

An exceptionally little current is required for keeping the RTC animated. We can find these RTCs in many applications like embedded systems and computer mother boards, etc. In this article we are going to see about one of the real time clock (RTC), i.e. DS1307.

Pin Description of DS1307:

Pin 1, 2: Connections for standard 32.768 kHz quartz crystal. The internal oscillator circuitry is intended for operation with a crystal having a specified load capacitance of 12.5pF. X1 is the input to the oscillator and can alternatively be connected to an external 32.768 kHz oscillator. The output of the internal oscillator, X2 is drifted if an external oscillator is connected to X1.

Pin 3: Battery input for any standard 3V lithium cell or other energy source. Battery voltage should be between 2V and 3.5V for suitable operation. The nominal write protect trip point voltage at which access to the RTC and user RAM is denied is set by the internal circuitry as 1.25 x VBAT nominal. A lithium battery with 48mAhr or greater will backup the DS1307 for more than 10 years in the absence of power at 25ºC. UL recognized to ensure against reverse charging current when utilized as a part of conjunction with a lithium battery.

Pin 4: Ground.

Pin 5: Serial data input/output. The input/output for the I2C serial interface is the SDA, which is open drain and requires a pull up resistor, allowing a pull up voltage upto 5.5V. Regardless of the voltage on VCC.

Pin 6: Serial clock input. It is the I2C interface clock input and is used in data synchronization.

Pin 7: Square wave/output driver. When enabled, the SQWE bit set to 1, the SQW/OUT pin outputs one of four square-wave frequencies (1Hz, 4 kHz, 8 kHz, and 32 kHz). This is also open drain and requires an external pull-up resistor. It requires application of either Vcc or Vb at to operate SQW/OUT, with an allowable pull up voltage of 5.5V and can be left floating, if not used.

Pin 8: Primary power supply. When voltage is applied within normal limits, the device is fully accessible and data can be written and read. When a backup supply is connected to the device and VCC is below VTP, read and writes are inhibited. However at low voltages, the timekeeping function still functions.

4.1.8.1 Features:

- Programmable square wave output signal
- Automatic power-fail detect and switch circuitry
- Consumes less than 500nA in battery backup mode with oscillator running
- Available in 8-pin DIP or SOIC
- Underwriters Laboratory (UL) recognized
- Real-time clock (RTC) counts seconds, minutes, hours, date of the month, month, day of the week, and year with leap-year compensation valid up to 2100
- 56-byte non-volatile RAM for data storage
- Two-wire interface (I2C)

4.2 SOFTWARE ANALYSIS

4.2.1. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, Mac OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2.The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude*to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

4.2.1.1 Properties Of Arduinoide

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

- It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++language.

FIGURE. 4.4. ARDUINO IDE APP

FIGURE. 4.5. PROGRAM INPUT IMAGE

CHAPTER 5

CONNECTION AND PROGRAM

5.1 CONNECTION

5.1.1 Arduino UNO to RTC timer

Vcc - 5v

GND - GND

SDA - A4

SCL - A5

5.1.2 RTC timer to I2C Module

Vcc - Vcc

GND - GND

SDA - SDA

SCL - SCL

5.1.3 I2C Module to LCD display

Directly put 16 pins to LCD display

5.1.4 Arduino UNO to Temperature sensor

Vcc - 5v

GND - GND

DATA PIN - 3th pin

5.1.5 Arduino UNO to Relay 1

Vcc - 5v

GND - GND

DATA PIN - 5th pin

5.1.6 Arduino UNO to Relay 2

Vcc - 5v

GND - GND

DATA PIN - 7th pin

5.2 ALGORITHM

1. Start.
2. Check the dairy shed or farm shed temperature.
3. Conclude the temperature.
4. T < 19^0 C the fogger is off.
5. T > 19^0 C the fogger is On to control the temperature.
6. Then again to step 2.
7. The timer has conclude the time.
8. Water has feeded to the water tub at specific interval.
9. Water has supplied to the floor by timer.
10. Then again to 7.
11. The processes continues.

5.3 PROGRAM

```
#include <DS3231.h>

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include <OneWire.h>

#include <DallasTemperature.h>

LiquidCrystal_I2C lcd(0x27,16,2);

int Relay1 = 4;

int Relay2 = 6;

#define ONE_WIRE_BUS 5

OneWire oneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);

DS3231  rtc(SDA, SCL);

Time t;
```

```
const int OnHour =8;//SET RELAY ON TIMER
const int OnMin = 35;
const int OffHour = 8;//SET RELAY OFF TIMER
const int OffMin = 36;
void setup() {
  rtc.begin();
  pinMode(Relay1, OUTPUT);
  digitalWrite(Relay1, LOW);
   pinMode(Relay2, OUTPUT);
  digitalWrite(Relay2, LOW);
  lcd.clear();
  lcd.begin(16,2);
  lcd.backlight();
   rtc.setDOW(TUESDAY);
  rtc.setTime(8,34,15);    //SET TIME
  rtc.setDate(03,03,2020);
}
void loop() {
   sensors.requestTemperatures();
  float temp = sensors.getTempCByIndex(0);
  t = rtc.getTime();
  {
    lcd.print(rtc.getDOWStr());
   lcd.setCursor(1,0);
```

```
 lcd.print("10.30");
 delay (1000);
 }
 // Send date
 {
  lcd.print(rtc.getDateStr());
  lcd.setCursor(1,1);
 lcd.print("10.30 ");
delay (1000);
}
// Send time
{
lcd.println(rtc.getTimeStr());
  lcd.setCursor(1,0);
 lcd.print("10.30 ");
 delay (1000);
}
 if(t.hour == OnHour && t.min == OnMin){
   digitalWrite(Relay1,HIGH);
   lcd.setCursor(1,0);
   lcd.println(" MOTOR ON   ");
   delay (1000);
   }
   else if(t.hour == OffHour && t.min == OffMin){
```

```
    digitalWrite(Relay1,LOW);
    lcd.setCursor(1,0);
    lcd.println("MOTOR OFF");
    delay (1000);
   }
  if(temp>=28)
{
 digitalWrite(Relay2, HIGH);
 Serial.print("temp");
Serial.print("Motor ON ");
}
else if(temp<=28)
{
 digitalWrite(Relay2, LOW);
Serial.print("temp");
Serial.print("Motor OFF");
}
}
```

CHAPTER 6

RESULT AND DISCUSSION

6.1 CIRCUIT CONNECTION

The circuit connections are given and testing images are given below,

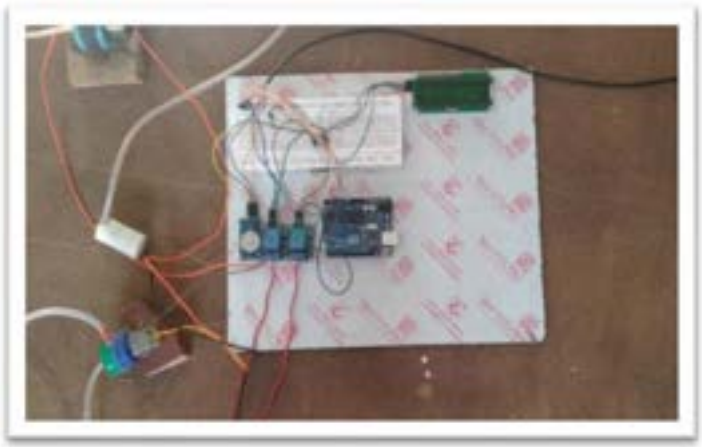

FIGURE. 6.1. ASSEMBLING OF COMPONENTS

FIGURE. 6.2. TESTING

6.2 WORKING PROCEDURE

While testing the output can be read in the Serial monitor of the Arduino. When the temperature level is above 85 degree Fahrenheit it will indicate as "Temperature level high", and if the temperature level is below 22° C degree then it will indicate as "Temperature level and cooling pump is off".

In the above the 22° C indicate the temperature level and cooling pump is on.

The output in the serial monitor is given below as images,

FIGURE. 6.3. DISPLAY IN SERIAL MONITOR

By program automatically water has pumped for some intervals to water feeder and cleaning the sheds at the perfect interval with the help of relay, it has been successfully checked.

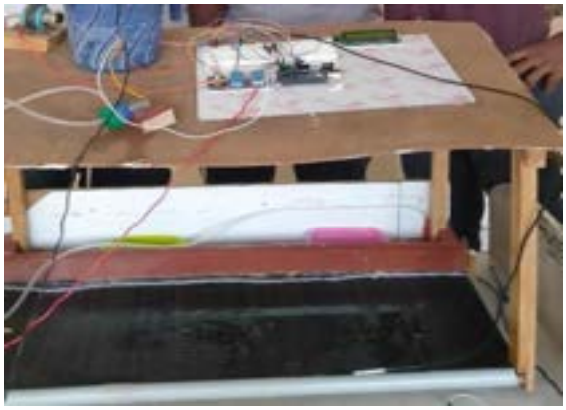

FIGURE. 6.4. WORKING MODEL

CHAPTER 7

CONCLUSION

We could that "AUTOMATION IN DAIRY FARM IN SMALL SCALE". Automation is useful for maintain the temperature or control the temperature in dairy farm.

From the result the fogger on automatically by using sensor. By using the automation it is possible to monitor the agriculture and its allied sector. The large number of farmer are now wanted a caution alert system. The combination of Arduino UNO and temperature senor can able to monitor the surrounding temperature. By implementing the automated monitoring system there is various benefits to the farmer. The cattle rearing is done every farm as for their additional income. Hence the Automation of dairy farm can also be key to maintain their income without decreasing. This also plays a big part in the integrated farm management. This automated system can be applicable for goat and sheep rearing and horse stable.

REFERENCES

1. Belsare.V.P, VyasnPandey, "Management of heat stress in dairy cattle and buffaloes for optimum productivity", Special Issue 2, on Journal of Agrometerology, 2008.
2. Carvallo N, Stefanelli R., Trinchero D., "Wireless interfaces for sensor networks embedded in tough environments", URSI – EMTS, Hiroshima, Japan, May 20-25, 2013.
3. Farooq.U, Samad.H.A, Shezad.F, Qayyam.A, "Physiologicl Responses of Cattle to Heat Stress", Vol. 38, Issue 43, 2010.
4. Jyotimala Sahu et.al, "International journal of Advances in Agricultural Science and Technology", Vol.6, Issue 2, 2019, ISSN: 2348 1358.
5. Kalyan Mohan Goli, Karthik Madidipatla, Thentu Sravani, "Integration of Wireless Technologies for Sustainable Agriculture", on IJCST,2011
6. Mahesh M. Galgalikar, "Real-Time Automization Of Agricultural Environment for Social Modernization of Indian Agricultural System", on IEEE Proceedings,2010.
7. Mahmoud Shaker, Ala's Imran, "Greenhouse Micro Climate Monitoring based on WSN with Smart Irrigation Technique", Vol.7, on IJECEECE, 2013.
8. Mohammad Ali, "Cattle and Dairy Farm Management", on IRJET, Vol. 4, Issue 2, Feb 2017.
9. Prathap Pragna, Manimaran.A, Beena.V, et.al, "Heat Stress and Dairy Cattle: Impact on Both Milk Yield and Composition", on International Journal Of Dairy Science, 2016.
10. Saha.T, Jewel.M.K.H, Ali.M.S, M.S.Raman.M.S, "Constructio and Development of an Automated Greenhouse System Using Arduino Uno", Vol. 1, Issue 8, on IJIEE, 2017.
11. Zare Shahneh.A, Masoumi.R, "Alterations in Reproductive Hormones During Heat Stress in Dairy Cattle", Vol.10, Issue 29, June 2011.
12. Emerson M. Babb (1981), "Analysis of Regional Milk Prices and Production Costs", Journal of Dairy Science, Volume 64, Issue 10, October, Pp. 20432047.
13. Morgan, Russell M., and Luther H. Keller (1987), "Economic Comparisons of Alternative Waste Management Systems on Tennessee Dairy Farms", Bulletin

656, University of Tennessee Agricultural Experiment Station, Knoxville.

14. Oltenacu P.A., Smith T.R., and Kaiser H.M. (1989), "Factors Associated with Seasonality of Milk Production in New York State" Journal of Dairy Science, Volume 72, Issue 4, April, Pp. 1072-1079.
15. Garsow, James D. and Sherrill B. Nott (1992), "Impact of Michigan Dairy Manure Handling Alternatives", No. 561, Department of Agricultural Economics", Michigan State University, East Lansing.
16. Hansen, Brandon D (1993), "An Economic Model for Analyzing Alternative Dairy Waste Handling Systems," M.A. thesis, Department of Agricultural Economics, Washington State University, Pullman, December.
17. Ntengua Mdoe, Steve Wiggins (1996), "Dairy products demand and marketing in Kilimanjaro, Tanzania", Food Policy, Volume 21, Issue 3, July, Pp. 319-336
18. Isabelle Schluep Campo and John Beghin (2005), "Dairy Food Consumption, Production, and Policy in Japan", Center for Agricultural and Rural Development (CARD) at Iowa State University, Pp. 44-55.
19. Denford Chimboza and Edward Mutandwa (2007), "Measuring the determinants of brand preference in a dairy product market" African Journal of Business Management Vol. 1, No. 9, December, Pp. 230-237
20. Hasan Cicek, et al. (2007), "Effect of some technical and Socio-Economic Factors on Milk Production Costs in Dairy Enterprises in Western Turkey" World Journal of Dairy and Food Sciences, Vol. 2, No. 2, Pp. 69-73.
21. Doyon. M., Criner. G. and Bragg. L.A. (2008), "Milk Marketing Policy Options for the Dairy Industry in New England" Journal of Dairy Science, Volume 91, Issue 3, March, Pp. 1229-1235.
22. Kedija Hussen1, Mohammed Yousuf1 and Berhanu Gebremedhin (2008), Paper on "Cow and camel milk production and marketing in agro-pastoral and mixed crop-livestock systems in Ethiopia", Conference on International Research on Food Security, Natural Resource Management and Rural Development held at University of Hohenheim, on October 7-9.
23. Rhone A., Ward R., De Vries A. and Elzo. M.A. (2008), "Comparison of two milk pricing systems and their effect on milk price and milk revenue of dairy farms in the Central region of Thailand", Tropical Animal health and production, Vol:40,

No:5, Pp:341-348.

24. Daniel R. Block (2009) "Public health, cooperatives, local regulation, and the development of modern milk policy: the Chicago milkshed 1900-1940" Journal of Historical Geography, Volume 35, Issue 1, January, Pp. 128-153.

APPENDIX I

COST ESTIMATION

COMPONENTS	AMOUNT
Arduino UNO	Rs.500
Relay	Rs.200
Temperature Sensor	Rs.150
Submergible Mini Pump	Rs.300
Fogger And Accessories	Rs.100
TOTAL COST	Rs. 1,250

PLATES

PLATE 1. DAIRY FARM BASE STRUCTURE

PLATE 2. DAIRY FARM FEEDING SECTOR

PLATE 3. DAIRY FARM WITHOUT ROOF STRUCTURE

PLATE 4. DAIRY FARM WITH ROOF STRUCTURE SIDE VIEW

PLATE 5. DAIRY FARM WITH ROOF STRUCTURE FRONT VIEW

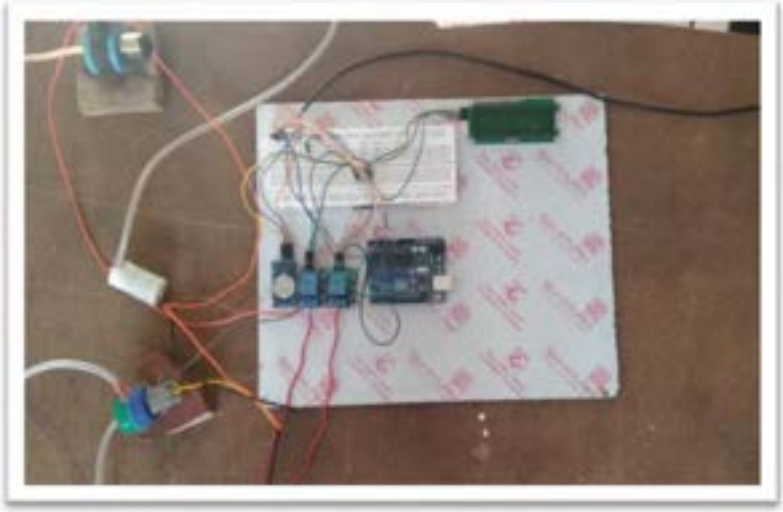

PLATE 6. CONNECTIONS OF HARDWARE

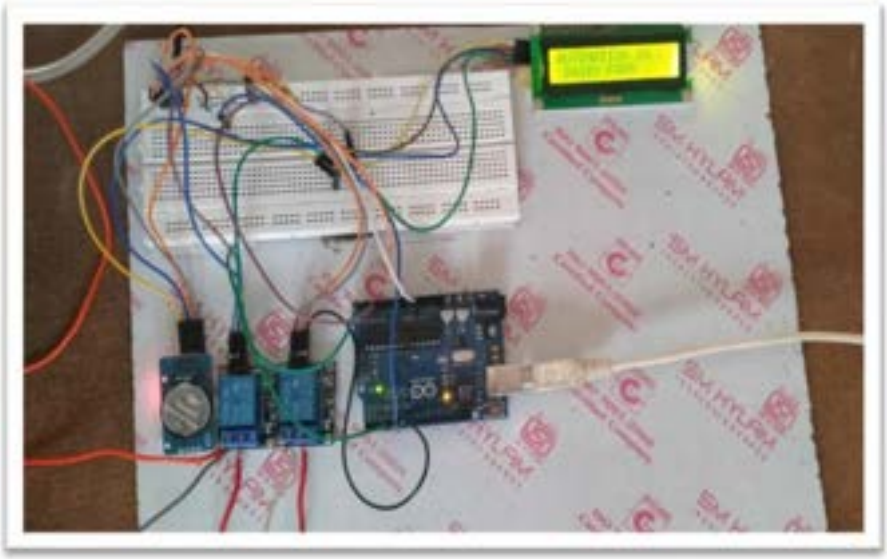

PLATE 6. TESTING

DESIGN AND FABRICATION OF SUGARCANE CHIPPING CUM PLANTING MACHINE

A PROJECT REPORT

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(AUTONOMOUS)

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ABSTRACT

Sugarcane planting is a very labour intensive job and involves considerable human drudgery. Cost of sugarcane planting by mechanized method is less compared to traditional methods. It also reduces drudgery involved in unit operations of sugarcane planting. The reduction in cane yield owing to delayed planting cannot be compensated by additional inputs viz., frequent irrigations, extra fertilizers and inter culture operations. In order to achieve uniform crop stand, correct seed rate, appropriate depth of setts placements and uniformity of setts with required overlapping are important. These, however can better be achieved by using tractor-drawn sugarcane cutter planter apart from economizing labor and energy. Thus, recently developed sugarcane cutter planters are getting very good acceptance amongst sugarcane cultivators. Generally planting of any crop is very much important as far as the crop growth and yield is concern. This project describes regarding the design refinement of a sugarcane cutter planter and its prototype development. In this machine, the complete sugarcane, which is fed by the laborers sitting on the machine, is cut automatically into pieces before dropping into furrows. It also opens the furrows, applies fertilizer, chemical and fungicide and also covers the sets and presses it automatically. It is operated completely by a manual force.

Key words: *Human drudgery, Intercultural operations, Prototype.*

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LIST OF ABBREVATIONS AND SYMBOLS

ABBREVATIONS

QBC	-	Quality bearing and components
SMAW	-	Shielded Metal Arc Welding
MS	-	Mild Steel
CU	-	Copper
DC	-	Direct current

SYMBOLS

Mt	-	Torque N-m.
Hb	-	Brinell hardness number.
Cb	-	Coefficient dependence on hardnes.
Kcl	-	Life factor.
n	-	No.of.rotations.
N	-	Life no of cycles.
T	-	Life in hours.
fd	-	Downward force
fc	-	Centrifugal force
E1, E2	-	Young`s modulus

LIST OF FIGURES

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Sugarcane, an important agro-industrial crop in India, plays a vital role in national economy by contributing 1.9 per cent to GDP. The crop is cultivated in 4.22 m ha producing 300 tonnes with a productivity of 75-80 t/ha. However, there have been fluctuations in area as well as productivity over the years on account of several factors. Generally gur (Jaggery) and sugar are prepared from sugarcane. Sugarcane is propagated from cuttings, rather than from seeds. Although certain types still produce seeds, modern methods of stem cuttings have become the most common method of reproduction. Each cutting must contain at least one bud, and the cuttings are usually planted by hand. There are various methods of sugarcane planting like flat, trench, pit, staggered row and spaced transplanting. Hand harvesting accounts for more than half of the world's production, and is especially dominant in the developing world. Sugarcane planting requires about 350 men/hours and 30-40 bullock pairs per hour per hectare. Mechanization of sugarcane harvesting is an essential input to the modern agriculture, as it enhances better productivity, besides reducing human drudgery and cost of cultivation. Cost of sugarcane cultivation by mechanized process is almost one third of complete manual process.

Thus sugarcane planter cutters are getting great response from farmers, due to the reduction of drudgery involvement in unit operations, i.e. sett preparation, carrying of seed cane, opening of furrows, dropping of setts. But the majority of small scale industries in India, presently engaged in manufacture of agricultural implements are lacking design capability, for manufacturing its components, proper selection of materials and metallurgical treatments, proper tolerances for components and assembly methods to ensure quality durability and reliability. Moreover, these industries do not have R & D facilities and qualified manpower to produce quality products. Considering above points in mind, development of manually operated sugarcane chipping cum planting was undertaken based on the needs of farmers. The major sugarcane growing areas are Maharashtra, Tamilnadu and other few developed states of India. The planters manufactured in India are trailing type and PTO driven. Based on the survey conducted, it was decided to study the PTO driven

machines and make design refinement for quality manufacture of these machines. The tooling should be easily interchangeable to solve the problems of replacement of parts during breakdown. If tooling is standardized manufacture of components will be at reduced cost. During entire design refinement process following points was considered in detail:

- Uniform setts cutting and placement in the furrow.
- Manufacture of standardized components to ensure interchangeability of components.
- Desirable bund former design to obtain required depth for dropping sugarcane setts.

1.2 OBJECTIVE

The goal of this project is to design and fabricate a simple low cost sugarcane chipping cum planting machine which will greatly help the small scale farmers of India.

The main objectives of the project are:

1. To design and develop a low cost sugarcane chipping cum planting machine.
2. To reduce the labor cost.
3. To ensure timely planting of sugarcane setts.
4. To reduce human errors while planting setts.
5. To reduce human drudgery.

It will also lead to the reduction in production cost of sugarcane by reducing the labour cost and also it will minimize the losses that occur due to the delay in timely planting of sugarcane and manual errors while planting.

1.3 NEED OF THE PROJECT

The sugarcane cultivating farmers these days are greatly affected by the high production cost involved in the cultivation of sugarcane. The high cost involved in the cultivation is generally associated with high labour cost. In addition the yield of the sugarcane is also mainly affected due to the delay in timely planting of sugarcane setts and the error that is caused while planting the setts. So it becomes a major concern to eradicate all these problems. Which inspired us to innovate a machine which brings solution to all these problems.

1.4 PROBLEM IDENTIFICATION

Basically in villages we could able to see that most of the small scale farmers who cultivates sugarcane will start hiring labours for the planting works from one month prior to

the date of planting. He/She is also forced to pay large sum of money bargained by the labours for the work. This generally lead to high production cost of cultivation of sugarcane. In addition to this the farmers also suffer from low yield caused due to the delay in timely plantation of sugarcane setts and the manual error caused by the labours while planting the setts. These are all the major problems which we came across while observing and conversing with sugarcane cultivating farmers. This forced us to design and develop a machine which finds solution to all these problems for the welfare of sugarcane farmers and their productivity.

1.5 OUR WORK IN THE PROJECT

Our work in this project involves integrating all the knowledge gained in our course to find a solution to the problem by seeking ideas from various projects and experts and finally designing and developing an innovative machine which eradicates most of the problems faced by the sugarcane cultivating farmers of our country and to increase the overall sugarcane productivity of our nation.

1.6 EXPECTED OUTCOME

By implementing this project the cost of cultivating the sugarcane is greatly reduced. The losses that arise out of delayed plantation of sugarcane and germination that decreases due to improper placements of setts as a result of human error can be reduced. Overall implementing this machine in general reduces the market price of sugarcane and increases the overall sugarcane productivity.

CHAPTER 2

LITERATURE REVIEW

Dr.ManishKumar *et al* (2018) reported, "A BRIEF STUDY ON DIFFERENT TYPES OF SUGAR CANE PLANTERS IN INDIA" Sugarcane (*Saccharum officinarum L.*) is an important cash crop and cultivated between 320N to 320S latitude covering more than 90 countries of the world. Sugarcane contributes about 64.6%of the total world sugar production. India is one of the greatest producers of sugar and has a neck-to-neck race with Brazil for the first position. The sugar industry is an instrumental in generating the sizable employment in the rural sector directly and through its ancillary units.

It is estimated that about 50 million farmers and their dependents are engaged in the cultivation of sugarcane and about 0.5 million skilled and unskilled workers are engaged in sugar factories and its allied industries.Wheat-sugarcane-Raton cropping system is followed in whole of western Uttar Pradesh and lower parts of Uttrakhand where sugarcane is the main cash crop and wheat is the major cereal. The system accounts for more than 60% of the total cultivated area in the region. However, lower average yield of planted cane (50 tonnes/ha) recorded in this

In this paper we studied the performance of the different types of sugarcane cutter planters used in India. The main objective of this paper is to study the different. This project greatly helped us in gaining knowledge about different sugarcane planters available in India their working principles and their function which gave us a numerous no. of ideas in designing the project.

Subrata Kumar Mandal *et al* (2016) reported "DESIGN REFINEMENT OF 2 ROW TRACTOR MOUNTED SUGARCANE CUTTER PLANTER."Sugarcane planting is a very labour intensive job and involves considerable human drudgery. Cost of sugarcane planting by mechanized method is less compared to traditional methods. It also reduces drudgery involved in unit operations of sugarcane planting. Thus, recently developed sugarcane cutter planters are getting very good acceptance amongst sugarcane growers generally planting of any crop is very much important as far as the crop growth and yield is concern.

This paper describes regarding the design refinement of a sugarcane cutter planter and its prototype development. In this machine, the complete sugarcane, which is fed by the laborers

sitting on the machine, is cut automatically into pieces before dropping into furrows. It also opens the furrows, applies fertilizer, chemical and fungicide and also covers the sets and presses it automatically. It is operated by 35 hp tractor and has 2 units.. The set length was 31.8 cm with an average overlap of 6.48 cm observed at the speed of 2.5 km/hr. The seed rate capacity of machine was found 5.55 tons per ha.

This research had made us to use readymade fabricated parts so that easy replacements of the parts in any case of repair can be easily done. The implement also designed in such a type so that the traction between soil and the tool does not harm any parts of the implement due to the frictional force between the soil and the tool. This project gave us an innovative idea in various areas of designing the machine this also gave us a materialistic approach to deal with the project.

Vaibhav.V *et al* (2015) reported "DESIGN AND FABRICATION OF MULTIPURPOSE MACHINE FOR SUGARCANE PLANTING."India is a major producer of the sugarcane in the world and during 2009-10 it produced 18.9 million tons of sugar, which was nearly 11.8 % of the total sugar production of the world. So there is large space for development in sugarcane plantation. In conventional method of planting sugarcane sets are planted manually in furrows. This process is very much time consuming and labour intensive. So we developed the new machine which cuts the sugarcane and feeds into furrow as well as feeding of fertilizer and spraying pesticide is done automatically.

We use the cam operated mechanism with rotary cutter which cuts the sugarcane in uniform length and fed into the furrow due to gravitational force automatically. So piece of the sugarcane is distributed uniformly in the furrow so density of the sugarcane production is uniform. In traditional method fertilizer is spread by the hand so the density of feeding fertilizer is varies as per the worker which leads to extra supply of fertilizer.

This paper clearly explains the mechanism which feeds the fertilizer in uniform quantity. So after all processes leveler spreads the soil on pieces of sugarcane in the furrow. The main objective behind developing this machine is to fabricate a cost effective sugarcane planting machine which is suitable for Indian conditions where the land holding of the farmer is very small. This paper laid the foundation to our idea in combining both cutting and planting of sugarcane in a single machine. The principle of multipurpose design of this project gave us the innovative idea to combine all operations required for sugarcane plantation in our design.

A.K.Sharma *et al* (2013) reported "STUDY OF SUGARCANE PLANTING TECHNIQUES." The various layouts like flat bed planting, furrows at various spacing,

paired row planting and ring pit method of planting are being used in different parts of the world. Row spacing may range from 3 to 7 feet (91-213 cm). The choice of spacing depends on local conditions and varieties. This was also supported by many experiments at different locations at different period. Bhullar (2002) concluded that in India under late sown conditions, planting in furrows in paired rows (60 x 30 cm using 75,000 three budded setts-ha-1), was the most beneficial method of planting. Planting of sugarcane at row pacing of 75 and 90 cm being at par produced significantly higher cane and sugar yield. The buds of one budded placed upward gave 72.2% germination than the buds placed sideways (69.43%), and downward (23.61 %), (Fishier and Malik, 1992). The buds positioned downward always give poor germination and much delayed emergence of shoots. The researchers also tested the yield of the sugarcane by planting it with 1 to 6 eyes or bud in it. The observations of various yield was noted down respectively.

This project gave us a thorough knowledge about various sugarcane planting techniques and kind of techniques that is to be followed to obtain a maximized yield is clearly dealt with the project. The spacing specified here in this project was followed in the designed machine by attaching the bund former to the exact position so as to promote the machine with further advantage of enhancing good yield. And the machine also designed in such a way that the setts that are falling on the field falls in upward direction so that maximum yield up to 70% as mentioned in this paper can be obtained.

Prof. S.N.Waghmare *et al* (2011) reported "A REVIEW AND ANALYSIS ON MULTIPURPOSE FARM MACHINERIES." The objective is to design a project for small scale farmers. And in one machine multi functions can be performed with cheap cost as compared to other agriculture machine. So that it is not essential that a skilled person to operate it. Mechanism of the machine should be very simple for gardening and small scale farming. It consists of an internal framework that supports a man-made object in its construction and use. It is analogous to an animal's skeleton. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). If the running gear such as wheels is included then the assembly is described as a rolling chassis. The chassis is considered to be one of the significant structures of an automobile. It is the frame which holds both the body of machine and the power train. Various mechanical parts like the engine and the drive train, the axle assemblies including the wheels, the suspension parts, the brakes, the steering components, etc., are bolted onto the chassis. Based on the overall performance of the machine we can definitely say that the project will satisfy the need of small scale farmer, because they are not able to purchase costly agricultural equipment.

The machine required less man power and less time compared to traditional methods, so if we manufacture it on a large scale its cost gets significantly reduce and we hope this will satisfy the partial thrust of Indian agriculture. So in this way we solve the labour problem that is the need of today's farming in India.

This machine gave us an idea to design a machine which is suitable for the small scale farmers of India as it reduces the cost of labour and greatly decreases the human drudgery and helps in timely operation. Further a particulate extension of this machine is made so as to fix sensors to make it fully automatic in future premises. This paper clearly dealt with the mechanism involved in designing multipurpose farm machineries. The various mechanisms behind combining the various activities on to a single platform were clearly explained in a simple and crispy manner along with various experimentations and observations. This paper also made us to think the possibilities of combining various equipments on to single parts and made them to work without any wear and tear.

R.K.Verma *et al* (2009) reported "**A STUDY ON FARM TOOLS AND EQUIPMENTS AND ITS DESIGN."** The study was conducted in the selected farm machine manufacturing companies in India. A total one hundred farm machine enterprises all over the India also taken into consideration (25 in each village) were randomly selected from the 22 states of India. Information related to indigenous tools used by them and other socio-personal traits were collected through interview schedule and focus group discussions. Most commonly used traditional agricultural tools and implements in various tribal dominating villages are illustrated in the study, which includes English or local name, description and their usages. A qualitative research approach was adopted for the study. In India, tribal farmers have been using a variety of traditional tools and implements for agricultural practices. The percentage distribution of traditional tools used by the tribal population of selected villages in Odisha and West Bengal.

This paper clears the fact that the *khurpa, sickle, daw*, *silnora, kula, jhuri* and *paniki* were found in every household. Spade was used by all households in Uttar Simlabari of West Bengal followed by 96, 72 and 56% household of Phatepur, Mobarakpur and Baredeswar of Odisha, respectively. It was observed that some of the tools like weed rack, hand stone mill, paddy spader, *bankua* and *khalui* were only found at Uttar Simlabari of West Bengal. From these observations we have found the types of tools that are available locally and ideas to perform little changes in the tools to make digger with digs the field with proper depth as per the optimum requirement of the sugarcane setts.

Punmia bhagat *et al* (2007) reported "**MOTION AND KINEMATICS OF FARM TOOLS AND EQUIPMENTS."** The development of guidance systems for agricultural vehicles receives more and more attention from researchers and manufacturers. The motivations are numerous; since automatic guidance reduces the work arduousness insures an optimal work precision throughout the day and on the whole field. For instance, it enables the exact placement of field inputs (seeds, fertilizers, pesticides) allows to operate wider tools at higher speeds, and therefore it can increase productivity. Many experiments have been conducted and reported in the literature. They can be classified into 2 categories, according to the kind of sensor to be used. The first category uses relative information. Researchers have focused for instance on the video camera sensor. Two kinds of difficulties arise: the first one is the reference extraction conditions of dust, for example, reveal the weakness of the detection side. The other problem arises when the new reference is computed in an iterative way from the previous one. The automatic guidance system can lead to oscillations. The tractor is assumed to move on a horizontal ground.

This paper enabled us in understanding the various kinematics involved in the operation of farm machineries. The curve linier motions and other complex kinematics which are involved in the functioning of the farm machineries are dealt clearly in this paper. The knowledge gained in this paper forms the base of the designing the conversion of rotary motion of the wheel into linier motion of the blade that involved in chipping operation. This paper also helped us in understanding the tractional force that involved between the machinery and soil and ways to reduce it for efficient operation.

Prof.Shivpratap *et al* (2005) reported "AN ANLYSIS ON TRACTOR OPERATED BUND FORMER AND ITS OPERATIONS."In mechanized farm, bund is prepared by a bund former either operated by tractor or animals for irrigation purposes and also to demarcate the fields. Tractor operated bund formers are normally either disc -or mould board or forming board type. If bund is formed with the help of traditional bund former, however, shaping and packing of bunds is done manually using spade and feet. To overcome the drudgery involve in these operations, a tractor operated bund former-cum-packer was designed and developed. An attempt is made for enabling the combined operations of bund forming and packing in single pass that can save fuel, time and other resources further.

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY FLOWCHART

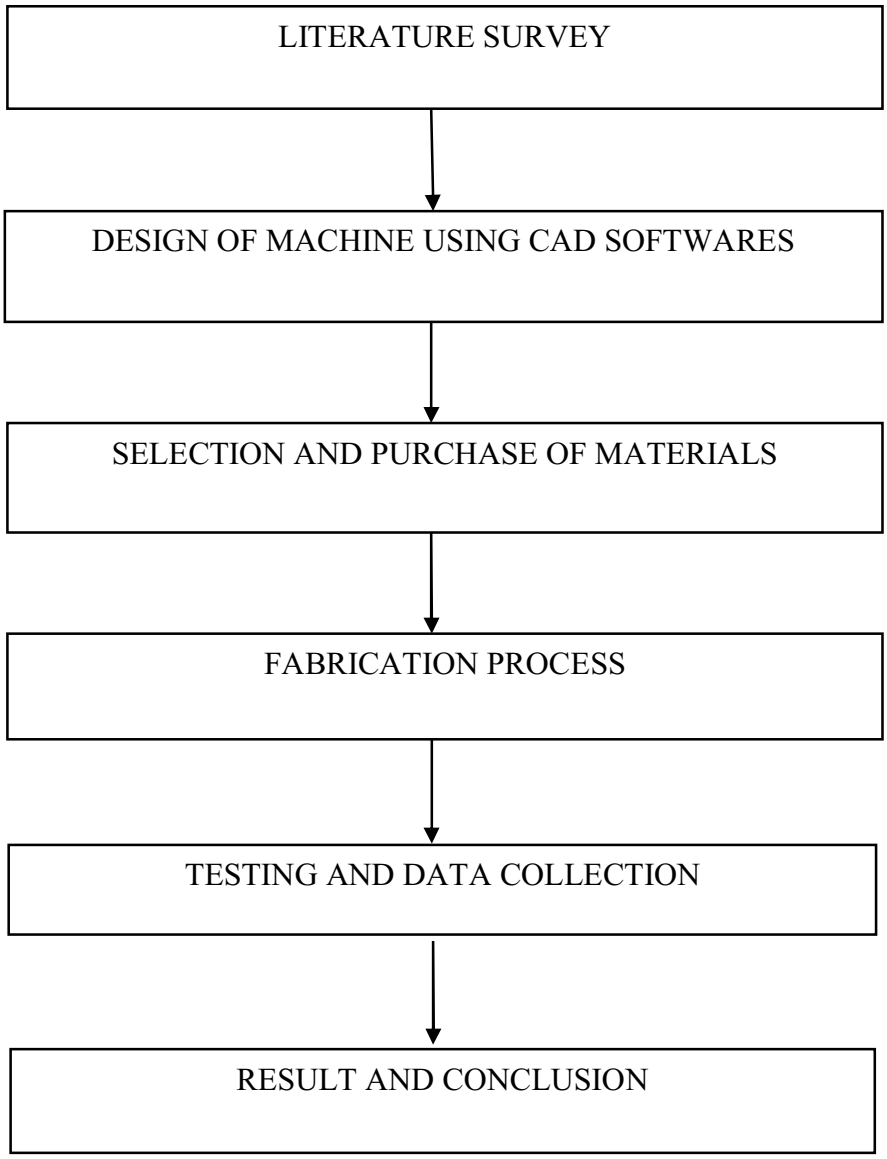

FIG 3.1 METHODOLOGY FLOWCHART

3.2 LITERATURE SURVEY

Literature review forms the base of any project. Various research journals, research papers, scientific journals of authors in India and around the world have been reviewed before starting the project. The major demand of the farmers and technical way of solving them was taken into account. The related projects which have been done earlier were keenly observed. The ideas of this project were taken from various research papers and previous projects which are then combined together to derive extraordinary solution for the problems faced.

3.3 DESIGN OF MACHINES USING CAD SOFTWARES

Engineering drawing is known as the language of engineers. The innovative idea which arises in the mind can be clearly explained only if that idea has been neatly sketched. Thus CAD software's help us a way of doing such drawings in an accurate and easy manner, hence forth the ideas was crafted into designs using this software. AUTOCAD 2020 and SOLID WORKS 2020 are the software's that are used in crafting this project. This forms the basis of designing any machine.

3.4 SELECTION AND PURCHASE OF MATERIALS

Selection of materials forms the basis of fabrication works. This also constitutes a major part in deciding the cost of the project. A clear idea has been made before purchasing of the raw materials. Things such as measurement of materials, properties of materials, cost of materials that is to be purchased should be planned and decided at the beginning stage of the project. Discussion with professors and local people will help us in sorting out the doubts which arises at this stage.

3.5 FABRICATION PROCESS

It is the main and complicated stage of any project, a special guidance from the project guide and other experts are required at this stage. Each and every step should be taken in cautious manner. The purchased raw materials were involved in many processes such as cutting, welding, drilling etc to be made into a desired project. Some change in the idea of design may occur at this stage of this due to the failure of preplanned process. This is the most time consuming stage and it must begin as soon as possible to get rid of delayed completion of work.

3.6 TESTING AND DATA COLLECTION

After the fabrication work was over it is the time for testing the machine on the field. The machine that is fabricated is supposed to be tested in the field to check its

efficiency. Testing is an important stage of the fabricated machine so that a conclusion can be made that whether that machine can be put into practical application or not. Further any problem that arises during the operation of the machine can be clearly noticed and necessary modification to overcome those problems can be taken.

3.7 RESULT AND CONCLUSION

This is the final stage of the project were the final result and efficiency of the machine should be specified. The information's such as no. of. Hectares that can be planted in an hour, the amount of human drudgery involved in operating the machine, maintenance required, name of the spare parts and their availability, safety measures that are to be followed while operating the machine etc are supposed to be specified in this area. This area determines that whether the project has the capability to put into practical applications or not is determined. The success of a project depends upon its final result.

CHAPTER 4

DESIGN AND FABRICATION

4.1 AUTOCAD DESIGN

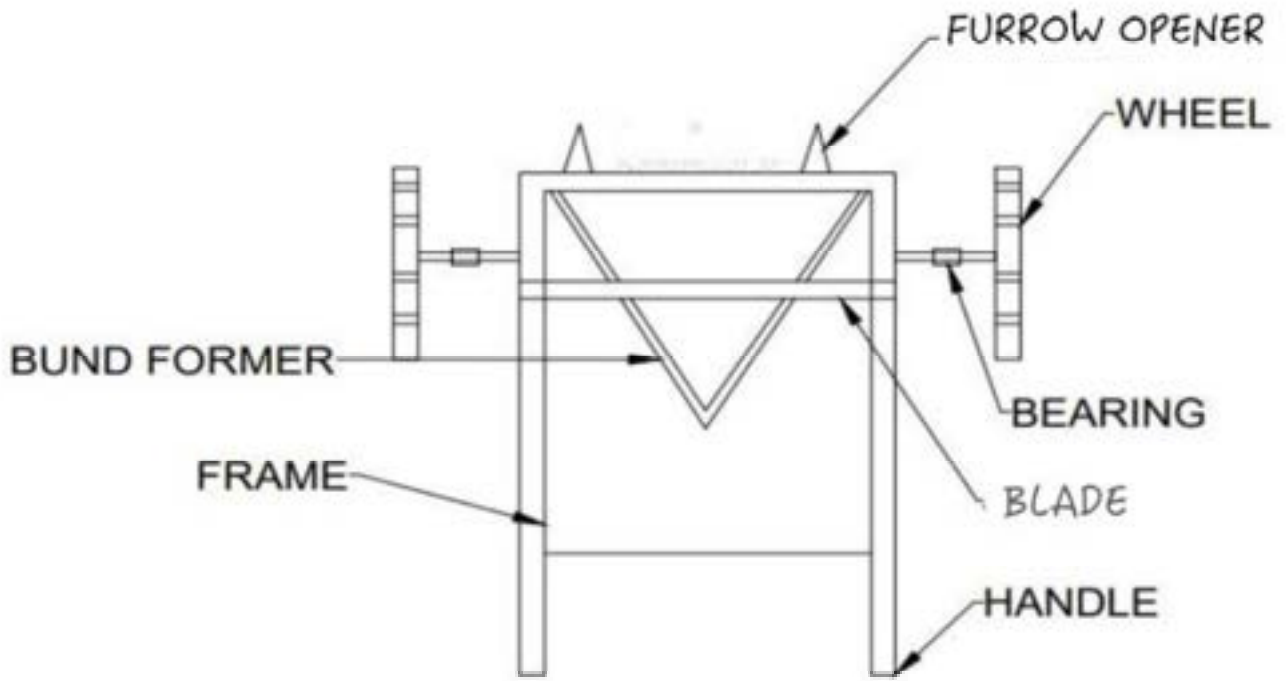

FIG 4.1 MACHINE DESIGN

4.2. COMPONENTS AND DESCRIPTION

1. Sheet metal
2. Blower
3. Crank shaft
4. Shaft
5. Wheel
6. Frame
7. Metal strip
8. Bearing
9. Disk

4.2.1 SHEET METAL

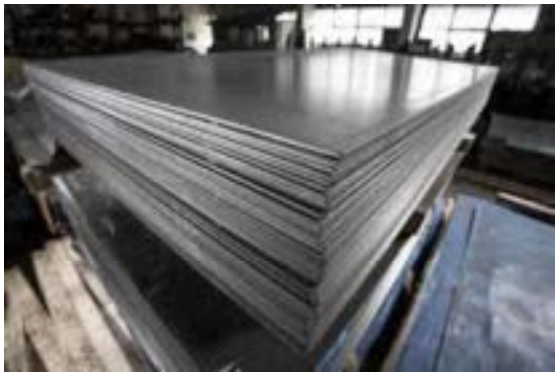

FIG 4.2 SHEET METAL

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal is available in flat pieces or coiled strips. The coils are formed by running a continuous sheet of metal through a roll slitter. There are many different metals that can be made into sheet metal, such as aluminum, brass, copper, steel, tin, nickel and titanium. For decorative uses, important sheet metals include silver, gold, and platinum (platinum sheet metal is also utilized as a catalyst.)

Sheet metal is used in automobile and truck (lorry) bodies, airplane fuselages and wings, medical tables, roofs for buildings (architecture) and many other applications. Sheet metal of iron and other materials with high magnetic permeability, also known as laminated steel cores, has applications in transformers and electric machines. Historically, an important use of sheet metal was in plate armor worn by cavalry, and sheet metal continues to have many decorative uses, including in horse tack. Sheet metal workers are also known as "tin bashers" (or "tin knockers"), a name derived from the hammering of panel seams when installing tin roofs

Sheet metal is used to make the table.

Material - Mild steel

Size - 40*15cm

Thickness - 1mm

4.2.2 BLOWER

A centrifugal fan is a mechanical device for moving air or other gases in a direction at an angle to the incoming fluid. Centrifugal fans often contain a ducted housing to direct outgoing air in a specific direction or across a heat sink; such a fan is also called a blower fan, biscuit blower, or squirrel-cage fan (because it looks like a hamster wheel). These fans increase the speed and volume of an air stream with the rotating impellers. Centrifugal fans use the kinetic energy of the impellers to increase the volume of the air stream, which in turn moves against the resistance caused by ducts, dampers and other components.

FIG 4.3 BLOWER

Centrifugal fans displace air radically, changing the direction (typically by 90°) of the airflow. They are sturdy, quiet, reliable, and capable of operating over a wide range of conditions. Centrifugal fans are constant-displacement or constant-volume devices, meaning that, at a constant fan speed, a centrifugal fan moves a relatively constant volume of air rather than a constant mass. This means that the air velocity in a system is fixed even though the mass flow rate through the fan is not. Centrifugal fans are not positive-displacement devices and centrifugal fans have certain advantages and disadvantages when contrasted with positive-displacement blowers: centrifugal fans are more efficient, whereas positive-displacement blowers may have a lower capital cost. The centrifugal fan is one of the most widely used fans.

Centrifugal fans are by far the most prevalent type of fan used in the HVAC industry today. They are often cheaper than axial fans and simpler in construction. They are used in

transporting gas or materials and in ventilation systems for buildings and vehicles. They are also well-suited for industrial processes and air pollution control systems. The centrifugal fan has a drum shape composed of a number of fan blades mounted around a hub. As shown in the animated figure, the hub turns on a driveshaft mounted in bearings in the fan housing. The gas enters from the side of the fan wheel, turns 90 degrees and accelerates due to centrifugal force as it flows over the fan blades and exits the fan housing Backward-curved blades, curve against the direction of the fan wheel's rotation. Smaller blowers may have backward-inclined blades, which are straight, not curved. Larger backward-inclined curved blowers have blades whose backward curvatures mimic that of an airfoil cross section, but both designs provide good operating efficiency with relatively economical construction techniques.

These types of blowers are designed to handle gas streams with low to moderate particulate loadings. They can be easily fitted with wear protection but certain blade curvatures can be prone to solids build-up. Backward curved wheels are often heavier than corresponding forward-curved equivalents, as they run at higher speeds and require stronger construction. Backward curved fans can have a high range of specific speeds but are most often used for medium specific speed applications—high pressure, medium flow applications Backward-curved fans are much more energy efficient than radial blade fans and so, for high power applications may be a suitable alternative to the lower cost radial bladed fan.

4.2.3 CRANK SHAFT

A crankshaft related to crank is a mechanical part able to perform a conversion between reciprocating motion and rotational motion. In a reciprocating engine, it translates reciprocating motion of the piston into rotational motion whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion. In order to do the conversion between two motions, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach. It is typically connected to a flywheel to reduce the pulsation characteristic of the four-stroke cycle, and sometimes a torsional or vibrational damper at the opposite end, to reduce the torsional vibrations often caused along the length of the crankshaft by the cylinders farthest from the output end acting on the torsional elasticity of the metal.

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FIG 4.4 CRANK SHAFT

A crankshaft for vessel engine is one of the most vital parts for ships. Crankshafts are roughly classified into two categories; built-up type crankshafts for 2-cycle diesel engines and solid type crankshafts for 4-cycle diesel engines. Built-up type crankshafts are made by shrink fitting journals to crank throws for the numbers of cylinders and are widely used for marine diesel engines with cylinder bore-diameters larger than approx. 400 mm. The two oil shocks forced low speed, two cycle, engine manufacturers to pursue lower energy consumptions and lower fuel costs. As a result, the engine strokes have become longer and the cylinder pressures have become higher. Also, the recent increasing size of ships has resulted in a requirement for higher powers and, at the same time, the needs to reserve maximum cargo space require downsizing of engines. The technical trend in the low-speed engine requires the built-up type crankshafts to have higher strength and higher reliability. Solid type crankshafts are press-formed from steel ingots and are used for mid- to high-speed, four cycles, engines with cylinder bore-diameters of less than 600 mm. Several developments are progressing for the 4 cycle engines to improve overall efficiencies. These include higher cylinder pressures, longer strokes and utilization of exhaust energy. As in the case of built-up type crankshafts, longer strokes and down-sizing are required for solid type crankshafts. An important requirement for solid type crankshafts is strength. Some of the engines employ materials with strength as high as 950 MPa. Along with the strengthening of materials, higher reliabilities are required more than ever for the crankshafts. This article describes the technical history of crankshaft materials and refers to notable trends in their technical developments.

4.2.4 SHAFT

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force. Design of shaft primarily involves in determining stresses at critical point in the shaft that is arising due to aforementioned loading. Other two similar forms of a shaft are axle and spindle. Axle is a non-rotating member used for supporting rotating wheels etc. and do not transmit any torque. Spindle is simply defined as a short shaft.

FIG 4.5 SHAFT

However, design method remains the same for axle and spindle as that for a shaft. 8.1.2 Standard sizes of Shafts Typical sizes of solid shaft that are available in the market are, Up to 25 mm 0.5 mm increments 25 to 50 mm 1.0 mm increments 50 to 100 mm 2.0 mm increments 100 to 200 mm 5.0 mm increments 8.1.3 Material for Shafts The ferrous, non-ferrous materials and non metals are used as shaft material depending on the application. Some of the common ferrous materials used for shaft are discussed below. Hot-rolled plain carbon steel. These materials are least expensive. Since it is hot rolled, scaling is always present on the surface and machining is required to make the surface smooth. Since it is cold drawn it has got its inherent characteristics of smooth bright finish. Amount of machining therefore is minimal. Better yield strength is also obtained. This is widely used for general purpose transmission shaft

Specifications

Shaft diameter: 12mm

Material: mild steel

Length: 26 inch

Alloy steels

Alloy steel as one can understand is a mixture of various elements with the parent steel to improve certain physical properties. To retain the total advantage of alloying materials one requires heat treatment of the machine components after it has been manufactured. Nickel, chromium and vanadium are some of the common alloying materials. However, alloy steel is expensive. These materials are used for relatively severe service conditions. When the situation demands great strength then alloy steels are used. They have fewer tendencies to crack, warp or distort in heat treatment. Residual stresses are also less compared to CS (Carbon Steel). In certain cases the shaft needs to be wear resistant, and then more attention has to be paid to make the surface of the shaft to be wear resistant. The common types of surface hardening methods are,

- Hardening of surface
- Case hardening and carburizing
- Cyaniding and nit riding

4.2.5 WHEEL

A wheel is a ring-shaped vehicle component that covers the wheel's rim to protect it and enable better vehicle performance. Most tires, such as those for automobiles and bicycles, provide traction between the vehicle and the road while providing a flexible cushion that absorbs shock. The materials of modern pneumatic tires are synthetic rubber, natural, fabric and wire, along with carbon black and other chemical compounds. They consist of a tread and a body. The tread provides traction while the body provides containment for a quantity of compressed air. Before rubber was developed, the first versions of tires were simply bands of metal that fitted around wooden wheels to prevent wear and tear.

Early rubber tires were solid (not pneumatic).

FIG 4.6 WHEEL

Today, the majorities of tires are pneumatic inflatable structures, comprising a doughnut-shaped body of cords and wires encased in rubber and generally filled with compressed air to form an inflatable cushion. Pneumatic tires are used on many types of vehicles, including cars, bicycles, motorcycles, buses, trucks, heavy equipment, and aircraft. Metal tires are still used on locomotives and railcars, and solid rubber (or other polymer) tires are still used in various non-automotive applications, such as some casters, carts, lawnmowers, and wheelbarrows.

4.2.5.1 WHEEL HISTORY

Historically, the spelling was wheel and is of French origin, which comes from the word tire, to pull. The reason for this naming is that originally "tire" referred to iron hoops or thick wires bound to carriage wheels. In French blacksmithing the word for a drawn iron rod is a tire, or pull. The same word was often used for any metal drawing or rolling process. In an article in the London Magazine/Intelligencer of 1853 "The Utility of Broad Wheels," it explains that the common practice was to bend two rods, called "tires," into hoops and bind them to the wheel, but it is preferable to use an iron band, called a "broad wheel" rather than the rods, because as the rods wear they bite into the wheel. Another early mention of a tire in English is in The Scots Magazine, Volume 15 By James Boswell (1753). Another origin of "tire" is provided by Online Etymology Dictionary, essentially that the word is a short form of "attire," and that a wheel with a tire is a dressed wheel. Some other etymologists may share this view.

The earliest tires were bands of leather, then iron, (later steel), placed on wooden wheels, used on carts and wagons. The tire would be heated in a forge fire, placed over the wheel and quenched, causing the metal to contract and fit tightly on the wheel. A skilled worker, known as a wheelwright, carried out this work. The outer ring served to "tie" the wheel segments together for use, providing also a wear-resistant surface to the perimeter of the wheel. The word "tire" thus emerged as a variant spelling to refer to the metal bands used to tie wheels.

The first practical pneumatic tire was made in 1888 for his son Johnnie's tricycle, in May Street, Belfast by Scots-born John Boyd Dunlop, proprietor of one of Ireland's most prosperous veterinary practices. It was an effort to prevent the headaches his 10-year-old son was given by jarring while riding on rough pavements. His doctor, John, later Sir John Fagan, had prescribed cycling as an exercise for the boy and, a regular visitor, Fagan participated in the development of the first pneumatic schemes. In Dunlop's tire patent specification dated

31 October 1888 his interest is only in its use in cycles and light vehicles. In September 1890 he was made aware of an earlier development but the company kept the information to itself. In 1892 Dunlop's patent was declared invalid because of prior art by forgotten fellow Scot Robertson of London (patents London 1845, France 1846, USA 1847), although Dunlop is credited with "realizing rubber could withstand the wear and tear of being a tire while retaining its resilience J B Dunlop and Harvey du Cross together worked through the ensuing considerable difficulties. Because of its superiority in handling and fuel economy, use of this technology quickly spread throughout Europe and Asia. In the U.S., the outdated bias-ply tire construction persisted, with market share of 87% as late as 1967.Delay was caused by tire and automobile manufacturers in America concerned about transition costs. In 1968, Consumer Reports, an influential American magazine, acknowledged the superiority of radial construction, setting off a rapid decline in Michelin's competitor technology. Even in the U.S., the radial tire now has a market share of 100%.

4.2.5.2 WHEEL SUPPORT

There are two aspects to how pneumatic tires support the rim of the wheel on which they are mounted. First, tension in the cords pulls on the bead uniformly around the wheel, except where it is reduced above the contact patch. Second, the bead transfers that net force to the rim. Air pressure, via the ply cords, exerts tensile force on the entire bead surrounding the wheel rim on which the tire is mounted, pulling outward in a 360-degree pattern.

Thus the bead must have high tensile strength. With no force applied to the outer tread, the bead is pulled equally in all directions, thus no additional net force is applied to the tire bead and wheel rim. However, when the tread is pushed inward on one side, this releases some pressure on the corresponding sidewall ply pulling on the bead. Yet the sidewall ply on the other side continues to pull the bead in the opposite direction.

Thus the still fully tensioned sidewall ply pulls the tire bead and wheel rim in the direction opposite to the tread displacement and matching the total force applied to push the tread inward. This sidewall ply to bead tension support is a big reason for cross-ply cord tire construction. The cross-ply cord arrangement orients the cords to more directly support the sling. However, with improved combinations of cord and rim material construction materials and manufacturing techniques, combined with ongoing focus and research on tire efficiency and durability, it became feasible to manufacture radial-ply cord tires, which for many applications aiming for high speed without excessive loads, outperform similar cross-ply cord tire designs with reduced tire temperature, decreased rolling resistance and greater longevity.

4.2.5.3 WHEEL DESIGN

Pneumatic tires are manufactured in about 450 tire factories around the world. Over one billion tires are manufactured annually, making the tire industry major consumer of natural rubber. It is estimated that by 2015, 1.72 billion tires are expected to be sold globally. Tire production starts with bulk raw materials such as rubber, carbon black, and chemicals and produces numerous specialized components that are assembled and cured.

Many kinds of rubber are used, the most common being butadiene copolymer. This article describes the components assembled to make a tire, the various materials used, the manufacturing processes and machinery, and the overall business model. Butadiene copolymer is the most popular material used in the production of rubber tire.

In 2004, $80 billion of tires were sold worldwide; in 2010 it was $140 billion (approximately 34% growth adjusting for inflation). The top five tire manufacturing companies by revenue are Bridgestone, Michelin, Goodyear, Continental, and Pirelli.

4.2.5.4 MATERIALS:

The materials of modern pneumatic tires can be divided into two groups, the cords that make up the ply and the elastomeric which encases them.

4.2.5.5 CORDS

The cords, which form the ply and bead and provide the tensile strength necessary to contain the inflation pressure, can be composed of steel, natural fibers such as cotton or silk, or synthetic fibers such as nylon or Kevlar.

4.2.5.6 ELASTOMER

The elastomeric, which forms the tread and encases the cords to protect them from abrasion and hold them in place, is a key component of pneumatic tire design. It can be composed of various composites of rubber material – the most common being butadiene copolymer with other chemical compound such as silica and carbon black.

4.2.5.7 ROLLING RESISTANCE

Optimizing resistance in the elastomeric material is a key challenge for reducing fuel consumption in the transportation sector. It is estimated that passenger vehicles consume approximately 5~15% of its fuel to overcome rolling resistance, while the estimate is understood to be higher for heavy trucks. However, there is a trade-off between rolling resistance and wet traction and grip: while low rolling resistance can be achieved by reducing the viscoelastic properties of the rubber compound (low tangent (δ)), it comes at the cost of wet traction and grip, which requires hysteresis and energy dissipation (high tangent (δ)).

A low tangent (δ) value at 60 °C is used as an indicator of low rolling resistance, while a high tangent (δ) value at 0 °C is used as an indicator of high wet traction. Designing an elastomeric material that can achieve both high wet traction and low rolling resistance is key in achieving safety and fuel efficiency in the transportation sector.

The most common elastomeric material used today is a styrene-butadiene copolymer. It combines butadiene, which is a highly rubbery polymer (*Tg*= −100 °C) that has low hysteresis and thus offers good rolling resistance, with styrene, which is a highly glass polymer (*Tg*= 100 °C) that has high hysteresis and thus offers good wet grip properties in addition to wear resistance.

Therefore, the ratio the two polymers in the styrene-butadiene copolymer is considered key in determining the glass transition temperature of the material, which is correlated to its grip and resistance properties.

Materials science research efforts are underway to improve such properties of elastomers. For instance, this involves modifying the microstructure of the copolymer (for instance, using solution styrene butadiene rubber (SSBR) to control the addition of vinyl butadiene units)as well as the macrostructure of the polymer (such as the width of molecular weight distribution (MWD)).

Current investigation also involves looking at the fictionalization of the elastomer through the addition of filler materials such as silica and carbon black, as well as testing other nano-fillers such as nano cellulose crystals, carbon nano tubes, and grapheme.

4.2.5.8 COMPONENTS:

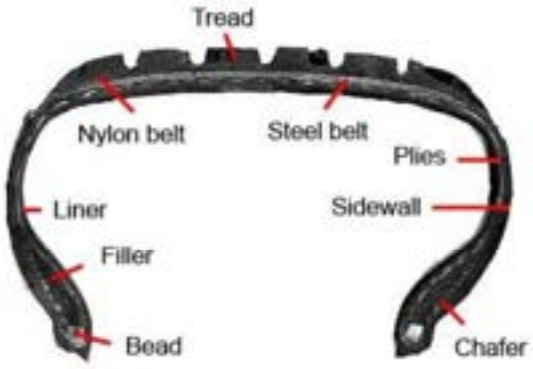

FIG 4.7 WHEEL CROSS SECTION

4.2.5.9 TREAD

The tread is the part of the tire that comes in contact with the road surface. The portion that is in contact with the road at a given instant in time is the contact patch. The tread is a thick rubber, or rubber/composite compound formulated to provide an appropriate level

of traction that does not wear away too quickly. The tread pattern is characterized by the geometrical shape of the grooves, lugs, sand ships. Grooves run circumferentially around the tire, and are needed to channel away water. Lugs are that portion of the tread design that contacts the road surface. Voids are spaces between lugs that allow the lugs to flex and evacuate water.

Tread patterns feature nonsymmetrical (or non-uniform) lug sizes circumferentially to minimize noise levels at discrete frequencies. Sipes are valleys cut across the tire, usually perpendicular to the grooves, which allow the water from the grooves to escape to the sides in an effort to prevent hydroplaning. Treads are often designed to meet specific product marketing positions. High performance tires have small void to provide more rubber in contact with the road for higher traction, but may be compounded with softer rubber that provides better traction, but wears quickly. Mud and snow (M&S) tires are designed with higher void ratios to channel away rain and mud, while providing better gripping performance.

The rain groove is a design element of the tread pattern specifically arranged to channel water away from the footprint. Rain grooves are circumferential in most truck tires. Many high performance passenger tires feature rain grooves that are angled from the center toward the sides of the tire. Some tire manufacturers claim that their tread pattern is designed to actively pump water out from under the tire by the action of the tread flexing. This results in a smoother ride in different types of weather. Sipe Tread lugs often feature small narrow voids, or sipes, that improve the flexibility of the lug to deform as it traverses the footprint area. This reduces shear stress in the lug and reduces heat buildup.

Testing of identical siped and unsiped tires showed measurable improvements in snow traction and ice braking performance, however diminishing and extending braking distances on wet and dry pavement by a few feet on siped tires. Off-road tire enthusiasts have been siping tires for years for greater traction, as many manufacturers now offer already siped off-road tires. Wear bar Wear bars (or wear indicators) are raised features located at the bottom of the tread grooves that indicate the tire has reached its wear limit.

When the tread lugs are worn to the point that the wear bars connect across the lugs, the tires are fully worn and should be taken out of service. Most wear bars indicate a remaining tread depth of 1.6 millimeters (0.063 in) and are deemed “worn out” at that point.

4.2.5.10 BEAD

Bead The bead is the part of the tire that contacts the rim on the wheel. The bead is typically reinforced with steel wire and compounded of high strength, low flexibility rubber. The bead seats tightly against the two rims on the wheel to ensure that a tubeless tire holds air without leakage. The bead fit is tight to ensure the tire does not shift circumferentially as the wheel rotates. The width of the rim in relationship to the tire is a factor in the handling characteristics of an automobile, because the rim supports the tire's profile

4.2.5.11 SIDEWALL

Sidewall Uneven sidewall wear, down to fabric plies, due to significant under-inflation the sidewall is that part of the tire that bridges between the tread and bead. The sidewall is largely rubber but reinforced with fabric or steel cords that provide for tensile strength and flexibility. The sidewall contains air pressure and transmits the torque applied by the drive axle to the tread to create traction but supports little of the weight of the vehicle, as is clear from the total collapse of the tire when punctured. Sidewalls are molded with manufacturer-specific detail government mandated warning labels, and other consumer information, and sometimes decorative ornamentation, likes whitewalls.

4.2.6 FRAME

The metal frame is generally made of mild steel bars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts. It can be case-hardened to improve wear resistance. They are available in bright rounds, squares and flats, and hot rolled rounds Suitable machining allowances should therefore be added when ordering.

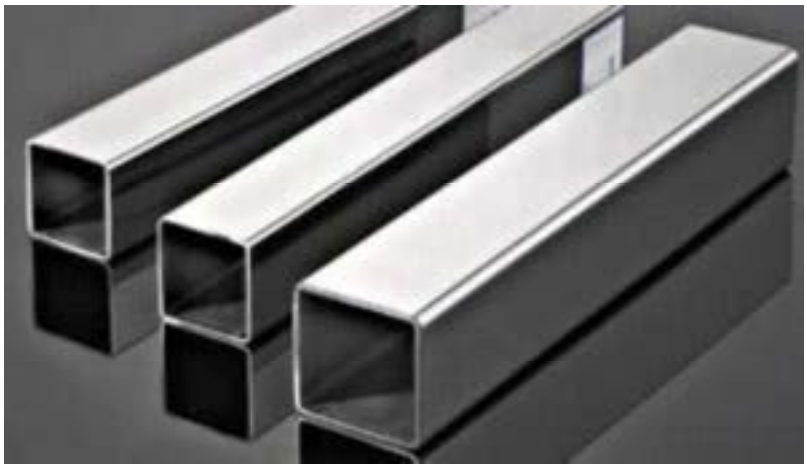

FIG 4.8 FRAME

It does not contain any additions for enhancing mechanical or machining properties. Bright drawn mild steel is an improved quality material, free of scale, and has been cold

worked (drawn or rolled) to size. It is produced to close dimensional tolerances. Straightness and flatness are better than black steel. It is more suitable for repetition precision machining. Bright drawn steel has more consistent hardness, and increased tensile strength. Bright steel can also be obtained in precision turned or ground form if desired.

Material - Mild steel

Size - 40*15cm

Thickness - 1mm

4.2.7 METAL STRIP

Metal strip or cold rolled strip is a steel product that is produced from a hot rolled strip that has been pickled. The coil is then reduced by a single stand cold roll steel mill straight away or reversing mill or in a tandem mill consisting of several single stands in a series. The strip is reduced to approximately final thickness by cold-rolling directly, or with the inclusion of an annealing operation at some intermediate thickness to facilitate further cold reduction or to obtain mechanical properties desired in the finished product.

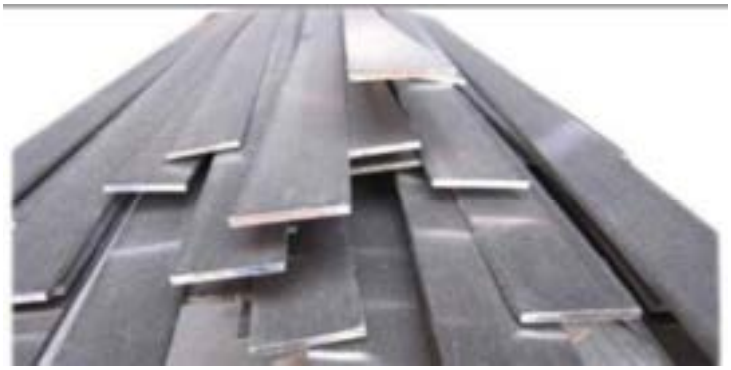

FIG 4.9 METAL STRIP

High carbon strip steel requires additional annealing and cold reduction operations. The coil is then slit to the desired width through the process of roll slitting. The final product typically consists of cold rolled steel that has been cut into strips of specific widths and coiled or oscillate coiled for delivery, frequently interleaved with paper or another material which protects the surface finish of the material and assists in retaining oil or some other rust prevention solution. This product is often later stamped to form a part from the strip steel.

4.2.8 BALL BEARING

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft).

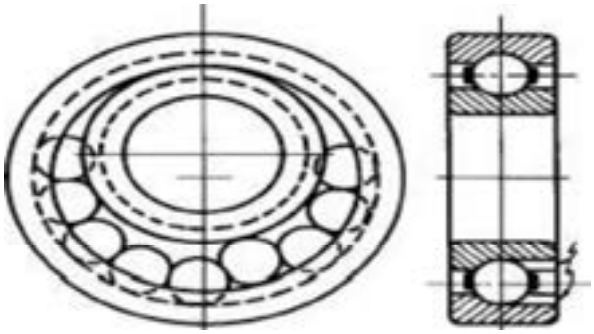

FIG 4.10 BALL BEARING

As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

Inner diameter: 12mm

Outer diameter: 37mm

Although bearings had been developed since ancient times, the first modern recorded patent on ball bearings was awarded to Philip Vaughan, a Welsh inventor and ironmaster who created the first design for a ball bearing in Carmarthen in 1794. His was the first modern ball-bearing design, with the ball running along a groove in the axle assembly. Jules Surrey, a Parisian bicycle mechanic, designed the first radial style ball bearing in 1869, which was then fitted to the winning bicycle ridden by James Moore in the world's first bicycle road race, Paris-Rouen, in November 1869.

4.2.8.1 DESIGN OF ANGULAR CONTACT

An angular contact ball bearing uses axially asymmetric races. An axial load passes in a straight line through the bearing, whereas a radial load takes an oblique path that acts to separate the races axially. So the angle of contact on the inner race is the same as that on the

outer race. Angular contact bearings better support combined loads (loading in both the radial and axial directions) and the contact angle of the bearing should be matched to the relative proportions of each. The larger the contact angle (typically in the range 10 to 45 degrees), the higher the axial load supported, but the lower the radial load. In high speed applications, such as turbines, jet engines, and dentistry equipment, the centrifugal forces generated by the balls changes the contact angle at the inner and outer race. Ceramics such as silicon nitride are now regularly used in such applications due to their low density (40% of steel). These materials significantly reduce centrifugal force and function well in high temperature environments. They also tend to wear in a similar way to bearing steel—rather than cracking or shattering like glass or porcelain. Most bicycles use angular-contact bearings in the headsets because the forces on these bearings are in both the radial and axial direction.

Axial

An axial or thrust ball bearing uses side-by-side races. An axial load is transmitted directly through the bearing, while a radial load is poorly supported and tends to separate the races, so that a larger radial load is likely to damage the bearing.

Deep-groove

In a deep-groove radial bearing, the race dimensions are close to the dimensions of the balls that run in it. Deep-groove bearings support higher loads than a shallower groove. Like angular contact bearings, deep-groove bearings support both radial and axial loads, but without a choice of contact angle to allow choice of relative proportion of these loads capacities.

Preloaded pairs

The above basic types of bearings are typically applied in a method of preloaded pairs, where two individual bearings are rigidly fastened along a rotating shaft to face each other. This improves the axial run out by taking up (preloading) the necessary slight clearance between the bearing balls and races. Pairing also provides an advantage of evenly distributing the loads, nearly doubling the total load capacity compared to a single bearing. Angular contact bearings are almost always used in opposing pairs: the asymmetric design of each bearing supports axial loads in only one direction, so an opposed pair is required if the application demands support both directions. The preloading force must be designed and assembled carefully, because it deducts from the axial force capacity of the bearings, and can

damage bearings if applied excessively. The pairing mechanism may simply face the bearings together directly, or separate them with a shim, bushing, or shaft feature.

Conrad

The Conrad-style ball bearing is named after its inventor, Robert Conrad, who was awarded British patent 12,206 in 1903 and U.S. patent 822,723 in 1906. These bearings are assembled by placing the inner ring into an eccentric position relative to the outer ring, with the two rings in contact at one point, resulting in a large gap opposite the point of contact. The balls are inserted through the gap and then evenly distributed around the bearing assembly, causing the rings to become concentric. Assembly is completed by fitting a cage to the balls to maintain their positions relative to each other. Without the cage, the balls would eventually drift out of position during operation, causing the bearing to fail. The cage carries no load and serves only to maintain ball position.

Conrad bearings have the advantage that they are able to withstand both radial and axial loads, but have the disadvantage of lower load capacity due to the limited number of balls that can be loaded into the bearing assembly. Probably the most familiar industrial ball bearing is the deep-groove Conrad style. The bearing is used in most of the mechanical industries.

Slot-fill

In a slot-fill radial bearing, the inner and outer races are notched on one face so that when the notches are aligned, balls can be slipped in the resulting slot to assemble the bearing. A slot-fill bearing has the advantage that more balls can be assembled (even allowing a full complement design), resulting in a higher radial load capacity than a Conrad bearing of the same dimensions and material type. However, a slot-fill bearing cannot carry a significant axial load, and the slots cause a discontinuity in the races that can have a small but adverse effect on strength.

Relieved race

Relieved race ball bearings are 'relieved' as the name suggests by basically have either the OD of the inner ring reduced on one side, or the ID of the outer ring increased on one side. This allows a greater number of balls to be assembled into either the inner or outer race, and then press fit over the relief. Sometimes the outer ring will be heated to facilitate assembly.

Like the slot-fill construction, relieved race construction allows a greater number of balls than Conrad construction, up to and including full complement and the extra ball count gives extra load capacity. However, a relieved race bearing can only support significant axial loads in one direction ('away from' the relieved race).

Fractured race

Another way of fitting more balls into a radial ball bearing is by radially 'fracturing' (slicing) one of the rings all the way through, loading the balls in, re-assembling the fractured portion, and then using a pair of steel bands to hold the fractured ring sections together in alignment. Again, this allows more balls, including full ball complement, however unlike with either slot fill or relieved race constructions, it can support significant axial loading in either direction.

Rows

There are two row designs: single-row bearings and double-row bearings. Most ball bearings are a single-row design, which means there is one row of bearing balls. This design works with radial and thrust loads. A double-row design has two rows of bearing balls. Their disadvantage is they need better alignment than single-row bearings.

Flanged

Bearings with a flange on the outer ring simplify axial location. The housing for such bearings can consist of a through-hole of uniform diameter, but the entry face of the housing (which may be either the outer or inner face) must be machined truly normal to the hole axis.

However such flanges are very expensive to manufacture. A more cost effective arrangement of the bearing outer ring, with similar benefits, is a snap ring groove at either or both ends of the outside diameter. The snap ring assumes the function of a flange.

Caged

Cages are typically used to secure the balls in a Conrad-style ball bearing. In other construction types they may decrease the number of balls depending on the specific cage shape, and thus reduce the load capacity. Without cages the tangential position is stabilized by sliding of two convex surfaces on each other. With a cage the tangential position is stabilized by a sliding of a convex surface in a matched concave surface, which avoids dents in the balls and has lower friction. Caged roller bearings were invented by John Harrison in the mid-18th century as part of his work on chronographs.

Hybrid ball bearings using ceramic balls

Ceramic bearing balls can weigh up to 40% less than steel ones, depending on size and material. This reduces centrifugal loading and skidding, so hybrid ceramic bearings can operate 20% to 40% faster than conventional bearings. This means that the outer race groove exerts less force inward against the ball as the bearing spins. This reduction in force reduces the friction and rolling resistance. The lighter balls allow the bearing to spin faster, and use less energy to maintain its speed. The ceramic balls are typically harder than the race. Due to wear, with time they will form a groove in the race. This is preferable to the balls wearing which would leave them with possible flat spots significantly harming performance. While ceramic hybrid bearings use ceramic balls in place of steel ones, they are constructed with steel inner and outer rings; hence the hybrid designation. While the ceramic material itself is stronger than steel, it is also stiffer, which results in increased stresses on the rings, and hence decreased load capacity. Ceramic balls are electrically insulating, which can prevent 'arcing' failures if current should be passed through the bearing. Ceramic balls can also be effective in environments where lubrication may not be available (such as in space applications). In some settings only a thin coating of ceramic is used over a metal ball bearing.

Fully ceramic bearings

These bearings make use of both ceramic balls and race. These bearings are impervious to corrosion and rarely require lubrication if at all. Due to the stiffness and hardness of the balls and race these bearings are noisy at high speeds. The stiffness of the ceramic makes these bearings brittle and liable to crack under load or impact. Because both ball and race are of similar hardness wear can lead to chipping at high speeds of both the balls and the race this can cause sparking.

Self-aligning

Self-aligning ball bearings, such as the Wingquist bearing shown in the picture, are constructed with the inner ring and ball assembly contained within an outer ring that has a spherical raceway. This construction allows the bearing to tolerate a small angular misalignment resulting from shaft or housing deflections or improper mounting. The bearing was used mainly in bearing arrangements with very long shafts, such as transmission shafts in textile factories. One drawback of the self-aligning ball bearings is a limited load rating, as the outer raceway has very low osculation (radius is much larger than ball radius). This led to the invention of the spherical roller bearing, which has a similar design, but use rollers

instead of balls. Also the spherical roller thrust bearing is an invention that derives from the findings by Linguist.

4.2.8.2 OPERATING CONDITION

Further information: Rolling-element bearing § Bearing failure the calculated life for a bearing is based on the load it carries and its operating speed. The industry standard usable bearing lifespan is inversely proportional to the bearing load cubed. Nominal maximum load of a bearing is for a lifespan of 1 million rotations, which at 50 Hz (i.e., 3000 RPM) a lifespan of 5.5 is working hours. 90% of bearings of that type have at least that lifespan, and 50% of bearings have a lifespan at least 5 times as long.

The industry standard life calculation is based upon the work of Lundberg and Palmgren performed in 1947. The formula assumes the life to be limited by metal fatigue and that the life distribution can be described by a Waybill distribution. Many variations of the formula exist that include factors for material properties, lubrication, and loading. Factoring for loading may be viewed as a tacit admission that modern materials demonstrate a different relationship between load and life than Lundberg and Palmgren determined.

4.2.8.3 FAILURE MODES

If a bearing is not rotating, maximum load is determined by force that causes plastic deformation of elements or raceways. The indentations caused by the elements can concentrate stresses and generate cracks at the components. Maximum load for not or very slowly rotating bearings is called "static" maximum load. Also if a bearing is not rotating, oscillating forces on the bearing can cause impact damage to the bearing race or the rolling elements, known as brinelling. A second lesser form called false brinelling occurs if the bearing only rotates across a short arc and pushes lubricant out away from the rolling elements. For a rotating bearing, the dynamic load capacity indicates the load to which the bearing endures 1,000,000 cycles. If a bearing is rotating, but experiences heavy load that lasts shorter than one revolution, static max load must be used in computations, since the bearing does not rotate during the maximum load.

If a sideways torque is applied to a deep groove radial bearing, an uneven force in the shape of an ellipse is applied on the outer ring by the rolling elements, concentrating in two regions on opposite sides of the outer ring. If the outer ring is not strong enough, or if it is not sufficiently braced by the supporting structure, the outer ring will deform into an oval shape from the sideways torque stress, until the gap is large enough for the rolling elements to

escape. The inner ring then pops out and the bearing structurally collapses. A sideways torque on a radial bearing also applies pressure to the cage that holds the rolling elements at equal distances, due to the rolling elements trying to all slides together at the location of highest sideways torque. If the cage collapses or breaks apart, the rolling elements group together, the inner ring loses support, and may pop out of the center.

Maximum load

In general, maximum load on a ball bearing is proportional to outer diameter of the bearing times the width of the bearing (where width is measured in direction of axle). Bearings have static load ratings. These are based on not exceeding a certain amount of plastic deformation in the raceway. These ratings may be exceeded by a large amount for certain applications. Increase in the load may be withstood up to the deformation level of bearing. Once if the plastic limit of the bearing is breached then it may cause deformation to the bearing.

Lubrication

For a bearing to operate properly, it needs to be lubricated. In most cases the lubricant is based on elasto hydrodynamic effect (by oil or grease) but working at extreme temperatures dry lubricated bearings are also available. For a bearing to have its nominal lifespan at its nominal maximum load, it must be lubricated with a lubricant (oil or grease) that has at least the minimum dynamic viscosity for a bearing where average of outer diameter of bearing and diameter of axle hole is 50 mm, and that is rotating at 3000 RPM, recommended dynamic viscosity is 12 mm^2/s. Note that dynamic viscosity of oil varies strongly with temperature a temperature increase of 50–70 °C causes the viscosity to decrease by factor 10.

If the viscosity of lubricant is higher than recommended, lifespan of bearing increases, roughly proportional to square root of viscosity. If the viscosity of the lubricant is lower than recommended, the lifespan of the bearing decreases and by how much depends on which type of oil being used. For oils with EP ('extreme pressure') additives, the lifespan is proportional to the square root of dynamic viscosity, just as it was for too high viscosity, while for ordinary oils lifespan is proportional to the square of the viscosity if a lower-than-recommended viscosity is used. Lubrication can be done with grease, which has advantages that grease is normally held within the bearing releasing the lubricant oil as it is compressed by the balls. It provides a protective barrier for the bearing metal from the environment, but

has disadvantages that this grease must be replaced periodically, and maximum load of bearing decreases (because if bearing gets too warm, grease melts and runs out of bearing). Time between grease replacements decreases very strongly with diameter of bearing for 40 mm bearing, grease should be replaced every 5000 working hours, while for a 100 mm bearing it should be replaced every 500 working hours. Lubrication can also be done with oil, which has advantage of higher maximum load, but needs some way to keep oil in bearing, as it normally tends to run out of it. For oil lubrication it is recommended that for applications where oil does not become warmer than 50 °C, oil should be replaced once a year, while for applications where oil does not become warmer than 100 °C, oil should be replaced 4 times per year. For car engines, oil becomes 100 °C but the engine has an oil filter to maintain oil quality; therefore, the oil is usually changed less frequently than the oil in bearings.

Direction of load

Most bearings are meant for supporting loads perpendicular to axle ("radial loads"). Whether they can also bear axial loads, and if so, how much, depends on the type of bearing. Thrust bearings (commonly found on lazy Susans) are specifically designed for axial loads. For single-row deep-groove ball bearings, SKF's documentation says that maximum axial load is circa 50% of maximum radial load, but it also says that "light" and/or "small" bearings can take axial loads that are 25% of maximum radial load. For single-row edge-contact ball bearings, axial load can be about 2 times max radial load, and for cone-bearings maximum axial load is between 1 and 2 times maximum radial load.

Often Conrad-style ball bearings will exhibit contact ellipse truncation under axial load. That means that either the ID of the outer ring is large enough, or the OD of the inner ring is small enough, so as to reduce the area of contact between the balls and raceway. When this is the case, it can significantly increase the stresses in the bearing, often invalidating general rules of thumb regarding relationships between radial and axial load capacity.

With construction types other than Conrad, one can further decrease the outer ring ID and increase the inner ring OD to guard against this. If both axial and radial loads are present, they can be added vectorially, to result in the total load on bearing, which in combination with nominal maximum load can be used to predict lifespan. However, in order to correctly predict the rating life of ball bearings the ISO/TS 16281 should be used with the help of calculation software.

Avoiding undesirable axial load

The part of a bearing that rotates (either axle hole or outer circumference) must be fixed, while for a part that does not rotate this is not necessary (so it can be allowed to slide). If a bearing is loaded axially, both sides must be fixed. If an axle has two bearings, and temperature varies, axle shrinks or expands, therefore it is not admissible for both bearings to be fixed on both their sides, since expansion of axle would exert axial forces that would destroy these bearings. Therefore, at least one of bearings must be able to slide.

A 'freely sliding fit' is one where there is at least a 4 μm clearance, presumably because surface-roughness of a surface made on a lathe is normally between 1.6 and 3.2 μm. If a shaft is supported by two bearings, and the center-lines of rotation of these bearings are not the same, then large forces are exerted on the bearing that may destroy it.

Fit

Bearings can withstand their maximum load only if the mating parts are properly sized. Bearing manufacturers supply tolerances for the fit of the shaft and the housing so that this can be achieved. The material and hardness may also be specified. Fittings that are not allowed to slip are made to diameters that prevent slipping and consequently the mating surfaces cannot be brought into position without force. For small bearings this is best done with a press because tapping with a hammer damages both bearing and shaft, while for large bearings the necessary forces are so great that there is no alternative to heating one part before fitting, so that thermal expansion allows a temporary sliding fit.

4.2.9 DISK

In geometry, a disk is the region in a plane bounded by a circle. A disk is said to be closed if it contains the circle that constitutes its boundary. The disk has circular symmetry. The open disk and the closed disk are not topologically equivalent (that is, they are not homeomorphic), as they have different topological properties from each other.

For instance, every closed disk is compact whereas every open disk is not compact. However from the viewpoint of algebraic topology they share many properties: both of them are contractible and so are hemitropic equivalent to a single point. This implies that their fundamental groups are trivial, and all homology groups are trivial except the 0^{th} one, which is isomorphic to Z.

FIG 4.11 DISK

The Euler characteristic of a point (and therefore also that of a closed or open disk) is 1. Every continuous map from the closed disk to itself has at least one fixed point; this is the case n=2 of the Brower fixed point theorem.

4.3 MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

4.3.1 SAWING:

Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade Steel blades of this type are resistant to wear even under daily usage. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal.

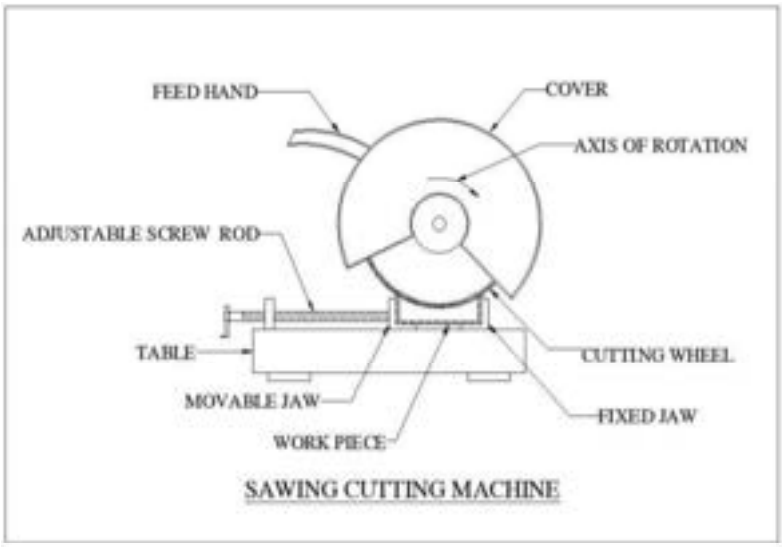

FIG 4.12 SAWING

4.3.2 WELDING:

Welding is a process for joining similar metals. Welding joins metals by melting and fusing 1, the base metals being joined and 2, the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

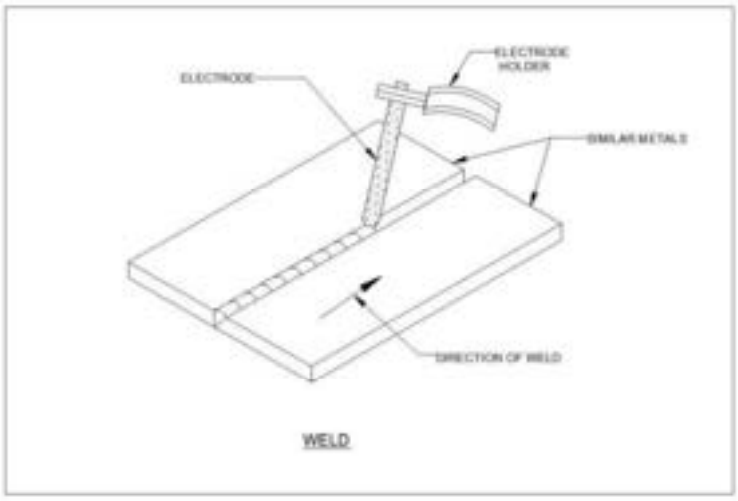

FIG 4.13 WELDING

Operation:

Several welding processes are based on heating with an electric arc, only a few are considered here, starting with the oldest, simple arc welding, also known as shielded metal arc welding (SMAW) or stick welding. In this process an electrical machine (which may be DC or AC, but nowadays is usually AC) supplies current to an electrode holder which carries an electrode which is normally coated with a mixture of chemicals or flux. An earth cable connects the work piece to the welding machine to provide a return path for the current. The weld is initiated by tapping ('striking') the tip of the electrode against the work piece which initiates an electric arc. The high temperature generated (about 6000^{o}C) almost instantly produces a molten pool and the end of the electrode continuously melts into this pool and forms the joint.

4.3.3 DRILLNG:

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drilled. Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed).

Also, the inside of the hole usually has helical feed marks. Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion and crack propagation at the stressed surface. A finish operation may be done to avoid these detrimental conditions. For fluted drill bits, any chips are removed via the flutes.

Chips may form long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long chips suggesting good material machinability. This minimizes the drill bit's tendency to walk that is, to be deflected from the intended center-line of the bore, causing the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the greater the tendency to walk. The tendency to walk is also preempted in various other ways, which include:

4.3.3.1 Deep hole drilling

It is defined as drilling a hole of depth greater than ten times the diameter of the hole. These types of holes require special equipment to maintain the straightness and tolerances. Other considerations are roundness and surface finish. Deep hole drilling is generally achievable with a few tooling methods, usually gun drilling or BTA drilling.

These are differentiated due to the coolant entry method (internal or external) and chip removal method (internal or external). Using methods such as a rotating tool and counter-rotating work piece are common techniques to achieve required straightness tolerances.

Secondary tooling methods include trepanning, skiving and burnishing, pull boring, or bottle boring. Finally, a new kind of drilling technology is available to face this issue: vibration drilling. This technology breaks up the chips by a small controlled axial vibration of the drill.

The small chips are easily removed by the flutes of the drill. A high tech monitoring system is used to control force, torque, vibrations, and acoustic emission. Vibration is considered a major defect in deep hole drilling which can often cause the drill to break. A special coolant is usually used to aid in this type of drilling.

4.3.3.2 Gun drilling

Gun drilling was originally developed to drill out gun barrels and is used commonly for drilling smaller diameter deep holes. The depth-to-diameter ratio can be even greater than 300:1. The key feature of gun drilling is that the bits are self-centering; this is what allows for such deep accurate holes. The bits use a rotary motion similar to a twist drill; however, the bits are designed with bearing pads that slide along the surface of the hole keeping the drill bit on center. Gun drilling is usually done at high speeds and low feed rates.

4.3.3.3 Trepanning

Trepanning is commonly used for creating larger diameter holes (up to 915 mm (36.0 in)) where a standard drill bit is not feasible or economical. Trepanning removes the desired diameter by cutting out a solid disk similar to the workings of a drafting compass. Trepanning is performed on flat products such as sheet metal, granite (curling stone), plates, or structural members like I-beams. Trepanning can also be useful to make grooves for inserting seals, such as O-rings.

4.3.3.4 Micro drilling

Micro drilling refers to the drilling of holes less than 0.5 mm (0.020 in). Drilling of holes at this small diameter presents greater problems since coolant fed drills cannot be used and high spindle speeds are required. High spindle speeds that exceed 10,000 RPM also require the use of balanced tool holders.

4.3.3.5 Vibration drilling

Vibration drilling of an aluminum-CFRP multi-material stack with MITIS technology. The first studies into vibration drilling began in the 1950s (Pr. V.N. Poduraev, Moscow Bauman University). The main principle consists in generating axial vibrations or oscillations in addition to the feed movement of the drill so that the chips break up and are then easily removed from the cutting zone.

There are two main technologies of vibration drilling: self-maintained vibration systems and forced vibration systems. Most vibration drilling technologies are still at a research stage. In the case of self-maintained vibration drilling, the Eigen frequency of the tool is used in order to make it naturally vibrate while cutting; vibrations are self-maintained by a mass-spring system included in the tool holder.

Other works use a piezoelectric system to generate and control the vibrations. These systems allow high vibration frequencies (up to 2 kHz) for small magnitude (about a few micrometers); they are particularly suitable for drilling small holes.

Finally, vibrations can be generated by mechanical systems the frequency is given by the combination of the rotation speed and the number of oscillation per rotation (a few oscillations per rotation), with magnitude about 0.1 mm.

This last technology is a fully industrial one (example: Sine Holing technology of MITIS). Vibration drilling is a preferred solution in situations like deep hole drilling, multi-material stack drilling (aeronautics) and dry drilling (without lubrication). Generally, it provides improved reliability and greater control of the drilling operation.

The main principle consists in generating axial vibrations or oscillations in addition to the feed movement of the drill so that the chips break up and are then easily removed from the cutting zone.

4.4 CALCULATIONS

4.4.1 DESIGN OF SHAFT

For the design of shaft following two methods are adopted, Design based on Strength In this method, design is carried out so that stress at any location of the shaft should not exceed the material yield stress.

However, no consideration for shaft deflection and shaft twist is included. Design based on Stiffness Basic idea of design in such case depends on the allowable deflection and twist of the shaft.

4.4.1.1 DESIGN BASED ON STRENGTH

The stress at any point on the shaft depends on the nature of load acting on it. The stresses which may be present are as follows.

Basic stress equations:

Bending stress

$$\sigma_b = \frac{32M}{\pi d_0^3 (1 - k^4)}$$

Where,

M: Bending moment at the point of interest

do: Outer diameter of the shaft

k: Ratio of inner to outer diameters of the shaft (k = 0 for a solid shaft because inner diameter is zero)

Axial Stress

$$\sigma_a = \frac{4\alpha F}{\pi d_0^2 (1 - k^2)}$$

Where,

F: Axial force (tensile or compressive)

α: Column-action factor(= 1.0 for tensile load)

The term α has been introduced in the equation. This is known as column action factor. What is a column action factor? This arises due the phenomenon of buckling of long slender members which are acted upon by axial compressive loads.

Here, α is defined as,

$$\alpha = \frac{1}{1-0.0044(L/K)} \quad \text{for } L/K < 115$$

$$\alpha = \frac{\sigma_{yc}}{\pi^2 nE}\left(\frac{L}{K}\right)^2 \qquad \text{for } L/K > 115$$

Where,

n = 1.0 for hinged end

n = 2.25 for fixed end

n = 1.6 for ends partly restrained, as in bearing

K = least radius of gyration,

L = shaft length

Σyc= yield stress in compression

Stress due to torsion

$$\tau_{xy} = \frac{16T}{\pi d_0^3(1-k^4)}$$

Where,

T: Torque on the shaft

xy τ: Shear stress due to torsion

Combined Bending and Axial stress

Both bending and axial stresses are normal stresses; hence the net normal stress is given by,

$$\sigma_x = [\frac{32M}{\pi d_0^3(1-k^4)} \pm \frac{4\alpha F}{\pi d_0^2(1-k^2)}]$$

The net normal stress can be either positive or negative. Normally, shear stress due to torsion is only considered in a shaft and shear stress due to load on the shaft is neglected.

Maximum shear stress theory

Design of the shaft mostly uses maximum shear stress theory. It states that a machine member fails when the maximum shear stress at a point exceeds the maximum allowable shear stress for the shaft material. Therefore,

$$\tau_{max} = \tau_{allowable} = \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2}$$

Substituting the values of σx and τxy in the above equation, the final form is,

$$\tau_{allowable} = \frac{16}{\pi d_0^3 (1-k^4)} \sqrt{\left\{ M + \frac{\alpha F d_0 (1+k^2)}{8} \right\}^2 + T^2}$$

Therefore, the shaft diameter can be calculated in terms of external loads and material properties. However, the above equation is further standardized for steel shafting in terms of allowable design stress and load factors in ASME design code for shaft.

4.4.1.2 SPECIFICATIONS

Material: Mild steel

Outer diameter: 250mm

Thickness: 5mm

Consider for example the function

$$f(x,y) = \left(\frac{x + \sqrt{1-y^2}}{2}, y \right)$$

Which maps every point of the open unit disk to another point on the open unit disk to the right of the given one? But for the closed unit disk it fixes every point on the half circle.

4.4.2 DESIGN OF CIRCULAR DISC

4.4.2.1 TORQUE CALCULATION ON A CIRCULAR DISC

- Diameter(d)=300 mm
- Thick(t)= 5 mm
- RPM(N)=100
- Let, Y.S. of mild steel(Y)=250 N/mm^2
- Now ,Allowable Shear Stress(S)=Y*0.5 =250*0.5 =125 N/mm^2
- Let, F.O.S.(F)=2.5
- Therefore, Allowable Shear Stress=S/F =125/2.5 = 50 N/mm^2

Also, Let Polar moment of Inertia is "J" and the Radius of shaft "R"(also the maximum distance from center)

Now, the formula for torque is,

Torque(T)= (J*S)/R

Now, J = (3.14*d^4)/32

= (3.14*300^4)/32

= 794812500 mm^4

Now, substitute all the values,

T = (794812500*50)/150

= 264937500 N-mm

T = 265 KN-M

Now, The formula for power required,

Power(P) = T*W

where, W= angular velocity

Now, W= (2*3.14*N)/60

= (2*3.14*100)/60

= 10.5 RPS

now substitute the values,

P = (265*10.5)

= 2774 KN-m/s

P = 2774 KW

4.5 WORKING PRINCIPLE

The equipment is placed where cane cultivation has to be done and the setup is moved manually by placing plugging rod into the soil surface, this tends to dig the hole for planting the cane. On the other hand the obtained rotation of wheel is converted into linear motion with the help of slider crank mechanism connected between axle shaft and blade. The obtained linear motion makes the blade to slide linear towards top and bottom and causes the loaded full cane to cut in to piece, when the blade moves towards top for next cutting stroke the loaded cane is feed into the cutting space automatically through gravitational force. The cane pieces are unloaded manually and planted inside the furrow.

4.6 STEPS INVOLVED IN FABRICATION PROCESS

1. Collecting the required raw materials.
2. Cutting the metal bars to required sizes.
3. Fabrication of frame as per the design with the help of the metallic bars by welding process.

4. Designing the wheel with the help of circular disc and metal strips by welding process
5. Ordering the blade as per the requirement.
6. Connecting the blade to the wheel with the help of crank shaft to convert rotary motion of wheel into linear motion of blade.
7. Designing the bund former with the help of metal plates and metallic bars.
8. Attaching the handle to push the machine with the help of metal bars.

4.7 CONSTRUCTION

The base frame which acts a bed of machine is fabricated with the help of square tubes and channels by metal cutting and metal joining process called welding. Two wheels are attached at the back end portion of frame with the help of axle shaft; the axle shaft is connected with base frame through bearing support in order to attain free rotation. At both the ends of axle shaft near the wheels crank rod is connected, this crank rod is coupled to the blade with the help of coupler rod. The blade is supported by the guide way for attaining proper linear motion. The feeding link is provided near the blade which holds and feeds the cane into the blade through gravitational force. At the front end portion of frame two plugging rods are placed to performing sand digging operation.

CHAPTER 5

RESULT AND DISCUSSION

5.1 ASSESMENT OF SEED RATE

Let us calculate the seed rate of the machine by assuming the land to be planted was one hectare with machine moving at the speed of 1km/hr with depth of furrow made by the bund former is about 12.5cm and the turning loss is around 10%.

We know that the space between the furrow openers = 60.9cm

We also know that the width of the machine = 60.9cm

Theoretical area/hr $= \frac{60.9}{100} \times \frac{1 \times 1000}{10000} = 0.06$ ha

Actual area/hr $= \frac{0.06 \times 90}{100} = 0.05$ ha

Time for sowing one hectare $= \frac{1}{0.05} = 20$ hrs.

Thus it has been found that maximum of 20 hrs is required to plant an area of 20 hectares.

5.2 ASSESMENT OF EFFICIENCY

This machine was put to use under variable soil conditions after ploughing and its efficiency in different soil conditions were noted down.

Dry soil

Loamy soil is generally rich in organic matter, humus and other nutrient content. Sugarcane is generally cultivated in this type of soil. The assessment of machine in this type of soil has shown much better result than compared to other soil conditions. It has been found that the time required for planting one hectare of loamy dry soil requires around 20hrs. Thus the machine gives 100% efficiency in loamy dry soil.

Wet soil

Soil sometimes may get extremely wet due to heavy down fall or excessive irrigation in such cases the planting was mostly not done unless some avoidable circumstances in such cases it was found that the machine' wheel get sticked to the ground and makes it difficult to move. Thus it is found that the efficiency of machine is less in wet soil.

5.3 RESULT

After all the assessment process it has been found then the efficiency of machine decreases with increase in the wetness of the soil and vice versa. This machine cannot be used in the land where heavy rainfall occurred or the soil is highly wet.

Usually sugarcane is planted straight before ploughing the land, only after the planting was over, the field is irrigated along ridges and furrows. The planting was also not done where the rainfall has occurred recently and the land is still wet. So the lower efficiency of the machine in wet soil does not affect the efficiency of the machine greatly in practical use.

Thus this machine attained its goal for the purpose of which it had been designed and fabricated. There is no doubt that this machine will greatly help the sugarcane cultivating farmers of India when it is modified and re-fabricated related to the commercial needs.

CHAPTER 6

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding planning, purchasing, assembling and machining while doing this project work.

We are proud that we have completed the work with the limited time successfully. The **"DESIGN AND FABRICATION OF SUGARCANE CHIPPING CUM PLANTING MACHINE"** is working with satisfactory condition. We are able to understand the difficulties in maintaining the tolerances and also quality.

We have done to our ability and skill making maximum use of available facilities. By using more techniques, it can be modified and developed according to the application.

REFERENCES

1. Annual Report 2016-17. Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Government of India.
2. Annual Report 2016-17, Ministry of Statistics and Programme, Govt. of India.
3. Peleg K. Produce handling, packaging, and distribution. The AVI Publishing Company. Inc. Westport, Connecticut. 1985; 38(8):55–95.
4. Tabatabaeefar A. Size and shape of potato tubers. Int. Agro physics. 2002; 16:301–305.
5. Gamea GR, Abd El-Maksoud MA, Abd ElGawad AM. Physical characteristics and chemical properties of potato tubers under different storage systems. Miss J. Ag. Eng. 2009; 26(1):385-408.
6. . Teye E, Abano EE. Physical properties of two varieties of sweet potato grown in Coastal Savannah Zone of Ghana. International Journal of Science and Nature. 2012; 3(1):105-109.
7. Yossry B, Abd Elhay. Determination of some physical and mechanical properties of potato tubers related to design of sorting, cleaning and grading machine. Misr J. Ag. Eng. 2017; 34(3):1375–1388.
8. Singh DK, Goswami TK, Chorasia MK. Physical properties of two popular Indian potato varieties. Journal of Food Process Engineering. 2006;29:337–348
9. Kumar Manish, Tripathi Ashok, 2015. "To Study of the Different Modes of Tillage for the Performance of Sugarcane Cutter Planter".

APPENDICES

LIST OF MATERIALS USED

S.No	DESCIRPTION	QTY	MATERIAL
1	WHEEL	2	RUBBER
2	CRANK SHAFT	1	STAINLESS STEEL
3	BEARING	8	STAINLESS STEEL
4	FRAME	AS PER REQUIRMENT	MILD STEEL
5	SHAFT	AS PER REQUIRMENT	MILD STEEL
6	METAL STRIP	AS PER REQUIRMENT	MILD STEEL
7	SHEET METAL	1	MILD STEEL
8	DISC	1	MILD STEEL
9	HANDLE	1	MILD STEEL
10	BLOWER	1	STAINLESS STEEL

COST ESTIMATION

SL.NO	DISCRIPTION	COST Rs:
1	WHEEL	600
2	CRANK SHAFT	400
3	BEARING	800
4	FRAME	1000
5	SHAFT	500
6	METAL STRIP	300
7	SHEET METAL	800
8	DISC	500
9	HANDLE	200
10	PAINT	500
11	TOTAL	5,600

LABOUR COST

Lathe, Drilling, Welding, Grinding, Power hacksaw, Gas cutting:

Cost = 2000/-

TOTAL COST

Total cost = Material Cost + Labour cost

= Rs 5,600 + 2000

Total cost for this project = Rs 7,600

PHOTOGRAPHY

Photo 1:Fabricated machine

Photo 2: Testing of machine in the field

AGROTECHNIQUES FOR MAXIMIZING YIELD IN GREEN GRAM *(Vigna radiata)*

A PROJECT REPORT

SUBMITTED BY

ELANGIYAA .R.B (16102024)

GAYATHRI .A (16102028)

JEEVITHA .S (16102039)

MEENAKSHI .R (16102055)

in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

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(AUTONOMOUS)

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ABSTRACT

Green gram (*Vigna radiata L.)* is the third most important pulse crop of India both in terms of area and production next to chickpea and pigeon pea. It is cultivated in kharif, rabi and summer seasons in different parts of the country. The production of pulse crops in India in general is not enough to meet the domestic need of the ever growing population. Green gram contains 25 percent protein, this being about two third of the protein content of soybean, twice that of wheat and thrice that of rice. The productivity is far below the potential and there is substantial scope for improvement with the adoption of improved technologies. The protein is comparatively rich in lysine, which is deficient in cereal grains. Among various improved technologies, the application of nutrient through foliar application of RDF + Water control spray(T1), RDF + Foliar application of Nitrobenzene 2% at 25 and 45 DAS(T2), RDF + Soil application of DAP at 2% 25 and 45 DAS (T3), RDF + Salicylic acid at 75ppm spray (T4), RDF + Urea at 2% + Nitrobenzene 2% + Salicylic acid at 75ppm spray (T5), RDF + 25kg of extra dose of nitrogen at 40 DAS + foliar application of DAP 2% at 25 and 45 DAS(T6) to increase the yield as well as nutrient use efficiency is considered to be an effective and economic method of supplementing part of nutrient requirement at critical stages. An uniform dose of RDF was applied to all the plots as basal.

An investigation entitled "Agrotechniques for maximizing yield in Green Gram" to study the effects of foliar nutrition on growth, yield, quality and economics of green gram in acid soil. The experimental was laid out in a Randomized Block Design with six treatments replicated thrice and the variety was Co8.

KEY WORDS: *Foliar application, treatments, yield and quality*

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LIST OF ABBREVATIONS AND SYMBOLS

Cm	-	Centimeter
cm2	-	Square centimeter
cm3	-	Cubic centimeter
DAS	-	Days After Sowing
g	-	Gram
ha	-	Hectare
pH	-	power of hydrogen
N	-	Nitrogen
Kg	-	Kilogram
mm	-	Millimeter
m2	-	Square meter
m.c	-	Moisture of content
dia.	-	Diameter

CHAPTER 1

INTRODUCTION

India is the largest producer and consumer of pulses in the world accounting for 32 per cent of world area and 25 per cent of production. Nearly 8 per cent of the pulse area is occupied by green gram, which is the third most important pulse crop of India in terms of area cultivated and production next to chick pea and pigeon pea. Against the production of 19.78 million tonnes during 2013-14 (from 25.21 million hectare area), consumption of pulses in India has been around 22-23 million tonnes. Thus India needs to import pulses every year to fulfil the domestic demand. Pulses estimation for Indian in 2018-19 25.19. Domestic production of major pulses is Green gram. Production trend of pulses in India is 25230.00. India's export and import of pulses is 248.01. It is estimated that Indian population will be around 1460 million by 2030 and demand for pulses would further grow in the years to come. The production of pulse crops in India in general and especially green gram in particular is not enough to meet the domestic demand of the ever growing population. The present productivity is far below the potential and provides substantial scope for improvement with the adoption of improved technologies. Among various other factors, application of nutrients through foliar application which increases the fertilizer use efficiency, thus increasing yield and reducing cost of production in pulses. This is considered to be an efficient and economic method of supplementing part of nutrients requirements at critical stages.

Green gram contains about 25 per cent protein, this being about two third of the protein content of soybean, twice that of wheat and thrice that of rice. The protein is comparatively rich in lysine, which is deficient in cereal grains. Hence, a diet combining green gram and cereal grains forms a balanced amino acid diet. Every 100 g of green gram seeds contains 132 mg calcium, 6.74 mg iron, 189 mg magnesium, 367 mg phosphorus and 124 mg potassium and vitamins like 4.8 mg ascorbic acid, 0.621 mg thiamine, 0.233 mg riboflavin, 2.251 mg niacin, 1.910 mg pantothenic acid and 114 IU vitamin A. It is also used as green manure crop. Being a legume, it has the capacity to fix the atmospheric nitrogen (30-50 kg/ha). It also helps in preventing soil erosion. India is producing 1.61mt. of green gram from an area of 3.38m.ha with an average yield per hectare of 474 kg (IIPR, Kanpur 2013-14). Jharkhand accounts for production of 637 kg per hectare green gram from an area of 16.1 (000'.ha) with productivity of 10.3 Important green gram growing states in India are Rajasthan, Odisha, Andhra Pradesh, Maharashtra, Tamil Nadu, Madhya Pradesh, Gujarat, Karnataka, and Bihar among which Rajasthan occupies larger area and production (1020 thousand ha and 391.2 thousand tonnes,

respectively). Tamil Nadu leads first in productivity with an average yield of 775 kg ha-1. Evaluation of suitable management practices to increase the productivity of pulses even under rain fed situation is essential. The yield potential of green gram is very low because of the fact that the crop is mainly grown in rain fed conditions with poor management practices and also due to various physiological, biochemical as well as inherent factors associated with the crop.

Apart from the genetic makeup, the physiological factor viz., insufficient portioning of assimilates poor pod setting due to the flower abscission and lack of nutrients during critical stages of crop growth, coupled with a number of diseases and pests (Mahala et al., 2001) were the reasons for the poor yield. The reasons for low yield of greengram are the slow rate of dry matter accumulation during the pre-flowering phase, poor pod setting, onset of leaf senescence during the period of pod development and low partitioning efficiency of assimilates to grain were identified as the main physiological constraints for yield.

OBJECTIVE

Main objectives in this study were to:

- To study the effect of foliar nutrition on growth yield and quality of green gram.
- To work out the economics of foliar nutrition in green gram cultivation
- To evaluate fertility status of soil after the harvest of the crop.

CHAPTER 2

REVIEW OF LITERATURE

KUMAR, P. NAIDU, S. RAHMAN, R. DOSS, A. AHAMED AND S. KAUR (2017) **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON GROWTH" said ,** The reported that growth attributing characters i.e plant height, branches/plant, root length, number and dry weight of root nodules, recorded higher values with the foliar application of DAP 2 % spray at flowering and 15 days later. Another recorded maximum plant height (20.24 cm) and dry matter accumulation (4.22 g/plant) in green gram with foliar application of urea @ 2% and it was at par with the foliar application of KNO3 @ 1% and it may be due to availability of nitrogen and potassium to the plant through foliar spray and potassium also regulate the osmotic tumour of cells and water balance which is driving force for cell division and elongation. Significantly higher leaf area index (5.82), leaf area duration (136.54 days), total dry matter production (39.36 g), plant height (25.75 cm), number of leaves per plant (64.66) and number of branches per plant (9.73) recorded with recommended dose of fertilizer along with foliar application of urea in groundnut and it may be due to the foliar application of nitrogen enhancing the accumulation and translocation of assimilates which resulted in prolonged vegetative phase and better photosynthetic capacity of the plant..Another report found that the combined foliar application of B, Mo, and Zn significantly increased plant height, dry matter and number of branches per plant in common bean and it might be due to micronutrient involvement in various physiological processes such as, enzyme activation, chlorophyll formation, electron transport and stomata regulation. Foliar treatment of 20:20:20 (N:P2O5:K2O) increased the plant height (29 cm), number of branches per plant (3.3), number of leaves per plant (11.6), root length (6 cm) a plant weight (4.6 g) in common bean. Sujatha (2001) reported that foliar application of salicylic acid (100 ppm) on green gram at 75 DAS increased the plant height (50.4 cm), root length (16.9 cm), number of leaves (18.4) and Leaf area index (LAI) (1.30). He reported that the growth parameters viz., LAI in green gram were significantly higher with the foliar spray of KNO3 (1 per cent) or KCl (1 per cent) and their combination. He reported that there was a pronounced inhibition of shoot growth by salicylic acid seed treatment in green gram. Foliar spray of 2 per cent DAP twice with recommended dose of fertilizer recorded the maximum plant height of green gram reported higher plant height (17.8 cm) in green gram due to foliar application of 1 per cent KCl twice at flowering and pod formation stages with basal N and P application followed by 2 per cent DAP + 1 per cent KCl spray. He stated that foliar spraying of 1 per cent urea significantly increased the crop growth rate (CGR) in soybean and he

observed that the foliar application of 1 per cent urea and 50ppm NAA significantly influenced the specific leaf area in soybean. A similar result was reported by Baghel and Yadhav (1992) with NAA in green gram. Another report observed that DAP at 50 kg per hectare at basal dose followed by foliar spray of urea and DAP twice significantly increased the leaf area index (LAI) and dry matter production during both kharif and summer seasons. The yield attributes were significantly higher when urea or DAP foliar spray was given in mung bean. Foliar application of MOP increased plant height and dry matter accumulation in pigeonpea. It also reduced flower drop in all the cultivars of pigeonpea because K increases cell expansion by regulating the solute potential and consequently the turgor potential which increases the rate of leaf expansion and also the total leaf area per plant and reduce flower drop. Potassium also involved in efficient translocation of photosynthates due to which dry matter accumulation also increases (Satyanarayana).

From our report, revealed that foliar application of salicylic acid (150 ppm) and urea enhanced plant height and number of branches per plant in green gram at 45DAS and 60DAS.

SIVA, JADHAV, TAHIR, GOWDA, CHAUDHARY, MONDAL AND MANOMARI (2017) **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON YIELD ATTRIBUTES"** said as reported significantly higher number of pods per plant with the foliar spray of panchagavyam and it was at par with foliar spray of 19:19:19 and also higher test weight in green gram. Significantly higher dry pod yield (4361 kg/ha), number of filled pods per plant (24.27), total number of pods per plant (29.53), 100 pod weight (135.33 g) and 100 kernel weight (41.16 g) were recorded with recommended dose of fertilizer along with foliar application of urea in green gram and it may be because of the additional amount of nitrogen supplied through the foliar application at 45 DAS and 60 DAS, which in turn might have met the required nitrogen demand of the crop during flowering and post flowering period of groundnut. This in turn might have resulted in greater availability, absorption, assimilation and translocation of nitrogen for increased photosynthesis and ultimately yield attributes were increased. Application of 100% recommended dose of NPK + 2% DAP + TNAU pulse wonder 5.0 kg per ha, had significantly increased plant height (37.62 cm), number of pods per plant (37.15), number of flowers per plant (50.12), and fruit setting percentage (72.55%) in green gram, it might be due to the balanced metabolism maintained continuously inside the plant to subsequent phases of growth. Another reported that the number of seeds per pod (10.80), 1000 grain weight (40.97 g) were found maximum in mash bean when 2% DAP + 1% K applied twice as foliar spray and it might be due to the effect of potassium on photosynthetic activity and potassium also play an important role in the translocation of photosynthesis and it has the ability to develop bold seed .

Similarly He revealed that the number of seeds per pod significantly increased with the application of potash. He found that the foliar application of 19:19:19 @ 0.4% along with soil application of ZnSO4 in pigeon pea recorded significantly higher number of pods per plant (251.07), number of seeds per pod (3.41), 100 seed weight (10.89 g) and seed yield (37.18 g plant-1) and the result showed that foliar spray of N, P and K significantly increased number of pods/plant, number of seeds / pod, biomass and grain yield. It may be concluded that foliar spray of N, P and K is the suitable application for the maximum yield of green grams.

From our literature, we use RDF and foliar application of nitrobenzene is the application for the maximum yield of green gram.

JADHAV AND KULKANI, SRITHRAN, BHOWNICK, VENKATESH AND TAHIR (2016) **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON QUALITY" said as,** He reported that the indicated that foliar sprays of 2 per cent DAP, 2 per cent urea and 2 per cent KCl remained at par and resulted in higher seed yield, net returns, protein content, nitrogen, phosphorus and potassium content in seed and straw and total uptake of nitrogen, phosphorus and potassium over water sprayed control. Another observed that foliar spray of 2% DAP + 40ppm NAA at 45 and 55 days after sowing recorded significantly higher grain protein content (24.45%) in green gram. Another report that the effect of foliar application of urea on growth, yield and quality of chickpea and recorded an increase in grain protein content of 17.88 to 19.31 per cent which was due to increased nitrogen availability for seed filling. He reported that in green gram at 50% flowering stage, nitrate reductase activity (NRA), Relative Water Content (RWC) were estimated and found maximum in 1.0% urea spray. All the genotypes significantly improved their NRA, RWC and chlorophyll content in leaf with increase in urea concentration up to 1%. He observed that, foliar spray of DAP two per cent + NAA 40 ppm + B 0.2 per cent + Mo 0.05 per cent at 30 DAS resulted in significantly increasing the protein content over control in green gram. He revealed that treatment of one per cent urea foliar application at pod filling resulted in highest protein content in seed (25 per cent) in green gram. Another reported that foliar spray of Navaras, Nuspartin, Tracels, urea and DAP enhanced the yield, and yield attributing characters, protein content of the grains in black gram. Protein content of the grains was highest with urea spray. Two sprayings Viz., at 20 and 80 DAS recorded the higher protein content of grain (23.04%) over a single spray at 20 or 30 days after sowing. Another report, observed that foliar spray of KNO3, thiourea and DAP increased the protein yield without affecting the oil content in soybean in moderate saline or alkaline soil.

From our literature, we use water for nutrients growth and increased the protein yield, increase chlorophyll content in leaf, enhance the yield.

SRITHARAN, SHASHIKUMAR, SINGH, CHAUDHARY AND YADAV, RAJAVEL AND VINCENT (2015) **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENT ON YIELD" said as,** He reported significantly higher grain yield of green gram with the foliar spray of 19:19:19 (1121 kg/ha) followed by panchagavya (1103 kg/ha) compared to rest of the treatments in green gram. Another reported that application of DAP 2 % spray at flowering and 15 days later recorded highest grain yield (916 kg /ha), straw yield (1527kg/ha) and harvest index (37.49%). He found that the foliar spray of 2% urea provide significantly highest yield (900 kg/ha) in black gram and yield increment was 20% over control and it might be due to improved morphophysiological traits and yield attributes. He revealed that spraying of 2 per cent DAP at 30 and 45 DAS recorded significantly higher seed yield (1094 kg/ha) over no spray (1050 kg/ha). The increased seed yield with 2 percent DAP was mainly due to the increased nutrient supply and reduced nutrient losses. He observed that application of 60 kg K2O ha–1 at sowing and combined foliar spraying of 2% urea and 0.25% multiplex at pre-flowering stage of chickpea resulted in maximum grain yield and ancillary characters. He reported that among foliar treatments, 2% urea spray (twice) at pre-flowering stage and 10 days thereafter could significantly produce the highest seed yield (1040.00 kg ha-1) and was closely followed by 2% DAP spray (983.75 kg ha-1) proved to be effective in improving growth and productivity of lathyrus in rice-utera system. He found that the foliar application of 2% urea at 75 DAS recorded highest seed yield (2437 kg/ha) and followed by 2% DAP spray at 75 DAS (2389 kg/ha) in chickpea. It may be because urea application contributed towards overall biomass production under rainfed condition. Five concentrations of water soluble fertilizer (19:19:19) i.e. no foliar spray (control), 0.25%, 0.5%, 0.75% and 1.0% applied at three critical crop growth stages (peak flowering, pod development and at pod filling stage). The result reveals that the grain yield (1661 kg/ha) was significantly higher with foliar application of 1.0% (19:19:19) followed by 0.75% and 0.50% (1518 and 1454 kg/ha respectively). But there was no significant difference observed due to the stages of spray application. The higher yield with 1.0% WSF was due to higher number of pods per plant (121.8), pod weight per plant (105.5 g), grain yield per plant (19.9 g), plant height, higher number of branches, leaf area and higher total dry matter production at harvest of green gram. Singh, (2013) reported that application of 25 and 37.5 kg P2O5/ha increased grain yield by 10.3 and 15.8% over no application of phosphorus in black gram. However, the differences between 25 and 37.5 kg/ha were non-significant during both the years. Though 2% urea spray improved the grain yield by, on an average, 3.0% over unsprayed control yet the differences were significant only in 2004. Foliar treatment of NPK (20:20:20)

increased grain yield (813 kg/ha) in common bean and it might be due to N: P:K enhances the plants vegetative growth and improve the ability of the plant for the synthesis, storage and translocation of nutrient from one part to other parts of the plant. Similar results were reported by Manivannan et al., (2002); Anitha et al., (2005); Zafar and Fayyaz (2007); Alam et al., (2010) and Saeed et al., (2013). They also reported that maximum biological yield (2423 kg/ha) by the foliar application of NPK. He studied the effect of foliar application of urea on physiological characters and yield of soybean and revealed that foliar application of urea @ 1.5% three times at reproductive stages may be used for getting increased seed yield in soybean (3.19 t/ha). He reported significantly higher seed yield of cowpea (1227 kg/ha) was recorded with foliar spray of 2% DAP, but remained at par with 2% urea (1189 kg/ha) and 2% KCl (1177 kg/ha). Similarly, foliar spray of 2% DAP, urea and KCl recorded significantly higher straw and biological yields and harvest index as compared to control. Rajavel and Vincent (2009) investigate that foliar spray of 2% urea recorded the highest yield of 955 kg/ha followed by foliar spray of KCl 1% along with soil application of humic acid @ 20 kg/ha (926 kg/ha). Application of PGR and nutrients increased the growth characters viz., Crop Growth Rate (CGR), Net Assimilation Rate (NAR), Leaf Area Development (LAD) at all growth stages. The yield enhancement may be due to improved morphological, physiological and biochemical parameters. The tested chemicals particularly 2% urea was found effective towards yield maximization in green gram. He observed that the foliar application of 2% DAP+ 1% KCl twice at flowering and pod filling stage in black gram recorded significantly higher grain yield (1007 kg/ha). The Percentage increase in grain yield was 32.8% over control and it might be due to the enhancement in growth and yield parameter as well as uptake of nutrients by crop. Obviously, cumulative effects of these parameters might have contributed to increased grain yield potential of the green gram.

From literature, we use RDF and Foliar application of nitrobenzene increase the grain yield per plant, plant height, and higher number of branches, leaf area and higher total dry matter production at harvest of green gram.

LIMBIKAI, SHASIKUMAR, DIXI AND RAMAN, VEERABHADRAPPAM, PENG (2017) **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON NUTRIENT UPTAKE" said as,** found that the foliar application of 19:19:19 (N:P2O5:K2O) @ 0.4% along with soil application of ZnSO4 in green gram recorded significantly higher uptake of N (126.66 kg/ha), P (45.73 kg/ha) and K (47.02 kg/ha). He indicated that application of recommended dose of fertilizers (RDF) as a basal dose and foliar spray of 40ppm NAA+0.5% chelated micronutrient+2% DAP given at 35 and 50 DAS recorded significantly higher phosphorus and potassium uptake (88.32, 10.72 and 35.09 kg ha-1 respectively). He observed that foliar spray of 2% DAP + 40ppm NAA at 45 and 55 days after sowing recorded significantly higher total uptake of nitrogen (76.38 kg/ha), phosphorous (10.66 kg/ha) and potassium (27.42 kg/ha) and sulphur (5.17 kg/ha) in black gram. He observed that nutrient uptake by green gram was higher at 45 DAS and reduced at harvest stage in which N, P and K uptake was 17.8 kg, 3.65 kg and 20.5 kg ha-1 respectively when the plants are supplied with 0.05 g sodium molybdate + 2 per cent DAP +100ppm Salicylic acid. Higher leaf nitrogen content (3.46 per cent) was recorded with three foliar application of urea sprayed at 60, 75 and 90 DAS than the control (3.16 per cent) under rainfed conditions in green gram. He observed that the foliar application of 2% DAP + 1% KCl twice at flowering and pod filling stage registered significantly higher N uptake (64.64 kg/ha), P uptake (6.75 kg/ha) and K uptake (46.51 kg/ha) in black gram and it might be due to increased supply of nutrients and good response of the plant to them. Increased NPK uptake due to foliar application was also observed by him. He observed that, foliar spray of DAP two per cent + NAA 40 ppm + B 0.2 per cent + Mo 0.05 per cent at 30 DAS resulted in significantly increasing the NPK uptake over control in green gram.

From our literature, we use RDP and foliar application of nitrobenzene increasing the nitrogen content uptake over control in green gram.

SHASHIKUMAR, LIMBIKAI, MUTHUVEL **entitled as "EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON SOIL STATUS" said as,** He indicated that application of recommended dose of fertilizers (RDF) as a basal dose and foliar spray of 40ppm NAA+0.5% chelated micronutrient+2% DAP given at 35 and 50 DAS recorded significantly higher available N and P2O5 content of soil (278.13 and 28.55 kg ha-1 respectively). He observed that foliar spray of 2% DAP + 40ppm NAA at 45 and 55 days after sowing recorded higher available N,P,K and S status of soil (240, 26.17, 300.17 and 37.17 kg ha-1 respectively) in green gram. He reported that, foliar spray of 2% DAP and 1% urea at flowering stage, increased the available N, P and K status of soil (131, 6.3 and 134 kg ha1, respectively) of rain fed green gram compared to no foliar spray.

From this literature, we use that the application of recommended dose of fertilizers as a basal dose and foliar spray of 2% DAP increased the flowering stage, increased the available N, P and K status of soil in green gram.

GOWDA, VINOTH KUMAR, GUPTA, DESHMUKH, THAKARE, PARASURANAM **entitled as " EFFECT OF FOLIAR APPLICATION OF NUTRIENTS ON ECONMICS" said as,** He reported that foliar spray of 19:19:19 recorded significantly higher net return (35838 `/ha) and B: C ratio in green gram. He reported that application of DAP 2 % spray at flowering and 15 days later recorded highest gross return (41221`/ha), net profit (23313 `/ha) and B:C ratio (1:2.30) in green gram. and found that the foliar application of 19:19:19 @ 0.4% along with soil application of ZnSO4 in pigeon pea recorded significantly higher gross return (55592 `/ha), net return (36323 `/ha) and B: C ratio (2.89). Another report indicated that application of recommended dose of fertilizers (RDF) as a basal dose and foliar spray of 40ppm NAA + 0.5% chelated micronutrient+2% DAP given at 35 and 50 DAS recorded significantly higher net returns and B/C ratio (` 52,900 ha-1 and 3.03 respectively), over rest of the treatments but it was at par with RDF + foliar spray of 2% DAP+0.5% chelated micronutrient. Foliar application of DAP (2%) and RDF gave maximum net income up to 51,201 `/ha.. He revealed that the foliar spray of 2 % DAP on soybean recorded significantly higher net return of ` 20,090 with B:C ratio of 2.22 and studied the effect of fertility levels and foliar nutrition on profitability, nutrient content and uptake of cowpea and concluded that foliar spray of 2 % DAP recorded higher net returns (24039 `/ha) compared to 2% urea and 2% KCl. Foliar application of 2% DAP + 100ppm salicylic acid + 0.05% sodium molybedate twice at vegetative and flowering stage proved to be the most promising nutrient management practice for summer green gram in terms of gross return and net return (11519 `/ha). Experiment conducted on sandy loam soil of Allahabad to study the effect of foliar spray of DAP and growth regulators on yield attributes indicated that, 2% foliar spray of DAP and NAA 40 ppm twice at 25 and 35 days after sowing resulted in higher benefit cost ratio (2.58) in green gram (Behera et al, 2007). boron@ 0.2 per cent and molybednum 0.05 per cent as foliar spray on green gram and study the effect of two per cent DAP, NAA 40 ppm, results revealed that foliar spray of DAP two per cent + NAA 40 ppm + B 0.2 per cent + Mo 0.05 percent at 30 DAS resulted in higher benefit cost ratio (1.97) over control (1.45) on sandy loam soil during rainy season at the Allahabad Agricultural Institute.

From literature, we use application of DAP spray at flowering recorded high gross return.

CHAPTER 3

METHODOLOGY

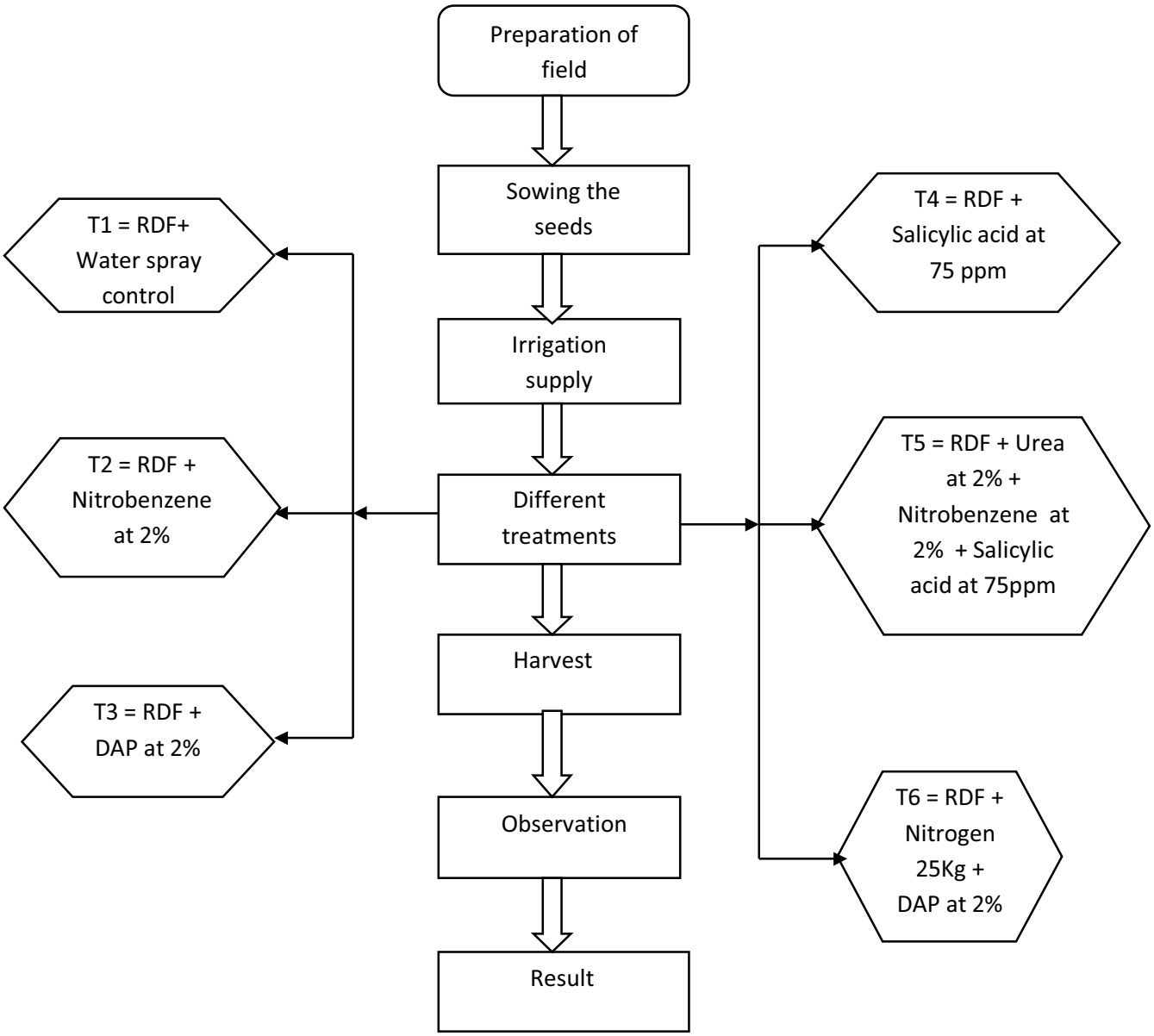

Fig.1: Flowchart

3.1 PREPARATION OF FIELD:

Experimental location

The experiment was conducted at the Paavai Engineering College at Namakkal. Its latitude (11.2195158) and longitude (78.167793). It is a clay soil and a soil ph of about 5.2 to 8.7. The experimental plots had assured irrigation facility coupled with uniform topography, good drainage and soil characteristics which is typical suitable for green gram cultivation.

An area of 34*21 ft or 68.4 m2 portion of the farm site was ploughed. The experiment was laid out in Randomized Block Design with six treatments replicate twice.

Prepare the land to get fine tilth by power tiller and form beds and channels. Apply lime @ 2 t/ha of FYM to prevent surface soil crusting.

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Details of layout plan

DESIGN	RANDOMIZED BLOCK DESIGN
Treatment	Six
Replication	Four
Net plot size	34*21 ft
Seed rate	25kg
Spacing	30*10cm

Table 3.1: Details of layout plan

Fig.1: layout of field

3.2 SOWING:

The experimental green gram was sown on 15th December 2019 using 25kg seeds per hectare. Two seeds were by dibbling them in furrow opened at a spacing of row to row is 30cm and plant to plant spacing is 10cm. Seeds were then covered with soil manually.

Variety:

The variety of green gram is Co8. The maturity days of crop is 60-65 days.

Soil:

Green gram can be grown on a variety of soils ranging from sandy loam to black cotton soils having a good drainage capacity. Saline and alkaline soils are not suitable for green gram cultivation. Green gram is very sensitive to water logging conditions.

Soil and Climatic requirement:

Green gram is a tropical pulse crop largely grown under semi arid and subtropical environment with annual rainfall of 60-75cm. It is a short day plant, can be grown in temperature between 20 to 40 c and optimum temperature is 28 to 30 c. Grown from sea level to 2000MSL. Ideal soils are well drained loam or sandy loam and saline alkali soils are not suitable. Opimum pH range is 6.5 to 7.5cm.

Seed selection:

Seeds used for cultivation must be from a genuine authorized source which will help you to select proper seed that has genetic purity and seeds must be vigorous to have good field stand. In the process of seed selection, one must check for diseased seeds, hard seeds, shrunken seeds immature seeds, deformed seeds.

Seed rate and sowing:

Seed rate and spacing depends on the,

- Seeds can be sown in line sowing.
- Flat beds. The seeds are dibbled at 2-3 cm depth at spacing 30*10cm in flat beds
- Seed rate on the variety of seed and that may vary from 25kg per hectare.

Seed Treatment:

With Carbandazium or Thiram @ 2g/kg of seed then after interval of 24 hours treat with 3 packets (600g) suitable strains of rhizobium biofertilizer with rice gruel 15 minutes before sowing.

Instead chemical, treat with Trichoderma viride @ 4g/kg or Pseudomonas fluorescence @ 10g/kg followed by bifertilizeer treatment.

For pre-monsoon sowing, seed treatment with paste made of ash (500g/kg of seeds) plus 3% gum followed by 5 hrs drying is recommended.

Spacing:

The spacing of green gram is 30cm*10cm

Irrigation:

Irrigate immediately after sowing, followed by life irrigation on the third day. Irrigate at intervals of 7to 10 days depending upon soil and climatic conditions. Flowering and pod formation stages are critical periods when irrigation is a must. Avoid water stagnation at all stages. . Apply KCl at 0.5 per cent as foliar spray during vegetative stage if there is moisture stress.- metabolism of nitrogen-containing compounds by animals and is the main nitrogen-containing substance in the urine of mammals. It is a colourless, odourless solid, highly soluble in water and practically non-toxic (LD50 is 15 g/kg for rat). Urea is widelyRecommended dose of fertilizer (RDF) – 25:50:0 (N:P2O5:K2O)

Source of fertilizer – N from Urea, P2O5 from DAP, K2O from MOP

Fig.2: Irrigation supply

After cultivation practices:

Gap filling:

If there is no germination within seven days of sowing and there is gap then fill that gap by dibbling the green gram seeds. Also during thinning fill the gap by planting the green gram plants.

Thinning:

In irrigatedgreen gram at the time of dibbling 2-3 green gram seeds are sow dibbled. Therefore it is necessary to carry out thinning operation within 7 days of sowing keeping only two healthy pplnts at each hill.

Weeding:

One or two inteculturing and one or two weeding should be carried out at 20 and 45 days after sowing. Fluchloralin or Pendimethalin @0.5kg per hectare or Oxadiazon @0.25kg per hectare as pre-emergence should be applied when hand weeding is not possible due to continuous rains during kharif season under middle Gujarat conditions. In wheat-moong cropping sequence, apply Flurchloralin @0.9kg per hectare as pre-emergence and carry out two hand weeding at 20-30 DASs in summer green gram.

Cropping system:

Green gram is taken in a crop sequence of sorghum-wheat-green gram, sorghum-potato-green gram or pearl millet-wheat-green gram.

3.3 TREATMENTS DETAILS:

Symbols	Treatments
T1	RDF + Water spray (control)
T2	RDF + foliar application of Nitrobenzene @ 2% at 25 and 45 DAS
T3	RDF + DAP @ 2% spray at 25 and 45 DAS
T4	RDF + Salicylic acid @ 75ppm at 25 and 45 DAS
T5	RDF +Nitrobenzene + Urea @ 2% + Salicylic acid @ 75 ppm spray at 25 and 45 DAS
T6	RDF + 25kg of extra dose of nitrogen at 40DAS + DAP @ 2% spray at 25 DAS

Table 3.2: Treatment details

3.4 DETAILS OF FOLIAR NUTRIENTS

3.4.1 Urea

Urea or Carbamide is an organic compound with the chemical formula CO (NH2) 2. Urea serves an important role in the used in fertilizers as a convenient source of nitrogen. Its nutrient composition is 46% N.

3.4.2 D.A.P

Di ammonium phosphate (DAP) with chemical formula (NH4)2HPO4 and IUPAC name diammonium hydrogen phosphate is one of a series of water-soluble ammonium phosphate salts that can be produced when ammonia reacts with phosphoric acid. Its nutrients composition is 46% P2O5 and 18% N respectively.

3.4.3 Salicylic acid:

Salicylic acid activates genes in some plants that produce chemicals that aid in the defence against pathogenic invaders. Salicylic acid contains GA and IAA which promotes cell replication. Trade name of salicylic acid is aspirin. Salicylic acid (from Latin salix, willow tree, from the bark of which the substance used to be obtained) is a mono hydroxybenzoic acid, a type of phenolic acid and a beta hydroxy acid. This colourless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin.

3.4.4 NPK (20:50:0)

NPK (20:50:0) is 1++00% water soluble fertilizers containing all the three major plant nutrients i.e. Nitrogen, Phosphorus and Potash for crops grown in green houses as well as other field crops. NPK is available in two forms: Foilar grade and drip grade.

1) Foliar, suitable for spraying.

2) Drip grade which is suitable for application through drip irrigation system.

Use of NPK either through drip or foliar prevents deterioration of soil texture as soil complexion and mechanical damage to the crop is eliminated

3.4.5 Nitrobenzene

It is a research based product containing nitrobenzene 24% w/w with naturally available vegetable protein. It is a plant energizer, flowering stimulants and yield booster. It enhances the plant canopy and induces profuse flowering and thereby increases the yield.

CHAPTER 4

BIOMETRIC OBSERVATION

4.1 Biometrics details:

The growth indices of plant were recorded at regular intervals throughout the life cycle of the crop in order to assess the probable relationship between different growth attributes and final yield. For recording biometric observations plant sampling were made at 20, 40 and 60 days after sowing (DAS) and at maturity. Five plants in the net plot area were randomly selected and tagged. The tagged plants were harvested for the studies of yield attributing characters of green gram. For recording the biometric observations such as dry matter accumulation of green gram, plants from the border rows were selected randomly drugged out from the second row of each plot to eliminate the border effect.

4.2 Pre-harvest observation

4.2.1 Plant height

In green gram, plant height of five randomly selected plants from each plot at 20, 40, 60 days after sowing (DAS) and at maturity were taken. Plants were measured from the ground level to the tip of the topmost leaf with the help of meter scale.The mean value of five plants was taken as the final plant height.

4.2.2 Dry matter accumulation

The five randomly selected plants from the second rows were cut above the ground at 20, 40, 60 days after sowing (DAS) and at maturity. The samples were dried in a hot-air oven at 65 ± 50 *C till the constant weight was obtained. The dry matter accumulation has been expressed in grams per m2.

4.2.3 Leaf area index (LAI)

It is defined as an assimilatory surface per unit area of land. Leaf area index was worked out at 20, 40 and 60 DAS by dividing the leaf area per plant by land area occupied by the plant.

$$LAI = \frac{\text{Leaf area per plant } (cm^2)}{\text{Land area occupied by plant } (cm)}$$

4.2.4 Number of root nodules per plant

The number of root nodules was counted on 40th day after sowing in randomly selected five plants. The plants were carefully removed from the soil without damaging the roots and roots were dipped in a bucket containing water to remove the soil and then nodules count was taken.

4.2.5 Number of branches per plant

Before harvest, five randomly selected tagged plants from each plot were taken out and number of branches of each plant was counted and arithmetic means were calculated.

4.3 Post harvest observation

4.3.1 Number of pods per plant

The numbers of pods in the five randomly selected plants were counted and arithmetic means of these five were recorded.

4.3.2 Number of seeds per pod

Total numbers of seeds from each of five randomly selected plants from each treatment were separated from pods and the number of seed is divided by number of pods.

4.3.3 100 seed weight

Seed samples were taken from the threshed and cleaned produce of each net plot and were exposed to sundry, 100 seed were counted and weighed to determine the 100 seed weight on electronic balance.

4.3.4 Grain yield

Harvested pods after picking from each net plot were threshed separately. After threshing, winnowing, cleaning and drying, Grain weight was recorded and concurrently grain samples were drawn from each plot to determine the moisture content with the help of moisture meter. Finally, the grain yield was computed at 14% moisture before being subjected to statistical analysis. The net plot yield was finally converted in to kg/ha by multiplying it with conversion factor.

CHAPTER 5

EXPERIMENTAL FINDINGS

The present investigation entitled "Effect of foliar nutrition on productivity of green gram (Vigna radiata L.)" was conducted during kharif 2020 at Agronomy Research Farm, Birsa Agricultural University, Ranchi. In this chapter, an attempt has been made to ascertain the degree of variations exhibited by different experimental variables applied in combination. Data thus obtained were analyzed and the statistical interpretations have been presented in this chapter.

5.1 Growth

Growth is an irreversible process in which there is an increase in size or dry weight or volume. Plant growth characters were evaluated in terms of plant height, nodule count, dry matter accumulation, leaf area index, number of branches and crop growth rate at different growth stages.

5.1.1 Plant Height

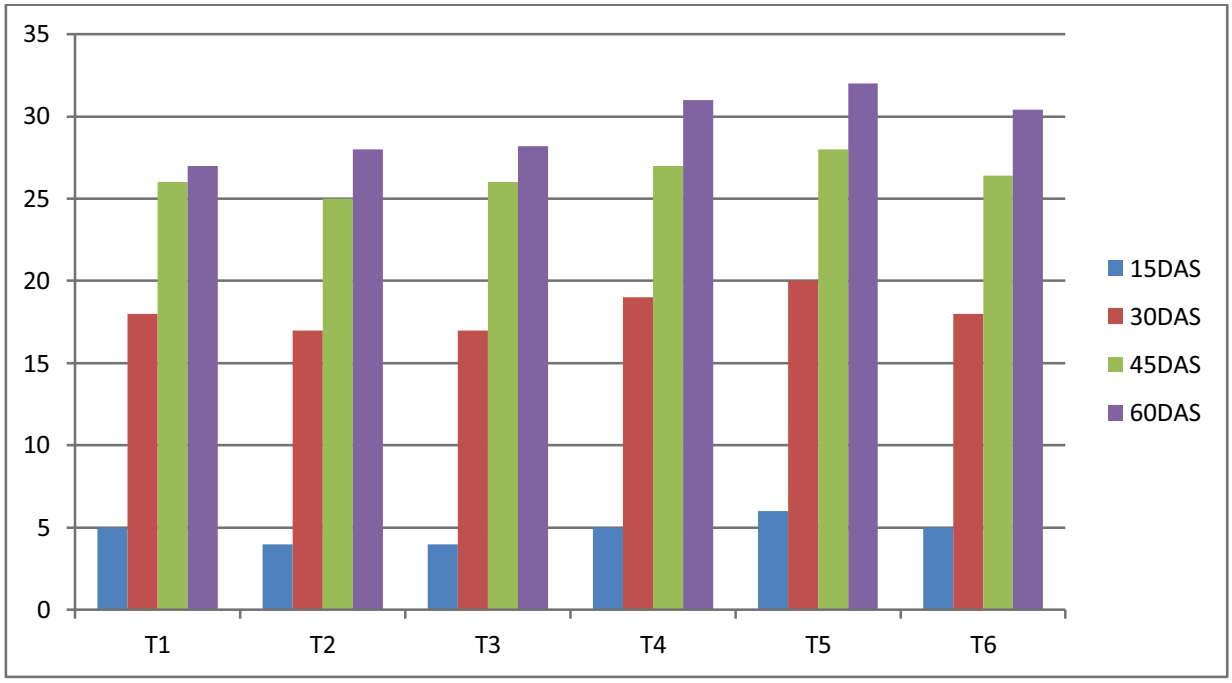
The data on plant height at progressive growth stages of green gram viz. 20, 40, 60 days after sowing and at harvest have been presented in Table 5.1. It is evident from data that at 20 DAS, plant height varied from 6cm to 32cm and was non-significant among the treatments. Maximum plant height (6cm cm) obtained with application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid and minimum (4cm) with application of RDF + DAP @ 2%. At 30 DAS, plant height varied from 6cm to 28 cm and was significantly influenced by the foliar application of nutrients. Maximum plant height 32cm was obtained with application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T5), which was at par with RDF + Water spray control (26cm) , RDF + Foliar Application of Nitrobenzene @ 2% (T2) (25cm), RDF + Soil application of DAP @ 2% spray (T3) (26cm), RDF + Salicylic acid @ 75ppm spray (T4) (27cm), RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75 ppm spray (T5) (28cm), RDF + 25kg extra dose of nitrogen + DAP @ 2% (T6) (26cm) ,except application of RDF + Water spray (control) (T1) and minimum (26cm) was obtained with RDF + Water spray (control) (T1). At later stages of crop growth i.e. 60 DAS, plant height varied from 28 cm to 32 cm and different treatments had significant effect on plant height. Maximum plant height (32cm) was recorded with RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T6), which was at par with RDF + Foliar application of nitrobenzene @ 2% (T2) (28cm), RDF + Soil application of DAP @ 2% spray (T3) (28cm), RDF + Salicylic acid @ 75ppm spray (T4) (31cm), RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T5) (32cm), RDF + 25kg of extra

dose of nitrogen + foliar application of DAP @ 2%, except application of RDF + Water spray(control) (T1) and minimum (27 cm) was obtained with RDF + Water spray(control) (T1).

At harvest, plant height varied from 27cm to 32 cm and different treatments had significant effect on plant height. Significantly higher plant height (32 cm) was obtained with application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T6) which is at par with all other treatments except application RDF + Water spray(control) (T1) and minimum (27 cm) was obtained with RDF + Water spray(control) (T1).

Treatments	Nutrient Management	15DAS	30DAS	45DAS	60DAS
T1	RDF + water spray control	5	18	26	27
T2	RDF + Nitrobenzene @ 2%	4	17	25	28
T3	RDF + DAP @ 2% spray	4	17	26	28.2
T4	RDF + Salicylic acid at 75ppm	5	19	27	31
T5	RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid	6	20	28	32
T6	RDF + 25kg of nitrogen + DAP @ 2%	5	18	26.4	30.4

Table 5.1 :Observation of plant height



Graph.5.1: Observation of plant height

5.1.2 Leaf area index

The data on leaf area index presented in Table 5.2 revealed that there was variation among the treatment but significant variation was observed at 60 DAS as influenced by the foliar application of nutrients.

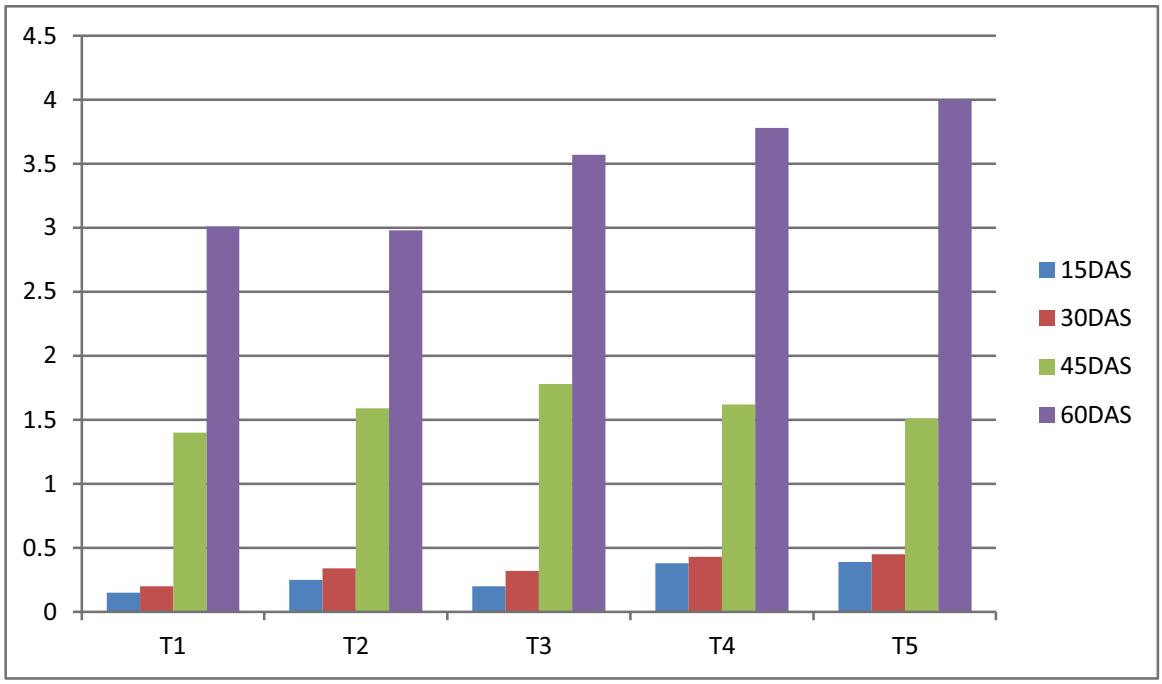
It is apparent from the data (Table 5.2) that, at 20 DAS leaf area index varied from 0.15 to 0.39 and was non-significant among the treatment. Maximum leaf area index (0.39) was recorded with application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T5), RDF + Salicylic acid @ 75ppm spray (T4) and minimum (0.35) with RDF + Water spray control (T1).

At 40 DAS, leaf area index varied from 1.40 to 1.98 and was non-significant among the treatment. Maximum leaf area index (1.98) was recorded with RDF + 25kg of extra dose of nitrogen + DAP @ 2% (T6) and minimum (1.40) with RDF + Water spray (control) (T1).

At 60 DAS, leaf area index varied from 3.01 to 4.00 and was significantly influenced by foliar application. Significantly maximum leaf area index (4.00) was produced with application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray (T6)which was at par with RDF + Foliar application of Nitrobenzene @ 2% (T2) (3.01), RDF + Soil application of DAP @ 2% spray (T3) (3.57), RDF + Salicylic acid @ 75 ppm spray (T4) (3.78), RDF + Nitrobenzene 2% + Urea 2 25 + Salicylic acid @ 75 ppm spray (T5) (4.00), RDF + 25kg of extra dose of nitrogen + Foliar application of DAP @ 2% while minimum leaf area index (2.98) was recorded with RDF + Water spray (control) (T1).

Treatments	Nutrient Management	15DAS	30DAS	45DAS	60DAS
T1	RDF + water spray control	0.15	0.20	1.40	3.01
T2	RDF + Nitrobenzene @ 2%	0.25	0.34	1.59	2.98
T3	RDF + DAP @ 2% spray	0.20	0.32	1.78	3.57
T4	RDF + Salicylic acid at 75ppm spray	0.38	0.43	1.62	3.78
T5	RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid	0.39	0.45	1.51	4.00
T6	RDF + 25kg of nitrogen + DAP @ 2%	0.30	0.32	1.49	3.34

Table 5.2: Observation of leaf area index



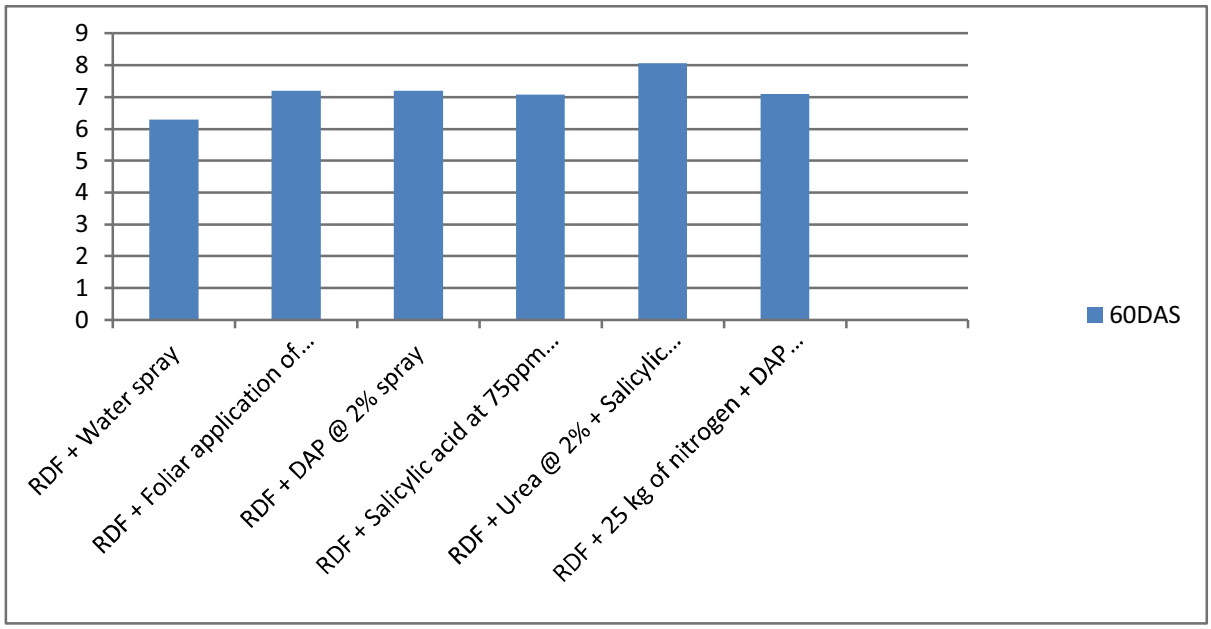
Graph.5.2: Observation of leaf index

5.1.3 Number of branches per plant

Data pertaining to number of branches per plant (Table 5.3) revealed that the foliar application of nutrients influenced the number of branches per plant significantly and varied from 6.30 to 8.07. At 60 DAS, significantly maximum number of branches per plant (8.07) was produced with application of RDF + Urea @ 2% + Salicylic acid @ 75ppm spray (T5) which was at par with RDF+ DAP @ 2% (T3) (7.20), RDF + Nitrobenzene @ 2% spray (T2) (7.20) and RDF + 25kg of extra dose of nitrogen + DAP @ 2% spray (T6) (7.10). Minimum number of branches per plant (6.30) was recorded with RDF + Water spray (control) (T1).

Treatments	Nutrient Management	60 DAS
T1	RDF + Water spray	6.30
T2	RDF + Foliar application of nitrobenzene @ 2%	7.20
T3	RDF + DAP @ 2% spray	7.20
T4	RDF + Salicylic acid at 75ppm spray	7.07
T5	RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid at 75 ppm	8.07
T6	RDF + 25 kg of nitrogen + DAP @ 2%	7.10

Table 5.3 observation of number of branches per plant



Graph.5.3: Observation of branches per plant

5.2 Crop Growth Stages

5.2.1 Crop Growth Rate

Analysis of the data on crop growth rate as influenced by the foliar application of nutrients as presented in Table 4.6. The data revealed that crop growth rate increased as the growth progressed and the values being the maximum at harvest.

It is apparent from the data that foliar application of nutrients exerted significant influence on crop growth rate at all the growth stages. At 20-40 DAS, crop growth rate varied from 3.68 to3.87 g/m2/day. Maximum crop growth rate (3.87 g/m2/day) was observed with application of Urea @ 2% + Salicylic acid @ 75ppm spray (T6) along with RDF and the effect was non-significant with all the treatments. At 40-60 DAS, crop growth rate varied from 4.00 to 7.37 g/m2/day. Application of RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid @ 75ppm spray(T6) recorded significantly maximum crop growth rate (7.37 g/m2/day) which was at par with RDF+ DAP @ 2% spray (T3) (6.64 g/m2/day), RDF + Nitrobenzene @ 2% spray(T2) (6.29 g/m2/day), RDF + Salicylic acid @ 75ppm spray(T4) (6.00 g/m2/day), RDF + 25kg extra dose of nitrogen + DAP @ 2% (5.75 g/m2/day), while minimum was recorded in RDF + Water spray (control) (T1).

At 60 DAS-harvest, different foliar treatments showed non-significant effect, crop growth rate varied from 3.49 to 6.52 g/m2/day. Maximum crop growth rate was observed with application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T6) along with RDF (6.52 g/m2/day).

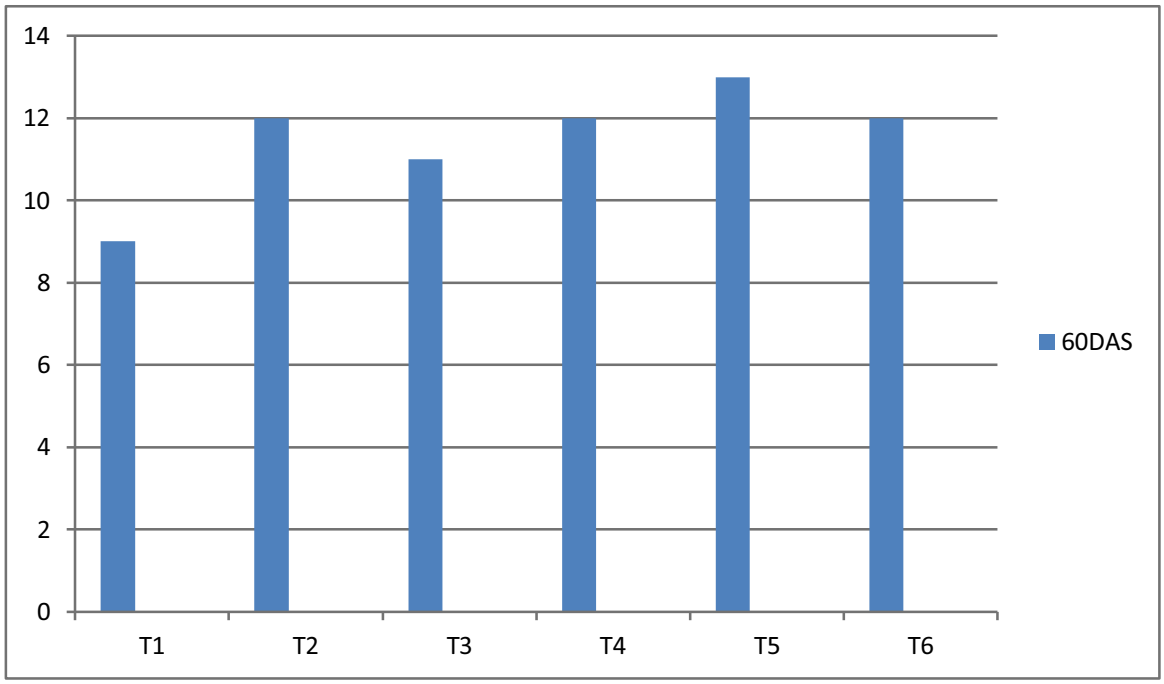
$$CGR = \frac{(W2 - W1)}{(T2 - T1)}$$

5.2.2 Number of pods per plant

It is evident from the data that foliar application of nutrient brought significant variation in pods per plant and varied from 12.15 to 15.55. A data indicated that the maximum number of pods per plant (15.55) recorded with application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T5) along with RDF, which was at par with RDF + Nitrobenzene @ 2% (T2), RDF + Soil application of DAP @ 2% (T3), RDF + Salicylic acid at 75 ppm spray . The lowest number of pods per plant was recorded with application of RDF + Water spray (control) (T1) (12.15). Foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray, Salicylic acid @ 75ppm spray and DAP @ 2% spray along with RDF produced 27.98%, 16.46%, 11.93%, 9.63% and 6.99% higher number of pods per plant than RDF + Water spray (control)(T1) respectively.

Treatments	Nutrient Management	60 DAS
T1	RDF + Water spray	9
T2	RDF + Foliar application of nitrobenzene @ 2%	12
T3	RDF + DAP @ 2% spray	11
T4	RDF + Salicylic acid at 75ppm spray	12
T5	RDF + Nitrobenzene 2% + Urea @ 2% + Salicylic acid at 75 ppm	13
T6	RDF + 25 kg of nitrogen + DAP @ 2%	12

Table 5.4 Number of pods per plant



Graph 5.4 Observation of Pods per plant

5.2.3 Number of seeds per pod

Number of seeds per pod varied from 11.80 to 13.27 and was significantly influenced by the foliar treatment. Analysis of data revealed that the highest number of seeds per pod (13.27) was recorded with application of RDF + Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T6) which was at par with all other treatments except RDF + Water spray (control) (T1) which recorded lowest number of seeds per pod (11.80).

5.3 Yield

The data pertaining to grain yield (kg/ha), straw yield (kg/ha) and harvest index (%) as influenced by foliar application of nutrients have been presented in the data

5.3.1 Grain yield

It is observed that grain yield was varied from 400 kg/ha to 800 kg/ha and significantly influenced by foliar application. It is evident from that green gram crop fertilized with RDF along with Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T5) produced highest grain yield (800 kg/ha) and it was statistically at par with RDF + Salicylic acid at 75ppm spray at flower initiation (T4) (711kg/ha), RDF + Urea @ 2% spray (T3) (710kg/ha) and significantly superior to RDF + Foilar application of Nitrobenzene @ 2% at 45 days (T2) (614 kg/ha), and RDF + Water spray (control) (T1) (400kg/ha).

The lowest grain yield was obtained in RDF + Water spray (control) (T1) (400 kg/ha). The application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray, Nitogen + DAP @ 2%, Urea @ 2% spray, Salicylic acid @ 75ppm spray and DAP @ 2% spray increase in grain yield of green gram over RDF + Water spray (control) (T1).

5.3.3 Harvest index

It is revealed from the data on harvest index that the harvest index did not differ significantly due to different levels of foliar application. Harvest index varied from 25.21 % to 28.53 %. The highest harvest index was obtained with application of RDF + Water spray (control)(T1) (28.53 %) while the lowest harvest index was recorded with RDF + Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T5) (25.21 %)

5.4 Nitrogen uptake

5.4.1 By grain

It is observed that nitrogen uptake by grain was varied from 9.10 kg/ha to 21.32 kg/ha and significantly influenced by foliar application. Significantly maximum nitrogen uptake was recorded with application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray(T5) along with RDF (21.32 kg/ha) which was at par with all other treatments except RDF + Nitrobenzene @ 500ppm spray(T2) (9.10 kg/ha) which received lowest nitrogen uptake.

5.4.2 By plant

Data pertaining to nitrogen uptake by straw of green gram revealed that the foliar application of nutrients significantly influenced the nitrogen uptake by straw and it was varied from 6.15 kg/ha to 20.51 kg/ha. The maximum nitrogen uptake by straw (20.51 kg/ha) was recorded in RDF + 25 kg of extra dose of nitrogen spray(T6), which was significantly superior to all other treatments except RDF + Urea @ 2% spray(T2) (27.92 kg/ha). The minimum nitrogen uptake by straw (8.15 kg/ha) was found with RDF + Nitrobenzene @ 500ppm spray (T2). The application of 25kg of extra dose of nitrogen and urea @ 2% spray found higher nitrogen uptake by straw over RDF + Nitrobenzene 2% at 45 DAS.

5.4.3 Total uptake

Data pertaining to total uptake of nitrogen in green gram have been revealed that foliar application of nutrients significantly influenced the total uptake of nitrogen and it was varied from 20.25 kg/ha to 51.46 kg/ha. It is evident from the data that among different treatment of nutrition, significantly highest total

uptake of nitrogen (51.46 kg/ha) was recorded with application of 25kg of extra dose of nitrogen (T6) along with RDF which remained at par with RDF + Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray(T5) (67.52 kg/ha) and RDF + Salicylic acid @ 75ppm spray(T4) (41.23 kg/ha). The lowest total nitrogen uptake (20.25 kg/ha) was obtained with RDF + Nitrobenzene @ 2% spray (T2). The application of Urea @ 2% + Salicylic acid @ 75ppm spray, Urea @ 2% spray and Salicylic acid @ 75ppm spray has recorded higher uptake of total nitrogen over RDF + Nitrobenzene 2% @ 45 DAS.

5.5 Phosphorus uptake

5.5.1 By grain

Data pertaining to phosphorus uptake by grain of green gram have been revealed that the foliar application of nutrients significantly influenced the phosphorus uptake by grain and it was varied from 1.38 kg/ha to 2.57 kg/ha. Significantly maximum phosphorus uptake by grain was recorded with application of Nitogen @ 2% spray (T6) along with RDF (2.57 kg/ha), which was at par with all other treatments except RDF + Nitrobenzene @ 500ppm spray(T8) (2.38 kg/ha) and RDF + Water spray (control) (T1) (1.50 kg/ha). Minimum phosphorus uptake by grain was recorded with application of RDF + Nitrobenzene 2% (T2) (2.38 kg/ha).

5.5.2 By plant

Data pertaining to phosphorus uptake by straw of green gram have been revealed that the foliar application of nutrients significantly influenced the phosphorus uptake by straw and it was varied from 1.69 kg/ha to 3.37 kg/ha. Significantly maximum phosphorus uptake by straw (2.37kg/ha) was recorded in RDF + Urea @ 2% spray(T6), which was at par with RDF + Urea @ 2% + Salicylic acid @ 75ppm spray(T6) (3.15 kg/ha). The minimum phosphorus uptake by straw (1.69 kg/ha) was found with RDF + Salicylic acid @ 75ppm spray (T4). The application of Urea @ 2% spray and Urea @ 2% + Salicylic acid @ 75ppm spray higher phosphorus uptake by straw over RDF + Salicylic acid @ 75ppm spray.

5.5.3 Total uptake

Data pertaining to total uptake of phosphorus (kg/ha) revealed that foliar application of nutrients significantly influenced the total uptake of phosphorus and it was varied from 2.64 kg/ha to 4.60 kg/ha. It was evident from the data that among different treatment of nutrition, significantly maximum total uptake of phosphorus (4.60 kg/ha) was recorded with application of Urea @ 2% + Salicylic acid @ 75ppm spray (T5) along with RDF which remained at par with RDF + Urea @ 2% spray (T2) (6.41 kg/ha). The lowest total phosphorus uptake (4.64 kg/ha). The application of Urea @ 2% + Salicylic acid

@ 75ppm spray, Urea @ 2% spray has higher uptake of total phosphorus over RDF + Salicylic acid @ 75ppm spray.

5.6 Phosphate uptake

5.6.1 By grain

Data pertaining to potassium uptake revealed that the foliar application of nutrients, significantly influenced the total potassium uptake by grain and straw of green gram and it was varied from 5.31 kg/ha to 4.70 kg/ha. Significantly maximum potassium uptake by grain was recorded with application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray(T4) along with RDF (5.31 kg/ha), which was at par with RDF + DAP @ 2% spray(T3) (3.80 kg/ha) and RDF + Salicylic acid @ 75ppm spray(T4) (3.58 kg/ha). The lowest potassium uptake by grain was recorded with RDF + Nitrobenzene @ 500ppm spray (T8) (2.70 kg/ha). The potassium uptake by grain increased by 34.25%, 31.70%, 23.40%, 21.92%and 18.72% when crop fertilized with RDF and sprayed with Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray, RDF + DAP @ 2% spray and RDF + Salicylic acid @ 75ppm spray over RDF + Nitrobenzene @ 2% spray.

5.6.2 By plant

Data pertaining to potassium uptake in straw revealed that the foliar application of nutrients significantly influenced the potassium uptake by straw of green gram and it was varied from 12.59 kg/ha to 6.46 kg/ha. Significantly maximum potassium uptake by straw (12.59 kg/ha which was at par with RDF + Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray (T5)(11.39 kg/ha). The minimum potassium uptake by straw (6.46 kg/ha) was found with RDF + Water spray (control) (T1).The application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray has higher potassium uptake by straw over RDF + Water spray (control) (T1).

5.6.3 Total uptake

Data pertaining to total uptake of potassium (kg/ha) have been revealed that foliar application of nutrients significantly influenced the total uptake of potassium and it was varied from 12.30 kg/ha to 18.78 kg/ha. It is evident from the data that among different treatment of nutrition, maximum total uptake of potassium (18.78 kg/ha) was recorded which was found to be significantly superior over all other treatments. The lowest total potassium uptake (14.30 kg/ha) was obtained with RDF + Water spray (control)(T1). The application of DAP @ 2% spray has higher uptake of total potassium over RDF + Water spray (control).

CHAPTER 6

SUMMARY AND DISCUSSION

The present investigation entitled "Effect of foliar nutrition on productivity of green gram (Vigna radiata L.)" was conducted during kharif 2020 at the Paavai field, Namakkal. The soil was sandy loam in texture and acidic (pH-5.55) in reaction, with low to medium in soil fertility: organic carbon (2.3kg), available nitrogen (139.1 kg/ha), available phosphorous (24.7 kg/ha), available potassium (148 kg/ha). The experiment was laid out in a randomized block design with ten treatments replicated thrice. The important findings of the experiment have been summarized and concluded here under this chapter:

1. Plant height increased with the growth stages and highest values were obtained at different stages for the treatment where, RDF along with foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray recorded maximum plant height at 45 DAS (28cm), 60 DAS (32cm).

2. Foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF produced maximum nodule number per plant (24.03) at 45DAS.

3. Dry matter production per m2 increased as the growth progressed and maximum value was obtained at harvest. RDF along with foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray recorded highest dry matter accumulation at 45 DAS (74.14 g/m2), 60 DAS (188.55 g/m2) and at harvest (206.70 g/m2).

4. Leaf area index increased with the progress in growth and maximum value was obtained at 60 DAS. Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF recorded maximum leaf area index (4.00) at 60 DAS.

5. The foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF produced maximum number of branches per plant (5.07) at harvest.

6. Crop growth rate (CGR) of green gram was recorded maximum at 45-60 DAS and thereafter it declined. Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF recorded highest CGR at 30-45 DAS (2.87 g/m2/day), 45-60 DAS (5.37 g/m2/day) and at 60 DAS-harvest (3.65 g/m2/day).

7. Among different treatments, higher number of pods per plant (15.55), seeds per pod (13.27) and 100 seed weight (3.47 g) was recorded with Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray along with RDF.

8. Application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @ 75ppm spray along with RDF recorded higher grain (800 kg/ha) and straw yield (1000 kg/ha).

9. Protein content was recorded maximum (26.40 %) with salicylic acid @75ppm spray along with RDF, although there was no significant difference among the treatments.

10. Total uptake of N (21.46 kg/ha) and K (18.78 kg/ha) was recorded maximum with application of 20:50:0 (N:P:K) @ 2% spray along with RDF and P (6.60 kg/ha) total uptake with Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF.

CHAPTER 7

CONCLUSIONS

On the basis of one year experimentation, following conclusions can be drawn:

1. Foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF produced higher growth, yield attributes, grain yield as well as straw yield of green gram.

2. Foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF to green gram crop led to better utilization of nutrient as it favoured highest uptake of nitrogen (N), phosphorus (P) and by grain as by straw.

3. Foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF to green gram crop was found advantageous as it produced highest net return and benefit cost ratio making it economically viable for the farmers.

Based on the result of present investigation, it may be concluded that foliar application of Urea @ 2% + Nitrobenzene 2% + Salicylic acid @75ppm spray along with RDF proved to be more productive and economically viable for green gram cultivation.

REFERENCE:

Ashour, I. N. and Thalooth, T. A. 1983. Effect of soil and foliar application of nitrogen duringpod development on the yield of soybean [Glycine max (L.) Merr.] plants. Field Crop Res., 6:261-266.

Baghel, M. S. And Yadhav, H. S. 1992. Response of blackgram to date of sowing and growth regulators to physiological parameters and seed yield. Bharatiya Krishi Annusandhan Patrika, 9:38-42.

Baker, D.E. and Suhr, N.H. 1982. Atomic absorption and flame emission spectrometr, p. 13-27.

Balusamy, M. and Meyyazhagan. 2000. Foliar nutrition to pulse crop. Training manual on recent advances in pulses production technology, CASA, Tamilnadu Agricultural University,p. 113-15.

Bameri, M., Abdolshashi, R., Mohammadi- Nejad, G., Yousefi, K. and Tabatabaie. 2010. Effect of different microelement treatment on wheat growth and yield. International Research Journal of Applied and Basic Sciences,3: 219-23.

Barik, T. and Rout, D. 1990. Effect of foliar spray of commercial micro-nutrient mixtures on growth, yield and quality of urdbean. Leg. Res., 13(1): 50-52.

Baruah, T.C. and Barthakur, H.P. 1997. A textbook of soil analysis vikas publishing house Pvt. Ltd.New Delhi, p. 334.

Beg, M. Z. and Ahmad, S. 2012. Effect of potassium on mungbean, Indian J. L. Sci.,1(2): 109-14.

Beg, M.Z., Ahmad, Sohrab.and Shrivastava and Deepak Kumar. 2013. Foliar application of potassium on urdbean. Indian J. Sci.,2(2):67-70.

Behera, Nigamanda and Elamathi, S. 2007. Studies on the time of nitrogen, application of foliar sprayof DAP, and growth regulators on yield attributes, yield and economics of green gram.Intl. J. Agric. Sci., p. 168-169.

Beninger, H. (1978). The role of potassium in yield formation. Potash Review Subject 16, Suite 78, Int., Potash Inst Berne (Switzerland),pp.3.

Berger, K.C. and Troug, E. 1939. Boron determination in soils and plants. Ind. Eng. Chem. Anal. Ed.,11: 540-45.

Bhowmick et al. 2014. Improvement of lathyrus productivity through seed priming and foliar nutrition under rice-utera system. Journal of Crop and Weed, 10(2): 277-280.

Birari, B.M. 1976. M.Sc. (Agri.) Thesis, MPAU, Rahuri (M.S.), India.

Chandrasekhar, C. N. and Bangarusamy, U. 2003. Maximizing the yield of mung bean by foliar application of growth regulating chemicals and nutrients. Madras Agric. J.,90(1-3): 142-145.

Chandrashekaran, R., Somasundram, E., Mohamed, Amanullah, M., Thirukumaran, K. and Sathamoorthi, K. 2004. Effect of foliar application of DAP and ZnSO4 on growth and productivity of groundnut. International Journal of Agricultural Science,4(2): 548-50.

Chaudhary G.L. and Yadav L.R. 2011. Effect of fertility levels and foliar nutrition on cowpea productivity. Journal of Food Legumes,24(1):67-68.

Chesti, M.H., T. And Bhat, M.P. 2012. Effect of organic and inorganic phosphorus sources on quality of green gram (Vigna radiata) under temperate condition of Jammu and Kashmir. Legume Research. 35(1): 47-49.

Deshmukh, S. G., Kale, H. B. and Solunke, P. S. 2008. Influence of graded fertility levels andurea spray on growth, yield and economics of rajma. Annals. of Plant Physiol.,22(2):189-191.

Dixit, Mohan, Pradeep. and Elamathi, S. 2007. Effect of foliar application of DAP, micronutrients and NAA on growth and yield of Green gram. Journal of Legume Research, 30(4): 305-07.

Doss, A., Anand, S.P. and Keerthiga, M. 2013. Effect of foliar application of DAP,Potash and NAA on growth yield and some biochemical constituents of Vigna mungo (L.) Hepper. WudpeckerJournal of Agricultural Research vol.,2(7):206-208.

Elayaraja D. and Angayarkanni,A. 2005. Effect of foliar nutrition on the nodulation and yield of rice fallow blackgram. The Andhra Agric. J., 52 (3&4): 602-604

Geetha, P. and Velayutham, A. 2009. Refinement of nutrient management techniques for growth, yield and nutrient uptake of rice fallow blackgram. Madras Agricultural Journal,96(1-6): 163-66.

Girma, K., Martin, K.L., Freeman, K.W., Mosali, J., Teal, R.K., Raun, W.R., Moges, S.M. and Arnall, B. 2007. Determination of the optimum rate and growth stage for foliar applied phosphorus in corn. Commun Soil Sc. Pl. Anal.,38: 1137-54.

Govindan,K and Thirumurugan,V. 2000. Response of green gram to foliar nutrition of potassium. Journal of Maharashtra Agricultural Universities, 25:302

Jackson, N.L. 1973. Soil chemical analysis. Prentice Hall of India Pvt. Ltd. New Delhi.

Jadhav R.L. and Kulkarni S. 2016. Effects of foliar spray of nutrients on productivity of greengram (Vigna radiata) in North Eastern transitional zone of Karnataka, India. Legume Research, 39(5):817-819.

Jain L.R. and Singh P. 2003. Growth and nutrient uptake of chickpea (Cicer arietinum L.) as influenced by bio fertilizers and phosphorus nutrient. Crop Research, 25: 410-413.

Kandagal, S.S., Panchal,Y.C. and Manjunath, S. 1990. Effect of growth regulators and nutrients on yield components of mungbean genotypes. J. Maharastra Agric. Univ., 15(2): 199-200.

Kelly, A., Nelson, P., Motavalli, P. and Manjula Nathan. 2005. Response of no-till soybean (Glycine max L.) to timing of pre-plant and foliar potassium applications in a clay pan soil. Agron. J.,97: 832-38.

Khalilzadeh, R., Mehdi, T. and Jalal, J. 2012. Growth characteristics of mungbean (Vigna radiata L.) affected by foliar application of urea and bio-organic fertilizers. Intl. J. Agric. Crop Sci.,4(10): 637-42.

Kuttimani, R. And Velayutham, A. 2011. Foliar application of nutrients enhances the yield attributes and nutrient uptake of green gram. Agric. Sci. Digest., 31(3): 202-205.

Limbikai, G.T. 2012. Response of blackgram to sulphur application and foliar sprays under rainfed condition. M.Sc. Thesis, U.A.S. Dharwad.

Madhu, G., Ganajaxi, M., Sudarshan Reddy, A., Rajesh, T.M. and Patil, I.D. 2014. Effect of date of sowing and foliar nutrition on yield and quality of Mungbean varieties. Progressive Research,9(Conf. Spl.):13-15.

Mahala, C. P. S., Dadheech, R. C. and Kulhari, R. K. 2001. Effect of plant growth regulators on growth and yield of blackgram (Vigna mungo) at varying levels of phosphorus. Crop Res.,18(1): 163-165.

Mahmoud, M., Shaaban, Abdalla, El-Sayed., F., El-Nour., A., El-Zanaty., A. M., ESaady and Mohamed, A. K. 2006. Boron/ nitrogen interaction effect on growth and yield of fababean plants grown under sandy soil conditions.

Manonmani, V. and Srimathi, P. 2009. Influence of mother crop nutrition on seed and quality of blackgram. Madras Agric. J., 96(16): 125-128.

Manu, M. and Wahab, K. 2002. Nutrient uptake and nodulation as influenced by irrigation and DAP spray in rice fallow blackgram. Plant Archives,2: 5557.

Naidu, T.C.M., Rao, Nageswara., Siva, D. and Rani, Ashoka, Y. 2015. Effect of foliar nutrition on antioxidant enzymes, photosynthetic rate, dry matter production and yield of mung bean under receding soil moisture condition. International Journal of Pure and Applied Bioscience, 3(1): 115-23.

Odeleye, F. O., Odeleye, O. M. O., and Animashaun. 2007. Effect of nutrient foliar spray on soybeangrowth and yield (Glycine max (L.) Merrill) in south west Nigeria. Not. Bot. Hort.Agrobot. Cluj.,35 (2).

Pandrangi, R.B., Wankhade, S.G. and. Nasre, R.A., 1991, Response of mung (Phaseolus aureus L.) to soil and foliar application of phosphatic fertilizers. Legume Res. Ind., 14(4): 187-188.

Parasuraman, P. 2001. Effect of seed pelleting with diammonium phosphate and potassium dihydrogen phosphate and foliar spray with diammonium phosphate on growth and yield of rainfed cowpea (Vigna unguiculata).

Pawar, S.E. and Bhatia C.R. 1980. The basis for grain yield differences in mungbean cultivars and identification of yield limiting factors. Theor. Appl. Genet., 57: 171-175.

Peng, Liu., Wu, Jianzhi. and Yang, Yuai. 2005. Effects of levels of Mo and boron supply on three absorption and distribution in soybean. China J. Zhejianj. Univ. Agric., 31(4): 399-407.

Radhamani S., Balasubramanian A. and Chinnusamy C. 2003. Foliar nutrion with growth regulators on the productivity of rainfed greengram. Agricultural Science Digest,23(4):307-308.

Rahman, Inayat., Afzal, Aftab., Iqbal, Zafar., Ijaz, Farhana, Shad, Salma., Manan, Shafiul. and Afzal, Muhammad. 2014. Response of common bean to basal applied and foliar feeding of different nutrient application. American-

Raju, R.A., and Reddy, M.N. 1998. Establishment techniques, seed rate and fertilizer application to summer blackgram in rice fallows. Indian Journal of Agronomy, 43: 411-13.

Ramamoorthy, K., Ramasamy, M., and Jehangir, K. S. 1995. Response of rainfed blackgram (Phaseolus mungo) to foliar nutrition of potassium. Indian Journal of Agronomy,40 (1):114-115.

PHOTOGRAPHY PLATE

PLATE :1 GERMINATION OF SEED

PLATE :2 DIAMMONIUM PHOSPHATE

PLATE :3 UREA

PLATE: 4 YIELD OF GREEN GRAM

PLATE: 5 GROWING OF CROPS

PLATE: 6 MATURED PODS

AUTOMATIC GREENHOUSE ROOFING SYSTEM BY USING IoT

A PROJECT REPORT

Submitted by

AJITH KUMAR V (16102002)

ARUN S (16102006)

DEEPANKUMAR R (16102016)

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ABSTRACT

Now a day, during the summer seasons the cultivated crops gets affected due to the heavy sunshine intensity and temperature. The main theme of this project is that to prevent the crops from the heavy sunshine, temperature, warmth and then save crops. The Temperature sensor and Humidity sensor is used for the working of automatic roof and control the environment condition. This system involves protects the crops by the auto roof which covers the greenhouse. Temperature sensor is used to measure sunshine intensity, temperature value from outer site of greenhouse. When to reached high temperature value, this system is automatically closed roof in greenhouse for reducing impact of high sunshine intensity. Humidity sensor is used to measure temperature value of innerside of greenhouse during high sunshine intensity season like April and May and ventilation fan and water sprayer is used to reducing temperature and to maintain favourable environment condition in greenhouse.

Our project can be considered as the central issue in designing portable greenhouse. This technology provides the portable roof with temperature sensor which it can use to measure temperature of outside in greenhouse and then control the roof condition (open or close) and humidity sensor can use to measure the humidity and temperature of inside greenhouse and then control ventilation fan and water spraying system . It is a portable greenhouse system that works on Arduino Microcontroller and employs two sensors to measure temperature and humidity condition. The Arduino board was selected as the microcontroller platform and its software counterpart, Arduino Software, was used to carry out the programming

Keyword: *Temperature and Humidity sensor, Arduino microcontroller, greenhouse, Arduino software.*

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LIST OF ABBREVATION

SYMBOL	ABBREVIARION
UNO	Unit Number One
HTMC	High Tech Media Communication
LIDAR	Light Detection And Ranging
PIR	Passive Infrared Sensor
AC	Alternative Current
IR	Infrared
TOF	Time Of Flight
SMS	Short Message Service
LCD	Liquid Crystal Display
USB	Universal Serial Bus
IDE	Integrated Development Environment
DC	Direct Current
SPAM	Spiced Ham
EEPROM	Electrically Erasable Programmable Read Only Memory
OAF	Obstacle Avoiding Function
VTS	Vehicle Tracking System

CHAPTER I

INTRODUCTION

1.1. GENERAL

The framework depends on Arduino microcontroller, programmed work, Ultrasonic sensor, Temperature sensor and Humidity sensor. This framework utilizes battery-powered force putting away sources as 12V battery that is energized from AC current. At that point AC current is put away in 12V DC battery. During summer season, part of harvests are high influenced by substantial daylight, temperature and warmth. Primary goal of our venture is to keep crops from high daylight force, temperature and warmth during summer season and make positive condition are keep up consequently.

Temperature sensor is utilized to gauge daylight power, warmth and temperature esteem from external site of nursery. When to arrive at high warmth and temperature esteem, this framework is consequently shut rooftop in nursery for lessening effect of high daylight force. Dampness sensor is utilized to gauge temperature estimation of within nursery during high daylight force season like April and May and ventilation fan and water sprayer is utilized to evacuate heat and to keep up ideal condition in nursery. Ultrasonic sensor is put front of the nursery rooftop. It is utilized to distinguish any specialist or human will enter the nursery and consequently open and close the entryway framework. Fundamental point of our task is make full and full programmed nursery framework for decreasing human work adequacy, working time and any wastage of vitality or force.

This device consists of temperature sensor, Arduino-Uno, motors and bio-degradable plastic materials for shade. When the high temperature is detected by the sensor it gives signal to Arduino-Uno. Further Arduino gives signal to the motor due to which the roof gets over the crops and protect crops from being destroyed. And when the reducing temperature ranges stops the roof automatically opens. This device is simple but

very useful for farmers to save their money which they have invested and their time. And above all it runs on the solar energy making it more cost effective and eco-friendly.

When inside of greenhouse have a high temperature during roof closed condition of greenhouse. The Humidity sensor is used to measure humidity and temperature of inside greenhouse and detect high heat condition gives signal to Arduino–UNO. Further Arduino gives signal to the water pump and ventilation fan due to which ventilation fan is used to reducing heat and pump is used to spray the water to crop for reducing heat.

1.2. OBJECTIVES

- To prevent crops and plants from the high sunshine intensity, warmth and temperature.
- To make favourable environment condition for plats growth.
- To control sunshine intensity, heat and temperature inside the greenhouse.

CHAPTER 2

LITERATURE REVIEW

***S.RAJESH, CHANG LEE AND G.SHARWESH*(2019)** entitled **"AUTOMATIC SMART ROOF SYSTEM USING ARDUINO AND RAIN DROP SENSOR"** said**,** This project deals with a when unseasonal rain falls on the harvested crops, which are kept to dried up, they rot up and get destroyed due to which farmers have to face enigma. Some crops must be dried before it is sold to the agriculture market yard, so the farmer needs some space for the crops to dry which most of the farmers don't have and it take loads of time to dry up. As the farmers have invested their time almost three to four months and huge amount of capital both, in the yield and as it gets ruined by rainfall, farmer's assets and time goes in vain. So as farmer's faces loss, this device is built up to protect them from severe loss. This device is used in agriculture purpose in a way when the rain drops falls on the rain sensor, the roof automatically gets over the crops kept for drying. This device consists of rain sensor, Arduino-Uno, motors and bio-degradable plastic materials for shade. When the rain is detected by the sensor it gives signal to Arduino-Uno. Further Arduino gives signal to the motor due to which the roof gets over the crops and protect crops from being destroyed. And when the rainfall stops the roof automatically opens. This device is simple but very useful for farmers to save their money which they have invested and their time. And above all it runs on the solar energy making it more cost effective and eco-friendly.

In Our project are working same principle but replacing the rain sensor to temperature sensor for detect high temperature ranges.

R.BALATHANDAPANI, D.BOOPATHI, S.JOTHEESHWARAN, G.ARUNDEVA **(2018)** entitled **"TEMPERATURE BASED SPEED CONTROL OF FAN USING ARDUINO"** said, In present scenario, availability of electricity is found to reach crucial stage. To protect and safeguard one's future we need to save the energy. As a slogan suggest "One unit saved is one unit generated". The project is a standalone automatic fan speed controller that controls the speed of an electric fan according to our requirement. Use of embedded technology makes this closed loop feedback control system efficient and reliable. Arduino microcontroller allows dynamic and faster control. Liquid crystal display (LCD) makes the system user friendly. The sensed temperature and fan speed level values are simultaneously displayed on the LCD panel. It is very compact as it is constructed by using few components and can be interfaced for several applications including air-conditioners, water-heaters, snow-melters, ovens, heat-exchangers, mixers, furnaces, incubators, thermal baths and veterinary operating tables. Arduino micro controller is the heart of the circuit as it controls all the functions. The temperature sensor LM35 senses the temperature and converts it into an electrical signal, which is forwarded to the microcontroller. The sensed and set values of the temperature are displayed on the 16x2-line LCD. The microcontroller drives Transistor to control the fan speed. This project uses regulated 12V, 2A power supply. This project is useful in process industries for maintenance and controlling of Boilers temperature.

In our project, we follow same principle of this projects but we are using some different methods for reducing heat in greenhouse by using ventilation fan system.

PROF. ABHIJIT G KALBANDE **(2018)** Entitled " **SMART AUTOMATION SYSTEM USING ARDUINO AND RAIN DROP SENSOR"** said, In this paper we present Idea related to agricultural based system in which as per our observation during the rainy seasons the cultivated crops gets affected due to the heavy rain fall. The main theme of this project which is presented in the paper is that to prevent the crops from the

heavy rain and save the rain water. The raindrop sensor and soil moisture sensor is used for the working of automatic roof. This system involves protects the crops by the auto roof which covers the whole field. The rain sensor is activated when there is a rain fall. The soil moisture sensor will sense the water level in the field. If the water level is beyond the normal level it will gives intimation to the controller. So when both the sensor is 'ON', it will gives intimation to the controller, GSM and it will indicate to the DC motor and it will automatically open the roof. In this project, the roof is open automatically when both the sensor is 'ON'. This complete system can be handled manually If there is any problem with opening the roof automatically, it is blend idea with controlling operation done through Arduino. GSM is report the conditions in the field through SMS to the mobile phone. The power is supplied to this project is using renewable energy sources as solar power. Direct power supply can also be fabricated which affect the basic cost to build entire system.

In our project, we follow same operation and working principle of this projects but we are replace raindrop sensor to temperature sensor and its connected to Arduino board.

***T.RAMMOHAN, ALISTER VARGHESE, S.DINESH BABU, N. JAYASAKTHIRAM, D.JAGADEESHWARAN*(2017)** entitled **"DESIGN AND DEVELOPMENT OF AUTOMATIC RETRACTABLE ROOF FOR CLOTHESLINE WITH NOTIFICATION SYSTEM "** said, Nowadays because of corporate culture people spend less time at house, and some require the help of latest technologies for safety and other basic needs. Smart home automation gadgets are created to minimize these problems. Main theme of this project is to prevent washed clothes becoming wet by rain while hanged in clothesline. This problem occurs when the user is not at reachable area when the rain occurs. A retractable roof which senses rainy condition and covers the clothes line from rain. Thus, the proposed hardware contains three modules sensing, driving, notification systems. Sensing and driving modules are controlled by

Arduino UNO controller. Notification system comprises of user's login details and status of the retractable roof. As in many retractable roof the driving mechanism is by a tubular motor. Tubular motor works in servo mechanism, hence in this prototype servo motor is used for driving module. And this proposed method is more simple in design and low cost to construct than its previous versions. In our project, we are using this technology only for greenhouse system. When high temperature occurring period are detect by using temperature sensor and give signal to Arduino UNO board and Arduino is control the greenhouse roofing system.

AZAHAR W SHAIKH AND SOMESH A INGOLE **(2017)** entitled**"PROTECTION OF VEHICLES AND CROPS FROM AUTOMATIC ROOFING AUTOMATION SYSTEM"** said, Now a days in the rainy season vehicles get affected due to rainfall. The main aim of this project is that to protect vehicles from heavy rain. Rain sensing module is used for working of auto roof . Rain sensing module activated when there is rain fall, it will give input to the controller and GSM then DC motor rotate to get cover on the vehicle. In this project roof is automatically open when sensor is 'ON' also it will be automatically closed when rain is stopped. The power supply is supplied to this project is using renewable energy sources as solar power. Direct power supply can also be fabricated but which affect the cost of system.

In our project, we are follow same working principle but to protect crops from high temperature during summer season by using automated greenhouse roofing system.

P. GOUTHAM GOUD, N. SURESH, Dr. E. SURENDHAR, G. GOUTHAM, V. MADHU KIRAN. **(2016)** entitled **"RAIN SENSOR AUTOMATICALLY CONTROLLED DRYING SHED FOR CROP YIELD FARMERS"** said, Now a day's technology is running with time, it completely occupied the life style of human beings. Even though there is such an importance for technology in our routine life there are even

people whose life styles are very far to this well-known term technology. So it is our responsibility to design few reliable systems which can be even efficiently used by them, farmers. The farmer who toil and does hard work to produce the crop suffers a lot at the end. The factors include unexpected rains when yielded crop is dried before selling, which will completely destroy the crop yield or make the yield second grade. To avoid such condition, automatic rain protected drying sheds are to be developed. In this project, we propose a system in which the rains are detected automatically and protective shield is wrapped on the rooftop sensor an intelligent microcontroller and a DC motor are employed. The rain sensor of such drying shed which protect the crop against rain and getting wet. To automate this task, a rain senses the rain and data is passed to the microcontroller. The microcontroller processes the data and activates the DC motor control circuit and a protective wrapper is wrapped on the roof top.

In our project, we follow same operation and working principle of this projects but we are replace raindrop sensor to temperature sensor and its connected to Arduino board and its control the greenhouse roofing system during summer season.

NAVEEN K B, NAVEEN KUMAR S K, PURUSHOTHAM M D, SAGAR G H, YOGESH M N (2016) entitled **"AUTOMATIC RAIN WATER AND CROP SAVING SYSTEM"** said, Agriculture is a backbone of our country. About almost of our country's revenue comes from agriculture. But during heavy rain falls, the farmers face lot of problems because there cultivated crops get washed off or destroyed. So in order to avoid this problem this project is designed which helps if saving the crops from heavy rainfall and protecting that rain water to use it for other purposes. The saved and stored water can be used for feeding animals, washing, cooking etc. and can also be reused to sprinkle it back to the field when needed. In this system an automatic roof is inculcated which works by taking the signals from the rain and soil moisture sensors and covers the whole field protect it from heavy rains. Whenever there is rainfall the rain sensor gets activated. Then

the controller indicates the stepper motor to run which opens the roof automatically to close and cover overall the field using a polythene sheet by based on temperature. Which is implemented is "Automated irrigation system with partition facility for effective irrigation of small scale farms" (AISPF). But this method has some drawbacks which can be improved and here we are with a method called "Automated irrigation system using weather prediction for efficient usage of water resources" (AISWP).

In our project, we follow same operation and working principle of this projects but we are replace raindrop sensor to temperature sensor and its connected to Arduino board and its control the greenhouse roofing system during summer season.

VEDASHREE.S, K.. NEERESH KUMAR, SMITHA.M, THIPPESH.D.R, KUMUDA.B, ZOYA PARVEZ, DEEPA .B (2016) entitled"**PROTECTION OF CROPS AND PROPER USAGE OF RAIN WATER WITH EMBEDDED SYSTEM USING GSM TECHNOLOGY"** said, The main theme of our project is during heavy rain falls, the farmers face lot of problems because there cultivated crops get washed off or destroyed. So in order to avoid this problem this project is designed which helps if protecting the crops from heavy rainfall and saving that rain water to use it for other purposes. The saved water can be used for feeding animals, washing, cooking etc. and can also be reused to sprinkle it back to the field when needed. In this system an automatic roof is inculcated which works by taking the signals from the rain and soil moisture sensors and covers the whole field to protect it from heavy rains. Whenever there is rainfall the rain sensor gets activated. The water level in the soil is sensed by the soil moisture sensor. Whenever there is rain, the rain sensor is „ON" and when the water level in the soil is beyond the normal level then soil moisture sensor is „ON". If both the sensors are „ON" then this information is given to the controller and the GSM. Then the controller indicates the DC motor to run which opens the roof automatically to close the field using a polythene sheet. If there is any problem in opening of the roof, then this is

intimated to the farmers thought SMS to their mobile phone using GSM. Then the roof can be opened manually using mechanical roller. In this project, the roof is open automatically when both the sensor is „ON". The emerging applications of GSM is used in this system. The power source to this project is supplied through solar power which is a renewable energy.

In our project, we follow same operation and working principle of this projects but we are replace raindrop sensor to temperature sensor and its connected to Arduino board and its control the greenhouse roofing system during summer season.

MD. NIAMUL HASSAN, AHMAD SHAMS NOOR (2015) entitled **"AN AUTOMATIC MONITORING AND CONTROL SYSTEM INSIDE GREENHOUSE"** said, In this work, we have proposed a framework that can gather the data identified with greenhouse environment and yield status and control the system automatically in view of the gathered data. By throatily observing periodic conditions, this study has the reason for securing connection between sensors flags and reference estimations. Control programming will give information finding of ongoing show. Through long time running and functional utilizing, the framework has been demonstrated that it has numerous points of interest. To monitor the environment inside greenhouse different parameters have been considered such as light, temperature, humidity, soil moisture etc. using different sensors like DHT22 temperature and humidity Sensor, LDR, grove-moisture sensor etc. which will be interfaced with microcontroller. It is a closed loop system that will execute control action to adjust temperature, humidity, light intensity and soil moisture if any unwanted errors (high/low) occur.

In our project, we are only monitoring Humidity and Temperature ranges for control environment condition in greenhouse for make a favorable condition of plant growth

RUPAM S. ROTE1AND RUPALI R. JAGTAP **(2014)** entitled **"AUTOMATIC VENTILATION CONTROL SYSTEM FOR ENERGY EFFICIENT BUILDINGS USING CO_2 SENSORS "** said, In this paper, the proposed work states automatic control strategy for ventilation systems in energy-efficient buildings. To maintain indoor CO_2 in the comfort zone to the accurate level and minimum ventilation rate is the main design goal of automatic ventilation controller. The system uses CO_2 as the main indicator of human comfort. The intelligent system as compared to traditional ON/OFF or fixed ventilation system gives better results in energy saving and also provide high indoor air quality. Through long time running and functional utilizing, the framework has been demonstrated that it has numerous points of interest. To monitor the environment inside greenhouse different parameters have been considered such as light, temperature, humidity, soil moisture etc. using different sensors like DHT22 temperature and humidity Sensor, LDR, grove-moisture sensor etc. which will be interfaced with microcontroller. It is a closed loop system that will execute control action to adjust temperature, humidity, light intensity and soil moisture if any unwanted errors (high/low) occur. The technical notes provide the block diagram description and the importance using AVR Microcontroller.

In our project, we are follow same principle but replacing CO_2 sensor and AVR microcontroller into Humidity sensor and Arduino UNO.

ASLINDA HASSAN, SIAG BING SHENG (2013) entitled **"AN AUTOMATED IRRIGATION SYSTEM USING ARDUINO MICROCONTROLLER"** said, An Automated Irrigation System Using Arduino Microcontroller" by Aslinda et al. proposes an automated irrigation using Arduino microcontroller system which is cost effective and can be used farm field or average home garden. The proposed system is developed to automatically water the plants when the soil moisture sensor has detected the soil is insufficient of water by using the Arduino as the center core. The automated irrigation system is a fully functional prototype which consists of a soil moisture sensor; an LCD display to show the moisture

percentage and pump status; a relay module which used to control the on and off switch of the water pump; and a water pump. When the soil moisture sensor sense the dry soil, it will show the moisture percentage on the LCD display, and the relay module will switch on the water pump automatically to start the watering process, or vice versa. Hardware testing is conducted to ensure the proposed system is fully functional.

In our project, We are follow same operation but not applying irrigation, only spraying of water by using pump for reducing heat in greenhouse.

P. GOUTHAM GOUD, N. SURESH, Dr. E. SURENDHAR (2007) entitled **"RAIN SENSOR AUTOMATICALLY CONTROLLED DRYING SHED FOR CROP YIELD FARMERS "** said, In this project, we propose a system in which the rains are detected automatically and protective shield is wrapped on the rooftop sensor an intelligent microcontroller and a DC motor are employed. The rain sensor of such drying shed which protect the crop against rain and getting wet. To automate this task, a rain senses the rain and data is passed to the microcontroller. The microcontroller processes the data and activates the DC motor control circuit and a protective wrapper is wrapped on the roof top. The Automatic Crop protection has been achieved successfully using microcontroller unit. The circuit has been tested and verified. We Developed Automatic crop protection shed programmed by using the microcontroller. The program has been successfully tested and verified for several specified conditions. The switching mechanism can be done automatically with the help of microcontroller using D.C motor. By using this project we can protect thousands of hectares of land from unseasonal rain. We can also increase the rate of production of crops by which we can improve the economical standards of farmers and as production increases the cost of the crop decreases for the users.

In our project, we follow same operation and working principle of this projects but we are replace raindrop sensor to temperature sensor and its connected to Arduino board and its control the greenhouse roofing system during summer season.

CHAPTER 3

METHODOLOGY

3.1. BLOCK DIAGRAM

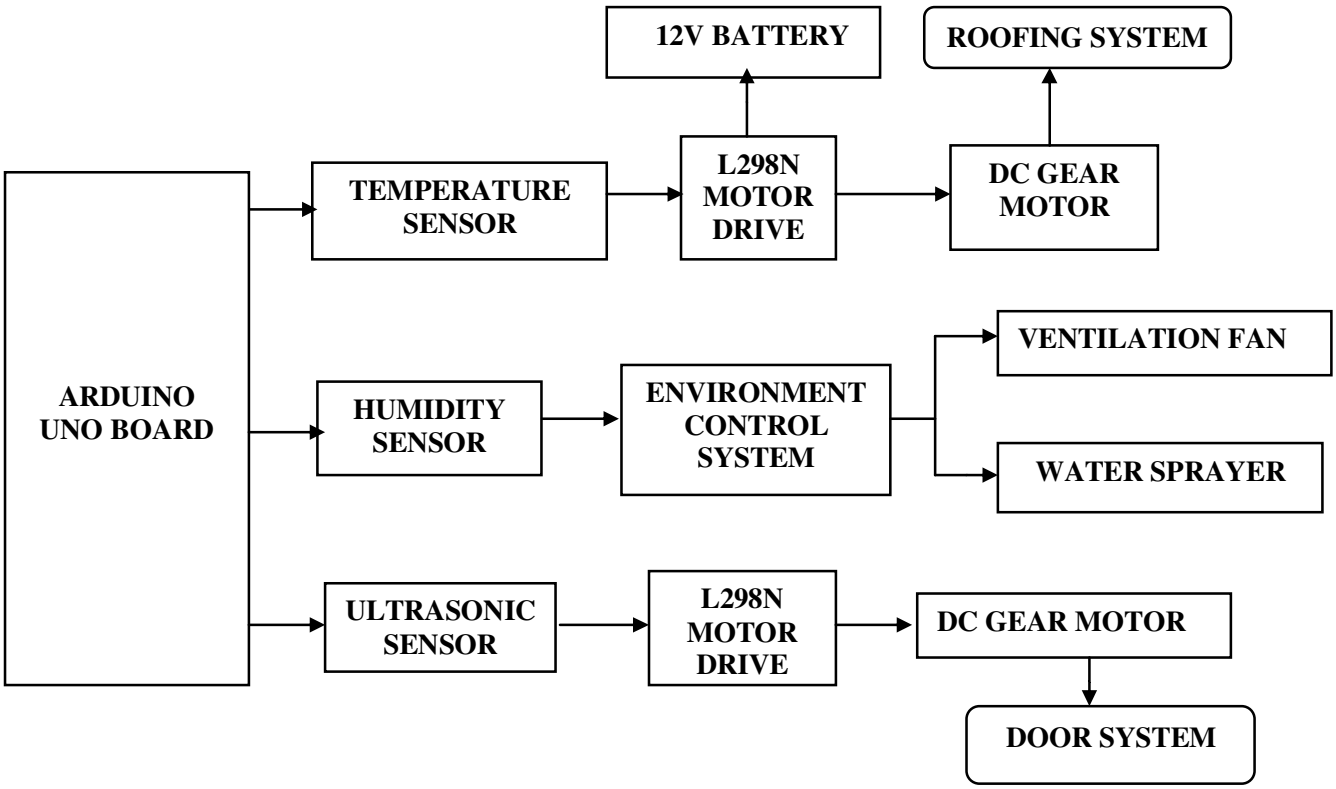

Fig. 3.1 Block diagram of AGRS

When Greenhouse contains lot of components for automatic roofing system and control the environment condition inside the greenhouse. Initially Roofing system is connected to DC Gear motor and is connected to Arduino-UNO board. When Arduino board is connected to two types of sensor such as Temperature sensor and another one is Humidity sensor. Temperature sensor is connected to roofing system and then Humidity sensor is connected to environment control system like parallel series connection of ventilation fan and submerged pump.

3.2. METHODOLOGY

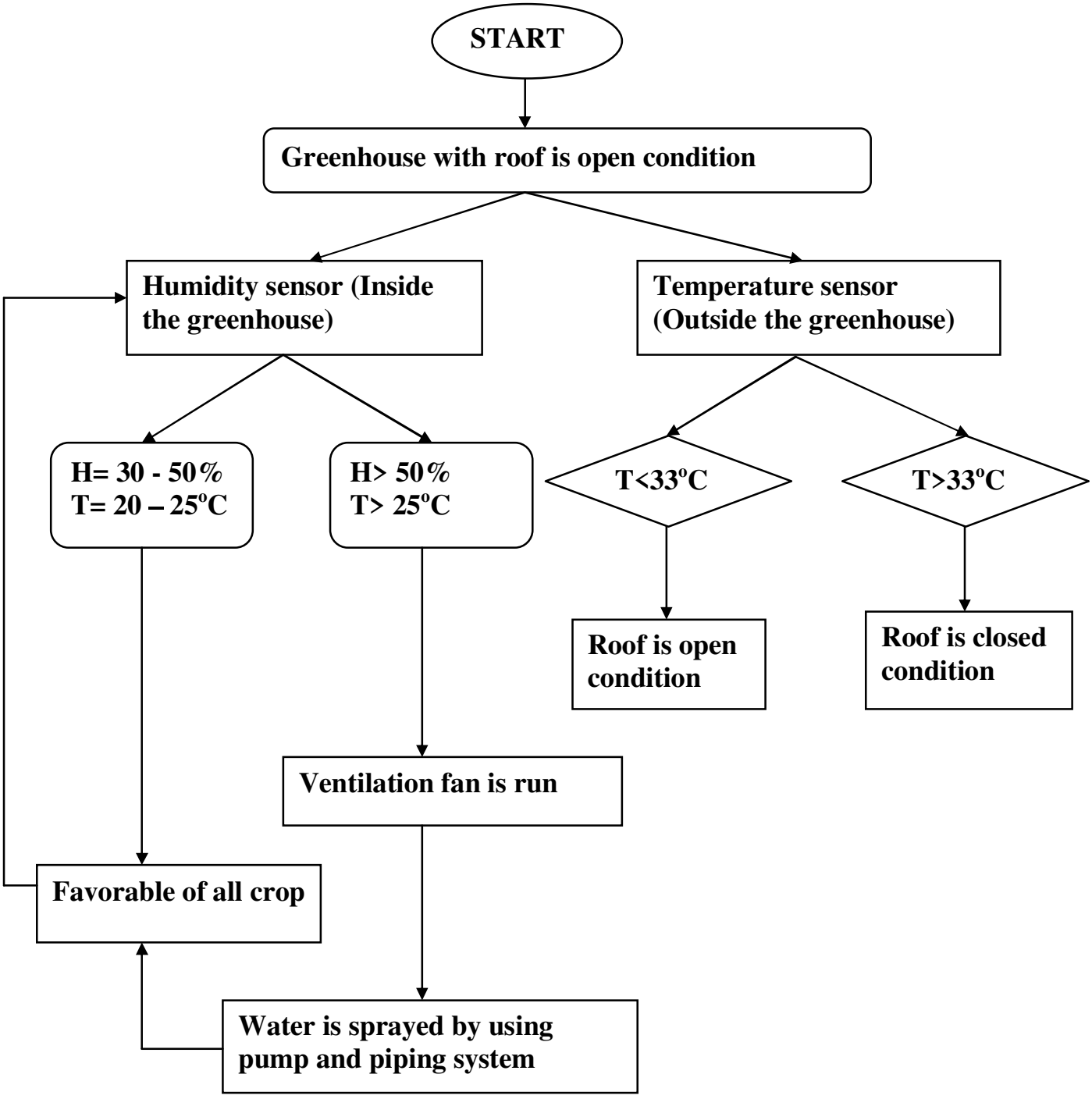

Fig.3.2 Flow chart of Methodology of AGRS

3.2.1. START: To give power of all components and check all components are worked well condition.

3.2.2. GREENHOUSE ROOF IS OPEN CONDITION: Initially greenhouse roof is always maintained open condition.

3.2.3. TEMPERATURE SENSOR: Temperature sensor is measured temperature range in outside greenhouse and signals are send to Arduino UNO.

3.2.4. T<33^{o}C: When a temperature range in outside greenhouse are less than 33^{o}C , maintained roof is open condition.

3.2.5. T>33^{o}C: When a temperature range in outside greenhouse are more than 33^{o}C , greenhouse roof are automatically closed.

3.2.6. HUMIDITY SENSOR: Humidity sensor is measured humidity and temperature range in inside greenhouse and signals are send to Arduino UNO.

3.2.7. H= 30 to 50 % and T< 25^{o}C: Favorable to all crops.

3.2.8. H>50% and T>25^{o}C: When ventilation fan is automatically ON for removing heat from inside the greenhouse and automatically water are sprayed by using pump for maintaining crops are wet condition and again to check humidity and temperature range in greenhouse..

CHAPTER 4

MATERIAL REQUIREMENT AND THEIR PROPERTIES

4.1. HARDWARE REQUIREMENT

- Arduino-UNO.
- Temperature sensor.
- Motor drive.
- Ultrasonic sensor.
- Servo motor.
- Dc gear motor.
- 16x2 LCD Display
- Submerged pump.
- Humidity sensor.
- Jumper wires.
- Ventilation fan.
- Polythene sheet.
- 12V battery.

4.2. SOFTWARE REQUIREMENT

- Arduino IDE.

HARDWARE ANALYSIS

4.1.1. ARDUINO - UNO

The Arduino UNO is an open-source microcontroller board based on the MicrochipATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by the USB cable or by an external 9-voltbattery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

- Microcontroller: Microchip AT mega328P.
- Operating Voltage: 5Volts.
- Input Voltage: 7 to 20Volts.
- Digital I/O Pins: 14 (of which 6 provide PWM output).
- Analog Input Pins: 6.
- DC Current per I/O Pin: 20mA.
- DC Current for 3.3V Pin: 50mA.
- Flash Memory: 32 KB of which 0.5 KB used by boot loader.

Fig.4.1 Arduino UNO board

4.1.2. HUMIDITY SENSOR

A humidity sensor senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

Fig.4.2 Humidity sensor

Humidity sensors detect the relative humidity of the immediate environments in which They are placed. They measure both the moisture and temperature in the air and express relative humidity as a percentage of the ratio of moisture in the air to the maximum amount

that can be held in the air at the current temperature. As air becomes hotter, it holds more moisture, so the relative humidity changes with the temperature. Most humidity sensors use capacitive measurement to determine the amount of moisture in the air. This type of measurement relies on two electrical conductors with a non-conductive polymer film laying between them to create an electrical field between them. Moisture from the air collects on the film and causes changes in the voltage levels between the two plates. This change is then converted into a digital measurement of the air's relative humidity after taking the air temperature into account.

4.1.3. TEMPERATURE SENSOR

The DS18B20 Stainless Steel Temperature Sensor is a pre-wired and waterproofed version of the DS18B20 sensor. Its unique 1-wire interface makes it easy to communicate with devices. It can converts temperature to a 12-bit digital word in 750ms(max). Besides, it can measures temperatures from -55°C to +125°C (-67F to +257F). In addition, this thermo probe doesn't require any external power supply since it draws power from data line. Its stainless steel probe head makes it suitable for any wet or harsh environment. The working principle of DS18B20 Stainless Steel Temperature Sensor and DS18B20 Temperature Sensor is same but the only difference is that the temperature sensor is placed inside the stainless steel probe.

- Power supply range: 3.0V to 5.5V
- Operating temperature range:-55°C to +125°C (-67F to +257F)
- Temperature-limit alarm system
- ±0.5°C Accuracy from -10°C to +85°C
- 9 to 12 bit selectable resolution
- Uses 1-Wire interface- requires only one digital pin for communication

Fig.4.3 Temperature sensor

4.1.4. MOTOR DRIVE MODULE:

The L298N H-bridge module can be used with motors that have a voltage of between 5 and 35v dc. With the module used in this tutorial, there is also an onboard 5V regulator, so if your supply voltage is up to 12V you can also source 5V from the board.

Fig.4.4 L298N Motor drive

- 2 connections for 5V 'hobby' servos connected to the Arduino's high-resolution dedicated timer – no jitter!

- Up to 4 bi-directional DC motors with individual 8-bit speed selection (so, about 0.5%resolution).
- Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil, interleaved or micro-stepping.
- 4 H-Bridges: L293D chipset provides 0.6A per bridge (1.2A peak) with thermal shutdown protection, 4.5V to25V.
- Pull down resistors keep motors disabled during power-up.
- 2-pin terminal block to connect external power, for seperate logic/motor supplies.

4.1.5. SUBMERSIBLE PUMP

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation's, a problem associated with a high elevation difference between pump and the fluid surfaces. Submersible pumps push fluid to the surface as opposed to jet pumps which create a vacuum and rely upon atmospheric pressure. Submersibles are more efficient than jet pumps. Hydraulic submersible pumps (HSP's) use pressurized fluid from the surface to drive a hydraulic motor down hole, rather than an electric motor, and are used in heavy oil applications with heated water as the motive fluid.

Electric submersible pumps are multistage centrifugal pumps operating in a vertical position. Liquids, accelerated by the impeller, lose their kinetic energy in the diffuser where a conversion of kinetic to pressure energy takes place. This is the main operational mechanism of radial and mixed flow pumps. In the HSP, the motor is a hydraulic motor rather than an electrical motor, and may be closed cycle (keeping the power fluid separate from the produced fluid) or open cycle (mingling the power fluid with produced fluid down hole, with surface separation). The pump shaft is connected to the gas separator or the protector by a mechanical

coupling at the bottom of the pump. Fluids enter the pump through an intake screen and are lifted by the pump stages. There are also screw-type submersible pumps, there is a steel screw which is used as a working element in them. The screw allows the pump to work in water with a high sand content and other mechanical impurities.

Fig.4.5 Submersible pump

4.1.6. 16x2 LCD DISPLAY:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Fig.4.6 16x2 LCD Display

4.1.7. POLYETHENE SHEET(FILM)

Polyethylene or polythene (abbreviated PE; IUPAC name polyethene or poly (methylene)) is the most common plastic. As of 2017, over 100 million tones of polyethylene resins are produced annually, accounting for 34% of the total plastics market. Its primary use is in packaging (plastic bags, plastic films, geomembranes, containers including bottles, etc.). Many kinds of polyethylene are known, with most having the chemical formula (C2H4)n. PE is usually a mixture of similar polymers of ethylene with various values of n. Polyethylene is a thermoplastic; however, it can become a thermo set plastic when modified (such as cross-linked polyethylene).

Fig.4.7 Polyethene sheet(film)

4.1.8. VENTILATION (EXHAUST) FAN

Fig.4.8 Ventilation fan

A Exhaust fan is any fan inside, or attached to, a building or greenhouse base used for active cooling. Fans are used to draw cooler air into the case from the outside, expel warm air from inside and move air across a heat sink to cool a particular component. Both axial and sometimes centrifugal (blower/squirrel-cage) fans are used in computers. Computer fans commonly come in standard sizes, and are powered and controlled using 3-pin or 4-pin fan connectors.

While in earlier house, kitchen, building, industries and greenhouse it was possible to cool most components using natural convection (passive cooling), many modern components require more effective active cooling. To cool these components, fans are used to move heated air away from the components and draw cooler air over them. Fans attached to components are usually used in combination with a heat sink to increase the area of heated surface in contact with the air, thereby improving the efficiency of cooling. Fan control is not always an automatically.

4.1.9. ULTRASONIC SENSOR

The ultrasonic sensor consists of a multi vibrator, which fixed at its base. The multi vibrator is combination of a resonator and vibrator. The ultrasonic waves generated by the vibration are delivers to the resonator. Ultrasonic sensor actually consists of two parts: the emitter which produces a 40 kHz sound wave and detector which detects 40 kHz sound wave and sends electrical signal back to the microcontroller. In our project, we are using HC-SR04 ultrasonic sensors which consist of 4 pins VCC, Trigger, Echo and GND.

- Effectual Angle: <15degree
- Ranging Distance: 2cm – 400cm
- Resolution: 0.3cm
- Measuring Angle: 30 degree

Fig.4.9 Ultrasonic sensor

4.1.10. SERVO MOTOR

Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. The Tower Pro SG90 is a simple Servo Motor which can rotate 90 degrees in each direction (approximately 180 degrees in total). The servo motor consists of three wires.

i. Yellow wire – Control
ii. Red wire - +5 V
iii. Black wire – Ground

Fig.4.10 Servo Motor

4.1.11. DC GEAR MOTOR

Fig.4.11 DC gear motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. . A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances.

SOFTWARE ANALYSIS

4.2.1. ARDUINO IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, Mac OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2.The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also include with the IDE distribution. The Arduino IDE employs the program *avrdude*to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

4.2.2.PROPERTIES OF ARDUINOIDE

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++languages.
- It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code

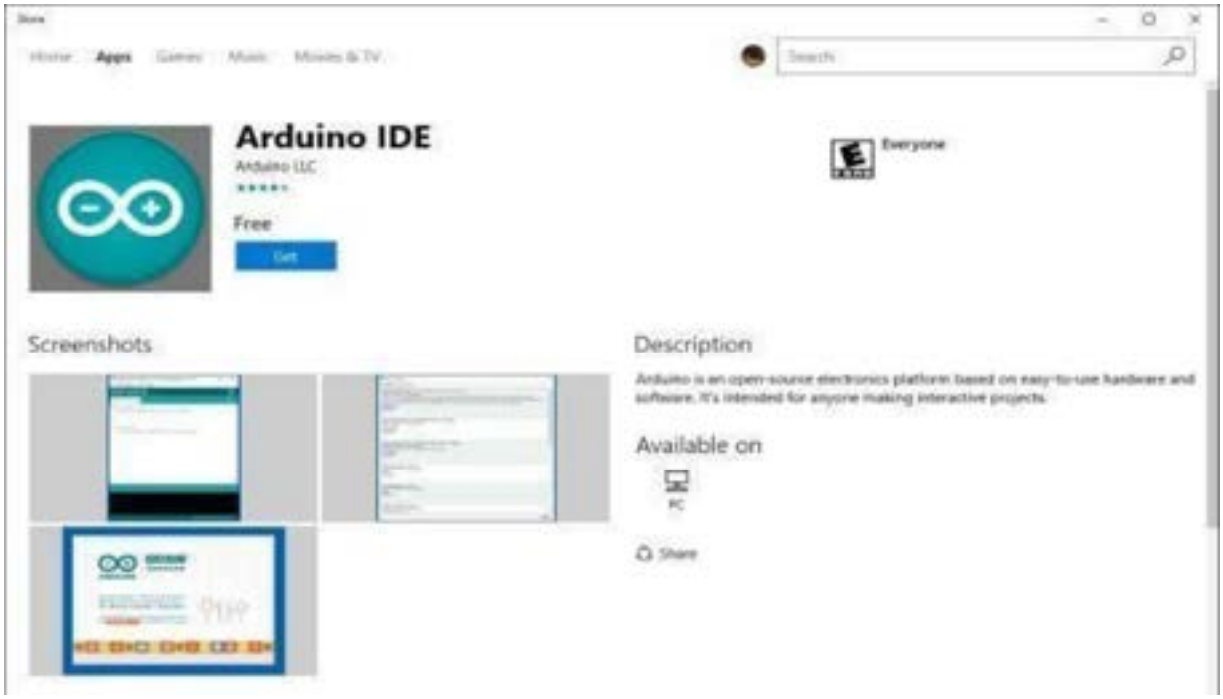

Fig.4.9 Arduino IDE APP

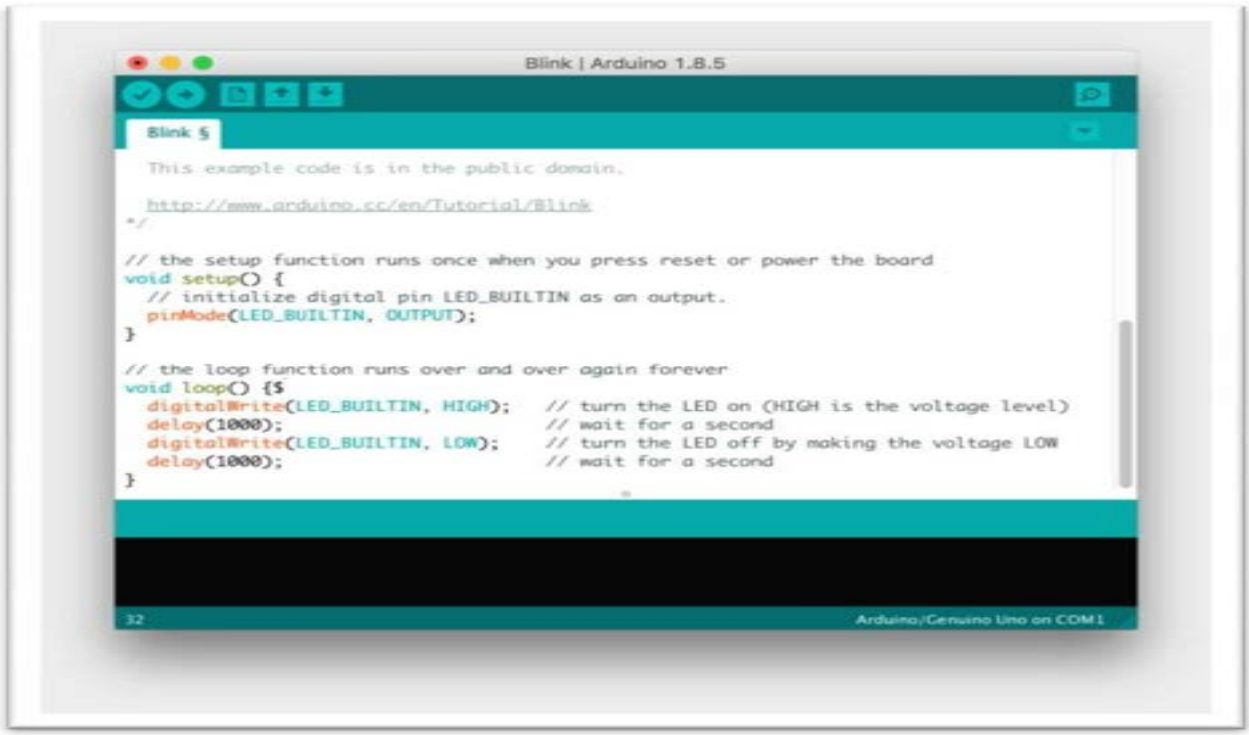

Fig.4. 10 Program input image

CHAPTER 5

DESIGN AND CONNECTIONS OF AGRS

5.1. CONNECTION OF COMONENTS

- ❖ Arduino-UNO
- ❖ Temperature Sensor
- ❖ Motor Drive
- ❖ Humidity sensor
- ❖ DC Gear Motor
- ❖ Submerged pump

5.1.1. ARDUINO UNO TO TEMPERATURE SENSOR

- Vcc - 5V
- DataPin - 2th Pin
- Gnd - Gnd

5.1.2. ARDUINOUNO TO HUMIDITY SENSOR

- Vcc - 5V
- DataPin - 7th Pin
- Gnd - Gnd

5.1.3. ARDUINO UNO TO MOTORSHIELD

- Vcc - Vcc
- InterfacingPin - 8,9,10,11 Pin
- Gnd - Gnd

5.1.4. MOTOR DRIVE TO DC GEAR MOTOR

- M1 - A^+ Pin
- M2 - A^- Pin
- M3 - B^+ Pin
- M4 - B^+ Pin

5.1.5. ARDUINO TO RELAY (SUBMERGED PUMP AND VENTILATION FAN)

- Vcc - 5V
- Data Pin - 4 th Pin
- Gnd - Gnd

5.1.6. ARDUINO TO ULTRASONIC SENSOR AND SERVO MOTOR

- Vcc - 5v
- Data Pin - 3 th Pin
- Trig Pin - 5 th Pin
- Echo Pin - 6 th Pin
- Gnd - Gnd

CHAPTER 6

ALGORITHM AND PROGRAMMES

6.1. ALGORITHM:

1. Start

2. Check roof is open or closed condition.

3. Measure temperature range.

4. T<28^{o}C to maintain roof is open condition.

5. T>28^{o}C to closed roof until reducing temperature range.

6. Measure humidity range in greenhouse.

7. H= 30 – 50 % , this condition don't run any components.

8. H>50 % , this condition to run ventilation fan and water sprayer.

9. Then again to check step 6.

6.2. PROGRAMME

```
#include <DallasTemperature.h>
#include <Stepper.h>
#include <OneWire.h>
#include <dht.h>
const int stepsPerRevolution = 200;
Stepper myStepper(stepsPerRevolution, 8, 9, 10, 11);
#define ONE_WIRE_BUS 4
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
float Temp = 0;
#define dataPin 5;
dht DHT;
void setup() {
sensors.begin();
Serial.begin(9600);
myStepper.setSpeed(60);
Serial.begin(9600);
pinMode(3,OUTPUT);
pinMode(2,OUTPUT);
Serial.begin(9600);
}

void loop() {
int a=0;
```

```
sensors.requestTemperatures();
Temp = sensors.getTempCByIndex(0);
int readData = DHT.read11(dataPin);
fload t = DHT.temperature;
fload h = DHT.humidity;
if( Temp < 28 && t>18,h>40  )
{
digitalWrite(3,HIGH && 2,HIGH);
if( a == 0)
{
a=1;
myStepper.step(200);
}
}

 else {
  digitalWrite(2,LOW && 2,LOW):
  myStepper.step(-200);
  delay(2000);
 }
 delay(1000);

}
```

CHAPTER 7

RESULT AND CONCLUSION

7.1. RESULT

As give 5V or 12V power to Arduino and Stepper motor and then stepper belt and key is connected to stepper motor in upper side of greenhouse. The polyethene film roof is connected to stepper belt for moment and then ventilation fan and submerged pump with pipe line, water sprayer is connected to lower side of greenhouse roof. When 5V power to give ventilation fan and Submersible pump constantly. So when a temperature range to reach more than 28°C to automatically close the roof for reducing heat effect on plants then decreasing temperature range is less than 28°C to open the roof. At the same time to measure humidity range in inside the greenhouse and increasing air temperature range is automatically run ventilation fan and sprayed water for reducing effect of heat. It is a process are continuously work with help of power source.

Fig.4.11 Sensors output

7.2. CONCLUSION

This project developed the Automatic roof and environmental condition control system with help of electronic components. This projects are mainly used to reducing impact of high sunshine, temperature, heat etc and to protecting plants from the diseases, hot air and some times it is structure are used to against of pest and insects attack. This prototype is working of automatically, so any human not interface to control or maintained the environments inside the greenhouse. This project obtain two types of cultivation system such as first is open cultivation system another one is protected cultivation system. This methods is used to increasing crop growth rate and agriculture productivity. It is not create any pollution, low power consumption, low economical and eco-friendly. This method is mainly suitable to horticulture and floor gardening system.

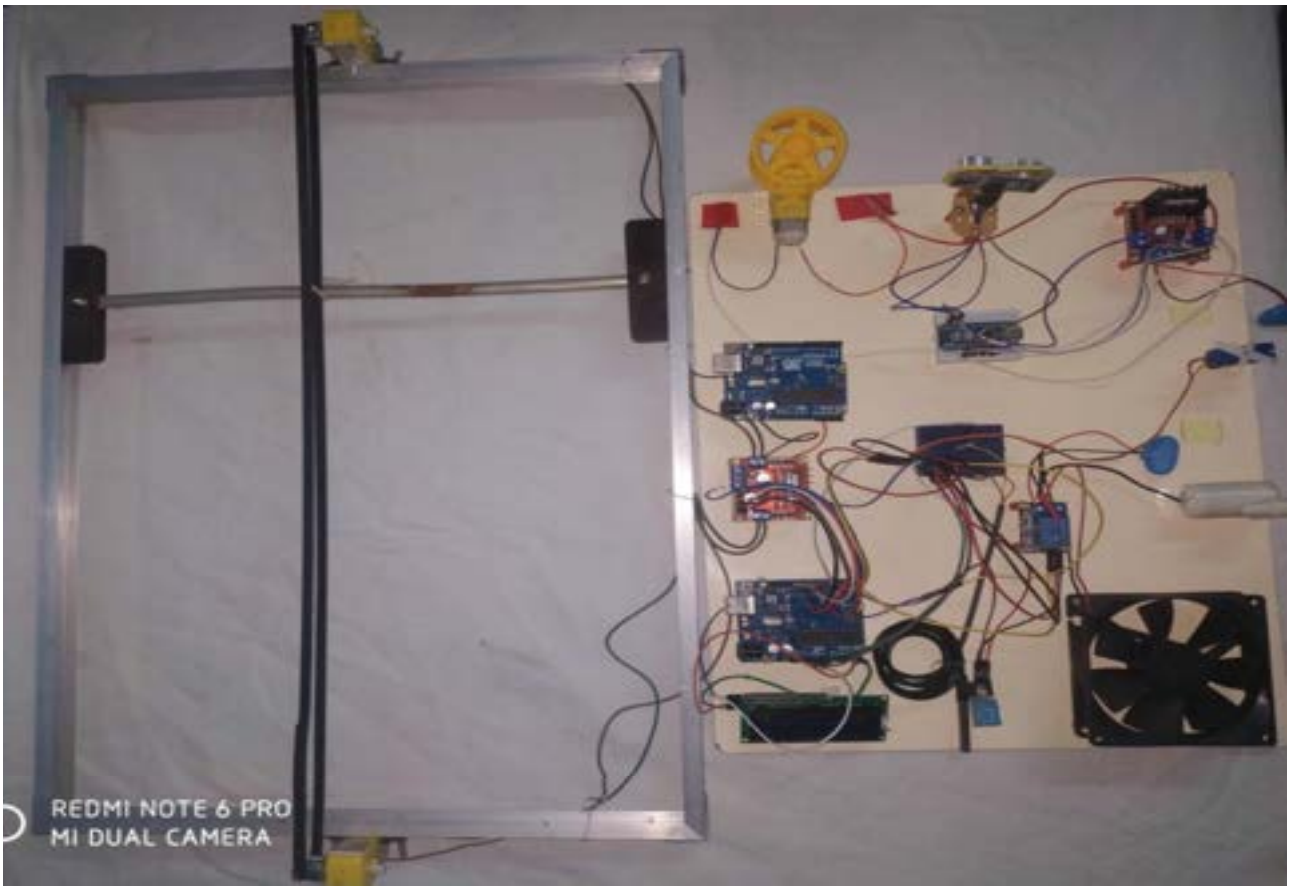

Fig.4.12 Full setup of AGRS

REFERANCE

1. AHM FazleElah; Mohammad ShafiurRehman; Intelligent Windshield For Automotive Vehicles 17th International Conference On Computer And Info. Technology 22-23 December 2014. International university, Dhaka bangladesh .

2. By Anthony J. De Blasi "Greenhouse Growing: Tips for Basic Greenhouse Cultivation" Mother Earth News

3. David Whiting (CSU Extension, retired) with Michael Roll and Larry Vickerman (former CSU Extension employees). Artwork by Scott Johnson and David Whiting

4. http://www.gpnmag.com/greenhouse-light.

5. http://www.ag.auburn.edu/hort/landscape/lightintensityquality.html.

6. http://www.electronics-tutorials.ws/io/io_4.html

7. http://www.robotshop.com/media/files/pdf/grove-moisture-sensor-sen92355p.pdf

8. Jose Luis Guzman, "Simulation of Greenhouse Climate Monitoring and Control with Wireless Sensor Network and Event-based Control", Department of Computer Science and Automatic Control, UNED C/. Juan Del Rosal, Madrid, Spain

9. KadakiaNishant, A Kothari, Mohit A Shah, Amit V Patel Vipul R:Automatic Rain Operated Wiper System in Automobile, International Journal for Scientific

Research & Development Vol. 3, Issue 02, 2015.

10.LumithaSeemaCutinha, Manasa K, VenkateshPai, Sadhana B;Automatic Cloth Retriever System, International Research Journal Of Engineering And Technology (IRJET) Volume: 03 Issue: 03 Mar-2016.

11."Light and Lighting Control in Greenhouse", Argus Control System Limited, White Rock, Canada

12..Masayu Binti Hussein, "Automatic Greenhouse Watering System Using Microcontroller" University Malaysia Pahang

13.Md. Anisul Hoque, "Greenhouse Effect", Leominster Road, London, UK, The Daily Star

14.Oladunmoye M. &Oluwatomi A.A.:Design And Construction Of An Automatic Sliding Door Using Infrared Sensor,Computing, Information Systems, Development Informatics & Allied Research Journal Vol. 5 No. 4. December 2014

15.PrabhakarHegade, Sunil Nayak, ParashuramAlagundi, Kiran M R:Automatic Protection of Clothes from Rain,International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 4, April 2016.

16.Quan Minh Vu, "Automated Wireless Greenhouse Management System", Master of Engineering in Electronics and Computer Systems, Massy University, Palmerston North, New Zealand, June 2011

17.R. Balathandapani, D. Boopathi, S. Jotheeshwaran, G. Arundeva, C. Saranya: Automatic Rain Water And Crop Saving System Using Embedded Technology,International Journal of Science, Engineering and Technology Research (IJSETR) Volume 4, Issue 3, March 2015.

18.Sumit P Patil, Jignesh R Dhabuwala, Liyakat Ali Patel;Automatic Sliding Window,International Journal Of Science And Research (IJSR) Issn (Online): 23197064

VERTICAL FARMING WITH AEROPONICS

PROJECT REPORT

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in

AGRICULTURE ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL.

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

Aeroponics growing of plants is becoming a household name for growing plants for their daily food at their kitchen table in metropolitan regions. When the prices of vegetables are growing high and the quality is not fresh farm, above all they all are not chemical free. Because this is a soil-less technique of growing plants, the manual work is cut down considerably while leaving no traces of soil stains. Once it is designed and placed, it begins to operate mechanically with minimum garden work is done to be taken care of. Aeroponics farming can be done to develop few plants to a high number of crops and types growing together by utilizing the maximum distance of a given unused spacing in the home.

KEYWORDS: *Aeroponics,PVC pipes,Mist Chamber.*

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CHAPTER 1
INTRODUCTION

1.1.GENERAL

Recently, the application of Vertical Farming into cities has increased. Vertical farming is a cultivating vegetable vertically by new agricultural methods, which combines the design of building and farms all together in a high-rise building inside the cities. This technology needs to be manifest both in the agricultural technique and architectural technology together. However, little has been published on the technology of Vertical Farming."We live vertically, so why can't we farm vertically?" Due to the limited access to land for farming, there is a need for sustaining farming tasks so as to pave the way for adding to food needs. Many aspects press on food industry and processing such as growth of population and its growing needs accordingly, reduction of natural sources due to growing cities, earth erosion, different forms of contamination, advent of biofuels, restrictions imposed on food production techniques affected by customers and rule providers which requires better quality, less use of chemicals and many useful environmental attempts 'from farm to fork'. Recently, environmental obsessions have been mixed with rising obsession with health as architecture design is concerned. Therefore, it has led to more interest in providing healthy food and incorporating it in the sustainable development project . The answer to these issues is Vertical Farming (VF). VF has grown as a project which combines the design of building and farms all together in a high-rise building. VF is a system of growing crops in skyscrapers, to maximize the use of land by having a vertical design whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fiber… by artificially stacking them vertically above each other .Vertical farms are now used in a lot of countries. At present, these farms are largely grown and produce different types of crops inside cities.

Aeroponics growing of plants is becoming a household name for growing plants for their daily food at their kitchen table in metropolitan regions. When the prices of vegetables are growing high and the quality is not fresh farm, above all they all are not chemical free. Because this is a soil-less technique of growing plants, the manual work is cut down considerably while leaving no traces of soil stains. Once it is designed and placed, it begins to operate mechanically with minimum garden work is done to be taken care of. Aeroponics

farming can be done to develop few plants to a high number of crops and types growing together by utilizing the maximum distance of a given unused space in home.

OBJECTIVES:

- To make farming easier to manage.
- To increase plant growth rate and yield.
- To produce disease free crops.
- To minimize the use of water.

CHAPTER 2

LITERATURE REVIEW

MODERN PLANT CULTIVATION TECHNOLOGIES IN AGRICULTURE UNDER CONTROLLED ENVIRONMENT

***Imran Ali Lakhiar,Jianmin gao,Tabinda Naz Syed*30 may 2018**

This review paper describes a novel approach to plant cultivation under soil-less culture. At present, global climate change is expected to raise the risk of frequent drought. Agriculture is in a phase of major change around the world and dealing with serious problems. In future, it would be difficult task to provide a fresh and clean food supply for the fast-growing population using traditional agriculture. Under such circumstances, the soil-less cultivation is the alternative technology to adapt effectively. The soil-less system associated with the Hydroponic and Aeroponics system. In the aeroponics system, plant roots are hanging in the artificially provided plastic holder and foam material replacement of the soil under controlled conditions. The roots are allowed to dangle freely and openly in the air. However, the nutrient rich-water deliver with atomization nozzles. The nozzles create a fine spray mist of different droplet size at intermittently or continuously. This review concludes that aeroponics system is considered the best plant growing method for food security and sustainable development. The system has shown some promising returns in various countries and recommended as the most efficient, useful, significant, economical and convenient plant growing system then soil and other soil-less methods.

POTENTIAL OF AEROPONICS SYSTEM IN THE PRODUCTION OF QUALITY POTATO

***M Chiipanthenga,M Maliro,P Demo,J Njoloma*13 feb 2014**

The production of potato seed under conventional system has not been effective in avoiding or reducing the build up of pathogens and has consequently led to reduced quality potato seed and low crop yields. Plants once cleaned through meristem culture and induction of tuberization under aeroponics system, produce high quality potato seed tubers rapidly that are free from contamination of pathogens. Further multiplication of potato seed tubers under aeroponics also compliments tissue culture (micropropagation), as it clones minitubers in a short time and reduces numerous labour steps associated with direct use of plantlets from tissue culture into the field in the post flask stage. Minitubers from air-rooted plants are planted directly in the field without a need for acclimatization to such environments. This system, as is the case with micropropagation, has potential to increase income and reduce cost

of production of quality seed, thereby, making it more accessible to growers in developing countries where potato production is heavily constrained by the use of poor quality seed tubers. This review gives an insight on the potential of aeroponics in compliment to plant tissue culture in revolutionalizing the potato seed production in the agricultural systems of developing countries.

AEROPONICS FOR THE CULTURE OF ORGAISMS, TISSUES AND CELL

P.J.Weathers*

Characteristics of aeroponics are discussed. Contrast is made, where appropriate, with hydroponics and aero-hydroponics as applies to research and commercial applications of nutrient mist technology. Topics include whole plants, plant tissue cultures, cell and microbial cultures, and animal tissue cultures with regard to operational considerations (moisture, temperature, minerals, gaseous atmosphere) and design of apparati.

AUTOMATIC AEROPONIC IRRIGATION SYSTEM BASED ON ARDUINO'S PLATFORM

A P Montoya[1], F A Obando[1], J G Morales and G Vargas **, 1 June 2017**

The recirculating hydroponic culture techniques, as aeroponics, has several advantages over traditional agriculture, aimed to improve the efficiently and environmental impact of agriculture. These techniques require continuous monitoring and automation for proper operation. In this work was developed an automatic monitored aeroponic-irrigation system based on the Arduino's free software platform. Analog and digital sensors for measuring the temperature, flow and level of a nutrient solution in a real greenhouse were implemented. In addition, the pH and electric conductivity of nutritive solutions are monitored using the Arduino's differential configuration. The sensor network, the acquisition and automation system are managed by two Arduinos modules in master-slave configuration, which communicate one each other wireless by Wi-Fi. Further, data are stored in micro SD memories and the information is loaded on a web page in real time. The developed device brings important agronomic information when is tested with an arugula culture (*Eruca sativa* Mill). The system also could be employ as an early warning system to prevent irrigation malfunctions.

SPORE DEVELOPMENT OF *Entrophospora kentinensis* IN AN AEROPONIC SYSTEM

Chi-Guang Wu ,Yen-Sher Liu &Ling

29 Aug 2018

Entrophospora kentinensis was propagated with bahia grass and sweet potato in an aeroponic system. Spores were produced 6 weeks later after host plants were transferred to an aeroponic chamber. Sporiferous saccules were formed either by external mycelium or within roots. Sporogenesis started inside the stalk of a sporiferous saccule by the formation of a septum in the lower channel of the stalk. The cytoplasm within the saccule seemed the major source for the spore formation. When the cytoplasm flowed downward, the central part of the stalk swelled and tiny vacuoles were formed at the periphery of the saccule. As the primordial spore was differentiated inside the stalk, another septum was formed right below the saccule. After spores mature, the terminal vesicles of saccules and the lower hyphal stalks degenerate and leave Differences in spore between *Acaulospora* and *Entrophospora* are discussed.

OVERVIEW OF THE AEROPONIC AGRICULTURE –AN EMERGING TECHNOLOGY FOR GLOBAL FOOD SECURITY

Imran Ali Lakhiar, Jianmin Gao, Tabinda Naz Syed, Farman Ali Chandio, Mazhar Hussain Tunio, Fiaz Ahmad, Kashif Ali Solangi

Jan 13 2020.

Traditionally, crops are cultivated in soil-based open field systems. Seasonality, environmental degradation, urbanization, and food security issues have replaced open-field systems with modern plant production systems. Soilless culture is one of the modern plant production systems, which involves much higher use of available resources. The presented study provides information about currently accessible soilless systems and discussed the aeroponic system. Compared to other soilless systems, aeroponic reduce water usage through continuous water circulation. However, the aeroponic is not entirely implemented among local farmers, and very few farmers have adopted the system due to the lack of research and technical information available in the literature. Therefore, this study was planned to provide information about the development and maintenance tasks required for practicing the aeroponic system. This study could provide knowledge to the researchers, farmers, and those people interested in practicing the aeroponic system.

FUTURE FOOD PRODUCTION SYSTEMS :VERTICAL FARMING AND CONTROLLED ENVIRONMENT AGRICULTURE

Kurt Benke &Bruce Tomkins

20 Nov 2017

The unremitting trends of increasing population, urbanization, diminishing water supply, and continuing climate change have contributed to declining stocks of arable land per person. As land resources for agriculture decrease, policy makers are faced with the challenge of sustainability and feeding the rapidly growing world population which is projected to reach approximately 9.7 billion in 2050. Solutions for improving future food production are exemplified by urban vertical farming which involves much greater use of technology and automation for land-use optimization. The vertical farm strategy aims to significantly increase productivity and reduce the environmental footprint within a framework of urban, indoor, climate-controlled high-rise buildings. It is claimed that such facilities offer many potential advantages as a clean and green source of food, along with biosecurity, freedom from pests, droughts, and reduced use of transportation and fossil fuels. In this article, the issues involved are evaluated together with potential advantages and disadvantages. Possible implications are identified for consideration by policy makers and to facilitate further economic analysis.

CONCEPT OF EXPERIMENTAL PLATFORM TO INVESTIGATE AEROPONIC SYSTEMS IN MICROGRAVITY CONDITIONS

AnnaJurga, JoannaKuźma, PawełPłuszka, PiotrChmielewsk[2], Edyta Bobrowska and Maciej Dragula

13 JULY 2018

The article presents the concept of experimental research system to investigate aeroponic cultivation in microgravity condition. The main scientific objective is to define the forces acting in droplet-root system exposed to microgravity conditions especially the adhesion and cohesion phenomena. The concept of a research platform is presented in this paper and includes electrical, hydraulic and optical system.

LOW EFFORT MANAGEMENT OF BASIL (OCIMUM BASILICUM) GROWTH IN AN AEROPONIC SYSTEM

Adam S. Vassallo

APRIL 2018.

Empowering individuals in high-density urban environments with the tools to affordably grow their own food with minimal effort could be a solution to sustainably

increase global food security. Aeroponic farming could potentially be used to achieve this goal. This study investigates the low effort maintenance of basil (Ocimum basilicum) growth in an aeroponic system. Aeroponic units that were supplied with nutrients and water at the start of a twentyeight-day experiment (experimental treatment) were compared with units where the nutrients and water were replaced on a weekly basis (reference treatment). This experiment was run twice, the first trial under solar light, and the second trial under T5 fluorescent light. The differences in biomass yields between trials was visibly noticeable, however not statistical significantly different. The biomass yield between treatments was not statistically significantly different. At the end of the first trial (solar light), the experimental treatment and reference treatment had mean total wet weights of 0.0182 g and 0.0151 g respectively. At the end of the second trial (T5 fluorescent light), the experimental treatment and reference treatment had mean total wet weights of 1.6564 g and 1.6484 g respectively. Further research using a longer experimental trial with more samples should be conducted to test for statistical biomass variance between treatment groups and between trials.

RE EXAMINING AEROPONICS FOR SPACEFLIGHT PLANT GROWTH

JM Clawson, A Hoehn, LS Stodieck, P Todd, RJ Stoner **2000**

Aeroponics is the process of growing plants in an air/mist environment without the use of soil or an aggregate media. Aeroponics has contributed to advances in several areas of study including root morphology, nutrient uptake, drought and flood stress, and responses to variations in oxygen and / or carbon dioxide root zone concentrations. The adaptability of the aeroponic process that has benefited researchers makes its application to spaceflight plant growth systems appealing. Greater control of growth parameters permits a greater range of crop performance throttling and the elimination of aggregates or common growth substrates lower system mass, lessens disease propagation between plants, and can decrease the required crew time for both planting and harvesting. However, because of the use of less reliable types of aeroponic techniques and concerns with open two phase fluids within the root zone in microgravity, many advanced life support technology researchers opted for nutirient delivery concepts that offered more fluid control, containment and simpler subsystem designs. The resulting systems have been successful for on-orbit plant growth, but have yet to achieve high performance crop production equal to terrestrial standards. Re-examining historical concerns, along with an overview of recent work demonstrating hypogravity aeroponics, shows the promise that aeroponics still holds for spaceflight crop production.

VERTICAL FARMING SUSTAINABILITY AND URBAN IMPLICATIONS

***DANIELA GARCIA-CARO BRICEÑO* ,2018**

Vertical Farming Sustainability and Urban Implications. Masterthesis in Sustainable Development at Uppsala University, No.2018/32,80 pp, 30 ECTS/hp Abstract: Meeting current and future demands for food is one of the biggest problems facing the world today. Despite the positive correlation that exists between food production and urban food demand, food systems remain separate and excluded from cities. Vertical farming has been proposed as a solution projected to address these issues in a sustainable way. This study aims to determine the sustainability of a vertical farm operation and its perceived value to food security and urban systems. This study implements a qualitative approach and case study research design useful for small, applied research studies, where data is collected via a literature review, emails, and semistructured interviews. Systems theory is used to frame the phenomena at hand since it allows for a holistic systems view, and the study's results are analyzed using emergy theory and a conceptual framework based on urban political agroecology. A vertical farm was selected as the focus of the case study, with the vertical farm sustainability serving as this study's unit of analysis. Contrary to existing information, the results indicate that the vertical farm studied is unsustainable due to its dependence on imported resources. Additionally, an assessment of vertical farm impacts through a conceptual framework on urban political agroecology determined that vertical farming is incompatible with agroecological principle, provides few positive impacts to urban systems, and makes most of its contributions to urban food security rather than food sovereignty. For the sustainable development of vertical farms and urban systems, emergy theory stresses that inputs into the system must be local renewable inputs (i.e. natural inputs located within the system boundaries), and that successful systems should create and implement reinforcing feedbacks. Nonetheless, vertical farming systems are quite immature and carry great potential for change; this study presents recommendations for vertical farming systems reorganizing more sustainably.

THE EFFECT OF NUTRIENT SOLUTIONS ON YIELD AND MACRONUTRIENT STATUS OF GREENHOUSE TOMATO GROWN IN AEROPONIC AND ROCKWOOL CULTURE WITH OR WITHOUT RECIRCULATION OF NUTRIENT SOLUTION

Komosa, A. ; Kleiber, T. ; Markiewicz, B. ,2014

Aeroponics creates possibilities to cultivate plants without soil or substrate, obtaining the optimal yield, saving water and nutrient solutions and do not contaminate the environment. In a three year experiment was shown that the higher total and marketable yields tomato cv. of 'AlboneyF_1' were in cultivation in rock wool with re circulating nutrient solution. Lower yields, however being in the same significance range, were in rock wool without recirculation of nutrient solution and aeroponic culture with A-1 and A-2 nutrient solutions, but the lowest in aeroponics with A-3 nutrient solution. The saving of nutrient solution in aeroponic culture, in relation to the cultivation in rock wool with non-re circulating system, was 58.1%, but comparing with re circulating system 18.8%. Plants grown in aeroponic culture with application of A-2 and A-3 nutrient solutions had higher contents of N, P and K in leaves than cultivated in rock wool with or no recirculation and in aeroponic with A-1 nutrient solution. All tested nutrient solutions (A-1, A-2 and A-3) in aeroponic culture caused the higher contents of Mg in leaves than in rock wool cultivation. The highest Ca leaves contents were in plants grown in rock wool with re circulating nutrient solution and aeroponic culture with A-2 and A-3 nutrient solutions. Plants grown in rock wool without recirculation of nutrient solution shown the lowest Ca contents, however there was no symptoms of blossom end rot (BER) on fruits. The yield and macronutrient status of tomato in aeroponic culture with application of A-1 nutrient solution were similar to the plants grown in rock wool with non-re circulating standard nutrient solution A-2.

CHEMICAL CHARACTERISTICS OF SOIL LESS MEDIA

***Avner Silber* ,2019**

Typical soilless media are commonly defined by root constraint and limited volume of substrate and accordingly, low buffer capacity for solution composition and limited supply of nutrients. Therefore optimal plant production necessitates specific and different attention to the chemical characteristics of the substrates. The surface charge properties and the dissolution characteristics of the substrate solids are important since they affect the ionic composition of nutrient solutions. Throughout the growth period organic compounds excreted from the plant roots or resulting from decomposition processes accumulate in the substrate.

Consequently the surfaces of the newly formed solids become heterogeneous and the chemical properties of the mixture may be significantly different from those of the single, well-defined component that was characterized before use. The general objective of this chapter is to define the chemical characteristics of soilless media. The specific objectives are: (1) to describe the charge characteristics of typical substrate used in the horticultural industry and to assess the interactions between pH, solution concentration of cations\anions, and substrate solids, especially adsorption and precipitation reactions. Special attention was dedicated to describe the solubility and possible interactions of nutritional elements with the substrate and to discuss the expected horticultural implications and (2) to illustrate the effects of plant-induced changes in the rhizosphere and to evaluate its effects on plant nutrition.

A MIST CHAMBER FOR THE CULTURE OF PLANTS

C.A.BEASLEY AND W.P.FOX

1970

Versatile mist chambers, framed with aluminum and glass and having access from top and sides, permit culture of an extensive number of, and different types of, vegetative plant organs as well as seeds and plant pathogens. Pneumatic atomizing nozzles are staggered to permit division of the chamber, and the spray emitted can be regulated from each nozzle. The amount of water vapor emitted is regulated by changing the air pressure or siphon height. Gauge-monitored pressure regulators and solenoid valves control the air and spray system. Timing devices can be used to inject water vapor at desired intervals. Air passing through a condensation tube is recycled past cone heaters, providing temperature from ambient to 90 F, and a duct and baffle system provides uniformity of temperature throughout. A combination recorder and controller maintains the desired temperature.

AN ASEPTIC MIST CHAMBER SYSTEM :A METHOD FOR MEASURING ROOT PROCESS OF PEAS

***J. M. Smucker ,A. E. Erickson*, 21 March 1907**

Although plants have been grown with their roots in mist chambers and sterile nutrient solutions, these methods have not been combined to provide a system which permits rapid changes in the gaseous composition of an aseptic rhizosphere. The objectives of this study were to design a mist chamber system which would withstand heat sterilization, maintain an aseptic rhizosphere, permit rapid gaseous exchange without altering rootwater relationships, and permit the measurement of morphological and physiological root responses

without disrupting the system.A pyrex glass mist chamber system is described which permitted a complete exchange of the root atmosphere in 5 min. Pea (*Pisum sativum* L.) seedlings were treated from 6 to 17 days in the aseptic mist chamber. Root respiration, root exudation, and rhizosphere volatiles were monitored. Detection limits were 1.0 ppm of ethanol, 1.0 and 0.25 μ g for the TMSi amino acids and sugars.This system provides for concise control of the rhizosphere and precise measurements of root responses to environmental stresses.

ROCKWOOL IN HORTICULTURE, AND ITS IMPORTANCE AND SUSTAINABLE USE

***W.T.BUSSEL* ,March 2004**

A brief history of the beginnings of the use of rockwool in horticulture in overseas countries, an outline of uses overseas of the current forms of water absorbent and water repellent horticultural rockwool, a summary of manufacturers of the product, a consideration of some of its advantages and disadvantages, and a listing of the crops grown in horticultural rockwool are given in this paper. An outline of the overseas experiences in both the disposal of and the sustainable reuse of horticultural rockwool is also given. A history of use in New Zealand of horticultural rockwool and the crops grown on the product are outlined. Options, which are both within and outside horticulture, for the sustainable reuse of the relatively small volume (c. 300 m/year) which becomes available for reuse in New Zealand at present are described and discussed. Many of these options may be applicable in other countries .

POTENTIAL REPLACEMENTS FOR ROCKWOOL AS GROWING SUBSTRATE FOR GREENHOUSE TOMATO

Suzanne E. Allaire1, Jean Caron1, Claudine Ménard2, and Martine Dorais2
OCT 2004

The greenhouse industry needs renewable, cheap, and available substitutes for rockwool. The physical properties and performance of rockwool substitutes such as low grade peat, composted bark white spruce and fir, shavings, sawdust, and peat-bark mixtures were compared during two greenhouse experiments with tomato grown in plastic bags. Air and water filled porosities greatly differed between substrates, particularly for sawdust and shavings. Relative gas diffusivity (Ds /Do) and the hydraulic conductivity were less different between substrates. The physical properties of the substrates changed over a production cycle

but the changes were small compared to treatment differences. Yields in peat-bark substrates were similar to rockwool substrates during both the short and long experiments but were lower in sawdust and shavings during the long experiment. The yield differences expected between media were less than the differences between some substrate physical properties of the various media. Yields were positively related to easily available water (EAW) and negatively related to Ds /Do and airfilled porosity (AFP). This indicated excessive drainage for the low-yielding substrates. In plastic bags, media properties related to aeration were not good indicators of production because the plants adapted to the lack of aeration by modifying their root distribution. White spruce and fir bark alone or mixed with low-grade peat showed high potential for greenhouse tomato production and represent an environmental sound alternative to rockwool.

PRELIMINARY STUDIES ON THE USE OF AEROPONICS FOR VEGETABLES CROPS UNDER LOCAL CONDITIONS

***A.F. Abou-Hadid, M.Z. El-Shinawy, M.A. Medany,* 1994**

The need for aeroponics was increased after facing the problems of soil-born diseases, the low plant density in hydroponics, and the relatively high water consumption in both soil and hydroponic cultures. The aeroponic system was found to be an efficient way for maximizing plant density per square meter. In addition, water consumptive use was as efficient as that of the hydroponics. A simple construction for the use of "A, Shape" aeroponic in vegetable production is discussed. Some problems occurred and suggestion for overcoming them were discussed. Nutrient analysis showed a significant increase in K, Cu and Mn in the sun side compared to the shade, while the contrary occurred for N and Zn.

GROWTH RESPONSE AND ROOT CHARACTERISTICS OF LETTUCE GROWN IN AEROPONICS ,HYDROPONICS AND SUBSTRATE CULTURE

***QianshengLi1,XiaoqiangLi2,BinTang3,MengmengGu1,*2014**

Aeroponics is a relatively new soilless culture technology, which may produce food in space limited cities or non-arable land with high water use efficiency. The shoot and root growth, root characteristics, mineral contents of two lettuce cultivars were measured in aeroponics, as compared with hydroponics and substrate culture. The results showed that aeroponics remarkably improved the root growth with a significant greater root biomass,

root/shoot ratio, and several times higher total root length, root area and root volume. However, the greater root growth did not lead to a better shoot growth compared with hydroponics, due to the limited availability of nutrients and water. It can be concluded that aeroponics systems may be better for high value true root crops production. Further research is necessary to figure out the suitable pressure, droplet size, and misting interval in order to improve the continuously availability of nutrients and water in aeroponics, if it is used to grow crops like lettuce.

CRUSHED ROCKWOOL AS A COMPONENT OF GROWING SUBSTRATES

MARTIN DUBSKY , January 2008

The possibility of peat replacement by crushed water absorbent rockwool in amount of 25 and 35% vol. in four types of substrates (peat one, 3 mixtures with alternative components -green waste compost and composted spruce bark) was verified in the experiments with ornamental shrubs and perennials in containers and with pot plants. Chemical (content of available nutrients and potential for nitrogen fixation) and physical (water capacity) properties of the components and substrates were determined. In the peat substrate, the addition of rockwool affected positively the plant growth. It increased water capacity and improved wettability of the peat substrate after irrigation. Plants grown in mixtures with lower content (to 40% vol.) of alternative components also had good market value. In mixtures with higher content of alternative components (65% vol.) lower water capacity and high potential for nitrogen fixation showed negatively. The addition of rockwool to substrates with alternative components had no significant effect. The addition of 25 or 35% vol. crushed rockwool can replace.

SURVEY PAPER ON AEROPONICS

Ajay kumar D , Namratha S, **2018**

Almost all plants need soil for their growth. Nutrients present in soil help in the development of plants. Aeroponics is the method of growing plants in a medium without the use of soil. Here the plants are provided with a nutrient solution which circulates in the medium that holds the plant. The nutrient solution contains macronutrients and micronutrients which contribute to the healthy growth of plant. The Aeroponics is based on the opportunity of cultivating fruits & vegetables whose roots are not implanted in a bedrock (the case with hydroponics) or soil, but in ampules in which practices for spraying plant nutrition is

CHAPTER 3

MATERIALS AND METHODS

3.1MATERIALS USED:

- PVC Pipe
- Fish Amino Acid
- Mesh Bucket
- Rockwool
- Motor
- Seed Tray
- Lettuce and Cucumber Seeds
- Mist Chamber

FIGURE 3.1: SEED TRAY

PROPERTIES OF SEED TRAY:

- ❖ Non toxic
- ❖ Light weight
- ❖ Do not damage roots
- ❖ Save seeds

FIGURE.3.2.MESH BUCKETS

PROPERTIES OF MESH BUCKETS:

- Plant holder
- Promote healthy roots
- Even drainage
- Proper aeration

FIGURE.3.3 ROCK WOOL

PROPERTIES OF ROCKWOOL:

- It has better water holding capacity.
- It helps in increasing root zone activity
- It is light weight
- Soilless germinating medium.

PROPERTIES OF MISTCHAMBER:

- It maintains ambient humidity and temperature
- It induces rooting and acclimatization
- It gives cooling effect and prevent drying
- It helps to spray water and nutrients to the plant roots

FIGURE.3.4 PVC PIPES.

PROPERTIES OF PVCPIPE:

- Tensile strength
- It helps to hold mesh buckets with plants
- Useful for vertical farming

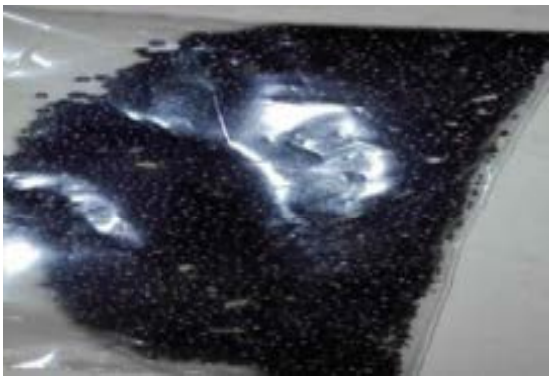


FIGURE:3.5 LETTUSE SEEDS.

Kingdom: Plant

Order: Asterales

Family: Asteraceae

PROPERTIES OF LETTUSE SEEDS:

Lettuce is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled. One variety, the woju, or asparagus lettuce, is grown for its stems, which ar`e eaten either raw or cooked. In addition to its main use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption. Europe and North America originally dominated the market for lettuce, but by the late Light – either direct sunlight for an outdoor vertical garden or artificial grow lights for an indoor one.

1. Air circulation – which can help cool down lettuce in outdoor vertical gardens.
2. Cool temperatures – ideally between 65 and 70F.
3. Fluffy well-aired soil.
4. High nitrogen fertilizer.
5. A watering system.

A "grow light" is simply an artificial form of sunlight. Plug them in, arrange to direct them onto the plants and watch them grow. There are increasingly abundant choices in styles and strength, but what is more important is in how possible this is. Nor do they need to cost an arm and a leg and nor do they have to eat up electricity like a hog. LED lights run on less than 18% of wattage used by standard house lamps and are every bit as effective and adjustable.

3.2 Use vertical air circulation to cool off your lettuce plants:

Vertical gardens can offer a unique level of air circulation. For one thing, they offer an unimpeded air circulation owing to the lack of competition that they would have in the ground. You see, when you plant lettuce in the ground, it's likely to get in contact with rivaling plants underground. Raised above ground level, it's much harder for other plants to get in the way.Air circulation also helps with lowering temperature. Because they are a plant which thrives in cooler weather, the obvious effect of sunshine building heat on the ground would make lettuce less harvestable in warmer months, and earlier so than when raised. That's where growing lettuce vertically can come in handy.

3.3 Assess the temperature for optimal growing conditions:

In as much as lettuce is typically referred to as a "cool weather plant", the term is somewhat relative. Factors such as shade and the possibility of growing indoors are obvious outliers. Nevertheless, lettuce grows best with temperatures between 60 and 65 degrees. At 70-80 degrees the lettuce plants tend to grow flowers and produce seeds.These plants can tolerate temperatures from 80-85 degrees, but only temporarily for optimal growing conditions. If you're growing lettuce in an indoor vertical garden, consider leaving the a/c during heat waves.

Throw in some fertilizer Help your lettuce grow faster and better by adding some high-nitrogen fertilizer into the planting medium during seeding. This will get the plants off to a more rapid start once they can tap in through their roots. Lettuce, in this sense, is easier to fertilize than plants which require stem or foliage growth. High nitrogen organic sources include fishmeal, blood meal, and cottonseed meal. Premixed chemical or natural fertilizers high in nitrogen include

mixes. The first number refers to the proportion of nitrogen to the other two major elements: phosphorus and potassium. Vertical gardens offer a far easier methodology for fertilizing in that many of the plants could be far above the ground to get closer to and tend without spillage or mess.

3.4 Finally put a good watering system in place:

Whether indoors or outside, you'll need a watering system for your vertically-growing lettuce. For those who can afford to spend a little, drip systems offer an amazing freedom in that they run a preset amount of water at preset intervals and times of day. It takes a bit of tweaking to find out the ideal water amount and when to apply it, but once you hit that sweet spot, an automatic drip system will allow you to travel without worrying about your developing lettuce. Can't afford an automated watering system, That's ok. You can still grow lettuce vertically with manual watering. Apply water using a squeezable watering container with the long tube formed to bend over the edges of the plant container. These terrific inventions can allow you to apply exact amounts of watering without making a mess.

AEROPONICS:

Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium. The word "aeroponic" is derived from the Greek meanings of air and ponos. Aeroponic culture differs from both conventional hydroponics, aquaponics, and in-vitro (plant tissue culture) growing. Unlike hydroponics, which uses a liquid nutrient solution as a growing medium and essential minerals to sustain plant growth; or aquaponics which uses water and fish waste, aeroponics is conducted without a growing medium.It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients.

3.5 METHODS:

The basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plant's dangling roots and lower stem with an automized or sprayed, nutrient-rich water solution. The leaves and crown, often called the canopy, extend above. The roots of the plant are separated by the plant support structure. Often, closed-cell foam is compressed around the lower stem and inserted into an opening in the aeroponic chamber, which decreases labor and expense; for larger plants, trellising isused

to suspend the weight of vegetation and fruit.Ideally, the environment is kept free from pests and disease so that the plants may grow healthier and more quickly than plants grown in a medium. However, since most aeroponic environments are not perfectly closed off to the outside, pests and disease may still cause a threat. Controlled environments advance plant development, health, growth, flowering and fruiting for any given plant species and cultivars.Due to the sensitivity of root systems, aeroponics is often combined with conventional hydroponics, which is used as an emergency "crop saver" – backup nutrition and water supply – if the aeroponic apparatus fails.High-pressure aeroponics is defined as delivering nutrients to the roots via 20–50 micrometre mist heads using a high-pressure (80 pounds per square inch (550 kPa)) diaphragm pump.

3.6 BENEFITS OF OXYGEN IN ROOT ZONE:

Oxygen (O2) in the rhizosphere (root zone) is necessary for healthy plant growth. As aeroponics is conducted in air combined with micro-droplets of water, almost any plant can grow to maturity in air with a plentiful supply of oxygen, water and nutrients.

Some growers favor aeroponic systems over other methods of hydroponics because the increased aeration of nutrient solution delivers more oxygen to plant roots, stimulating growth and helping to prevent pathogen formation.

Clean air supplies oxygen which is an excellent purifier for plants and the aeroponic environment. For natural growth to occur, the plant must have unrestricted access to air. Plants must be allowed to grow in a natural manner for successful physiological development. The more confining the plant support becomes, the greater incidence of increasing disease pressure of the plant and the aeroponic system.Some researchers have used aeroponics to study the effects of root zone gas composition on plant performance. Soffer and Burger studied the effects of dissolved oxygen concentrations on the formation of adventitious roots in what they termed “aero-hydroponics.” They utilized a 3-tier hydro and aero system, in which three separate zones were formed within the root area. The ends of the roots were submerged in the nutrient reservoir, while the middle of the root section received nutrient mist and the upper portion was above the mist. Their results showed that dissolved O2 is essential to root formation, but went on to show that for the three O2 concentrations tested, the number of roots and root length were always greater in the central misted section than either the submersed section or the un-misted section. Even at the lowest concentration, the misted section rooted successfully.

3.7 DISEASE FREE CULTIVATION:

Aeroponics can limit disease transmission since plant-to-plant contact is reduced and each spray pulse can be sterile. In the case of soil, aggregate, or other media, disease can spread throughout the growth media, infecting many plants. In most greenhouses, these solid media require sterilization after each crop and, in many cases, they are simply discarded and replaced with fresh, sterile media.A distinct advantage of aeroponic technology is that if a particular plant does become diseased, it can be quickly removed from the plant support structure without disrupting or infecting the other plants.

Due to the disease-free environment that is unique to aeroponics, many plants can grow at higher density (plants per square meter) when compared to more traditional forms of cultivation (hydroponics, soil and Nutrient Film Technique [NFT]. Commercial aeroponic systems incorporate hardware features that accommodate the crop's expanding root system.

3.8 AEROPONICS FOR EARTH AND SPACE:

FIGURE.3.6.NASA AEROPONIC LETTUSE SEED GERMINATION:

In 1998, Stoner received NASA funding to develop a high performance aeroponic system for use on earth and in space. Stoner demonstrated significantly increased growth rates of dry biomass in lettuce plants grown in aeroponic systems compared to other cultivation techniques. NASA subsequently utilized numerous aeroponic advancements developed by Stoner.

Research was conducted to identify and develop technologies for rapid plant growth in a variety of gravitational environments. Low-gravity environments pose problems like effectively delivering water and nutrients to plants and recovering the effluents. Food production in space faces other challenges including water handling, minimization of water use, and minimization of the systems weight. Food production on planetary bodies like the Moon and Mars will also require dealing with reduced gravity environments. Because of the different fluid dynamics present at differing levels of gravity a major focus in developing plant growth systems has been optimizing nutrient delivery systems.

There are a number of nutrient delivery methods currently utilized (both on Earth and in low gravity). Substrate dependent methods include traditional soil cultivation, zeoponics, agar, and nutrient-loaded ion exchange resins. In addition to substrate dependent cultivation, many methods that don't use soil have been developed including the nutrient film technique, ebb and flow, aeroponics, and many others. Because of their high nutrient solution throughput hydroponic systems can produce rapid plant growth. This necessitates large water volumes and substantial recycling of the solution which makes controlling solutions more difficult in microgravity conditions.

To deliver nutrients aeroponic systems use hydro-atomized sprays that minimize water use, increase root oxygenation, and produce excellent plant growth. The nutrient solution throughput of aeroponic systems is higher than in other systems developed to operate in low gravity. Aeroponics' elimination of substrates and the need for large nutrient stockpiles reduce the amount of waste material that needs to be processed by other life support systems. The removal of the need for a substrate also simplifies planting and harvesting (making automation easier), decreases the weight and volume of expendable materials, and eliminates a potential pathogen transmission pathway. These advantages demonstrate the potential of aeroponic production in microgravity and the efficient production of food in outer space.

3.9 NASA INFLATABLE AEROPONICS:

In 1999, Stoner, funded by NASA, developed an inflatable low-mass aeroponic system (AIS) for space and earth for high performance food production.This advancements are very useful in space aeroponics.Aeroponics International's (AI's) innovation is a self-contained, self-supporting, inflatable aeroponic crop production unit with integral environmental systems for the control and delivery of a nutrient/mist to the roots.

This inflatable aeroponic system addresses the needs of subtopic 08.03 Spacecraft Life Support Infrastructure and, in particular, water and nutrient delivery systems technologies for food production. The inflatable nature of our innovation makes it lightweight, allowing it to be deflated so it takes up less volume during transportation and storage. It improves on AI's current aeroponic system design that uses rigid structures, which use more expensive materials, manufacture processes, and transportation. As a stationary aeroponic system, these existing high-mass units perform very well, but transporting and storing them can be problematic.

On Earth, these problems may hinder the economic feasibility of aeroponics for commercial growers. However, such problems become insurmountable obstacles for using these systems on long-duration space missions because of the high cost of payload volume and mass during launch and transit.The NASA efforts lead to developments of numerous advanced materials for aeroponics for earth and space.

BENEFITS OF AEROPONICS FOR EARTH AND SPACE:

NASA aeroponic lettuce seed germination- Day 3

Aeroponics possesses many characteristics that make it an effective and efficient means of growing plants.Plants grown using aeroponics spend 99.98% of their time in air and 0.02% in direct contact with hydro-atomized nutrient solution. The time spent without water allows the roots to capture oxygen more efficiently. Furthermore, the hydro-atomized mist also significantly contributes to the effective oxygenation of the roots. For example, NFT has a nutrient throughput of 1 liter per minute compared to aeroponics' throughput of 1.5 milliliters per minute.The reduced volume of nutrient throughput results in reduced amounts of nutrients required for plant development.

Another benefit of the reduced throughput, of major significance for space-based use, is the reduction in water volume used. This reduction in water volume throughput corresponds with a reduced buffer volume, both of which significantly lighten the weight needed to maintain plant growth. In addition, the volume of effluent from the plants is also reduced with aeroponics, reducing the amount of water that needs to be treated before reuse.The relatively low solution volumes used in aeroponics, coupled with the minimal amount of time that the roots are exposed to the hydro-atomized mist, minimizes root-to-root contact and spread of pathogens between plants.

GREAT CONTROL OF ENVIRONMENT:NASA aeroponic lettuce seed germination (close-up of root zone environment)- Day 19.Aeroponics allows more control of the environment around the root zone, as, unlike other plant growth systems, the plant roots are not constantly surrounded by some medium (as, for example, with hydroponics, where the roots are constantly immersed in water).

IMPROVED NUTRIENT FEEDING**:**

A variety of different nutrient solutions can be administered to the root zone using aeroponics without needing to flush out any solution or matrix in which the roots had previously been immersed. This elevated level of control would be useful when researching the effect of a varied regimen of nutrient application to the roots of a plant species of interest. In a similar manner, aeroponics allows a greater range of growth conditions than other nutrientdelivery systems. The interval and duration of the nutrient spray, for example, can be very finely attuned to the needs of a specific plant species. The aerial tissue can be subjected to a completely different environment from that of the roots.

MORE USER FRIENDLY:

The design of an aeroponic system allows ease of working with the plants. This results from the separation of the plants from each other, and the fact that the plants are suspended in air and the roots are not entrapped in any kind of matrix. Consequently, the harvesting of individual plants is quite simple and straightforward. Likewise, removal of any plant that may be infected with some type of pathogen is easily accomplished without risk of uprooting or contaminating nearby plants.

MORE COST EFFECTIVE:

Close-up of aeroponically grown corn and roots inside an aeroponic (air-culture) apparatus. Aeroponic systems are more cost effective than other systems. Because of the reduced volume of solution throughput (discussed above), less water and fewer nutrients are needed in the system at any given time compared to other nutrient delivery systems. The need for substrates is also eliminated, as is the need for many moving parts .

USE OF SEED STOCKS:

With aeroponics, the deleterious effects of seed stocks that are infected with pathogens can be minimized. As discussed above, this is due to the separation of the plants

and the lack of shared growth matrix. In addition, due to the enclosed, controlled environment, aeroponics can be an ideal growth system in which to grow seed stocks that are pathogen-free. The enclosing of the growth chamber, in addition to the isolation of the plants from each other discussed above, helps to both prevent initial contamination from pathogens introduced from the external environment and minimize the spread from one plant.

3.10 PS NUTRAC SERVICES:

Due to complexity of this new system our scientists are constantly doing research and experiments to expand the variety of plants this system works with.

The structure and system took years to assemble which makes it crucial for PSN to handle the setup and maintenance end to end as very little detail has been thoroughly researched and structured for reasons that the layman may not be aware of.

- Costruction/assemble of green or screen house
- Setup and construction of aeroponics structure
- Setup of system
- Providing,advising and planting of seeds or plants
- Full training with staff and supervisors on usage and harvest
- Maintanence of equipment and structure.

AEROPONICS KIT LAYOUT AND SETUP:

FIGURE.3.7.AEROPONICS KIT.

MAKING OF AEROPONICS KIT:

The PVC pipe of 3 feet is taken. To grow plants vertically in PVC pipe the holes are made into the side walls of the PVC pipe .The holes are made using a wooden rotary tool .The sizes of the holes is made based on the size of the mesh bucket as per to hold it. The mesh buckets are fixed into the holes of the PVC slantingly by using glue to hold the plants . The PVC pipe is placed in a water with a motor .The motor is connected to a pipe .The top end of the pipe contains a mist chamber from where water is sprayed to the plant

roots.Aeroponics is a method of farming that uses an automized. Nutrient mist as the growing substrate rather than soil or water. The technology has huge advantages in water consumption reduction and low space requirements, making it a great candidate for urban farming.The MIT Cityfarm team is researching the farming method by prototyping an aeroponics façade system in the Media Lab. While the team is concentrating on urban needs, aeroponics growing technologies could have just as huge an impact on food production in water-scarceregions, such as Israel, since aeroponics utilize 98% less water than conventional farming. By connecting Cityfarm and the Ecological Greenhouse of Kibbutz Ein Shemer in Israel for collaboration on improving the technology, teams from both sectors that can benefit from aeroponics can contribute to increasing the speed at which aeroponics advances and gains support. The Greenhouse functions based on a platform of combining social action, education, and research in marine agriculture, renewable energy, and agricultural technologies. At the Greenhouse, students from Jewish and Arab backgrounds learn about the agricultural sciences from educational staff, and they go on to contribute to projects either self-devised or initiated by the Greenhouse. With its knowledgeable staff and high traffic of students, the Greenhouse is an ideal incubator for experimenting with and improving aeroponics.A neglected corner of the Greenhouse was designated as aeroponics territory, and I got to work setting up, cleaning, and building with huge amounts of help and support from the Greenhouse staff. We had a first aeroponic system planted with lettuce and running by the second week. It was pretty soggy and very leaky, so we started working on the next versions with new designs and better materials, simultaneously working on a smaller-scale demonstration tank. We wanted to make aeroponics less of a mystery for students. Because so many tours and classes were visiting the aeroponics experiments, we set up a section purely for presentation. Instead of lifting the lids on the big aeroponic systems, we wanted students to be able to peer into a window and see the piping systems and suspended plant roots for themselves.

METHODOLOGY:

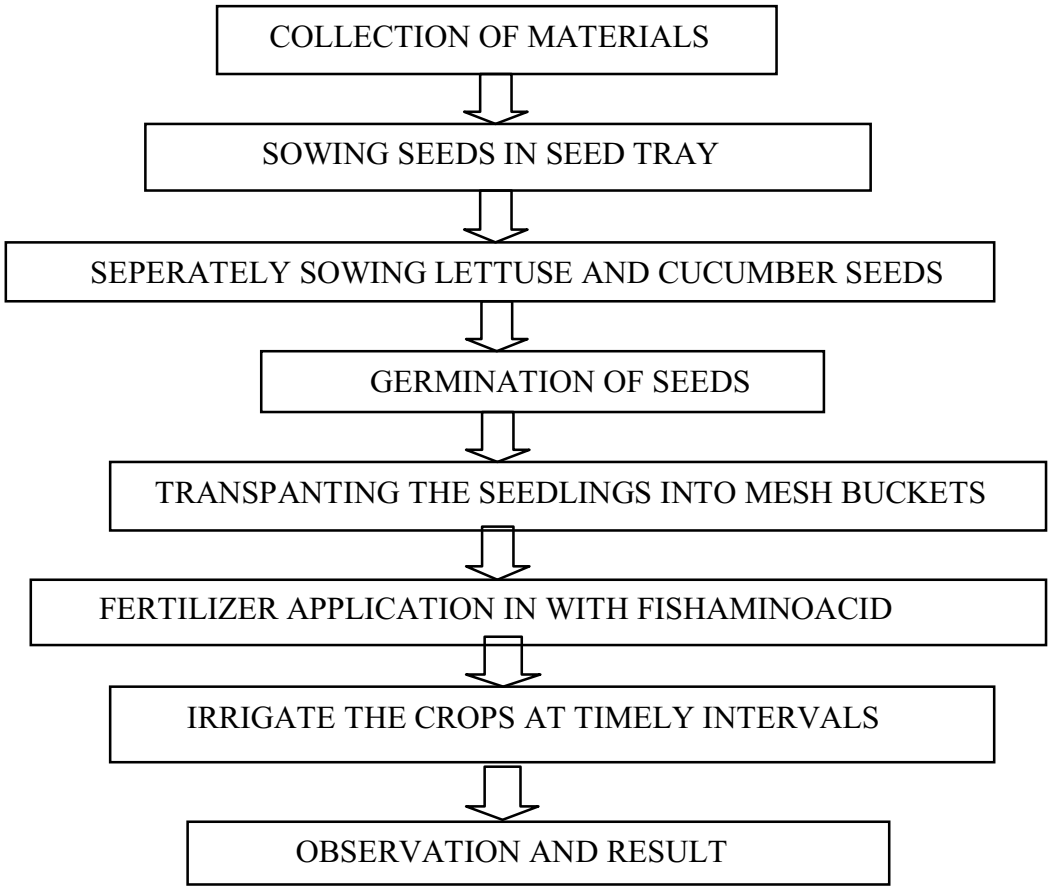


FIGURE 3.8: FLOW CHART OF THE PROJECT.

For evaluating the response of Green gram to seed inoculation with *Rhizobium* and use of Nitrogen fertilizer a pot culture experiment was conducted under natural conditions.The plants were sown by using four seeds per hole in a seed tray and sterlised soil was added in each polybag .Nitrogen fertilizer at 33.3g per polybag for Green gram were applied in the form of Diammonium phosphate (DAP). Fertiliser were applied at the time of transplanting of the untreated seedlings. For seed inoculation, seeds were coated with paste of rhizobium inoculum and left undisturbed for 30 minutes to get dry and sown in seedtrays. All agronomic practice were kept uniform and normal for all treatments. Three seed inoculated and three Nitrogen fertilizer added were used. Experiment was carried out for seven weeks. Data on seed germination, nodulation index, plant height at maturity,wet weight and dry weight was recorded. Five plants were randomly selected and uprooted from pot and washed in tap water. Then plants height and wet weight were recorded. Dry weights of these plants were recorded after keeping them in hot air oven at 60 0C for 8 hours.Nodules from seed inoculated plant were removed from root with the help of a sterlised blade and rhizobial cells were isolated by squash method.

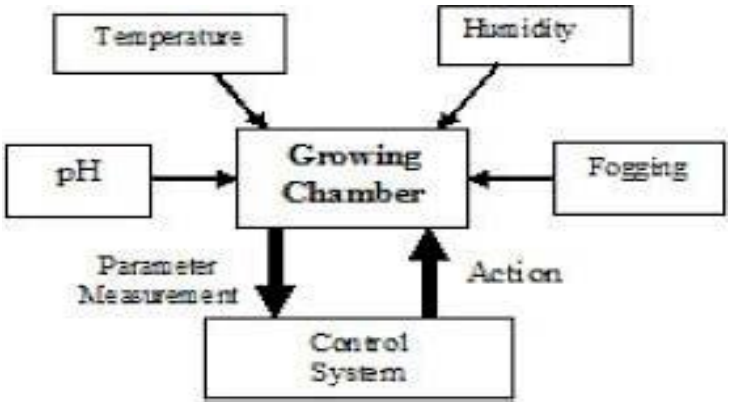


FIGURE.3.9: AEROPONIC GROWING SYSTEM

CHAPTER 4
RESULT AND DISCUSSION

Technical AnalysisInformants reported on the possibility of transferring andreplicating these technologies using local materials, equipment and personnel. None of the technologies have anypatents and all have been adapted locally. The difference related to the degree of or local adjustment. Theaeroponics and fiber-cement tiles technologies generallyneed a high degree of local adaptation, while the semi-hydroponics and conventional technologies require intermediate to modest levels of adaptation respectively. With regard to the aeroponics and fiber-cement tiles technologies,potential forreplicability in developing countries can berelatively low in light of requirements for equipment, external inputs and specialized personnel to ensure effectiveoperations. Semi-hydroponics is characterized by an intermediate degree of replicability because the use of solidsubstrates provides robustness. The conventional technology has a high degree of replicability.With regard to requirements for equipment, materials andinputs, the greatest need exists for aeroponics.

There is direct relationship between the degree of complexity and efficiency of the technologies evaluated.Technologies that were more complex and demanding inexpertise were also found to be more efficient in terms oftheir overall production output and economic performance.At the same time there is an inverse relationship between thedegree of complexity and the robustness of the differentmini-tuber production systems. The ability to withstandshocks, such as power or water cuts, is low for aeroponicsand the fiber-cement tiles technology. The conventionalsolid-substrate-based technology is the least complex andcertainly not as efficient as compared to the soilless system .However, it is the most robust technology among the different systems compared. In general, depending on a countryor region's context, different technologies that carefullybalance efficiency and robustness must be sought. Thus the yield and growth of the crops are observed and foud better with the comparitive cultivation with traditional cultivation and aeroponic system of cultivation.

PARTICULARS	RADISH	CUCUMBER	LETTUCE
NO OF LEAVES	4	11	15
PLANT HEIGHT	3cm	20cm	5cm
YIELD	45gm	125gm	500gm

TABLE 4.1: OBSERVATION 1-20 DAYS

PARTICULARS	RADISH	CUCUMBER	LETTUCE
NO OF LEAVES	7	21	35
PLANT HEIGHT	8cm	45cm	12cm
YIELD	65gm	250gm	725gm

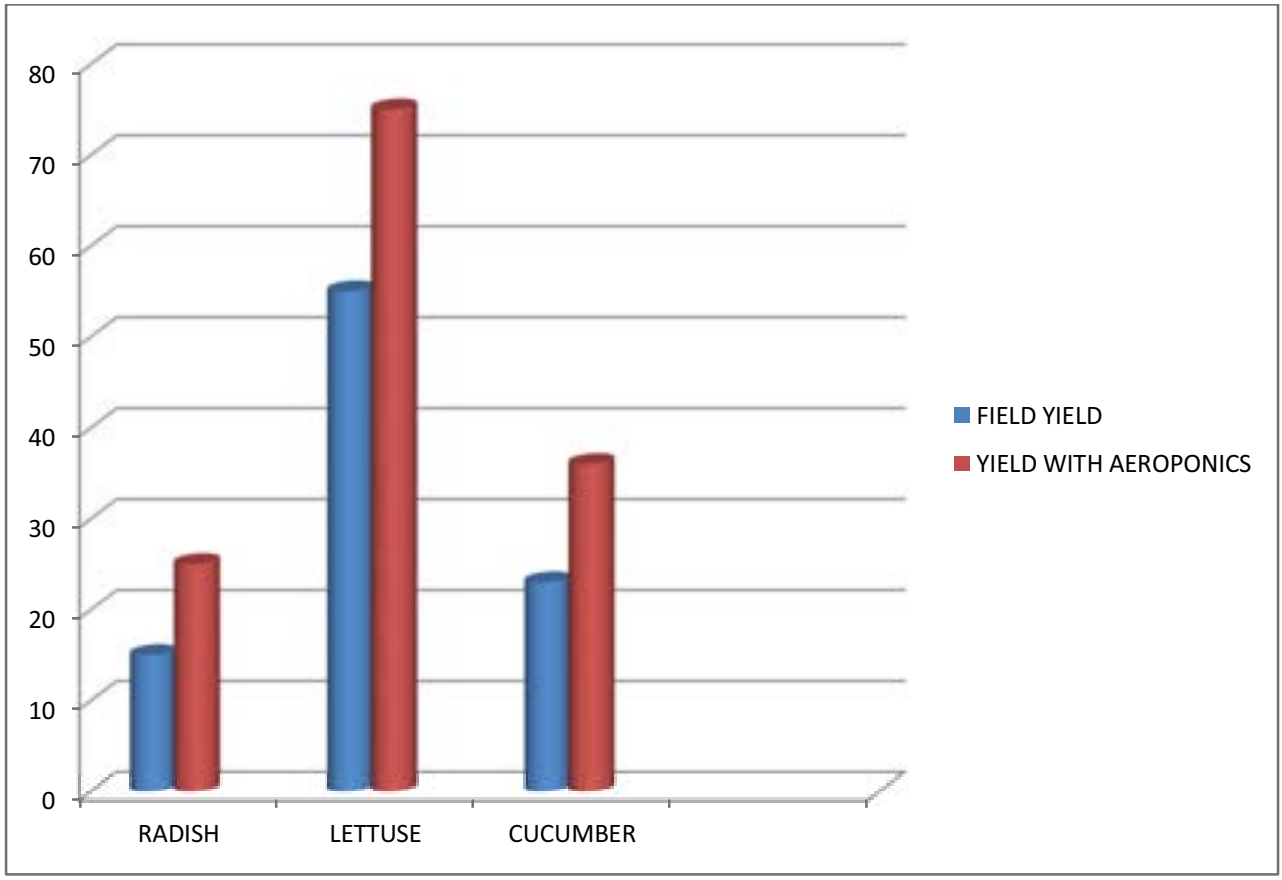
TABLE 4.2: OBSERVATION 21- 40 DAYS

PARTICULARS	RADISH	CUCUMBER	LETTUSE
NO OF LEAVES	10	30	50
PLANT HEIGHT	12cm	60cm	20cm
YIELD	100gm	350gm	1kg

TABLE 4.3 : OBSERVATION 41- 50 DAYS

CROPS	YIELD IN VF (TONS/HAC)	FIELD YIELD (TONS/HAC)
RADISH	23	15
LETTUSE	55	75
CUCUMBER	36	33

TABLE:4.4 CONCLUSION



CHAPTER 5

CONCLUSION

Aeroponics was a form of hydroponics technique where the plants are grown using mineral nutrient solutions instead of soil.Hydroponics and Aeroponics plays very important role for the commercial food production.Aeroponically grown plants will get perfectly balanced diet.In recent decades,NASA has done extensive project research for their Control Ecological Life Support System(CELSS). NASA sponsored Stoners research for natural liquid biocontrol,known then as ODC, that activates plants to grow without the need for pesticides as a means of control pathogens in closed loop culture system.Aeroponic bio-pharming is used to grow pharmaceutical medicine of plants.

Due to increase in world population and the need to face all their food customs this technically developed form of agriculture can be used which yield more then conventional agriculture and are cultivated as disease free crops and grown organically.

CHAPTER 6

REFERENCES

1. C. Stanghellini, "Horticultural production in greenhouses:efficient use of water," Acta Horticulturae, vol. 1034, pp. 25–32, 2014.

2. D. Pimentel, B. Berger, D. Filiberto et.,"Water resources:agricultural and environmental issues," Bioscience, vol. 54,no. 10, pp. 909–918,2004.

3. D. Savvas, G. Gianquinto,Y. Tuzel, and N. Gruda, "Soilless culture," in Good Agricultural Practices for GreenhouseVegetable Crops: Principles for Mediterranean Climate Areas(No. 217),

4. D. K. Großkinsky, J. Svensgaard, S. Christensen, andT. Roitsch, "Plant phenomics and the need for physiologicalphenotyping across scales to narrow the genotype-to-phenotype knowledge gap," Journal of Experimental Botany,vol. 66, no. 18, pp. 5429–5440, 2015.

5. E. Playán and L. Mateos, "Modernization and optimization ofirrigation systems to increase water productivity," Agricultural Water Management, vol. 80, no. 1-3, pp. 100– 116, 2006. International Center of Applied Aeroponics (ICAA), PressRelease: Golden Potato, Hanoi, Vietnam, 2014.

6. J. James and M. P. Maheshwar, "Plant growth monitoringsystem, with dynamic user-interface," in 2016 IEEE Region10 Humanitarian Technology Conference (R10-HTC), 5, Agra, India, December 2016.

7. L. Levidow, D. Zaccaria, R. Maia, E. Vivas, M. Todorovic, andA. Scardigno, "Improving water-efficient irrigation: prospectsand difficulties of innovative practices," Agricultural WaterManagement, vol. 146, pp. 84–94, 2014.

8. M.Lee and H. Yoe, "Analysis of environmental stress factorsusing an artificial growth system and plant fitness optimization," BioMed Research International, vol. 2015, Article ID292543, 6 pages, 2015.

9. M. Taher Kahil, J. Albiac, A. Dinar et ., "Improving the performance of water policies: evidence from drought in Spain,"Water, vol. 8, no. 2, p. 34, 2016.

10. S. M. Moon, S. Y. Kwon, and J. H. Lim, "Minimization oftemperature ranges between the top and bottom of an air flowcontrolling device through hybrid control in a plant factory,"The Scientific World Journal, vol. 2014, Article ID 801590,7 pages, 2014.

11. NASA Spinoff, Innovative Partnership Program, Publicationsand Graphics Department NASA Center 2006.

12. W. Foote, To Feed the World in 2050, We Need to ViewSmall-Scale Farming as a Business, Skoll World Forum,Oxford, UK, 2015

13. Wei, M. Zhang et al., "Sensors for measuring plantphenotyping: a review," International Journal of Agriculturaland Biological Engineering, vol. 11, no. 2, pp. 1–17, 2018.

14. W. Baudoin, R. Nono-Womdim, N. Lutaladio et al., GoodAgricultural Practices for Greenhouse Vegetable Crops: Principles for Mediterranean Climate Areas (No. 217), Food andAgriculture Organization of The United Nations, Rome,2013.

DESIGN AND FABRICATION OF GROUNDNUT POD STRIPPER AND DESHELLER

A PROJECT REPORT

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ABSTRACT

Our project focused on the design and fabrication of a groundnut pod stripper and Desheller machine on electrically powered by 1 hp motor. The machine has the capacity of stripping and shelling of 100 kg of groundnut per hour respectively. The machine was fabricated from locally soured materials of steel rod, bearing, shaft, ect.., which makes it cheap and easily affordable and also easy and cheaper to maintain. It is also of light weight and it consist hopper, Desheller, separator and blower unit.

KEYWORDS: Groundnut, farmer, time consumption, traditional method of pod separator and Desheller, Automatic pod separator and Desheller.

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CHAPTER 1

INTRODUCTION

1.1 .GENERAL

Groundnut is the sixth most important oilseed crop in the world. It contains 46-50% oil and 25-28% protein, and is a rich source of dietary fiber, minerals and vitamins. It grows best on soils that are well drained, loosely textured and well supplied with calcium, potassium and phosphorous. Over 100 countries worldwide grow groundnut. The main purpose of this paper is to understand the knowledge of design and fabrication mechanism of portable groundnut Sheller machine. The design is very simple and eco-friendly which uses simple mechanism properties such as shelling system, automatic separating system and crushing chamber etc.

The study of manufacturing was very important for this project. In this project the process of designing the different parts of this shelling and separating machine considering all forces and ergonomic factor for people to use, This project is mainly about generating a new concept of groundnut shell (crush) that would make easier to transport anywhere and suitable to crush groundnut. After the design has completed, it was transformed to its real product where the design is used for guideline. A simple hand operated groundnut Sheller machine has a semi-cylindrical form closed on both sides. At one end shaft carrying a lever and which is fixed across the centre of the semi cylinder.

The major drawback of this machine is labour intensive and consumes lots of time. Output is about 20-30 kg/hour. But the particular design of this project reduces all the causes and improves the efficiency. It consists of the hopper, crushing chamber, separation chamber, blower unit and the frame for support. The crushing chamber and blower unit is powered by electrically which save the time. The machine is also light weight and easy to operate and maintain, the spare parts are also available locally. India is an agricultural based country. Since last 50 year's lot of changes has been occurred in agriculture sector. Many new agricultural based industries have been started new varieties

and species of plant have been discovered. In our country most of the people can be depend on the agriculture sector/field. The Groundnut is one of the products in the Marathwada-Nasik region. The product in the farm, in abundant quantity. There is lot of time waste in old method of groundnut pod separating. The time required for 1 Kg of groundnut pod separating from this groundnut is about 1 to 2 hours. so we have we have produces new machine for fast groundnut pod separating. In the Marathwada region people collect the groundnut from the groundnut plant directly for pod separating purpose.

The ground spreads on the ground and the pod of groundnut can be separated manually. Because of this method lot of time waste takes place as well as due to striking process some ground nut can be brakes of damage. But by using the groundnut pod separating machine we separate the pod from groundnut efficiently and large quantity in very less time. So we increase the work capacity and saving the time efficiently & effectively. So our machine in very useful to separating the pod from groundnut. Seed is the basic input in agriculture. However, for maximum gain in productivity the use of both improved varieties and improved integrated crop management practices are required. Not only do they contribute to increasing productivity individually, but they also act synergistically. In most of the conventional practices quality of groundnuts while plucking is harmed, so in order to avoid this groundnut plucking and sorting machine can efficiently pluck as well as sort groundnuts and hence better results can be obtained.

1.2. INITIAL CONCEPT

Introducing low cost automation was to overcome problems with the current manual traditional method. The concept of the work is,

- Observe the manual methods to identify the important process variables.
- Quantify the important method.
- Develop a prototype automation system which could control over all of the process.
- Investigate all areas of automated forming.

1.3. OBJECTIVES

- To minimize the time for separating the ground nut pod and desheller from plant body.
- To minimize man power.
- To simplify the process.
- To improve efficiency of operation of separation of groundnut pods from plant body.
- To develop a low cost machine this can be used by farmer
- It satisfies the need of village people to earn more money.
- The aim of project is to design & develop a low-cost groundnut pod separator which will help farmer to reduce time required to separate groundnuts.
- To reduce human efforts.
- To increase efficiency and get more profit.
- To reduce high requirement of labours.
- To modify the design of chaff cutting machine which can allow the farmer to not only cut the sugarcane in a form which can be utilized as a fodder for animal but can also grind various feeding materials such as dry corn straw, grass, soyabean, wheat stalk, with ease and thus reducing themanual work of farmer and increases the fodder production.

CHAPTER 2

REVIEW OF LITERATURE

ARBOGAST G. MBEIYERERWA (2016) reported that **SOCIO-ECONOMIC FACTORS LIMITING SMALLHOLDER GROUNDNUT PRODUCTION IN TABORA REGION**

"Groundnut is among the most important crops for smallholder farmers in Tanzania, providing both food and income for households. Groundnut is a nutritious source of fats, protein, carbohydrates, vitamins and minerals for human consumption and parts of the crop can be used for livestock feed. This study identified factors which contribute to the stagnation of groundnut production among smallholder producers in Rambo district of Tabora region in Tanzania. Quantitative data were collected using a survey questionnaire administered to 400 smallholder farmers. Multistage, simple random and purposive sampling were used to select participants. Qualitative data were also collected through focus group discussions, key informant interviews and personal observation. A multivariate regression technique was used to examine socio-economic factors influencing small-scale groundnut production in the district. In addition, the profitability of various crops produced in the study area was assessed using gross margin analysis. Results indicate that hours spent farming, cultivated land size, the price of groundnut from the previous season, cost of seeds and cost of pesticides significantly influence groundnut production in the area. Data further indicate that groundnut was the third most profitable crop in the area after beans and rice. The study also revealed gender disparity in land ownership. Few women owned land despite being major providers of labour. Based on the evidence, the study recommends that the government, among other policy responses, expand extension services to ensure that smallholder groundnut farmers have access to high-yielding groundnut seed varieties, agro-chemicals, improved farm inputs, storage and marketing facilities.

M.A. HAQUE (2016) reported that **PERFORMANCE EVALUATION OF A BAMBARA GROUND NUT SHELLER**

"The shelling of pod to obtain clean seed is one of the most tedious operations in Bambara groundnut processing. As a result, it has constituted a bottle- neck to the large scale production and processing of this important proteinous crop. To overcome the problem, some physical properties of bambara groundnut pod relevant in bulk handling andprocessing, were investigated and a sheller using roller mechanism was designed for the crop, constructed and tested.Measurements of the physical properties showed that at the moisture content of 5% (wb), the major, intermediate and minor diameters of Bambara groundnut pod averaged 1.89 cm, 1.57 cm and 1.44cm respectively. The true and bulk densities, porosity and one thousand-pod weight averaged 754.83 kg/m3 and 432 kg/m3, 42.77% and 1.24 kg, respectively and the angle of repose and static coefficient of friction of the pod on steel sheet averaged 30.4o and 0.56. Results of machine performance tests showed that the moisture content, material feed rate and the interaction between them had significant effect on the quantity of shelled, unshelled and partially shelled pods as well as that of damaged seeds and winnowed chaffs at 1% level of significance. Shelling and winnowing efficiencies decreased while percentage of partially shelled and unshelled pods increased with increase in moisture content and feed rate. The maximum shelling and winnowing efficiencies of 80% and 79.5% respectively, were obtained at the moisture content of 5% (wb) and feed rate of 93.6 kg/h. The percentage seed damage increased with increase in moisture content between 5 and 10% (wb) - to a maximum value of about 38%, and decreased with further increase in moisture content. At low moisture levels, it increased with increase in feed rate but at higher moisture levels, it decreased with increase in feed rate. Regression models that could be used to express the relationship existing between the sheller performance indices, pod moisture content and feed rate were established. Further work would be carried out to modify the sheller and optimize its performance.

A.N. GITAU, P.MBOYA, B.N.K.NJOROGE, M.MBURU (2015) reported that **PERFORMANCE OF A MANUALLY OPERATED GROUNDNUT DECORTICATOR**

"Shelling of groundnut pods using manual decorticators in Kenya is characterized by high kernel breakages and low shelling efficiencies. As a result, farmers get low income due to low cost of broken kernels and a lot of time is lost in the tedious shelling operation. To overcome this problem, pertinent parameters that influence shelling efficiency of manually operated groundnut decorticators were identified. Two manually operated decorticators were tested and modifications done on one of the decorticators to optimize its technical performance. Results of machine performance tests showed that for WBS (Wooden beater Sheller) at a feed rate of 30 kg/hr and 22.6 mm clearance, shelling efficiency in- creased with decrease in moisture content for all the groundnut varieties. The highest shelling efficiency was 55.3% for ICGV 99568, 39.2% for ICRISAT Groundnut Variety (ICGV) 90704 and 29% for ICGV 12991 at moisture content of 5.92% wb. For RBS (Rod Beater Sheller) at a feed rate of 30 kg/hr and 22.6 mm clearance, the highest shelling efficiency was 58.3% for ICGV 99568, 42.7% for ICGV 90704 and 35% for ICGV 12991 at moisture content of 7% wb. Identification of the pertinent parameters showed that pod moisture content, clearance and sieve size influence performance of manually operated groundnut. Theoretical predictive models developed were optimized which showed that a maximum shelling efficiency of 88.73% can be achieved with percent damage of 4% when the sieve size is 11 mm and clearance is 16 mm with a regression coefficient of over 85%. With the modifications done on the WBS decorticator, the highest shelling efficiency of 87% was obtained at a clearance of 10 mm for ICGV 99568 which is the largest in size from the three varieties. The shelling efficiency of the modified decorticator is far above those of the RBS and WBS because the sieve sizes and clearances of the later were not optimized. The results of the theoretical optimization of the manually operated groundnut decorticator implies that farmers who shell for seeds can now obtain more seeds shelled with low breakage and therefore will get more income.

SANTOSH MANGAVE AND BHAGYESH DESHMUKH ET AL (2015) reported that

DESIGNED THE PORTABLE GROUNDNUT SHELLER MACHINE.

"The fabricated machine is manually operated. Sheller machine is used to shell only dry pods and it can be used as a groundnut Sheller machine for domestic application. It is a manual process where the groundnuts are removed from shell. The pedal is used for the movement of the crusher. There will be no energy consumption and the cost of production is less. It has less maintenance cost. It is very cheap and five experiments were performed with peanuts. Since this machine is made for small businessman or for farmers, therefore the work carried out by this machine is less. The decocting process of groundnut by this machine is more economical and faster than manual process or any other processes. Groundnut sheller machine will save the tremendous time, energy manpower and save financial input of the project, reducing the cost and time considerably which is the backbone of the present world economy. Done investigations on two manually operated decorticators and were tested and modifications done on one of the decorticators to optimize its technical performance. The performance tests showed that the requirements of the farmers including low kernel breakages and high shelling efficiencies could be achieved by the modified decorticator. Designed and fabricated a machine where sprockets of a bicycle are rotated by pedaling action and this rotary motion is used to rotate the shaft of a screw conveyor. The peanut gets crushed in between the flights around the shaft and the casing of the conveyor.

From our project using 1Hp electric motor and its has been operated by alternating current (Ac). To remove pods and shell.

ADEDEJI OMOTADE SEGUN, AJUEBOR FN **(2014)** reported that **PERFORMANCE EVALUATION OF MOTORIZED GROUNDNUT SHELLER**

"A power operated groundnutsheller that shells groundnut by mechanical shearing and cleans the shelled seeds from chaff pneumatically was designed, fabricated and tested. To increase the shelling efficiency and capacity and to reduce breakage of the seeds as well as reduce power consumption, certain modifications were carried out after the preliminary test. The modifications included a reduction in the shelling speed, rubberisation of the rotating beaters, optimization of the concave slots and adjustments in the blower speed. The modified machine was tested to evaluate its general performance. The best performance of the sheller was achieved at 260 rpm shelling speed, 30 mm – 40 mm concave clearance, feeding rate of 150 kg (pods)/h giving an output of 80 kg seed/h. The shelling efficiency, cleaning efficiency and breakage were 98%, 85%, and less than 5%, respectively. A blower speed between 1000 rpm – 1400 rpm is adequate for effective separation when chute sloped at 20° to the horizontal.

ASHISH S. RAGHTATE DR. C. HANDA (20014) reported that **DESIGN CONSIDERATION OF GROUNDNUT SHELLER MACHINE**

"Groundnut is grown on small scale farmers in developing countries like India. The average kernel price is approximately twice the price of pod. Lack of groundnut processing machines, especially groundnut Sheller, is a major problem of groundnut production, especially in our country India. A research-work for design, fabricate, and performance evaluation of a groundnut Sheller consisting of feed hopper with a flow rate control device, shelling unit, separating unit and power system. The performance of the machine was evaluated in terms of throughput capacity, shelling efficiency, material efficiency and mechanical damage. Regression models that could be used to express the relationship existing between the Sheller performance indices, pod moisture content and feed rate were establish. This paper describes about the design of various components of groundnut Sheller machine. Hence in this design of various parts are necessary, and design of various parts due to which the design quality of those parts will be improved.

Overall, this project involves processes like design, fabrication and assembling of different components etc.

KHARE G.N ET AL. **(2009)** reported that **DESIGN AND FABRICATION OF GROUNDNUT SHELLING AND SEPARATING MACHINE**

"Shelling is the removal of grains from their pod either by stripping, impact action and rubbing or any combination of these methods .The most popular method of groundnut shelling, which is still widely used is the method of crushing or pressing the pods in between the thumb and the first finger to break off the pods and release the seed. This method has low efficiency, it is time consuming, and has high demand of energy. Groundnut shelling machine is a machine used to remove the shell of groundnut so as to obtain the groundnut seeds. There are different machines have been fabricated and used to shell wide variety of groundnut pods .These machines are too costly and complex in operation and maintenance. The lowest price of the hand operated groundnut Sheller machine is Some of these machines have very high shelling capacity. Shelling capacity varies from machine to machine ranging from 5kg-seeds/h to 60kgseeds/h. Some hand operated Sheller machines are suitable for domestic application but they only do shelling operation, separation of seeds we have to do manually by using traditional methods such as by using natural wind or by using sieve. A simple hand operated groundnut Sheller has a semi-cylindrical screen closed on both sides. A shaft carrying a lever at one end is fixed across the centre of the semi-cylinder as shown in the on the lever is a pair of plate with shoes or beater bars, having blunts on their undersides. For successful operation of the machine, the operator stands by the side, then holding the operating lever (handle) and swinging it by pushing to and fro to provide shelling action on the shoes assembly. The semi-rotary, action of the shoes shells the pods against the screen but this type of machine.

From our project using 1Hp electric motor and its has been operated by alternating current (Ac). To remove pods and shell.

ARJUN VISHWAKARMA, TEJAS TANDALE (2009) reported that **DESIGN OF AN ELECTRICALLY POWERED GROUNDNUT SHELLING MACHINE**

"The machine was fabricated using materials that were easily available. It can be used for both household and industrial purposes. The advantage to be derived from the use of this machine overcomes its shortcomings. This design gives major advantages in the case of power consumption. The required power for above stated capacity is 1 hip while 1.98 as for conventional machine. Our designed machine is light weight compact and slim in construction. It is easy to operate and transport from here to anywhere. The bearing is used to all four shafts. It does not require percent lubrication. But it is suggested to lubricate bearing by oil periodically. The self-lubricated bearing can be used for shafts, but it will increase cost.

MR. ARJUN VISHWAKARMA, TEJAS TANDALE, PROF R. H.KEKAN (2009) reported that **DESIGN AND DEVELOPMENTOF A GROUNDNUT POD SEPARATING**

"Groundnut pods were separated from its crop by the workers. The output got from this method, was very low and it does not fulfill the market demand because it was very time consuming process. Our project mainly consists of robotic arm and spiked rotating drum. Robotic arm will pluck out the groundnut crop and feed it on the spiked rotating drum. Spikes on rotating drum will separate the pods from ground crop. There are big Groundnut Harvesters available in market, but farmers having small farm area can't afford that harvester. Our machine is small, lightweight, and low in cost. Farmers having small farm area can afford and use our machine capacity of shelling 400kg of groundnut per hour with a shelling and separating efficiencies of 95.25% and 91.67%respectively. The machine was fabricated from locally sourced materials, which makes it cheap and easily affordable and also easy and cheaper to maintain. It is also of light weight and comprises of the hopper, crushing chamber, separation chamber and the blower unit. During the process of testing, it was observed that majority of the groundnut pods that came out unshelled or partially shelled were the ones with one seed per pod and those with two small seeds in their pods.

WANGETTE ISAAC SIMIYU (2008) reported that **INFLUENCE OF GROUNDNUT AND MACHINE CHARACTERISTICS ON MOTORISED SHELLER PERFORMANCE**

"Groundnut shelling is a fundamental process in post-harvest management. Manual shelling is inefficient and laborious with low throughput. Motorised shellers experience less than 100% shelling efficiency and varying levels of kernel damage, hence, the need for optimization. Research work involving many factors require large numbers of experimental runs, resulting in high costs and are time consuming. Taguchi design of experiments enables to arrive at best parameter combination for optimal conditions with least number of analytical investigations. In this work, Taguchi method with S/N and ANOVA techniques were applied to optimize groundnut sheller performance involving the influence of six machine and groundnut factors on three output parameters. Best output results were obtained as follows: Throughput per unit power consumption of 921.03 (kg/h)/kWh at 12.2 m/s shelling speed, rubber paddle shelling blades, CG 7 variety, 6% mc, 1200 kg/h feed rate and 10 mm concave clearance. Shelling efficiency of 99.08% at 12.2 m/s shelling speed, rolling steel pipe shelling blades, Valencia red variety, 6% mc, 2000 kg/h feed rate and 10 mm concave clearance. Kernel mechanical damage of 1.25% at 7.4 m/s shelling speed, fixed rubber pipe shelling blades, Valencia red variety, 12% mc, 800 kg/h feed rate and 15 mm concave clearance.

ALONGE, A. F ET AL (2007) reported that **DEVELOPMENT AND PRELIMINARY TESTING OF A BAMBARA GROUNDNUT SHELLER**

"A centrifugal bambara groundnut pod shelling machine was designed and constructed to crack various sizes and varieties of bambara groundnut. The sheller was fabricated with locally available materials from the formation of a new idea which aimed at easing the pain, stress, intensive labour, time consumption, undue cost and the cumbersome operation encountered in the traditional method of shelling. The machine consists of three main units, namely the hopper, shelling unit and power transmission unit. The sheller uses impact technique and was designed to shell Bambara groundnuts effectively and also

to eliminate drudgery associated with the traditional methods of shelling legumes. Five hundred (500) samples of sundried Bambara groundnuts at 6% (wet basis) which were randomly selected were shelled at an impeller rotation speed of 1636 rpm. The results of the test showed that the shelling efficiency, seed damage, partially shelled pods, unshelled pods and the machine capacity were 83.2%, 17.4%, 7.8%, 9% and 75000 seeds/hr respectively.

From our project using 1Hp electric motor and its has been operated by alternating current (Ac). To remove pods and shell.

TUSHAR WALKE ET.AL **(2005)** reported that **DESIGNED AND FABRICATED THE GROUNDNUT MACHINE WHICH IS ELECTRICALLY OPERATED.**

"The working of the machine is power supplied to motor it rotates the roller. Groundnuts are supplied in crushing chamber through hopper and they get crushed between Semicircular net and the roller. Thus, the ground nuts are removed from the shell. The machine was fabricated using materials that were sourced locally. It can be used for both domestic and industrial purposes. The advantage to be derived from the use of this machine far outweighs its shortcomings. The test result showed that the machine can shell a total of 400kg of groundnut in an hour. Designed and fabricated the machine that has the capacity of shelling 400kg of groundnut per hour with a shelling and separating efficiencies of 95.25% and 91.67% respectively. The machine was fabricated from locally sourced materials, which makes it cheap and easily affordable and also easy and cheaper to maintain. It is also of light weight and comprises of the hopper, crushing chamber, separation chamber and the blower unit. The fresher and small farmer or business man can start business by investing less capital. Groundnut decorticator consists of feed hopper with a flow rate control device, shelling unit, separating unit and power system.

From our project using 1Hp electric motor and its has been operated by alternating current (Ac). To remove pods and shell.

TEJAS TANDALE, ARJUN VISHWAKARMA (2005) reported that **DESIGN AND FABRICATION OF GROUNDNUT DECORTICATOR**

"Groundnut is the 6th most vital oilseed trim on the planet. It contains 48-50 for every oil and 26-28 for each protein, and is a rich wellspring of dietary filaments, minerals and vitamins. It develops best on soils that are very much depleted, freely finished and well provided with calcium, potassium and phosphorous. More than 100 nations overall develop groundnut. Creating nations constitute 97 for every of the worldwide territory and 94 for each of the worldwide creation of this yield. The creation of groundnut is packed in Asia and Africa (56 for each and 40 for every of the worldwide zone and 68 for every and 25 for each of the worldwide generation, individually) Shelling is the expulsion of grains from their stalk, unit or whelp, either by stripping, affect activity and rubbing or any mix of these techniques. The most well known strategy for shelling which is still generally utilized as a part of the northern piece of Nigeria is the technique for pounding or squeezing the units between the thumb and the finger to sever the cases and discharge the seed.

KULBHUSHAN M. SHEJOLE, NITIN B. BORKAR, AND ABHIJIT M (2001) reported that **PEDAL OPERATED GROUNDNUT DECORTICATOR MACHINE**

"This paper deals with the pedal operated groundnut decorticator machine is better option to use farmer instead of hand operated. The machine is pedal operated so that there is no energy consumption which wills helps to reduce the cost of productions. This machine also saves time and manpower. If we go on continuous work we got a higher output in very short time. The operating procedure of this system is very simple, so there is no skill labour required to operate a machine. this produces an average mass of 3.43Kg of peeled roasted groundnut seeds, 0.462Kg of unpeeled groundnut seeds, 0.399Kg of partially peeled groundnut seed and 0.07Kg of broken groundnut seed. An average time of 488.8seconds and an average peeling efficiency of 78.46% was recorded. It was observed that the higher the mass of the roasted groundnut seeds the longer the time of peeling. The machine is cheap because the parts are locally fabricated. The technology could

provide employment and at the same time make available quality roasted groundnut seeds at low cost for domestic and commercial use in Nigeria.

DARSHAN GOWDA C P (2001) reported that **AUTOMATIC GROUNDNUT DECORTICATOR**

"Groundnut is the sixth most important oilseed crop in the world. Groundnut is a valuable source of edible oil (43-55%) and protein (25-28%) for human beings, and fodder for livestock. The major problem in groundnut production in country like India is the lack of groundnut processing machines available to farmers. In the beginning the peanuts were separated from its shells by the workers. The output from this method was very less and could not satisfy the market demand as it was very time consuming process. Numbers of groundnut Sheller machines are available in the market but they are large in size, costly and not suitable for domestic applications, they are best suitable for industrial applications where mass production is required. Hence it is essential to design and fabricate a portable groundnut decorticator machine for domestic application. In this project the process of designing the different parts of this shelling and separating machine considering all forces and ergonomic factor for people to use. The particular design of this project reduces all the causes and improves the efficiency. It consists of the hopper, crushing chamber, separation chamber, blower unit and the frame for support. The crushing chamber and blower unit is powered by electrically which save the time. The Output is about 20-25 kg/hour. The machine is also light weight, easy to operate and maintain.

From our project using 1Hp electric motor and its has been operated by alternating current (Ac). To remove pods and shell.

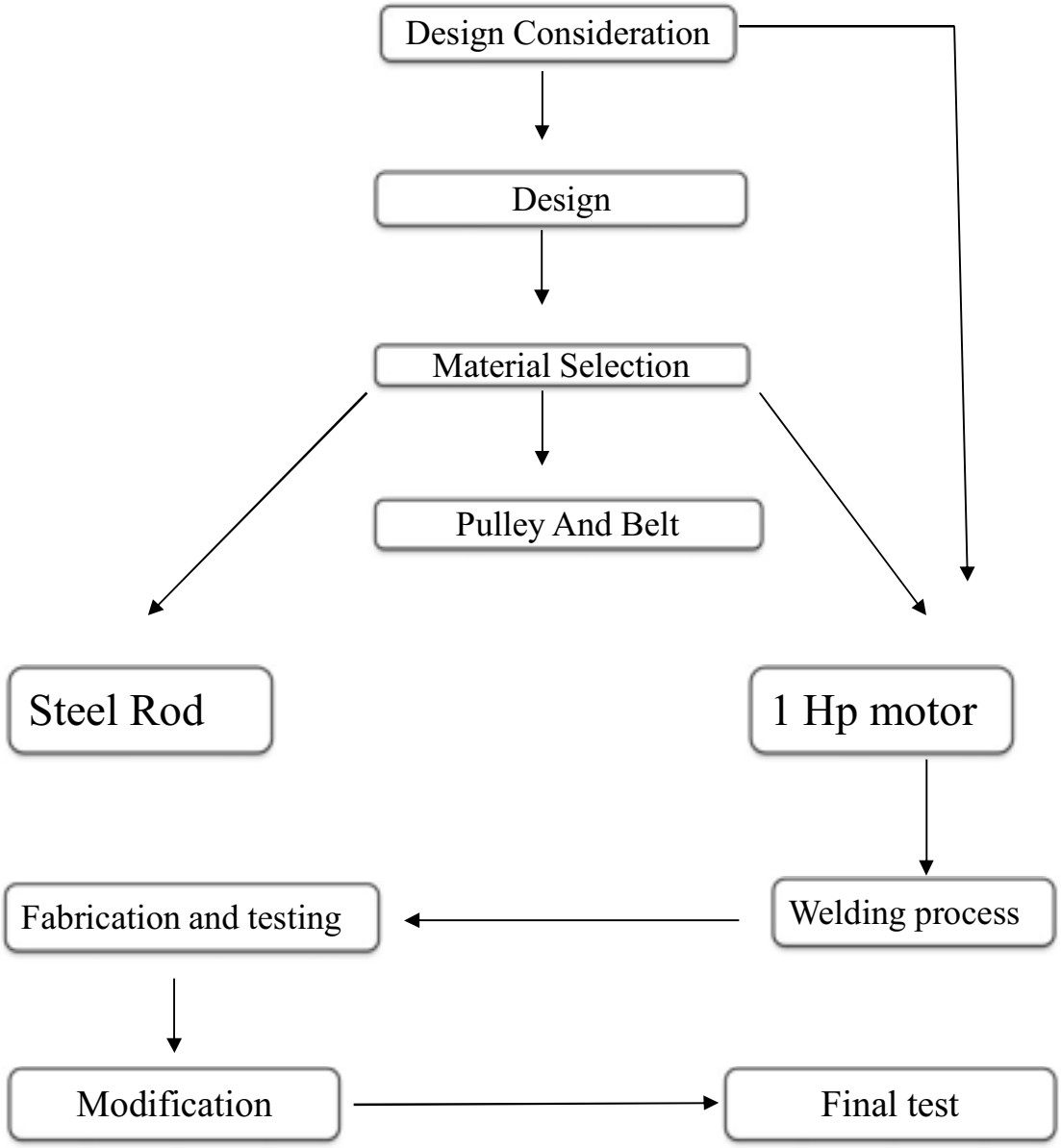
ROSHAN P GHODKHANDE, NILESH D DHOTE, (2000) reported that **DESIGN AND MODIFICATION OF GROUNDNUT DECORTICATOR**

"Decortications of groundnut is a tedious and time consuming process. Commercial available hand operated decorticators require more energy with less output. An attempt was made to develop and evaluate pedal operated groundnut decorticator. The study revealed that, the pedal operated decorticator gave an output of 25-30 kg/hr which was more than hand operated decorticator hand shelling. The difference in unit cost of operation for the unit was appreciably less than that of hand operated decorticator. By considering less fatigue to the operator and higher output, the pedal operated decorticator could be advantageously used for decortications of groundnut. Decortications of groundnut in which the pods is pressed between the thumb and first finger. This process is a "traditional methods". This method is mostly used in rural areas. This method is very tiresome. It has been observed that the efficiency and productivity with hand operated groundnut decorticator and the traditional method is less. Due to this tiresome working operation, Commercial available hand operated decorticators require more energy with less output. By considering this pedal operated groundnut decorticator is beneficial for decortications of groundnut pods.

CHAPTER 3

METHODOLOGY

3.1. FLOWCHART



CHAPTER 4

DESIGN ANALYSIS AND CALCULATIONS

4.1. DETERMINATION OF POWER REQUIRED TO BREAK THE GROUNDNUT PODS

Considering a single spike, the torque required to drive the system may be obtained from the following expression:

$T = n_a \times n_s \times F \times r$ (1)

Where,

n_a = number of active anchor at a time = 5

n_s = number of spike per anchor = 7

F = force per spike required to break the groundnut pod.

r = distance from the axis of rotation to the point of action of the force = 0.11m.

The average force required to break the groundnut pod is 2N. From equation (1), we get

T = 5 x 7 x 2x 0.11=7.7Nm

The power required in breaking the pods in the shelling chamber may be obtained from

$P = T \times \omega_2 = T \times \left[\frac{\pi \times N2}{30}\right]$ (2)

Where,

N_2= speed of rotation of the driven shaft = 240rpm

From equation (2), we get

$P = 7.7 \times \left[\frac{\pi \times 240}{30}\right]$

=193.32 W

4.2. DETERMINATION OF SPIKE DIAMETER

The loading on each spike is taken to be that of a concentrated intermediate load on a cantilever. Hence the deflection on it is

$$y = \frac{F \times a4}{8 \times E \times I}(a - 3 \times l) = \frac{64 \times F \times a4}{8 \times E \times л \times d4}(a - 3 \times l) \quad (3)$$

From equation (3), we get

$$d = \sqrt[4]{\frac{8 \times F \times a4}{E \times л \times y}(a - 3 \times l)} \quad (4)$$

Where,

d= spike diameter

y= deflection =-5×10^{-10} m

e= modulus of elasticity = 200×10^9 N/m^2

a= radius of the spike = 0.01

l = length of the spike = 0.02m

$$d = \sqrt[4]{\frac{8 \times 2 \times 0.01}{200 \times 109 \times л(-5 \times 10-10)}(0.01 - 3 \times 0.02)} = 2.99\text{m}$$

A diameter of 4mm was selected for use.

4.3. DETERMINATION OF PULLEY DIAMETERS

The diameters of the pulleys may be determined from the relation

$N1\ D_1 = N_2\ D_2$

$$\rightarrow \frac{N1}{N2} = \frac{D2}{D1} \quad (5)$$

Where,

N1 = speed of driving pulley = 1440rpm

N2 = speed of driven pulley

D1 = diameter of driving pulley = 0.04m

D2 = diameter of driven pulley

From equation (5), we get

$$D_2 = \frac{N1D1}{N2}$$

$$= \frac{1440 \times 0.04}{240} = 0.24\text{m}$$

4.4. DETERMINATION OF TENSION IN THE BELT

For a v-belt, the relationship between tension T1 and T2 in given by

$$2.3 \log \left[\frac{T1}{T2}\right] = \mu\theta\, cosec\, \beta \quad (6)$$

Where,

μ =coefficient of fiction between the belt and side of groove = 0.25

θ = angle of contact on the smaller pulley = 2.75rad

β = half angle of groove = 75

T_1 = tension on the tight side

T_2 = tension on the slack side

From equation (6), we get

$$\frac{T1}{T2} = \log^{-1}\left[\frac{\mu\theta \, cosec\, \beta}{2.3}\right] = \log^{-1}\left[\frac{0.25\times 2.75\times cosec\ 17.5}{2.3}\right]$$

$$\frac{T1}{T2} = 9.86 = T_1 = 9.86\ T_2 \quad (7)$$

Torque transmitted is given by

$$T = (T_1 - T_2) \times R_1 \quad (8)$$

Where,

T = torque transmitted

R = radius of pulley = 0.12m

From equation (8), we get

$$\frac{T}{R1} = 8.86\ T_2 = T_2 = \frac{T}{R1 \times 8.86} = \frac{7.7}{0.12 \times 8.86} = 7.24 \quad (9)$$

Substituting equation (9) into equation (7), we get

$T_1 = 9.86\ T_2 = 9.86 \times 7.24$

$T_1 = 71.39$ N (10)

4.5. DETERMINATION OF BENDING MOMENTS ACTING ON THE SHAFT

The forces acting on the shaft include: the weight of the crushing drum = 20N, the weight of the pulley attached to the shaft which drives the crushing drum, the resultant force effect of the belt tensions and the reactions at the bearings support. Fig. 1 shows the belt drive assembly.

$$F_V = T_1 \times \sin 8 \times \sin 29 + W_P = 17.45 \text{ N} \quad (11)$$

$$F_H = T_1 \times \cos 8 \times T_2 \times \cos 29 = 77.03 \text{ N} \quad (12)$$

Where,

F_V = vertical load effect of the belt drive assembly

F_H = horizontal load effect of the belt drive assembly

W_P = weight of the crusher pulley = 4N

Summing forces in the vertical direction gives

$$R_{AV} + R_{CV} = 20 + 17.45 = 37.45 \text{ N} \quad (13)$$

Taking moment about

$$R_{CV} \times 0.28 = 17.45 \times 0.34 + 20 \times 0.14$$

$$R_{CV} = 31.19 \text{ N}$$

From equation (13), we get

$$R_{AV} = 37.45 - R_{CV}$$

$$R_{AV} = 37.45 - 31.19 = 6.26 \text{ N}$$

From

$M_{AV} = 0$ Nm

$M_{BV} = 6.26 \times 0.14 = 0.88$ Nm

$M_{CV} = 6.26 \times 0.28 - 20 \times 0.14 = -1.15$ Nm

$M_{DV} = 6.26 \times 0.34 - 20 \times 0.20 + 31.19 \times 0.06 = 0$ Nm

Summing forces in the horizontal direction gives

$$R_{AH} + R_{CH} = 77.03 \text{ N} \quad (14)$$

Taking moment about

$R_{CH} \times 0.28 = 77.03 \times 0.34 = R_{CH} = 93.54$ N

From equation (14),

$R_{AH} = 77.03 \text{ N} - R_{CH}$

$R_{AH} = 77.03 \text{ N} - 93.54 = -16.51$ N

From

$M_{AH} = 0$ Nm

$M_{BH} = -16.26 \times 0.14 = -2.31$ Nm

$M_{CH} = -16.26 \times 0.28 = -4.65$ Nm

$M_{DH} = -16.26 \times 0.34 - 20 + 93.54 \times 0.06 = 0$ Nm

Resultant bending moment at A

$M_A = \sqrt{(MAV)2 + (MAH)2} = 0\text{Nm}$ (15)

Resultant bending moment at B

$M_B = \sqrt{(MBV)2 + (MBH)2} = 2.47\text{Nm}$ (16)

Resultant bending moment at C

$M_C = \sqrt{(MCV)2 + (MCH)2} = 4.74\text{Nm}$ (17)

Resultant bending moment at D

$M_D = \sqrt{(MDV)2 + (MDH)2} = 0\text{Nm}$ (18)

From equation (17), the maximum bending moment occurs at C with a value of 4.74Nm

4.6. DETERMINATION OF SHAFT DIAMETER

For a solid shaft having little or no axial loading, the shaft diameter may be determined from the following ASME code equation

$$D^3 = \frac{16}{\pi \tau Max} \sqrt{(kb\ Mb)2 + (kt\ Mt)2} \quad (19)$$

Where,

D = Shaft diameter

τ_{Max} = Permissible shear stress

M_b = Maximum value of bending moment

Mt = Maximum value of twisting moment

Kb= Combined shock and fatigue factor applied to bending moment

Kt= Combined shock and fatigue factor applied to twisting moment

The maximum permissible shear stress may be taken as42 MPa for shafts with allowance for keyways. For suddenly applied load, and. From equation (19), we get Kb= 0 .2 Kt=1.5

$$D = \sqrt[3]{\frac{16}{\pi \times 42 \times 10} 6\sqrt{(2.0 \times 4.74)2 + (1.5 \times 7.7)2}}$$

D = 12.19mm

A standard size of 25mm was selected.

4.7. DETERMINATION OF POWER TO DRIVE THE FAN

The power required to drive the fan may be obtained from the following expression

$$P_F = \frac{Q \times Ps}{\eta} \quad (20)$$

Where,

F_P = power required to drive the fan

Q = fan flow rate = 0.11m3/s

P_S = static pressure of fan = 336N/m2

η= static efficiency of fan = 75%

From equation (20), we get

$$P_F = \frac{Q \times Ps}{\eta}$$

$$P_F = \frac{0.11 \times 336}{0.75}$$

P_F = 49.28 W

The total power required by the machine = 193.52+49.28 = 242.8W, a 1hp electric motor was selected.

4.8. DESIGN CALCULATIONS

According to he motor specifications: voltage: 220-260 volts Current amp): 2 amps RPM: 1400 Capacity: 1 HP

Power:

P = VI

P = 240 X2
P = 480 Watt

We know that P = 2лNT/60

T = P X60 /2πN
T_{SHAFT} = 480X60/2л1400

T = 3.27 N-m

Energy consumption

E IN KWH = P X TIME
= 480 X 24
= 11520 W-hour/ day
= 11.52 kw- hour/day

For month,

= 11.52x 30 kw-hour/months

= 345.6 kw-hour/month

1-unit cost is 8.5 rupees

= 345.6 x 8.5 = 2937.6 /- per month.

Shaft calculations:

We have diameter of hollow shaft as follows

Outer diameter= 40mm

Inner diameter = 38mm

The shaft experienced with two moments bending moment as well as twisting moment.

$T/J = \tau/R$

We know that T = 3.27 N-m= 3270 N-mm

$J = л/32 ((D0)^4-(DI)^4)$

$= л/32 ((40)^4- (38)^4) = 46619.7$ mm4

$=3270/46619.7 = \tau/20$

$\tau_{shaft} = 3270x20/46619.7 = 1.4$ N/mm2

Bending stress = $M/I = \sigma/Y$

Bending stress due to self-weight = 5kg

Weight = 5x9.81 = 49.1 N

Stress (σ) = P/A

$\sigma = 49.1/ (л/4) ((40)^2-(38)^2)$

$\sigma = 0.4$ N/mm2

For circular shaft: $I= л/64 ((D0)^4-(DI)^4)$

$$I = \pi/64 ((40)^4-(38)^4) = 23309.83 \text{ mm4}$$

Bending moment (M) = (σ X I)/Y

$$M = (0.4X\ 23309.83)/20 = 466.197 \text{ N-mm}$$

Shaft subjected to combined torsion and bending:

$$\tau_{max} = (16 \times d_0 / \pi((d_0)^4 - (d_i)^4)) (M)^2 + (T)^2$$

$$= (16X40X3303.1)/\pi ((40)4-(38)4)$$

$$\tau_{max} = 1.41 \text{N/mm2}$$

$$\sigma_{max} = (16 \times d_0 / \pi ((d0)^4 - (di)^4)) (M+ (M)^2 + (T)^2)$$

$$= 16X40\ X\ (3769.3)/ \pi ((40)^4-(38)^4)$$

$$\sigma_{max} = 1.62 \text{ N/mm2}$$

4.9. DESIGN OF THE EQUIPMENT

4.9.1. DESIGN OF FRAME

We considered the frame of height of 3m and we kept shield around it so that the groundnut pods which move in random direction does not go out. The complete design can be viewed in fig 4.9.1.1

Fig 4.9.1.1. Design of Frame

4.9.2. DESIGN OF ROLLER AND SHAFT

We designed a rotor with the help of hollow shaft of diameter 4 cm and length of 48 cm. We also kept flat mild steel plate on four sides of the hollow shaft. The flat plat which we considered is of length 30 cm and thickness of 5mm. Curved plates is welded on the flat plates with the help of arc welding. This rotor helps to break the ground nut pods. Due to shear force between rotor and ground nut pods the shell of the pods breaks. The figure 2 shows the design of shaft and figure 3 shows the rotor complete design.

Fig 4.9.2.2. Roller

Fig 4.9.2.3.Shaft

4.9.3. DESIGN OF COMPLETE EQUIPMENT

The complete equipment is shown in the figure 4. We assembled the rotor and cycle rim and a slope which can be seen in the figure. The slope is of at an inclination of 45 degrees.

Fig 4.9.3. Complete Design

CHAPTER 5

COMPONENTS AND SPECIFICATIONS

- Frame
- Electric motor
- Roller
- V-Belt
- Pulley
- Hopper
- Fan
- Semicircular Net
- Input shaft
- Fork
- Output shaft

5.1. FRAME

The frame is used to support all the components. Material of frame is cast iron and height up to 1m.

Fig 5.1. Frame

5.2 ELECTRIC MOTOR

The motor is a solitary stage air conditioning commutators motor, 1hp power implying that the speed is endlessly 1440 rpm. The motor is mounted on the base plate and is associated with the information shaft by methods for a v belt.

Output = 230 volt

Current =7amps

Power =0.74kw/1 HP

Fig.5.2. Motor

5.3 ROLLER

Roller is made up of hollow cylinder of 1ft dia. and 1ft length with the rods welded on its periphery. The material of roller is cast iron.

Fig.5.3 Roller

5.4 V-BELT

V-Belt is used to transmit rotary motion of shaft of motor to the shaft of roller. Material of the belt is rubber or polymer for strength and reinforcement.

Fig .5.4. Belt

5.5 PULLEY

Pulley is used to transmit the torque of motor to the roller. One pulley is directly mounted over the motor shaft and another pulley mounted on the shaft of roller. And both the pulleys are connected with the help of V-belt. Pulley Dia. =75mm.

Fig .5.5. Pulley

5.6. HOPPER

Hopper contains groundnuts before and during shelling process. It is use to continuous supply of the groundnut to the crushing unit.

Fig 5.6. Hopper

5.7 FAN

Fan is mounted on the shaft of the motor just in front of pulley at some distance. This fan separates the shell and the peanuts.

5.8. INPUT SHAFT

The info shaft is held in metal ball upheld in the focal bearing piece. The info shaft conveys decrease pulley at one end while the info wrench at the flip side. The information wrench is settled on the info shaft and conveys the fork at the flip side.

Fig.5.8. Input Shaft

5.9. SEMICIRCULAR NET

This semicircular net is fitted beside the roller at very small distance so that shell of groundnut should be easily cracked and peanuts remain uncracked.

5.10. FORK

The fork is associated with the information wrench toward one side where as it is associated with the output shaft at the flip side by means of fork stick.

5.11. OUTPUT SHAFT

The output shaft is a vertical part which is upheld in two brambles bearing an either closes that are held in appropriate bearing squares. The game plan changes over clockwise turn of output shaft. This course of action changes over clockwise turn of yield when information shaft. This game plan changes over clockwise pivot of yield when info shaft turns frame 0 to 180 degrees, yet amid this operation or movement transformation the yield likewise moves in the pivotal bearing, Which needs to be compelled, which should be obliged, subsequently a spring is fused in the set up.

5.12. TRANSMISSION

The mechanical power delivered by prime mover we used to drive different machines in the workshop and plants. A transmission framework is the system, which manages transmission of the power and movement from prime mover to shaft or, then again from one shaft to the next. The machine apparatus drive is a total of component that transmits movement from an outside source. To the agent components of the machine device the outside wellspring of vitality is for the most part a three stage A.C. engine, which has a rotating movement at its yield shaft. The revolving movement of the engine is transmitted to the agent component to give an agent working or assistant movement. At the point when the required movement is revolving; the transmission happens through instruments that exchange Rotating movement starting with one shaft then onto the next. Transmission of the movement from the outside source to the agent component can occur through Mechanical components, for example, belts, Riggings, chains and so on.

5.11. MECHANICAL TRANSMISSION AND ITS COMPONENTS

5.12.1. Belt Transmission

5.12.2. Gear transmission

5.13.3. Chain Transmission

5.12.1. BELT TRANSMISSION

Belt drive is a standout amongst the most widely recognized viable gadgets transmitting movement and power from one shaft to the next by methods for thin inextensible belt over running over to pulleys. This to a great extent utilized for broadly useful on plants and production lines particularly when the separation between the Poles is not exceptionally awesome. At the point when the inside separation between the two shafts is extensive than the tight side of the belt ought to be the lower one the pulley called driver is mounted on the driving shaft while the pole while the other, which is mounted on the pole to which power is to be transmitted is known as the determined pulley or devotee. At the point when the belt moves over the pulleys there is dependably the plausibility of slipping between the belt and pulley and hens the character of the movement transmitted is not positive when positive activity is required. Riggings and chain must be utilized.

5.12.2. GEAR TRANSMISSION

Proficiency of energy transmission in belt and rope drives is less. The power might be transmitted from one shaft another by methods for mating gears with high transmission Effectiveness and a rigging drive is additionally give when the amongst driver and devotee is little.

5.12.3. CHAIN TRANSMISSION

Chains are utilized for high transmission number. They are for the most part utilized when separation between focus is short yet the middle separation is as much as 8m. They are currently for the most part utilized for transmission of energy in cycle, engine vehicle, and farming hardware in workshops. It is general necessity for any machines that they ought to arrangement for managing velocity of travel. The direction might be accessible in discrete strides or it might be steeples i.e. ceaseless. The

configurations are known as ventured drives Ex. Machine, processing machine, printing machine and so forth.

5.13. FUTURE EXTENSION

The agribusiness is the fundamental calling of immense of populace around the world .A few changes should be possible in this machine also. It will be utilized over long scale. This machine gives better help to ranchers with the goal that they can get appropriate salary of their harvest. The degree in rural field is gigantic. It will be a limitless segment to deal with to limit man control and enhance effectiveness of operation, reduction cost of operation, lessening endeavors. The world is developing so quickly and all need sound sustenance for solid life. This sustenance originates from agribusiness. So the yield dealing with strategies ought to be effective to keep it sound. The new developments in farming field won't just offer assistance agriculturist additionally advantageous to satisfy request by not bringing on value climb.

5.14. WORKING PRINCIPLE

By utilizing electrical motor, the pivoting minute exchanged with the assistance of belt to the rotor shaft and fan shaft. The progression pulley is kept up on the electrical motor shaft. At the point when rotor turning the groundnut falls in the container and afterward groundnut squeezed between the rotor and flame broil. Around then groundnut seed and case isolated. The groundnut case and groundnut seeds fall in the plate. Because of high fan speed the high speed of air is made by utilizing this high speed air the light weight unit is tossed out from the machine and the groundnut seed falls in the plate because of this weight. We gather the seeds in the pot of pack.

CHAPTER 6

ADVANDAGES

- To reduce time consumption
- To reduce the cost of machine
- To speed up the process
- Maintenance cost very low.
- Easy to handle the farmer.
- The machine should not have high weight. It should be easily move anywhere.

CHAPTER 7

RESULTS AND DISCUSSIONS

The various parts of the machine were assembled, after which the electric motor was mounted, the machine was then test run without groundnut poured into the hopper. This was done to study the behaviour of the machine. Fig. 4 shows the electrically powered groundnut shelling and separating machine. Test was then carried out to evaluate the performance of machine based on its shelling efficiency, the time taken to shell a known weight of groundnut pods and the capacity of the machine. The shelling efficiency was assessed by taking four separate experimental samples of 100 groundnut seed poured into the hopper while the machine was running. After each group was passed through the machine, the output was analyzed by physically counting the shelled, unshelled, partially shelled, broken or shattered groundnut. The sum of the shelled and shattered groundnuts makes up the shelling efficiency.

TABLE 1 Test results for shelling efficiency

Test	Separating and Deshelling (Numbers)	Un Separating and Deshelling (Numbers)	Partially (Numbers)	Shattered (Numbers)	% Separating and Deshelling
1	30	5	13	17	47
2	35	5	7	18	54
3	30	8	6	16	50
4	36	3	5	16	60

The shelling efficiency of the machine was calculated as follows

Average number of groundnut shelled $= \frac{30+35+30+36}{4} = 33$

Average number of groundnut shattered $= \frac{17+18+16+16}{4} = 17$

Therefore, shelling efficiency of the machine $= (\frac{33}{100}+\frac{17}{100}) \times 100 = 50\%$

The separation efficiency was determined by shelling two sets of groundnut and re-weighing after shelling. Table 2 shows the test results for the separation efficiencies.

TABLE 2 Test results for separation efficiency

Test	Initial weight(kg)	Final weight(kg)	Final weight(kg)	Separating efficiency (%)
1	0.6	0.52	0.08	$\frac{0.52}{0.6} \times 100 = 86.67$
2	0.6	0.58	0.02	$\frac{0.58}{0.6} \times 100 = 96.67$

Therefore, separation efficiency $= \frac{86.67+96.67}{2} = 91.67\%$

During the test, to determine the capacity of the machine, it was observed that it took 54 seconds to shell 6kg of groundnut. It then means that in one minute, one can shell o total of 6.7kg of groundnut and in 1 hour, a total of 400kg of groundnut can be shelled. It was also observed that groundnut with one seed per pod were the ones that came out unshelled or partially shelled. Others that also came out unshelled or partially shelled were the ones that had two small seeds in their pods

CHAPTER 8

CONCLUSION

1. This work presents the design of an electrically powered groundnut pods stripper and shelling machine.
2. It can be used for both domestic and industrial purposes.
3. The advantage to be derived from the use of this machine far outweighs its shortcomings.
4. It was also observed that groundnut with one seed per pod and those with two small seeds in their pods were the ones that came out unshelled or partially shelled.

COST ESTIMATION

Steel Rod	Rs 500
1HP motor	Rs 1500
Belt and pulley	Rs 500
Hopper	Rs 800
Welding cost	Rs 500
Roller	Rs 900
Bearing	Rs 300
Total	Rs 5000

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REFERENCES

1. Pande, S., et al. "Disease management factors influencing yield and quality of sorghum and groundnut crop residues." *Field Crops Research* 84.1-2 (2003): 89-103.

2.Wijnands, J. H. M., Jaap Biersteker, and E. N. Van Loo. *Oilseeds business opportunities in Ethiopia 2009*. PPP, 2009.

3.Geleta, Tarekegn, et al. "Integrated management of groundnut root rot using seed quality." *International Journal of Pest Management* 4 (2007): 53-57.

4.Kebede Desta, 1997. Attaining small holder household food security through promotion of mechanization technology: The experience of ministry of Agriculture. Proceed of the first conference of the ESAE, 1(1): 62-73.

5.Design and Fabrication of Groundnut Shelling and Separating Machine by Ikechukwu Celestine Ugwuoke, Olawale James Okegbile ,Ibukun Blessing Ikechukwu.

6.Nathan Trujillo. Lowrider Bicycle Magazine. laced up a pair of 144-spoke Phoenix wheels.

7.Hughes, Thomas Parke. Networks of power: electrification in Western society, 1880-1930. JHU Press, 1993.

8.Mangave, Santosh, and Bhagyesh Deshmukh. "Design of Portable Groundnut Sheller Machine." Department of mechanical engineering, WIT, Solapur. International Journal of Mechanical Engineering and Information Technology 3: 1125-1129.

9. Ashok. S. Andhale, Sayed Wajahat, Pranav Lawhale, Kunal Mendhe. "Design and Development of Groundnut Pod Separating Machine".

10.Design and Fabrication of Pedal Operated Groundnut Decorticator Machine" Kulbhushan M. Shejole, Nitin B. Borkar, Abhijit M. Bobade.

11.Raghtate, Ashish S., and Dr CC Handa. "Design and fabrication of groundnut sheller machine." IJIRST–International Journal for Innovative Research in Science & Technology 1.7 (2014).

12.Walke, Tushar, et al. "Design & Fabrication of Groundnut Sheller Machine." International Journal of Engineering Science 5997 (2017).

13.Ugwuoke, Ikechukwu Celestine, Olawale James Okegbile, and Ibukun Blessing Ikechukwu. "Design and Fabrication of Groundnut Shelling and Separating Machine." Department of Mechanical Engineering, Federal University of Technology Minna, Niger State, Nigeria. International Journal of Engineering Science Invention ISSN (Online) (2014): 2319-6734.

14.Design and Fabrication of Groundnut Pod Separating Machine Deshmukh Shubham, GiramkarHarshawardhan, Kadam Bharat, JedheShubham,Adhapure D.U.

15.Design And Fabrication Of Groundnut Decorticator Arjun Vishwakarma, TejasTandale, Prof R.H.kekan

16.Gitau, A. N., et al. "Optimizing the Performance of a manually operated groundnut (Arachishypogaea) decorticator." Open Journal of Optimization 2.01 (2013): 26.

17.Mungase, Pratima G., et al. "Peanut Sheller using Screw Conveyor." (2016).

EFFECTS OF DIFFERENT TREATMENTS IN FLOWER CROPS

A PROJECT REPORT

Submitted by

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ABSTRACT

In this project we are using three flower crops such as Ixora coccinea, chrysanthemum and crossandra under polyhouse cultivation. The temperature, relative humidity and ventilation of air are controlled by the equipments fixed in the polyhouse. Crops grown in the polyhouse are protected from intense heat, bright sunlight, strong winds, hailstones and cold waves. They are grown in two different mediums such as vermiculite and perlite. It is grown by using different treatments like hydrogen peroxide, growth hormone compared with normal growth of the flowers. The effect of the solutions and the mediums are observed. The root elongation and the shoot development of the flowers enhance the development of the flower. Various mediums help the flower growth in the developing periods and the blooming of the flowers is collected. Gibberellin is used as growth hormone that regulates the stem elongation, flower development.

KEY WORDS: Gibberllic acid, hydrogen peroxide, vermiculite, perlite.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

With globalization of markets, shrinking land and climate change, the protected cultivation of high value crops has emerged as the single most important technology for ensuring high productivity, improved quality and profitable returns. A technique wherein the microclimate around the plant is controlled fully, partially or modified to protect the crop from adverse weather protected cultivation ensures conservation of soil moisture and efficient use of energy mainly solar. The need for protected cultivation are higher yield, better quality, off-season production, controlled pollination, easier plant protection, weed free cultivation and year round cultivation.

1.2 FLOWER CROPS

The flower crops are chrysanthemum, crossandra and ixora coccinea. They are grown in different mediums.

1.2.1 CRYSANTHEMUM

The chrysanthemum is important ornamental crop mainly grown for the production of cut flowers, loose flowers and pot plants. The plant belongs to family Asteraceae and is popularly known as "Queen of the East". The utility and popularity of chrysanthemum have increased recently with the introduction of new cultivation technique "year round production of chyrsanthemums" based on scientific work conducted in the field of plant physiology photoperiodism and genetics.

1.2.2 CROSSANDRA

It is one of the famous and an important commercial flower crop cultivated throughout India. This flower is also called as "fire cracker flower". This flower is popularly known as "kanakambaram" in south India. The flower is also grown in countries like tropically areas of Africa and Madagascar. This flower becomes popular in India due to its bright attractive color and light weight. These flowers are used for woman hair adornment and making garments. Normally women mix these flowers with jasmine flowers and use them as hair adornment. Crossandra belongs to Acanthaceae.

1.2.3 IXORA COCCINEA

Ixora is said to be native to Asia and whose name derives from an Indian deity. There are about 400 species spread from Africa to India to Southern Asia. They differ in leaf size, plant height, and flower size and flower color. This plant which blooms throughout the year is easy to grow. The flowers are found in a wide range of colors. Ixora flower has traditionally been associated with enhanced sexuality and the rekindling of passion.

1.3 IMPLIMENTATION

The project is experimented at the polyhouse cultivation in an enclosed environment. The plant growth is carried out in an area in which the temperature and relative humidity are maintained. The flower crops such as ixora coccinea, crossandra and chrysanthemum are grown in two different mediums such as perlite and vermiculite with the application of hydrogen peroxide and growth hormone such as gibberellin are done. The observations of their growth is measured and calculated in different days and their effect is observed by their flowering. The crop growth is maintained under a period of time. The solid medium of which are solid in nature. Planting with soilless potting mix does not include the use of soil. Instead, plants are grown in a variety of organic and inorganic materials. Using these materials rather than soil allows growing healthier plants without the threat of soil-borne diseases. Growing hormones are those chemical signals that coordinate the different parts of an organism. Hormones in plants act I similar ways. They are produced by cells in one area of the plant such as the leaves, stems or root and then transported to a different area of the plant in order to produce a response.

Gibberellins are hormones produced in meristem of stems and roots that help regulate stem elongation. This group of hormones is actually named after a fungus caused some rice plants to unbelievably tall event to the point where rice plants would follower because the stem was too tall for the roots to support. Like that we are using gibberellin for the growth of the flower crops. Hydrogen peroxide is made up of the same atoms that water is made from with the exception of an additionally oxygen atom that extra oxygen gives hydrogen peroxide. It helps encourage healthy root growth because of the extra oxygen molecule. Oxygen can help plant roots observe nutrients from the soil. Therefore this extra bit of oxygen better enables the root to absorb the more nutrients which means faster healthier more vigorous growth. We are estimating the growth difference among various treatments in different flowers. The growth of the three flowers are monitored and observed in different operations and their plant height, number of leaves, stem height, leaf length are analyzed.

FIGURE 1.1 GREENHOUSE

1.4 OBJECTIVES

- To determine the quality of solutions in flower crops by using different treatments.
- To analyze the growth difference using different mediums.
- To evaluate the growth in different applications.

CHAPTER 2

LITERATURE REVIEW

Xu Gizhong, Chen Haijiang, Ma Baokun, Lhang Wencai (2001) *entitled as* **"EFFECT OF EXOGENOUS SPERMIDINE ON FLORAL INDUCTION, ENDOGENOUS POLYAMINE AND HORMONE PRODUCTION, AND EXPRESSION OF RELATED GENES IN 'FUJI' APPLE"** said Flower bud formation in 'Fuji' apple (*Malus domestica Borkh.*) is difficult, which severely constrains commercial production. Spermidine (Spd) plays an important role in floral induction, but the mechanism of its action is incompletely understood. To investigate the effect of Spd on flowering, 6-year-old 'Fuji' apple trees were treated with 1×10^{-5}mol L^{-1} Spd to study the responses of polyamines [putrescine (Put), Spd and spermine (Spm)], hormones [gibberellins (GA_3) and abscisic acid (ABA)], and polyamine hormone and flowering related genes. Spd application promoted flowering during floral induction by increasing *MdGA2ox2* (*gibberellin 2-oxidase*) through GA_3 reduction and increasing *MdNCED1* and *MdNCED3*(*9-cis-epoxycarotenoid dioxygenase*) through ABA enrichment during 60 to 80 days after full bloom. The flowering rate as well as the expressions of flower-related genes, except for *MdLEY* (*LEAFY*), also increased, thereby promoting flowering. In addition, spraying with Spd significantly increased the contents of endogenous polyamines except for Spm in terminal buds by increasing the expressions of polyamine-associated genes. We hypothesize that the contribution of Spd to flowering is related to crosstalk among polyamines, hormone signals and related gene expressions, which suggests that Spd participates in the apple floral induction process.

From this we have taken the concept of using the gibberellin in flower crops in two different mediums in which they increased and promoting flowering and increases the shoot development and increases the flower buds and their production in flowering.

H Emami, M Saeidnia, A Hatamzadeh, D Bakhshi, E Ghorbani (2011) *entitled as* "**THE EFFECT OF GIBBERELLIC ACID AND BENZYLADENINE IN GROWTH AND FLOWERING OF LILY (*Lilium longiflorum)*"** said in order to study growth and flowering characteristics of Lilium longiflorum by using tow growth regulators, gibberellic acid and 6-benzyladenine, an experiment was performed in 2008 by using factorial experiment arranged in a completely randomized design with three replication in research greenhouse, college of agricultural science, University of Guilan. In this experiment, unit bulbs soaked for 24 hours by gibberellic acid and 6-benzyladenine, and then they planted in greenhouse. Results showed that the maximum bud number was relateda to gibberellic acid 150 ppm with benzyladenine 75 ppm. The highest chlorophyll a content was related to gibberellic acid 75 ppm with benzyladenine 75 ppm, gibberellic acid 75 ppm and benzyladenine 75 ppm respectively. In addition, the highest total chlorophyll achieved when we used gibberellic acid 75 ppm with benzyladenine 75 ppm. The highest initial fresh weight was related to gibberellic acid 75 ppm. Gibberellic acid 75 ppm, benzyladenine 150 ppm and benzyladenine 75 ppm showed the maximum anthocyanin content respectively. The maximum vase life was related to gibberellic acid 75 ppm. In order to achieve qualification, longevity of vase life and economic aims, we suggested using gibberellic acid 75 ppm with 6-benzyladenine 75 ppm.

From this we have taken the idea of using gibberellin in a proper ratio of floral bud and root elongation. In another treatment we are using the hydrogen peroxide for the strong root growth. The longevity of vase life and the bud number is getting increased.

Brintha Karunarathna and Kumuthini D Harris (2016) *entitled as* "**EFFECT OF COCONUT WATER ON THE CUTTING ESTABLISHMENT OF IXORA (IXORA COCCINEA L.)**" said an experiment was carried out to study the effect of coconut water on cutting establishment of Ixora (Ixora coccinea) at the shade house of Crop Farm, Eastern University, Sri Lanka during the period February 2016 to May. The experimental was laid out in Complete Randomized Design (CRD) replicated thirty times.

The treatments were: coconut water treatment (T1) and without coconut water treatment (control T0). The poly bags were filled with top soil: red soil: cow dung at the ratio of 1:1:1 and leaving 1 inch at the top for watering. The uniform cuttings were selected.The cuttings were taken in the early morning and the cutting ends were kept in water prior to planting to keep the

cuttings turgid. Then the cuttings were planted into the prepared poly bags and labeled. Coconut water was collected in a clean bucket in the early morning. Once in five days, 100 ml coconut water was poured into the bags (T1). The results suggest that, length of roots (52 %), the number of roots (63 %) and root initials (70 %) plant height (28 %), number of branches (44 %) and number of leaves (70 %) increased with the application of coconut water to the cuttings. Therefore, under the conditions of this experiment, establishment ability is high when the cutting treated with coconut water. This is one of the cheapest ways to induce number of roots and shoots in Ixora. Roots are used for stomach troubles and dysentery, treatment for bloodshot eyes, sores and ulcers. Ixora is a moderate to root plant species and rooting ability is moderate under natural conditions.

There were significant differences ($P < 0.05$) in the length of the longest root between coconut treated cuttings (T1) and the control (T0) (Table 1). Also, 95% confidence intervals (1.413, 3.521), (1.471, 3.530) and (16.644) confirms that there is the difference between coconut water applied cuttings and the control. The average length of roots in T1 and T0 were 11.09, 8.63 at 30 DAP, 14.75, at 45 DAP and 23.50, at 60 DAP. This might be due to the effect of cytokinins, auxin present in coconut water. Therefore, it is evident that Cytokinins and IBA present in the coconut water stimulated the formation of masses of undifferentiated cells (callus). The callus cells are then induced to form roots as a result of exposing them to certain hormones like auxins (in the coconut water) that produced roots.

This increase in root length also may be due to the effect of growth regulators IBA on the metabolites translocation and carbohydrates metabolism. Rout (2006) observed that IBA produced a higher yield of roots in Camellia sinensis compared to the other auxins. This result is inconsistent with the studies of Okunlola (2016) who reported that rooting hormones applied wood cuttings of Bougainvillea spectabilis had a significant effect on length of roots compared to that of control.

Average length of longest root (cm) at 30, 45 and 60 DAP Average root length (cm) 30 DAP 45 DAP 60 DAP value P value Number of roots and root initials per cutting. The number of roots per cutting is given in Table 2. Coconut treated cuttings had a significant effect on a number of roots per cutting. At 30, 45 and 60 DAP, the higher percentage of roots per cutting

was recorded (77%, 32% and 63% respectively) in those cuttings treated with coconut water than in control.

The concept of using gibberellic acid and hydrogen peroxide using in flower crops and their growth is increased by applying them for a certain period of time. The flowers production will be more in number and their elongation is formed.

Tariq Saeed, Imran Hassan, Nadeem Abbasi (2014) *entitled as*"**EFFECT OF GIBBERELLIC ACID ON THE VASE LIFE AND OXIDATIVE ACTIVITIES IN SENESCING CUT GLADIOLUS FLOWERS**" saidcut flowers face the problem of short display life and lose their aesthetic value rapidly. In order to enhance the vase life of gladiolus, its cut spikes were subjected to different levels of gibberellic acid (GA3), viz., 0, 25, 50, 100 and 200 mg L−1 in vase solution, during two consecutive years 2010 and 2011. The GA3 treatment significantly influenced the vase quality attributes and antioxidants capacity of gladiolus cut flowers. Gibberellic acid at 25 mg L−1 caused the longest time taken to open the floret and increased the floret opening, vase life duration and fresh weight. The highest anti oxidative activities of superoxide dismutase and free radicals scavenging were also recorded with GA3 at 25 mg L−1. The highest peroxidase, catalase activity and the lowest membrane leakage were recorded with GA3 at 50 mg L−1. Present study concludes that GA3 applied at lower concentrations (25 mg L−1) renders greater beneficial effects on vase life quality, membrane stability and antioxidant activities in gladiolus cut spike, and further higher application rates because no improvement in the flower longevity compared with control.

From this we are using gibberllic acid in three types of flowers crops are crossandra, chrysanthemum and ixora coccinea to reduce early senescence instead of using in gladiolus flowers.From this we have taken the idea of using vermiculite and perlite in flower formation and root elongation in the flower crops.

Margit Olle, MahieuNgouajio, Anastasios Siomos (2012)*entitled as***VEGETABLE QUALITY AND PRODUCTIVITY AS INFLUENCED BY GROWING MEDIUM** saidthe aim of the review is to present an overview of the effects of mineral soil, inorganic and organic growing media on the growth, development, yield and quality of vegetables grown under greenhouse conditions. The findings from the literature suggest that the yield of various vegetables tends to be higher for the plants grown in various growing media compared to those grown in the soil. A number of authors have reported that dry matter, sugar, soluble solids, vitamins and carotenoids content in tomatoes; acidity and taste have better marks when grown in soilless culture systems compared to soil. Only very few authors have indicated that soil culture could increase acidity, dry matter, carotenoids and sugar content in tomatoes compared to soilless culture systems. Growth and development of vegetables are enhanced, when plants are grown in inorganic media compared to organic ones. For yield enhancement several authors have recommended growing vegetables in inorganic media (rockwool, sand) rather than organic media. Furthermore, there is a growing body of studies indicating the benefit of mixing organic and inorganic components for vegetable growing media with improved performance in greenhouse production. In most cases, the addition of compost did not change the yields of vegetables grown on organic media. Also it is difficult to draw broad conclusions on the impact of various organic substrates on the chemical composition of vegetables based on the information in the literature. Some inorganic substrates can influence growing medium so that vegetables grow faster, but that may depend on substrate used. As a substrate, zeolite had advantages over perlite, as it increased growth of crisp-head lettuces. As observed with organic media, it is difficult to draw general conclusions on the impact of inorganic media on the chemical composition of vegetables.

From this we are using different mediums like perlite and vermiculite in flower crops for their root and bud formation and their growth in their application.

Guihong Bi, Williams B Evans, Glenn B Fain (2009) *entitled as* **"USE OF PULP MILL ASH AS A SUBSTRATE COMPONENT FOR GREENHOUSE PRODUCTION OF MARIGOLD"** saidPulp mill ash was evaluated as a substrate component in the production of greenhouse-grown French marigold (*Tagetespatula* L. 'Janie Deep Orange'). Peat-based substrates (75:10:15 by volume blend of peatmoss, vermiculite, and perlite) amended with 0% to

50% (by volume) pulp mill ash were compared with a standard commercially available substrate. With the exception of an unfertilized control, each substrate blend contained 5.93 $kg \cdot m^{-3}$ 14N–6.2P–11.6K (3- to 4-month release) and 0.89 $kg \cdot m^{-3}$Micromax. Substrates containing higher volumes of ash had finer particles, less air space, and more waterholding capacity than the commercial substrate. Bulk density increased with increasing ash volume, and substrate containing 50% ash had 120% greater bulk density than the commercial substrate. Substrates containing ash generally had higher pH and electrical conductivity (EC) than the commercial substrate with substrate pH and EC increasing with increasing ash volume. In general, marigold plants grown in peat-based substrates with the addition of 0% to 50% ash had similar growth indices, flower dry weights, numbers of flowers, and SPAD values as plants grown in commercial substrate; however, plants grown in substrates containing 30% to 50% ash had lower shoot dry weights or root quality ratings than plants grown in commercial substrate. Plant growth index, shoot dry weight, and root quality rating decreased with increasing ash volume and availability of elements of the inorganic substrate.

From this we have taken the idea of using the floral bud formation in applying the gibberllic acid and hydrogen peroxide in for their growth and elongation of shoot and root formation.

SL Sukanya, J Sudisha, P Hariprasad, SR Niranjana, HS Prakash, SK Fathima (2009) *entitled as*"**ANTIMICROBIAL ACTIVITY OF LEAF EXTRACTS OF INDIAN MEDICINAL PLANTS AGAINST CLINICAL AND PHYTOPATHOGENIC BACTERIA"** said the ethnobotanical efficacy of Indian medicinal plants; Achyranthes aspera, Artemisia parviflora, Azadirachta indica, Calotropis gigantean, Lawsonia inermis, Mimosa pudica, Ixora coccinea, Parthenium hysterophorus and Chromolaena odorata were examined.

Leaves were extracted using different solvents such as methanol, ethanol, ethyl acetate and chloroform. Among treatments, maximum in vitro inhibition was scored in methanol extracts of C. odorata which offered inhibition zone of 10, 9, 12 and 12 mm against E. coli, S. aureus, X. vesicatoria and R. solanaccearum, respectively, followed by chloroform extract of the same plant leaf with inhibition zone of 8, 4, 4 and 4 mm, respectively. A significant inhibition of E. coli was found in aqueous and in all tested solvent extracts of A. indica. In case of S. aureus, maximum inhibition of 8 mm was obtained in aqueous extracts of A. indica and 6 mm from methanol

extract of L. inermis. The minimum inhibitory concentration (MIC) value for the clinical is confirmed.

The flowers ixora coccinea, chrysanthemum and crossandra in the application of the growth hormones in which the flower crops are grown and the observation is noted.

Rahul Kumar, Ashima Khurana, Arun K. Sharma (2014)*entitled as*"**ROLE OF PLANT HORMONES AND THEIR INTERPLAY IN DEVELOPMENT AND RIPENING OF FLESHY FRUITS"** said plant hormones have been extensively studied for their roles in the regulation of various aspects of plant development. However, in the last decade important new insights have been made into their action during development and ripening, in both dry and fleshy fruits. Emerging evidence suggests that relative functions of plant hormones are not restricted to a particular stage, and a complex network of more than one plant hormone is involved in controlling various aspects of fruit development.

Though some areas are extensively covered, considerable gaps in our knowledge and understanding still exist in the control of hormonal networks and crosstalk between different hormones during fruit expansion, maturation, and various other aspects of ripening. Here, we evaluate the new knowledge on their relative roles during tomato fruit development with a view to understand their mechanism of action in fleshy fruits. For a better understanding, pertinent evidences available on hormonal crosstalk during fruit development in other species are also discussed. We envisage that such detailed knowledge will help design new strategies for effective manipulation of fruit ripening. Fruiting bodies have evolved to facilitate seed maturation and their subsequent dispersal. A diverse range of fruit types from dry to fleshy forms exists across plant species.

Evolutionary studies predict that species that produce dry fruit are the ancestors of species that produce fleshy fruit, and this is the reason for the prevalence of common developmental mechanisms between the two types (Knapp, 2002). In *Arabidopsis*, the model plant with dry fruits, a high-level regulatory network of transcription factors controlling fruit development has been identified.

Similarly, studies on tomato, a model for fleshy fruits, have provided new insights into the networks responsible for the control of ripening (Tomato Genome Consortium, 2012).

Together, strong similarities between dry and fleshy as well as within different fleshy fruits in the molecular circuits governing development and maturation indicate that regulatory networks are conserved across a wide spectrum of angiosperm fruit (Seymour *et al.*, 2013). Though information on interplay between hormones at several levels of these steps remains scarce, nonetheless with the advent of "omics" tools, significant progress has been achieved in characterization of hormone responses (Osorio *et al.*, 2011; Rohrmann *et al.*, 2011). These efforts have led to identification of distinct as well as overlapping patterns in the expression of genes associated with hormone action across plant species.

From this we are using gibberllic acid as plant hormone is applied in flower crops growing under different mediums to estimate the growth difference.

CJ Goh (1979) *entitled as* **"HORMONAL REGULATION OF FLOWERING IN A SYMPODIAL ORCHID HYBRID *DENDROBIUM LOUISAE"*** said the growth habit, axillary bud differentiation and flowering behaviour in a sympodial orchid hybrid, DendrobiumLouisae cv. 'Dark' were studied. Flowering occurred only after termination of vegetative growth in the pseudobulb. Intermediate shoots with both vegetative and reproductive growth were produced when plants were placed in the shade. Decapitation did not stimulate floral initiation. In mature pseudobulbs, Cytokinin (benzyladenine) stimulated flowering. Gibberellic acid enhanced the cytokinin effect but was itself not effective. It is suggested that flowering in this orchid hybrid is regulated by growth substances, both qualitatively and quantitatively.

In this they are using cytokinin and gibberllic acid is applied in orchid hybrid to regulate the hormonal regulation. From this we are taken gibberllic acid is applied in three flower crops to stimulate the flowering and bud initiation.

CHAPTER 3

METHODOLOGY

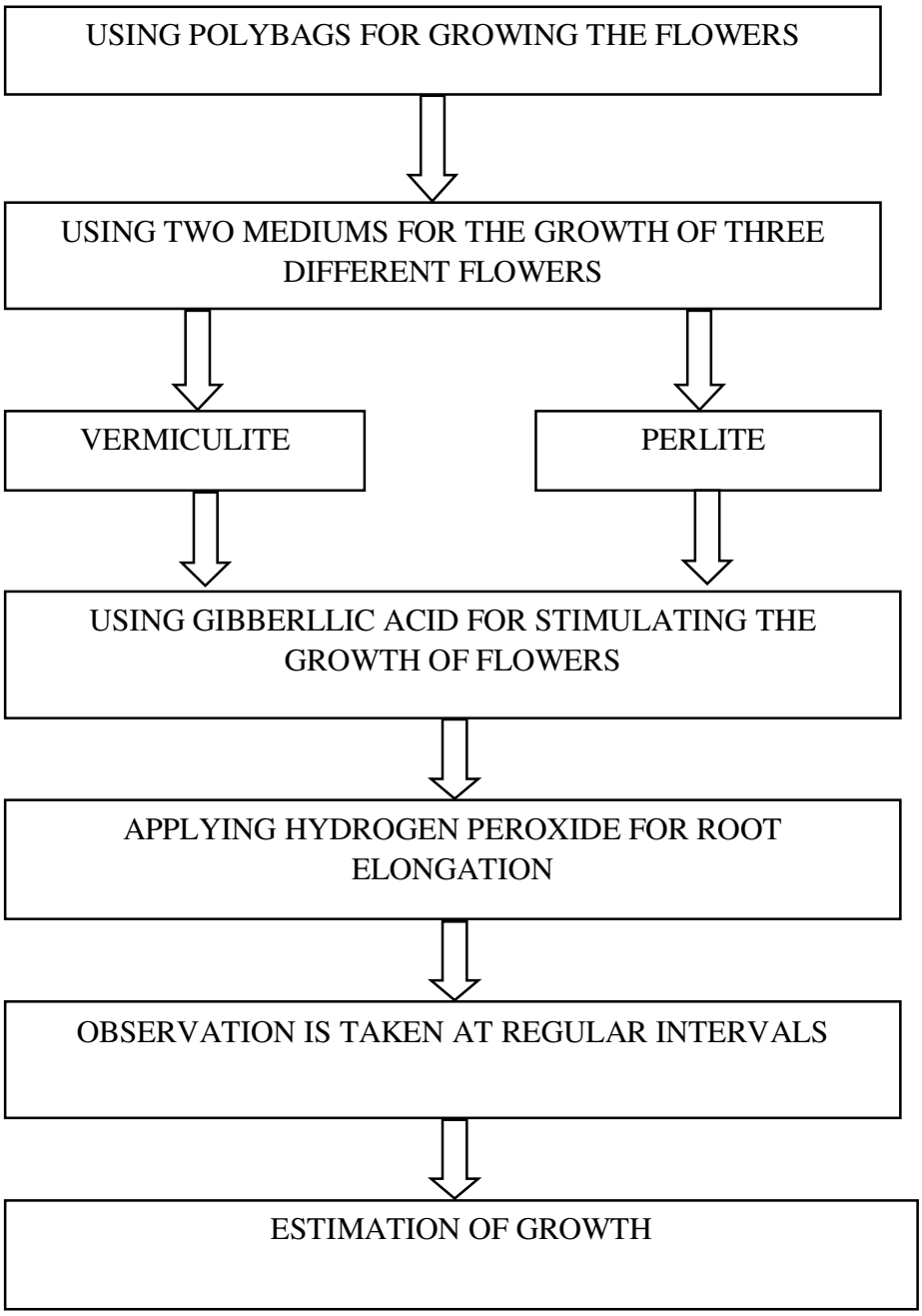


FIGURE 3.1 Methodology of flowchart

3.1 Using polybags for growing the flowers

In this we are using polybags for growing three different flowers such as Crossandra, Chrysanthemum and Ixora coccinea under polyhouse cultivation. The polyhouse enhances the growth of the plants under favorable conditions.

3.2 Using two different mediums for the growth of flowers

We are using two mediums such as vermiculite and perlite applied in three different flowers to estimate the growth difference. Each flower crops is treated with two different mediums to calculate the growth compared with normal growth of flower crops.

3.3 Vermiculite

It is an aluminium-iron-magnesium silicate that resembles mica in appearance. When vermiculite is soaked in water for some hours it enlarges its volumes up to 3 to 4 times in its original volume. It is filled in polybags and growing the seedlings by adding some water. It improves soil aeration, retaining moisture, nutrients to feed roots, cuttings, seeds for faster and maximum growth. Vermiculite acts more like sponge and holding much more water.

3.4 Perlite

It is an amorphous volcanic glass that has relatively high water content greatly expanding when heated. Perlite can absorb 2 to 3 times its weight in water. It provides proper aeration and excellent water retention properties. We were applied perlite in separate polybags and growing flower seedlings to estimate the growth of the plants.

3.5 Using gibberllic acid for stimulating the growth of flowers

We are using growth hormone gibberllic acid in three flower crops to stimulate the flower initiation, shoot elongation. We are taking amount of gibberllic acid and add few drops of rubbing alcohol in order to dilute the gibberllic acid powder. Then just add water to get the right concentration. Finally the prepared gibberllic acid is sprayed on plants.

3.6 Apply hydrogen peroxide for root elongation:

Mix 3% of hydrogen peroxide into a gallon of water. Then spray the solution for every 3 to 5 days. This helps to maintain healthy soil, allow roots to breath and elongate root elongation.

3.7 Observation is taken at regular intervals:

We are taking observation at 15 days interval to calculate the growth differences among the flower crops compared with normal growth of the flower.

3.8 Estimate the growth:

Finally we are estimating the plant height, no of leaves, stem height and leaf length are analyzed and compared with normal growth of the flowers.

CHAPTER 4

MATERIALS REQUIRED

4.1. GIBBERLLIN

A single low concentration of GA 3 application did not interfere with the phenotypic characteristics of the chrysanthemum cultivar Faroe Gibberellins commonly known as gibberellic acids first came to the attention of western scientists in 1950's, they had been discovered much earlier in Japan. Rice farmers of Japan had long known of a fungal disease called foolish seedling or *bakanae* disease in Japanese that causes rice plants to grow taller and eliminated seed production. Plant pathologists found that these symptoms in rice plant were induced by a chemical secreted by a pathogenic fungus, *Gibberellafujikuroi*. Culturing this fungus in the laboratory and analyzing the culture filtrate enabled Japanese scientists in the 1930s to obtain impure crystal of two fungal "compounds" possessing plant growth promoting activity. One of these, because it was isolated from the fungus *Gibberella*, was named gibberellin A. In 1950s scientists of Tokyo University separated and characterized 3 different gibberellins from gibberellin A sample, and named them gibberellin A_1, gibberellin A_2 and gibberellin A_3. The numbering system for gibberellins used in the past 50 y builds on this initial nomenclature of gibberellins A_1(GA_1), GA_2, and GA_3.In the same year, 2 research groups, one at Imperial Chemical Industries in Britain and other at the US Department of Agriculture (USDA) in Illinois, elucidated the chemical structure of the compound that they had purified from *Gibberella* culture filtration and named gibberellic acid.

This compound was later shown to be identical to the gibberellin isolated by the Japanese scientist. For this GA_3 is also referred to as gibberellic acid. GA_3 is the principal component in *Gibberella* culture. The GA_3 is the most frequently produced GA in commercial industrial scale fermentations of *Gibberella* for agronomic, horticultural and other scientific uses.

Identification of a GA from a plant extract was first made in 1958 with the discovery of GA_1 from immature seeds of bean (*Phaseoluscocineus*). As more and more GAs from *Gibberella* and different plant sources were characterized, a scheme was adopted in 1968 to

number them (GA_1–GA_4), in chronological order of their discovery. Gibberellic acid (GA), a plant hormone stimulating plant growth and development, is a tetracyclic di-terpenoid compound. GAs stimulate seed germination, trigger transitions from meristem to shoot growth, juvenile to adult leaf stage, vegetative to flowering, determines sex expression and grain development along with an interaction of different environmental factors viz., light, temperature and water. The major site of bioactive GA is stamens that influence male flower production and pedicel growth. However, this opens up the question of how female flowers regulate growth and development, since regulatory mechanisms/organs other than those in male flowers are mandatory. Although GAsare thought to act occasionally like paracrine signals do, it is still a mystery to understand the GA biosynthesis and its movement. It has not yet confirmed the appropriate site of bioactive GA in plants or which tissues targeted by bioactive GAs to initiate their action. Presently, it is a great challenge for scientific community to understand the appropriate mechanism of GA movement in plant's growth, floral development, sex expression, grain development and seed germination.

FIGURE 4.1 Gibberllic acid

4.1.1 Properties of gibberellin

- It promotes growth and elongation of cells.
- It stimulates rapid stem and root growth.
- It increases the seed germination rate.

- It breaks the dormancy.
- It increases the flower budding level.

4.1.2 Treatment of gibberellin

The gibberellin is used as a growth regulator for the shoot development of three different applications in flower crops by which the application is done for the plant by mixing with water in a one third ratio for its development of growth of the plant.

4.2 HYDROGEN PEROXIDE

Hydrogen peroxide is a very pale blue, clear liquid, slightly more viscous than water. Hydrogen peroxide is the simplest peroxide (a compound with an oxygen–oxygen single bond). It is used as an oxidizer, bleaching agent, and antiseptic. Hydrogen peroxide is the simplest peroxide (a chemical with an oxygen–oxygen single bond). It is a colorless liquid at room temperature. Small amounts of gaseous hydrogen peroxide occur naturally in the air, but it is unstable and decomposes readily to oxygen and water with release of heat. Hydrogen peroxide is used as a chemical intermediate, as a bleaching agent in the paper and textile and pulp industry, and in water treatment operations. Hydrogen peroxide is a strong oxidizing agent characterized by a chemical structure that possesses unpaired electrons. This makes it highly reactive and gives it the ability to damage cellular macromolecules, including proteins, lipids, and nucleic acids.

Hydrogen peroxide is corrosive to the skin and the eyes and its vapor is irritating to the respiratory tract. Ingestion of hydrogen peroxide may produce oxygen bubbles, or oxygen embolism, in the blood, resulting in hemodynamic compromise, including cardiovascular collapse. There is inadequate evidence in humans for carcinogenicity, genotoxicity and reproductive toxicity of hydrogen peroxide.

Hydrogen peroxide can be used for any of the following in the garden: pest control treating root rot pre-treating seeds foliar spray to kill fungus infection preventive on damaged trees While it has also been used as a general "fertilizer" either added in during watering or sprayed onto the foliage, hydrogen peroxide is not fertilizer, but it can help boost plant growth. Hydrogen peroxide helps encourage healthy root growth because of the extra oxygen molecule. Oxygen can

help plant roots absorb nutrients from the soil. Therefore, this extra bit of oxygen better enables the roots to absorb more nutrients, which means faster, healthier, and more vigorous growth.

Hydrogen peroxide can help discourage unwanted bacteria/fungi that may be lurking in the garden. To give plants an added boost of oxygen or for pest control using the 3% solution, add 1 teaspoon per cup of water in a spray bottle and mist the plant. This amount is also suitable for pre-treating seeds to control fungal infections. For plants with root rot or fungal infections, use 1 tablespoon per cup of water. The solution can be made up and stored for future use, but be sure to store it in a cool, dark place as exposure to light diminishes the potency. Mix one part hydrogen peroxide to ten parts of water. That is one cup per four square feet of garden. Mix the solution in a watering can or into a large sprayer. Water at the base of the plants and avoid wetting the foliage. Be very careful when using this percentage of peroxide. It can bleach and/or burn the skin. Spray the veggie garden after every rainfall or as needed.

It is not only this is an environmentally friendly alternative to pesticides, but it has the added benefit of being anti-fungal and gives plants a healthy boost of oxygen too. Hydrogen peroxide, well known as an ingredient in disinfectant products, is now also approved for controlling microbial pests on crops growing indoors and outdoors, and on certain crops after harvest. This active ingredient prevents and controls bacteria and fungi that cause serious plant diseases.

FIGURE 4.2 hydrogen peroxide

4.2.1Properties of hydrogen peroxide

- It helps to encourage healthy root growth because of the extra oxygen molecules`
- It acts as an antimicrobial agent.
- It controls the pest and root rot disease.
- It is acidic in nature.
- It has a viscosity higher than water.

4.2.2 Treatment of hydrogen peroxide

The application of hydrogen peroxide is done in the floral growth for the availability of extra oxygen molecules in the plant growth. It is applied on the basis of 5 ml of dosage for the plant growth.

4.3 VERMICULITE

It is a group of platy minerals, hydrous silicates of aluminum, magnesium, and iron that expand markedly on being heated: used in the expanded state for heat insulation and as a plant growth medium. Vermiculite, hydrous phyllosilicate minerala undergoes significant expansion when heated.

Exfoliation occurs when the mineral is heated sufficiently, and commercial furnaces can routinely produce this effect. Vermiculite formed by the weathering or hydrothermal alteration of biotite or phlogopite. Large commercial vermiculite mines currently exist in Russia, South Africa, China, and Brazil. It has been used in various industries for over 80 years. It is used in industrial markets, agriculture, construction etc. Vermiculite is the mineralogical name which has given to hydrated laminar magnesium-aluminum-iron silicate which resembles mica in appearance. Vermiculite is a naturally occurring mineral that is mined and processed into puffy, lightweight granule which is mixed with soil to improve aeration and drainage.

They provide highest quality agricultural vermiculite specially meant for agriculture purposes and it has the excellent properties to be essential component for seedling, planting, germination and cutting. It improves aeration. It loosens the soil so that the roots can easily reach down and grow through the soil .It exchange drainage and small, round white particles of exfoliated vermiculite do not absorb water, each little bead creates a tiny pocket among the granules of soil. Water can easily flow through the soil and the roots. It is great for clay soils and helps to improve drainage in any area. It act as a Permanent Soil Conditioner. Unlike compost (decayed organic matter), eventually breaks down into the soil, vermiculite does not break down. Compost does add vital nutrients, but if you need to improve drainage permanently then vermiculite is a great solution.

Vermiculite is a pH neutral, which is around 7.0 or so, but because of some compounds found within it, it can slightly raise pH, a plus for acidic soils. Exfoliated vermiculite naturally reacts with soil compounds and makes the availability of other nutrients such as calcium, potassium and magnesium. Most commercial potting soil comes premixed with vermiculite, so there needs a purpose to add it.

FIGURE 4.3 Vermiculite

4.3.1 Properties of vermiculite:

- It has a high cation exchange capacity.
- It contains aluminium, iron, magnesium and silicates.
- It has high water holding and air holding capacity.

- It absorbs excess nutrients.
- It is a non abrasive and non irritant.

4.3.2 Treatment of vermiculite:

The vermiculite is used as a medium by which the growth of the flower crops is observed. Their heat insulation capacity will make the medium to expand and the availability will be more in its content.

4.4 PERLITE:

Perlite is a glassy volcanic rock with a rhyolitic composition and 2–5 per cent of combined water. The main known world's perlite reserves (about 70 per cent) are located along the Aegean coast in Turkey. The commercial product is produced by heating the ground, sieved material to 760–1100°C. The combined water in the perlite is converted to gas at high temperature in the oven and subsequently the volume expands 4–20 times its original volume, resulting in a lightweight high porosity material. Perlite is frequently used in potting soil mixtures and as a standalone growing medium. It is produced in various grades, the most common being 0–2 and 1.5–3.0 mm in diameter. The various grades differ in their physical characteristics.

Physical Characteristics – Expanded perlite is very light with a particle and BD of 0.9 and 0.1 g cm^{-3}, respectively. It is very porous, has a strong capillary action and can hold 3–4 times its weight in water. Burés et al. (1997a) reported that water retained at 10 kPa is much higher for the coarse fraction (0.5–1.0 mm diameter) than for the fine fraction (0.25–0.50 mm diameter) of expanded perlite. This difference in water-holding capacity between the coarse and fine fractions indicates that most of the water is held by the coarse particles in internal pores. However, it is not explained by the volume of internal porosity. The slope of the reduction in water content as the water tension increases is moderate relative to sand and stone wool. The available and non-available water in commercial perlite of 0–4 mm diameter was 13.6 and 36.5 per cent of its volume, respectively. The water retention curve of perlite shows moderate hysteresis. The saturation of perlite was very rapid, independent of its initial moisture. The saturated hydraulic conductivity depends on particle diameter.

For commercial perlite of 0–4 mm diameter, having 50 per cent of the particles smaller than 0.5 mm, saturated hydraulic conductivity was 0.3 cm min^{-1} . A reduction of 2 orders of magnitude in the hydraulic conductivity was obtained as the water suction increased from 0 to 30 cm water. This change is moderate in comparison to sand.

Chemical Characteristics – Perlite is neutral with a pH of 7.0–7.5, but it has no buffering capacity and contains no mineral nutrient. When the pH is low there is a risk of toxic Al release into the solution. In horticultural applications, perlite is used throughout the world as a component of soil-less growing mixes where it provides aeration and optimum moisture retention for superior plant growth. For rooting cuttings, 100% perlite is used. Studies up have shown that outstanding yields are achieved with perlite hydroponic systems. Other benefits of horticultural perlite are its neutral pH and the fact that it is sterile and weed-free. In addition, its light weight makes it ideal for use in container growing. Other horticultural applications for perlite are as a carrier for fertilizer, herbicides and pesticides and for pelletizing seed. Horticultural perlite is as useful to the home gardener as it is to the commercial grower. It is used with equal success in greenhouse growing, landscaping applications and in the home in house plants.

FIGURE 4.4 Perlite

4.4.1Properties of perlite:

- It makes soil ventilated and improves its drainage.
- It increases infiltration and decreases evaporation.
- It makes moisture and nutrients readily available to plants.
- Salt acts as a soil improver.

4.4.2 Treatment of perlite:

The perlite is the one used as a medium for the growth of the different flower plants in which its increase the growth of them by its capacity of withholding the moisture for a longer period of time.

FIGURE 4.5 Different treatments

CHAPTER 5

PACKAGE OF PRACTICES

5.1 PACKAGE OF PRACTICE OF CHRYSANTHEMUM

FAMILY:

Asteraceae

VARIETY:

CO2

COLOUR:

Purple

TEMPERATURE:

16 to 250 Celsius

RELATIVE HUMIDITY:

70 to 85%

CO2:

600 – 900 ppm

PHOTOPERIOD:

Long day conditions with 13 hours light and 11 hours darkness during vegetative stage

SOIL:

We are using sandy loam soil as growing medium in polybags

GROWING MEDIA:

We are using vermiculite and perlite as growing medium in 6 pots. Vermiculite is soaking in water for some hours it enlarges 3 to 4 times its original volume and placed in to separate three polybags. Perlite is placed in 3 polybags separately to increasing its original volume 2 to 3 times by the addition of water.

PROPAGATION:

Terminal cuttings

PLANTING:

20 days old saplings are transplanted in to separate polybags.

IRRIGATION:

Apply 1.2 liters of water per week.

GROWTH REGULATORS:

We are taking amount of gibberllic acid and add few drops of rubbing alcohol in order to dilute the gibberllic acid powder. Then just add water to get the right concentration. Finally the prepared gibberllic acid is sprayed on plants in 3 pots in perlite medium.Mix 3% of hydrogen peroxide into a gallon of water. Then spray the solution for every 3 to 5 days in 3 polybags in vermiculite medium. This helps to maintain healthy soil, allow roots to breath and elongate root elongation

PINCHING:

First pinching is done in 3 weeks after planting.

OBSERVATION PERIOD:

We are transplanting 20 days old saplings of cut chrysanthemum in separate polybags and the flower initiate from the 45 days after planting.

DISEASES:

Fusarium wilt. It is caused by fusarium oxysporum due to water stress and poor drainage. Stems show a reddish brown discolourisation of vascular systems. The infected plants show chlorosis and necrosis starting from lower leaves. The apical leaves show curving. It is controlled by spraying Bavistin at 0.05% and carbendazium at 0.1% is sprayed in 15 days interval.

BIOMETRIC OBSERVATION:

PLANT HEIGHT:

By using gibberllic acid in perlite medium the plant height is 22.2 cm is increased compared with using hydrogen peroxide the plant height is 18.3 cm in perlite and also grown greater than normal growth of about 11 cm.

By using hydrogen peroxide in vermiculite medium the plant height is 21.2 cm is increased compared with using gibberllic acid the plant height is 16.3 cm in vermiculite and also grown greater than normal growth of about 11 cm.

NO OF LEAVES:

By using gibberllic acid in perlite medium the no of leaves 28 is increased compared with using hydrogen peroxide the no of leaves is 25 in perlite and also the leaves are higher than the normal growth of leaves is 12.

By using hydrogen peroxide in vermiculite medium the no of leaves 20 is increased compared with using gibberllic acid the no of leaves 15 in vermiculite and also the leaves are higher than the normal growth of leaves is 12.

LEAF LENGTH:

By using gibberllic acid in perlite medium the leaf length is 5.5 cm is increased compared with using hydrogen peroxide the leaf length is 4.2 cm in perlite and also grown greater than normal growth of leaf length is about 2 cm.

By using hydrogen peroxide in vermiculite medium the leaf length is 6.1 cm is increased compared with using gibberllic acid the leaf length is 4.7 cm in vermiculite and also grown greater than normal growth of leaf length is about 2 cm.

STEM HEIGHT

By using gibberllic acid in perlite medium the stem height is 11 cm is increased compared with using hydrogen peroxide the stem height is 8.3 cm in perlite and also grown greater than normal growth of about 6 cm.

By using hydrogen peroxide in vermiculite medium the stem height is 13.5 cm is increased compared with using gibberllic acid the stem height is 10 cm in vermiculite and also grown greater than normal growth of about 6 cm.

HARVEST:

The correct stage of harvesting is done in 50 days after planting.

5.2 PACKAGE OF PRACTICE OF CROSSANDRA

FAMILY:

Acanthaceae

VARIETIES:

Arka ambara

COLOUR:

Orange

TEMPERATURE:

30 to 35 Celsius

RELATIVE HUMIDITY:

50 to 65%

PH:

6 to 7.5

SOIL:

We are using sandy loam soil as growing medium in polybags.

GROWING MEDIA:

We are using vermiculite and perlite as growing medium in 6 pots. Vermiculite is soaking in water for some hours it enlarges 3 to 4 times its original volume and placed in to separate three polybags. Perlite is placed in 3 polybags separately to increasing its original volume 2 to 3 times by the addition of water.

PROPAGATION:

Seeds can be propagated through terminal cuttings.

PLANTING:

Seedlings are transplanted at 4 to 6 leaves stage that is 8 to 10 days old saplings are transplanted in to the polybags.

IRRIGATION:

Irrigation is done at weekly intervals.

GROWTH REGULATORS:

We are taking amount of gibberllic acid and add few drops of rubbing alcohol in order to dilute the gibberllic acid powder. Then just add water to get the right concentration.

Finally the prepared gibberllic acid is sprayed on plants in 3 pots in perlite medium. Mix 3% of hydrogen peroxide into a gallon of water. Then spray the solution for every 3 to 5 days in 3 polybags in vermiculite medium. This helps to maintain healthy soil, allow roots to breath and elongate root elongation

PINCHING:

First pinching is done in 3 weeks after planting.

OBSERVATION PERIOD:

We are transplanting 10 days old saplings of crossandra in separate polybags and the flower initiate from the 55 days after planting.

DISEASES:

Wilt. It is caused by fusarium solani. Leaves of infected plants become pale and drop. Margin of the leaves show pinkish brown discolourisation. It is controlled by spraying Bavistin at 0.05% and carbendazium at 0.1% is sprayed in 15 days interval. The affected plants should be pulled out and destroyed to reduce the diseases.

BIOMETRIC OBSERVATION:

PLANT HEIGHT:

By using gibberllic acid in perlite medium the plant height is 18.1 cm is decreased compared with using hydrogen peroxide the plant height is 24.7 cm in perlite and also grown greater than normal growth of about 10.6 cm.

By using hydrogen peroxide in vermiculite medium the plant height is 17.5 cm is decreased compared with using gibberllic acid the plant height is 26.3 cm in vermiculite and also grown greater than normal growth of about 10.6 cm.

NO OF LEAVES:

By using gibberllic acid in perlite medium the number of leaves 17 is decreased compared with using hydrogen peroxide the no of leaves is 21 in perlite and also the leaves are higher than the normal growth of leaves is 9.

By using hydrogen peroxide in vermiculite medium the no of leaves 24 is decreased compared with using gibberllic acid the no of leaves 30 in vermiculite and also the leaves are higher than the normal growth of leaves is 9.

LEAF LENGTH:

By using gibberllic acid in perlite medium the leaf length is 3.8 cm is decreased compared with using hydrogen peroxide the leaf length is 4.6 cm in perlite and also grown greater than normal growth of leaf length is about 2.4 cm.

By using hydrogen peroxide in vermiculite medium the leaf length is 3.8 cm is decreased compared with using gibberllic acid the leaf length is 5.3 cm in vermiculite and also grown greater than normal growth of leaf length is about 2.4 cm.

STEM HEIGHT:

By using gibberllic acid in perlite medium the stem height is 11.2 cm is decreased compared with using hydrogen peroxide the stem height is 13.3 cm in perlite and also grown greater than normal growth of about 8.6 cm.

By using hydrogen peroxide in vermiculite medium the stem height is 11.8 cm is decreased. Compared with using gibberllic acid the stem height is 15.6 cm in vermiculite and also grown greater than normal growth of about 8.6 cm.

HARVEST:

The correct stage of harvesting is done in 80 days after planting.

5.3 PACKAGE OF PRACTICES OF IXORA COCCINEA

FAMILY:

Rubiaceae

ANOTHER NAME:

Jungle geranium, flame of woods, jungle flame

VARIETY:

Coccinea

PHOTOPERIOD:

It must have at least four hours a day of direct sunlight

COLOUR:

Red

TEMPERATURE:

15 Celsius

RELATIVE HUMIDITY:

60 to 70%

PH:

6 to 7.5

SOIL:

We are using sandy loam soil as growing medium in polybags

GROWING MEDIA:

We are using vermiculite and perlite as growing medium in 6 pots. vermiculite is soaking in water for some hours it enlarges 3 to 4 times its original volume and placed in to separate three polybags. Perlite is placed in 3 polybags separately to increasing its original volume 2 to 3 times by the addition of water.

PROPAGATION:

Seeds can be propagated through stem cuttings. Trim each cutting immediately below a leaf, remove that leaf and dip the cue end in hormone rooting powder.

PLANTING:

Seedlings are transplanted at 4 to 6 leaves stage that is 8 to 10 days old saplings are transplanted in to the polybags.

PRUNING:

Pruning can be control its shape and size

IRRIGATION:

Irrigation is done at weekly intervals

GROWTH REGULATORS:

We are taking amount of gibberllic acid and add few drops of rubbing alcohol in order to dilute the gibberllic acid powder. Then just add water to get the right concentration. Finally the prepared gibberllic acid is sprayed on plants in 3 pots in perlite medium. Mix 3% of hydrogen peroxide into a gallon of water. Then spray the solution for every 3 to 5 days in 3 polybags in vermiculite medium. This helps to maintain healthy soil, allow roots to breath and elongate root elongation.

PINCHING:

First pinching is done in 2 weeks after planting.

OBSERVATION PERIODS:

We are transplanting days old saplings of crossandra in separate polybags and the flower initiate from the 55 days after planting.

DISEASES:

Leaf spot. It is a result of various fungal pathogens that cause discoloured spots, raised areas or brownish yellow patches on the leaves of infected plants. Preventing this fungal disease by avoiding over watering and removing plant matter that has fallen to the ground.

BIOMETRIC OBSERVATION:

PLANT HEIGHT:

By using gibberllic acid in perlite medium the plant height is 30.5 cm is increased compared with using hydrogen peroxide the plant height is 22.3 cm in perlite and also grown greater than normal growth of about 18.4 cm.

By using hydrogen peroxide in vermiculite medium the plant height is 28.6 cm is increased compared with using gibberllic acid the plant height is 20.7 cm in vermiculite and also grown greater than normal growth of about 18.4 cm.

NO OF LEAVES:

By using gibberllic acid in perlite medium the no of leaves 45 is increased compared with using hydrogen peroxide the no of leaves is 29 in perlite and also the leaves are higher than the normal growth of leaves is 18.

By using hydrogen peroxide in vermiculite medium the no of leaves 22 is increased compared with using gibberllic acid the no of leaves 16 in vermiculite and also the leaves are higher than the normal growth of leaves is 18.

LEAF LENGTH:

By using gibberllic acid in perlite medium the leaf length is 18.7 cm is increased compared with using hydrogen peroxide the leaf length is 13.6 cm in perlite and also grown greater than normal growth of leaf length is about 10 cm.

By using hydrogen peroxide in vermiculite medium the leaf length is 19.2 cm is increased compared with using gibberllic acid the leaf length is 14.5 cm in vermiculite and also grown greater than normal growth of leaf length is about 10 cm.

STEM HEIGHT:

By using gibberllic acid in perlite medium the stem height is 23.5 cm is increased compared with using hydrogen peroxide the stem height is 19.2 cm in perlite and also grown greater than normal growth of about 11.3 cm.

By using hydrogen peroxide in vermiculite medium the stem height is 21.2 cm is increased compared with using gibberllic acid the stem height is 17.6 cm in vermiculite and also grown greater than normal growth of about 11.3 cm.

HARVEST:

The correct stage of harvesting is done in 75 days after planting.

planting

CHAPTER 6

RESULT AND DISCUSSION

From this project we have observed the growth of flower crops in gibberllic acid is increased in Chrysanthemum and Ixora coccinea in perlite medium. It increased the leaf length, no of leaves, stem length and plant height.

The effect of hydrogen peroxide is increased in crossandra in vermiculite medium. It increased the root elongation, stem and plant height.

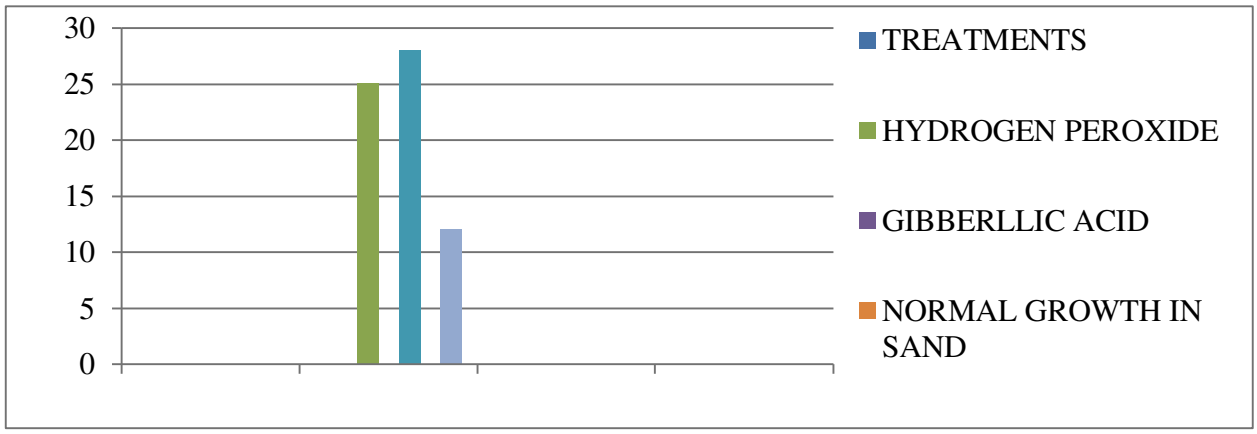
6.1 TABLES

6.1.1 CHRYSANTHEMUM

Table.6.1.observation period for 30 days using perlite as medium in chrysanthemum

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	18.3	25	4.2 cm	8.3
GIBBERLLIC ACID	22.2	28	5.5 cm	11
NORMAL GROWTH IN SAND	11	12	2 cm	6

Graph.1



The observation of the plant is taken for the 30 days in which the plant height, number of leaves, leaf length and stem height are increased in gibberllic acid compared with the hydrogen peroxide and normal growth.

The table shows that the major variation of the crop chrysanthemum is increased by using perlite as the medium in the first 30 days of growth and the effect of applying gibberllic acid in the crop than hydrogen peroxide and in the normal growth.

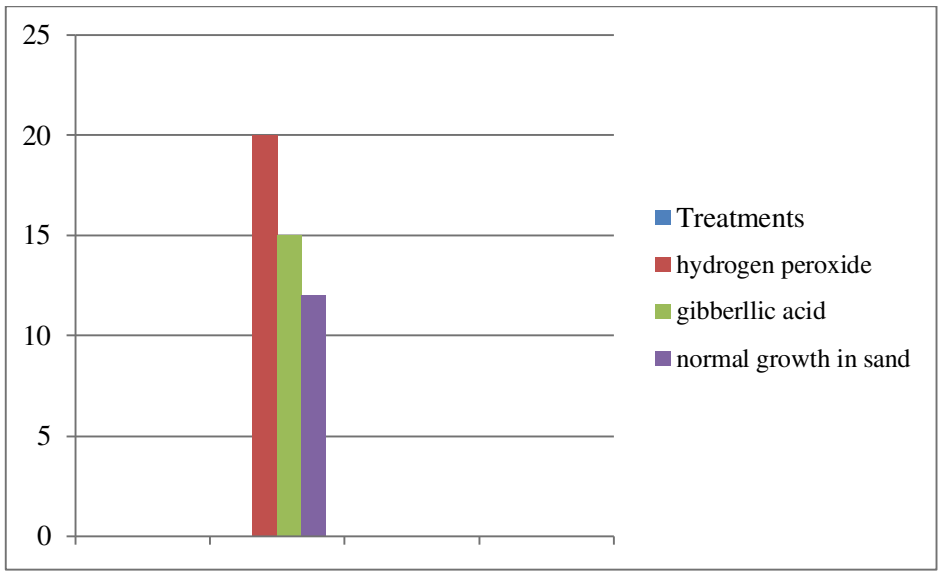
The graph represents the growth of plant by applying gibberllic acid in perlite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop chrysanthemum .

6.1.2 CHRYSANTHEMUM

Table 6 .2 observation period for 30 days using vermiculite as medium in chrysanthemum

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	21.2	20	6.1	13.5
GIBBERLLIC ACID	16.3	15	4.7	10
NORMAL GROWTH IN SAND	11	12	2	6

Graph.2



The observation of the plant is taken for the 30 days in which the plant height, number of leaves, leaf length and stem height are increased in hydrogen peroxide compared with the gibberllic acid and normal growth.

The table shows that the major variation of the crop chrysanthemum is increased by using vermiculite as the medium in the first 30 days of growth and the effect of applying gibberllic acid in the crop than hydrogen peroxide and in the normal growth.

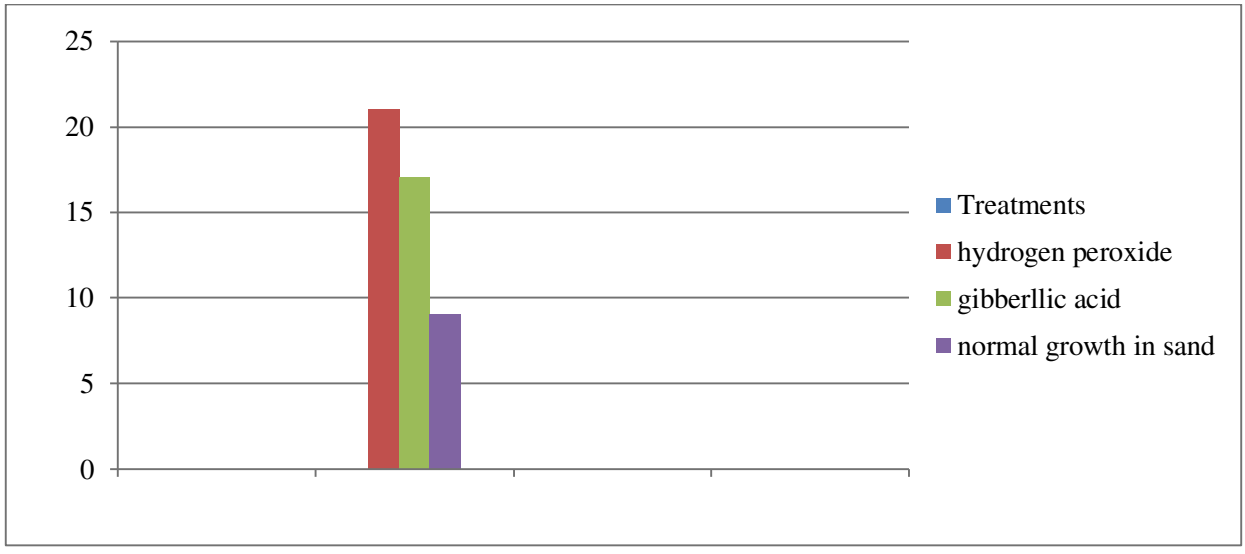
The graph represents the growth of plant by applying hydrogen peroxide in vermiculite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop chrysanthemum .

6.1.3 CROSSANDRA

Tabl6e. 3 observation period for 30 days using perlite as medium in crossandra

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	24.7	21	4.6	13.3
GIBBERLLIC ACID	18.1	17	3.8	11.2
NORMAL GROWTH IN SAND	10.6	9	2.4 cm	8.6

Graph.3



The observation of the plant is taken for the 30 days in which the plant height, number of leaves, leaf length and stem height are increased in hydrogen peroxide compared with the gibberllic acid and normal growth.

The table shows that the major variation of the crop crossandra is increased by using perlite as the medium in the first 30 days of growth and the effect of applying hrdrogen peroxide in the crop than gibberllic acid and in the normal growth.

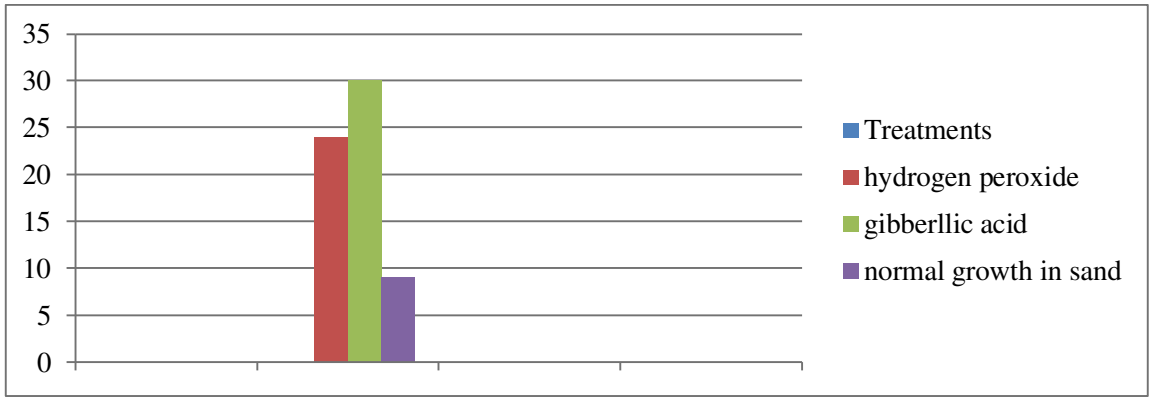
The graph represents the growth of plant by applying hydrogen peroxide in perlite medium is increased when compared with the normal growth and gibberllic acid in which it increases the growth in the flower crop crossandra.

6.1.4 CROSSANDRA

Table6 .4 observation period for 30 days using vermiculite as medium in crossandra

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES (CM)	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	17.5	24	5.3	11.8
GIBBERLLIC ACID	26.3	30	3.8	15.6
NORMAL GROWTH IN SAND	10.6	9	2.4	8.6

Graph.4



The observation of the plant is taken for the 30 days in which the plant height, number of leaves, leaf length and stem height are increased in gibberllic acid compared with the hydrogen peroxide and normal growth.

The table shows that the major variation of the crop crossandra is increased by using vermiculite as the medium in the first 30 days of growth and the effect of applying gibberllic acid in the crop than hydrogen peroxide and in the normal growth.

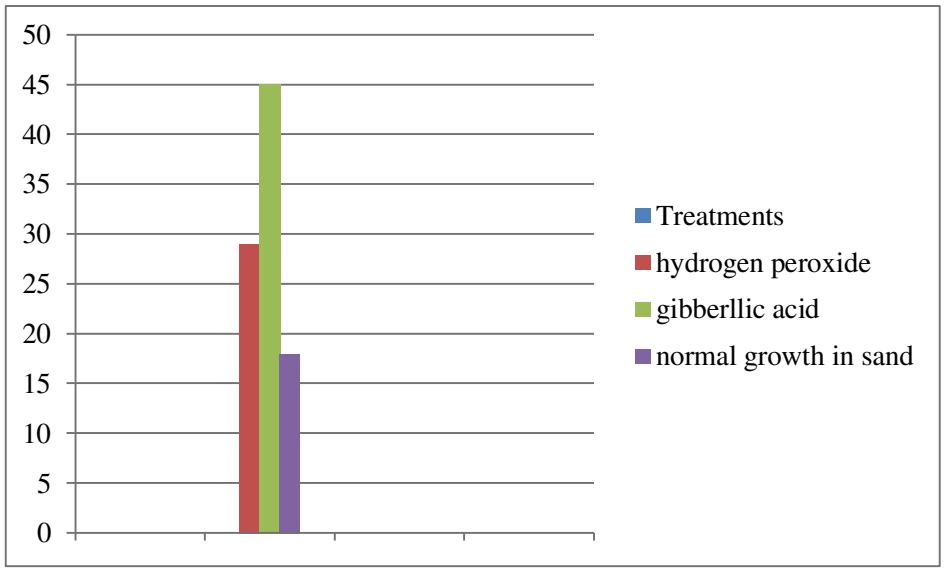
The graph represents the growth of plant by applying gibberllic acid in vermiculite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop crossandra.

6.1.5 IXORA COCCINEA

Table6 .5 observation period for 30 days using perlite as medium in ixora coccinea

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	22.3	29	13.6	19.2
GIBBERLLIC ACID	30.5	45	18.7	23.5
NORMAL GROWTH IN SAND	18.4	18	10	11.3

Graph.5



The observation of the plant is taken for the 30 days in which the plant height, number of leaves, leaf length and stem height are increased in gibberllic acid compared with the hydrogen peroxide and normal growth.

The table shows that the major variation of the crop Ixora coccinea is increased by using perlite as the medium in the first 30 days of growth and the effect of applying gibberllic acid in the crop than hydrogen peroxide and in the normal growth.

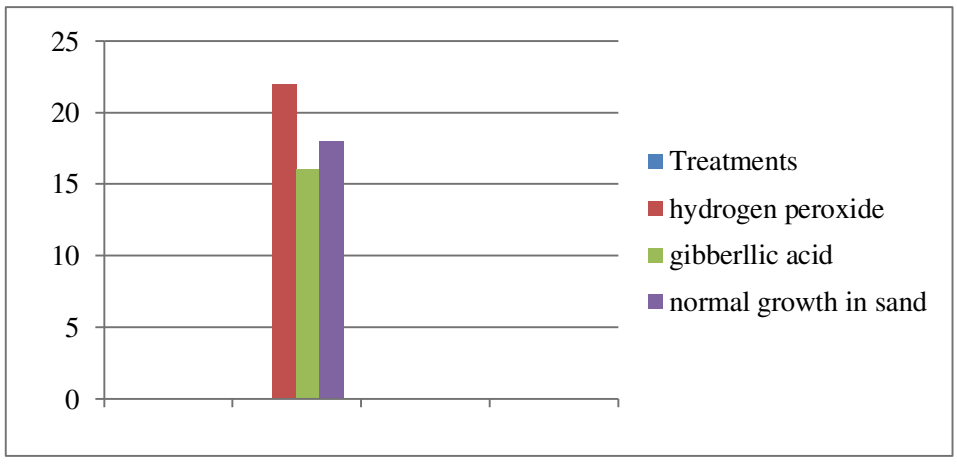
The graph represents the growth of plant by applying gibberllic acid in perlite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop Ixora coccinea .

6.1.6 IXORA COCCINEA

Table6 .6 observation period for 30 days using vermiculite as medium in ixora coccinea

TREATMENTS	PLANT HEIGHT (CM)	NO OF LEAVES	LEAF LENGTH (CM)	STEM HEIGHT (CM)
HYDROGEN PEROXIDE	28.6	22	19.2	21.2
GIBBERLLIC ACID	20.7	16	14	17.6
NORMAL GROWTH IN SAND	18.4	18	10	11.3

Graph.6



The table shows that the major variation of the crop Ixora coccinea is increased by using vermiculite as the medium in the first 30 days of growth and the effect of applying hydrogen peroxide in the crop than gibberllic acid and in the normal growth.

The graph represents the growth of plant by applying hydrogen peroxide in vermiculite medium is increased when compared with the normal growth and gibberlic acid in which it increases the growth in the flower crop Ixora coccinea .

RESULT AND DISCUSSION

From this project we have observed the growth of flower crops in gibberllic acid is increased in Chrysanthemum and Ixora coccinea in perlite medium. It increased the leaf length, no of leaves, stem length and plant height.

The effect of hydrogen peroxide is increased in crossandra in vermiculite medium. It increased the root elongation, stem and plant height.

CONCLUSION

The graph represents the growth of plant by applying gibberllic acid in perlite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop chrysanthemum

The graph represents the growth of plant by applying hydrogen peroxide in vermiculite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop chrysanthemum .

The graph represents the growth of plant by applying gibberllic acid in perlite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop Ixora coccinea .

The graph represents the growth of plant by applying gibberllic acid in vermiculite medium is increased when compared with the normal growth and hydrogen peroxide in which it increases the growth in the flower crop crossandra

REFERENCE

1. Kende H, Zeevaart JA. The five" Classical" plant hormones. The plant cell. 1997;9: 1197–1210. doi: 10.1105/tpc.9.7.1197.

2.Dilip WS, Singh D, Moharana D, Rout S, Patra SS. Effect of Gibberellic AcidDifferent Concentrations at Different Time Intervals on Seed Germination and Seedling Growth of Rangpur Lime. J Agroeco Nat Resource Management. 2017;4: 157–165.

3.le Roux S, Barry GH. Vegetative Growth Responses of Citrus Nursery Trees to Various Growth Retardants. Horttechnology. 2010;20: 197–201.

4.Tan M-L, Song J-K, Deng X-X. Production of two mandarin x trifoliate orange hybrid populations via embryo rescue with verification by SSR analysis. Euphytica. 2007;157: 155–160. doi: 10.1007/s10681-007-9407-5.

5.Hanzaii MM, Tafazoli E. Effects of gibberellic acid (GA3), naphtalin acetic acid (NAA), ethephon and urea on alternate bearing control in Kinnow mandarin (Citrus reticulata Blanco). Journal of Science and Technology of Agriculture and Natural Resources. 2002;6: 91–103.

6.Greenberg J, Holtzman S, Fainzack M, Egozi Y, Giladi B, Oren Y, et al. Effects of NAA and GA 3 Sprays on fruit size and the incidence of creasing of "Washington" navel orange. Acta Horticulturae. 2010;884: 273–280.

7.Bermejo A, Primo-Millo E, Agusti M, Mesejo C, Reig C, Iglesias DJ. Hormonal Profile in Ovaries of Mandarin Varieties with Differing Reproductive Behaviour. Journal of Plant Growth Regulation. 2015;34: 584–594. doi: 10.1007/s00344-015-9492-y.

8.Davies FS, Zalman G. Gibberellic acid, fruit freezing, and post-freeze quality of "Hamlin" oranges. HortTechnology. 2006;16: 301–305.

9.Guardiola JL. Overview of flower bud induction, flowering and fruit set. Proceedings of Citrus Flowering and Fruit short course IFAS Citrus Research and Education Center, University of Florida. 1997. pp. 5–21.

10.Stover E. Relationship of flowering intensity and cropping in fruit species. HortTechnology. 2000;10: 729–732.

11.Stephenson AG. Flower and fruit abortion: proximate causes and ultimate functions. Annual review of ecology and systematics. 1981;12: 253–279.

12.Davenport TL. Citrus flowering. Horticultural Reviews. 1990;12: 349–408.

13.Jahn O. Effects of ethephon, gibberellin, and Ba on fruiting of Dancy tangerines. Journal of the American Society for Horticultural Science. 1981;106: 597–600.

14.Takagi T, Tomiyasu A, Matsushima M, Suzuki T. Seasonal-changes of Ga-like substances in fruit and current shoots of Satsuma mandarin trees. Journal of the Japanese Society for Horticultural Science. 1989;58: 569–573.

15.Johnson RS, Handley DF. Thinning response of early, mid-, late-season peaches. Journal of the American Society for Horticultural Science (USA). 1989;414: 852–855.

PLANNING, ANALYSIS AND DESIGN OF SHOPPING MALL

A PROJECTREPORT

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ABSTRACT

This project presents the plan, analysis and design of a shopping mall structure of an underground car parking storey and G+2 stories and investigate its performance under various lateral loading conditions. The main goal is to assess current Indian Standard design practice and to analyze using STAAD Pro and to find a detailing strategy which will ensure a sufficient level of safety for various levels of loading demands.

In this project we will design and analyze the building which utilize this limited area and satisfying each and every needs of the people. It will also designed in such a way that it would be economical. The civil engineers have to think of construction of high rise structures, instead of the traditional type of reinforced concrete structure enclosed by thick walls of bricks or any other construction materials.

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LIST OF SYMBOLS

SYMBOLS		ABBREVATION
A_{st}	-	Area Of steel reinforcement Area of concrete
A_c	-	Gross area of section Breadth of web Effective width of flange
		Depth of flange
D_f	-	Depth of web Effective depth
M_{ux}	-	Design moment along xx axis
M_{uy}	-	Design moment along yy axis
P	-	Axial load
p_u	-	Design axial load for limit state design
P_t	-	Percentage of reinforcement
S_v	-	Spacing of stirrups
SBC	-	Safe bearing capacity of soil

CHAPTER 1

INTRODUCTION

Structural design is "An Art of understanding the behavior of structural elements subjected to different types of loads". "It is the art of calculation of internal forces like design moments, shear forces, axial load and twisting moments in structural elements". A typical four storied building has been taken for design. Usually multi-storied buildings are constructed in the form of reinforced concrete framed structures which is also said as "Rigid Frame".

1.1 Planning and Construction:

Structural planning and construction starts with group collaboration between client, Architect, Structural Engineer, Consultant and contracting firm.

1.2 Structural Planning:

Structural planning of the frame is done after getting the architectural drawing.

- Positioning and orientation of columns
- Positioning of beams
- Spanning of slabs
- Layout of stairs
- Selecting proper type of footing

1.3 Action of Forces and Computation of Loads:

The design engineer should have clear concept of the action forces acting on the structure. The basic structural actions which a structural engineer should know are as follows.

1.3.1 Axial Force:

Axial force occurs in the member like columns, arches, cables and trusses due to force passing through the centroidal axis. Membrane action which occurs in the structures like shells and plates along the surface only.

1.3.2 Bending Action:

Forces which are parallel or transverse to the member axis cause bending

action. It occurs essentially in case of 2D structures like slabs and beam.

1.3.3 Shear Action:

Shear action is induced by in-plane parallel forces only.

1.3.4 Twisting Action:

Torsional moment induced in the out of plane of forces. E.g., beam holding cantilever slabs, beams curved in plan.

1.3.5 Combined Action:

It is the combination of one or more of the above action.

1.4 Analysis of Structures:

Elastic analysis: Used in working stress method.

Limit analysis: Used in limit state design for RCC structures.

1.5 Member Design:

It involves the design of slab, beam, column and footing sequentially.

1.6 Detailing, Drawing and Preparation of Schedule:

Detailing and drawing preparation should do after ensuring adequate strength and satisfactory behavior of structure. Detailed drawing and schedule should prepare for all reinforcement details such as footing, column, beam, staircase and slabs.

CHAPTER 2

ANALYSIS OF SECTION USING STAAD Pro

2.1 About STAAD Pro:

STAAD Pro (Structural Analysis and Design Program) is one of the most popular structural engineering software products for 3D model generation analysis and multi- material design. It has an intuitive, user-friendly GUI, visualization tools, powerful analysis and design facilities and seamless integration to several other modeling and design software products. The software is fully compatible with all Windows operating systems but is optimized for Windows XP.

For static or dynamic analysis of bridges, containment structures, embedded structures (tunnels and culverts), pipe racks, steel, concrete aluminum or timber buildings, transmission towers, stadiums or any other simple or complex structure, STAAD Pro has been the choice of design professionals around the world for their analysis needs.

2.2 STAAD Pro Overview:

2.2.1 Types of structures:

- **Space:** Three dimensional framed structures with loads applied in any plane.
- **Plane:** Two dimensional structures framed in the X-Y plane with loads in same plane.
- **Floor:** Two or three dimensional structures having no horizontal (Global X or Z) movement of structures (FX, FY & MY are restrained at every joint).
- **Truss:** Any structures consists of truss members only, we can have only axial member forces and no bending in members.

2.2.2 Overall Procedure in Working with STAAD Pro Model Generation:

There are two methods for building a model and assigning the structure data using STAAD Pro.

- Using the command file.
- Using the graphical model generation mode or graphical user interface (GUI).

2.3 Performing Analysis and Design:

The Modeling Mode of the STAAD Environment is used to prepare the structural input data. After the input is prepared, we may choose to analysis engine depending upon the nature of the analysis required.

2.4 Post-Processing:

The Post Processing mode of STAAD offers facilities for on screen visualization and verification of the analysis and design results.

The pages in this mode allow us to view displacements, forces, stresses, etc both graphically and numerically.

2.5 Summary

- Creating a structural model. This consists of generating the structural geometry, specifying member properties, materials constants, load, analysis and design specifications, etc.
- Visualization and verification of the model geometry.
- Running the STAAD analysis engine to perform analysis and design.

2.6 Verification of results:

- Graphically and numerically.
- Report generation and printing.
- Inter-operability. In other words, using STAAD Pro in conjunction with other programs, such as STAAD etc, STAAD Foundation.

CHAPTER 3

DESIGN OF SHOPPING MALL

3.1 Design of Two Way Slab:

3.1.1 Data:

Span = 6 m × 4m

Live load = 4 kN/m^2

Finish = 1 kN/m^2

F_{ck} = 25 N/m^2

F_y = 415 N/m^2

3.1.2 Type of Slab:

L_y / L_x = 6 / 4

= 1.5 < 2

Hence two way slab

3.1.3 Calculation of Effective Depth:

Overall depth, D = Effective span / 25

= 4000 / 25

= 160 mm

Assuming a clear cover of 30 mm, Effective depth,

d = 160 - 30 mm

= 130 mm

3.1.4 Calculation of Effective Span:

c / c of support:

= 4000 + 230 / 2 + 230 / 2

= 4230 mm

Clear span + depth:

= 4000 + 130

= 4130 Mm

3.1.5 Load Calculation:

Self weight of slab = 25 x 0.16 x 1

	=	4 kN/m^2
Floor finish	=	1 kN/m^2
Live load	=	4 kN/m^2
Total service load, w	=	9 kN/m^2
Ultimate load, W_u	=	1.5 x 9
	=	13.5 kN/m^2

3.1.5 Ultimate Design Moments and Shear Force Refer IS 456:2000 Table 6:

L_Y / l_x	=	1.5
α_x	=	0.104
α_y	=	0.046
M_{ux}	=	$\alpha_x W u L_x^2$
	=	0.104 x 13.5 x 4^2
	=	22.464 kNM
M_{ux}	=	$\alpha_y W u L_x^2$
	=	0.46 x 13.5 x 4^2
	=	9.93 kNM
V_{ux}	=	$W_U L_X / 2$
	=	13.5 x 4 / 2
	=	27 kN

3.1.6 Check for Depth:

M_{max}	=	$0.138 f_{ck} b d^2$
d^2	=	22.46 x 10^6 / 0.138 x 25 x 1000
d	=	80.685 < 130 mm

Hence the effective depth selected is sufficient to resist the design ultimate moment.

3.1.7 In X-Direction:

22.46x10^6	=	0.87 x A_{st} x 415 x 130 (1- A_{st} x 415 / 1000 x 130 x 25)
A_{st}	=	571.96 mm^2

Adopt 10 mm diameter bars at 300 mm

A_{st}	=	78.53 mm
S	=	(78.53 / 571.96) x1000
	=	137.29 mm = 140 mm

3d = 3 x130

= 390 mm

Provide 140 mm @10 mm dia

A_{st} = 78.53 / 140 x 1000

= 560.92 mm^2

3.1.8 In Y-Direction:

$9.936x10^6$ = 0.87 x A_{st} x 415 x 130 (1-A_{st} x 415/1000 x 130 x 25)

A_{st} = 217.7 mm^2

Adopt 10 mm diameter bars at 300 mm

A_{st} = 78.53mm

S = (78.53 / 217.7) x 1000

= 360.72 mm

= 360 mm

3d = 3 x130

= 390 mm

Provide 140 mm@10mm dia

A_{st} = 78.53 / 360 x1000

= 218.13 mm^2

3.1.9 Check For Shear Stress:

Considering the short span unit width of slab

τv = Vu / b.d

= 27 x 10^3 / 1000 x 130

= 0.207 N / mm^2

P_t = A_{st} x 100 / b d

= 100 x 217.7 / 1000 x 130

= 0.16%

Refer table 19 – IS 456 and read out

$k\tau c$ = 0.39 x 0.27

= 0.105 Nmm^2

$K\tau c$ = τv

Hence the shear stresses are within safe permissible limits.

3.1.10 Check for Deflection Control

Considering unit width of slab in short span direction L_x

(L/d) basic = 30

P_t = 0.16

Refer IS 456 fig;4,5,6

K_t = 1.4

K_c = 1

K_f = 1

$(L/d)_{max}$ = 4000 / 160

= 25

Hence deflection control is satisfied

3.1.11 Torsional Reinforcement:

A_{st}, for torsional = 0.75 x A_{st} provided

= 0.75 x 511.96

= 384 mm^2

Length over which torsion steel is provided

= (1/5) x short span

= (1/5) x 4000

= 800 mm

Provide 8mm dia bar @ 130mm for a 1span of 800mm at all 4 corners

3.2 Design of Beam:

3.2.1 Cross Sectional Dimension:

Effective span = 6.00m

Span/depth = 24

Depth(d) = 250 mm

Overall depth = 250 + 50

D = 300 mm

3.2.2 Ultimate Moment and Shear Force:

Max Bending Moment = 700 kN-m

Max Shear Force = 200 kN

3.2.3 Limiting moment:

M_u limit = $0.138 \times fck \times b \times d^2$

= $0.138 \times 25 \times 300 \times 250^2$

= 85.39 kN-m

$M_u > M_u$ limit so the section is over reinforced

3.2.4 Main Reinforcement:

To find A_{sc}

Mu - Mu limit = $f_{sc}A_{sc}$ (d – d")

F_s = $0.0035 \times (Xumax - d") / Xumax \times Es$

$\frac{Xumax}{d}$ = 0.48

Xumax = 0.48×250

= 120 mm

Provide 5 no of 16 mm dia bar

f_{sc} = $(0.0035 \times (360 - 50) / 360) \times 2 \times 10^5$

= 602.74 N / mm^2

Y = 0.87 x 415

= $361N/mm^2$

Mu – Mu limit = $F_{sc}A_{sc}$ (d – d")

205.15 = $361 \times A_{sc}$ (250 - 50)

A = 629.90 mm^2

A_{sc} provide = 804.3 mm^2

To find A_{st}

A_{st} $A_{st1} + A_{st2}$

A_{st1} $(0.36 \times f_{ck} \times b \times Xumax) / (0.87 \times f_y)$

$0.36\ 25 \times 300 \times 360 / 0.87 \times f_y$

2692.74 mm^2

3.3 Design of Lintel:

3.3.1 Data:

Size of lintel = 230 x 150 mm

Using 8mm ϕ with a Nominal Cover of 20mm d= D – NC - ϕ/2

= 150 – 24

= 126 mm

Span = 4000 mm

Height of equilateral Triangle = 0.866 x L

= 0.866 x 4000

= 3.464 m

Height of wall above the lintel = 3.5 - (2.1 + 0.15)

= 1.25 m

3.464 m > 1.25 m

3.3.2 Load Calculation:

Weight of Triangular Position of Masonry

W_1 = ½ x b x h x d x Weight of masonry

= ½ x 1 x 1.25 x 0.23 x 18

= 2.58 kNm

Weight of Sunshade

Assume sunshade depth 150 mm = 1 x 0.6 x 0.15 x 25

= 2.25 kN/m

Self-weight of Lintel = 0.23 x 0.15 x 1 x 25

= 0.86 kN/m

Total UDL (W) = 5.69 kN/m

Factored UDL (Wu) = 5.69 x 1.5

= 8.53 kN/m

Maximum Bending Moment

$$M = \frac{w \times Le^2}{8}$$

$$= \frac{8.53 \times 4^2}{8}$$

$$= 17.06 \text{ kN m}$$

Area of Steel Required

Mu $= 0.87 \times f_y \times A_{st} \times d \times \left(1 - \frac{A_{st} \times f_y}{F_{ck} \times bd}\right)$

$A_{st} = 110.84 \text{ mm}^2$

A_{st} min $= 0.12\ \% \times b \times d$

$= 0.12 /100 \times 230 \times 126$

$= 34.78 \text{ mm}^2$

$= \frac{\pi}{4} \times 8^2$

$= 50.26 \text{ mm}^2$

No of bars $= \frac{A_{st}}{a_{st}}$

$= \frac{110.84}{50.26}$

$= 3$ Nos

Provide 3Nos of 8 mm ø bar Fe 415 steel bar @ bottom as main reinforcement & 2Nos of 8 mm ø bar @ top as hanger bar.

Details

Length	4000mm
Breadth	230mm
Depth	150mm

Main Reinforcement

Top	Provide 2Nos of 8mm ø bar Fe415 steel bar
Bottom	Provide 3Nos of 8mm ø bar Fe415 steel bar
Stirrups	8mm dia 2 legged stirrup 170mmc/c

3.3Design of Sunshade:

Data

Assume on conforni thickness of 150 mm width of effective depth of 130mm. Consider 1m length of sunshade.

Self-weight of sunshade = 1x 0.6 x 0.15 x 25

= 2.25 kN

Factored load (W) = 2.25 x 1.5

= 3.37 kN/m

To Find Moment

$$Mu = \frac{W \times L}{2}$$

$$= \frac{3.37 \times 10^3 \times 600}{2}$$

$$= 1.01 \times 10^6 \text{ N mm}$$

To Find Area of Steel Requirement

$$Mu = 0.87 \times f_y \times A_{st} \times d \times \left(1 - \frac{A_{st} \times f_y}{F_{ck} \times bd}\right)$$

$$0.87 \times 415 \times A_{st} \times 130 \times \left(1 - \frac{A_{st} \times 415}{25 \times 1000 \times 130}\right)$$

A_{st} = 21.72 mm^2

A_{st} min = 0.12 % x b x d

= 0.12 /100 x 1000 x 150

= 180 mm^2

$$= \frac{\pi}{4} \times 6^2$$

= 28.27 mm^2

No of bars = $\frac{A_{st}}{a_{st}}$

$$= \frac{180}{28.27}$$

= 6 Nos

Provide 6Nos of 6mm ø main bar @ 157mm C/C.

Details

Length = 600 mm

Thickness of slab = 150 mm

Main reinforcement 6 nos of 6 mm Ø @ 157 mm c/c.

Distributor 6 nos of 6 mm Ø @ 180 mm c/c

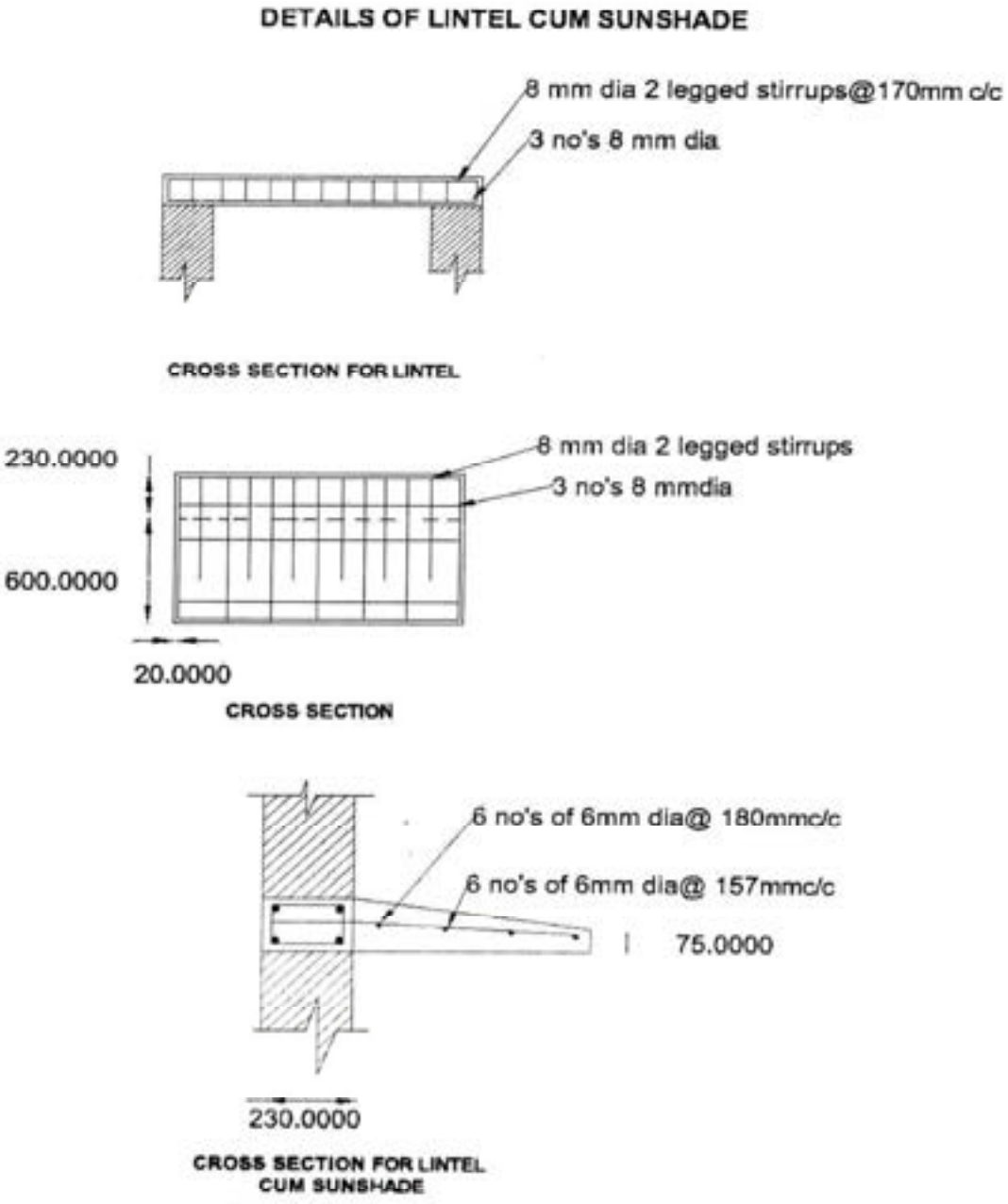


Figure 3.1 Reinforcement details of lintel cum sunshade

3.4 Design of Dog Legged Staircase:

Given Data

Rise	= 180 mm
Tread	= 300 mm
L	= 3400 mm
B	= 2440 mm
F_{ck}	= 25 N/mm^2
F_y	= 415 N/mm^2
No of steps	= 20 No's

To Find Dimensions

$\frac{span}{depth}$ = 20

$\frac{3400}{depth}$ = 20

d = 170 mm

Assume 10 mm dia & NC 15 mm

Over all depth (D) = d + N

= 170+15

= 185 mm

= 4.62 kN/m

To Find Load Calculation:

Dead loads of slab on slope Wd = 0.185 x 1 x 25

= 4.62 kN/m

3.5 Design of Septic Tank:

Number of Users = 1000

Rate of water supply = 135 lit/head/day

The quantity of water supplied = Per capita rate X Population

= 1000 X 135

= 135,000 lit/day

Assuming that 80% of water supplied becomes sewage, we have the quantity of sewage produced.

= 135000 x 0.8

= 108000 lit/day

Assuming the detention time to be 24 hours, we have

The quantity of sewage produced during the detention period (i.e., the capacity of the tank)

= (108000 x 24)/24

= 108000 liters

Now assuming the rate of deposited sludge as 30 liters/capita/year; and also assuming the period of cleaning as 1 year, we have

The Volume of Sludge deposited

= 30 x 1000 x 1

= 30000 liters Total required capacity of the tank

= Capacity for sewage + Capacity for sludge

= 108000 + 30000

= 138000 liters

= 138cu-m

Assuming 3 m as the depth of the tank, we have

The surface area of the tank = $138/3\ m^2$

= $46\ m^2$

If the ratio of the length to width is kept as 31, we have

3B x B	= 46
B^2	= 46 / 3
	= 15.33
say	= 4m
Provide Width	= 4m
Provide length of the tank	= 12 m
Area of cross-section provided	= 12 x 4
	= $48\ m^2$ (same as required)

Thus, the dimensions of the septic tank will be 12 m x 4 m x (3 + 0.3) m overall depth, [0.3 m used as free-board]

Hence, Use a tank of size is (12 x 4 x 3.3) m

Design of Dispersion Trench:

Flow of sewage per day = 135

Extra flow taken for future expansion = 12.15 m^3

Assume the percolating capacity of Filter media of the pit as = 1.25 $m^3/m^2/day$

Volume of pit required = 147.15 / 1.25

= 117.72 m^3

Assume the depth of pit 3.5 m below the invert level the inlet pipe.

Area required = 117.72 / 3.5

= 33.63m^2

D = $\sqrt{(4x7.08/3.14)}$

D = 6.5 m

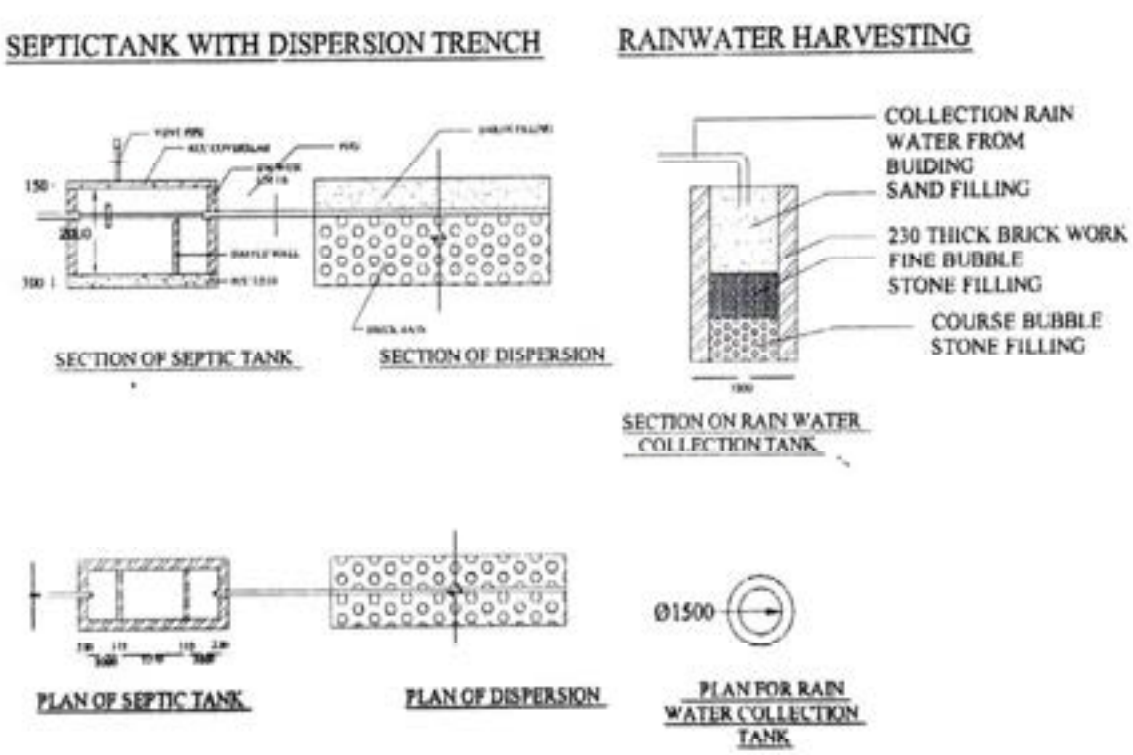


Figure 3.2 Details of Septic Tank

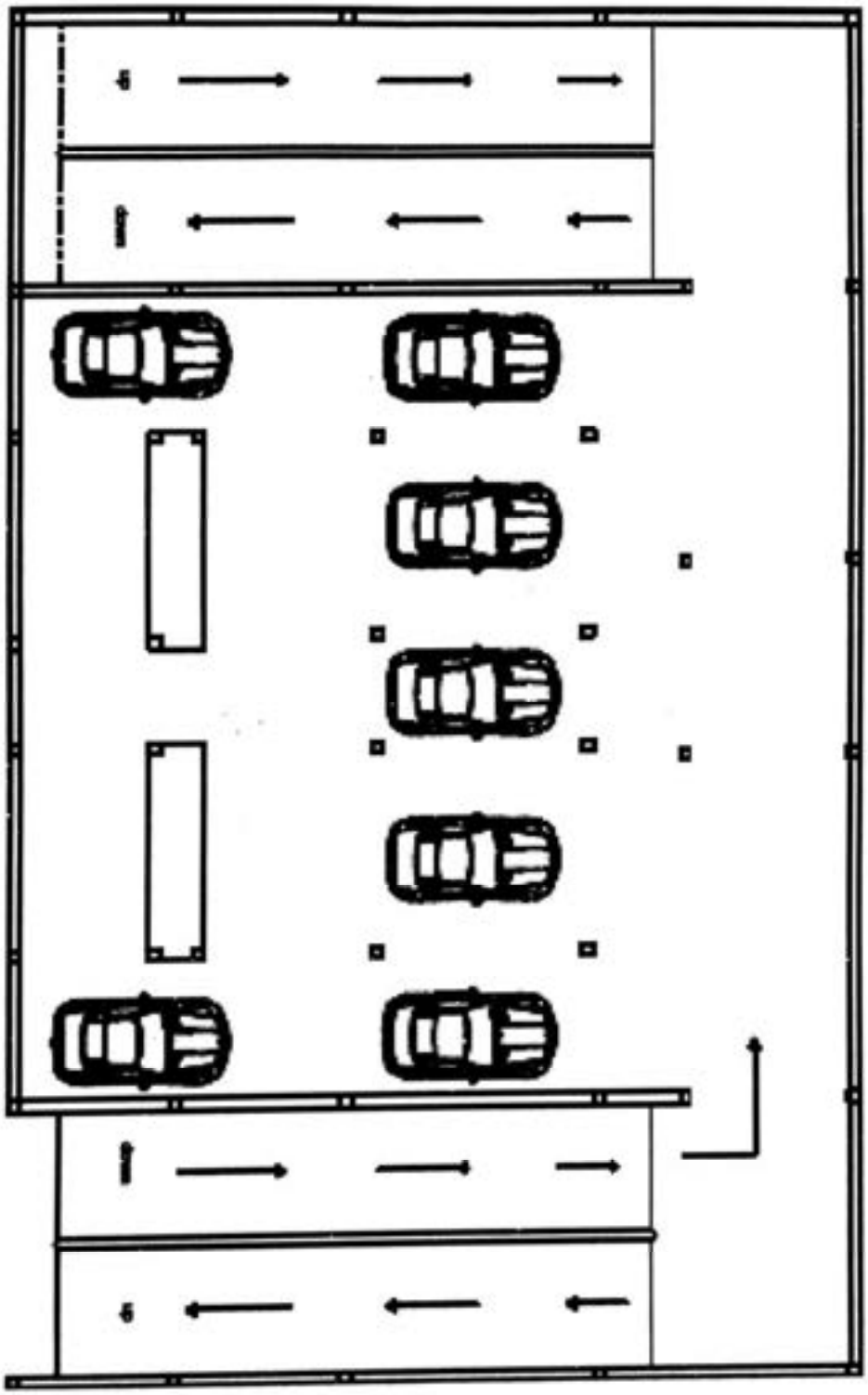
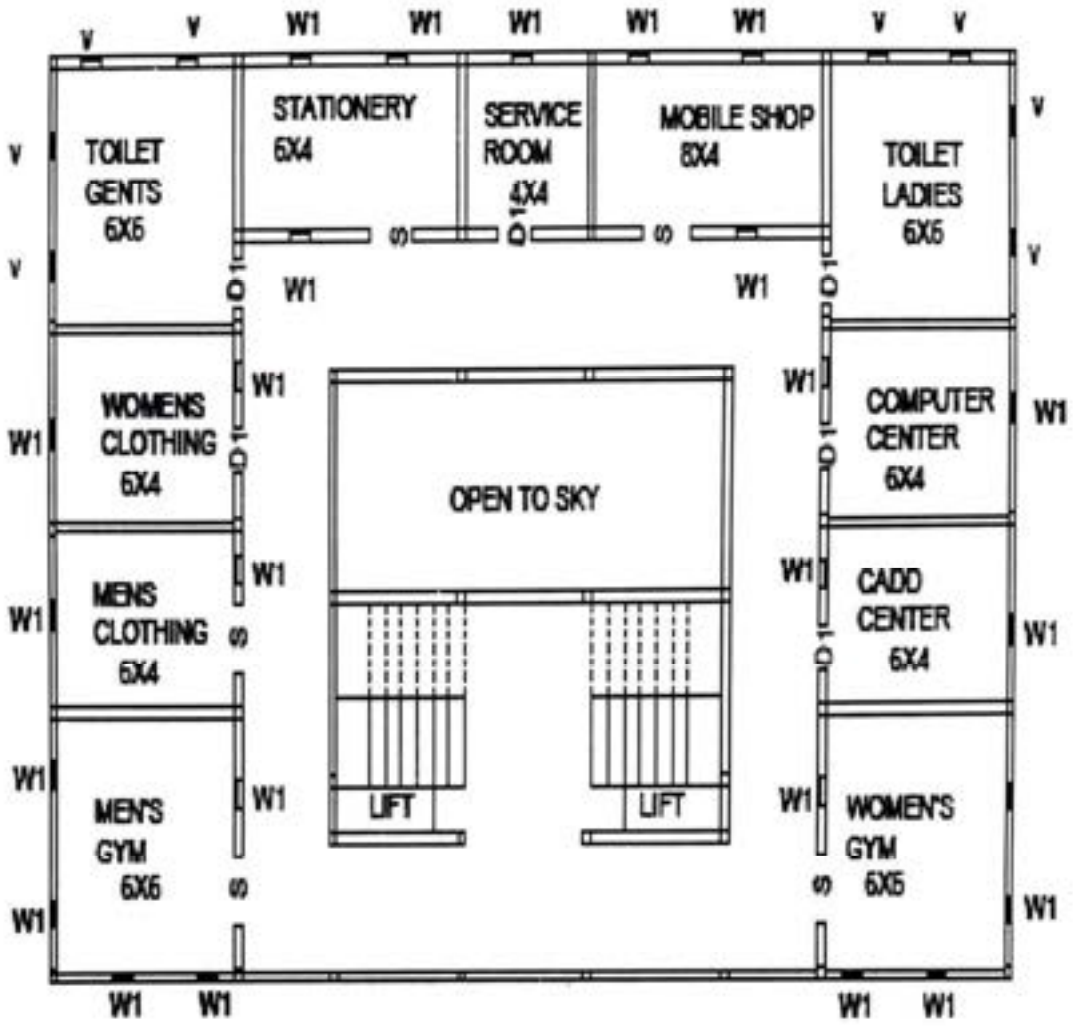


Figure 3.3 Parking



SPECIFICATIONS

D1=1x2x0.23

W1=0.60x0.60x0.23

MD = 2X2X0.23

V=0.60x0.25x0.23

LIFT =3x1

SHUTTER=1.5X2X0.23

ALL DIMENSIONS ARE IN m

Figure 3.3 First Floor

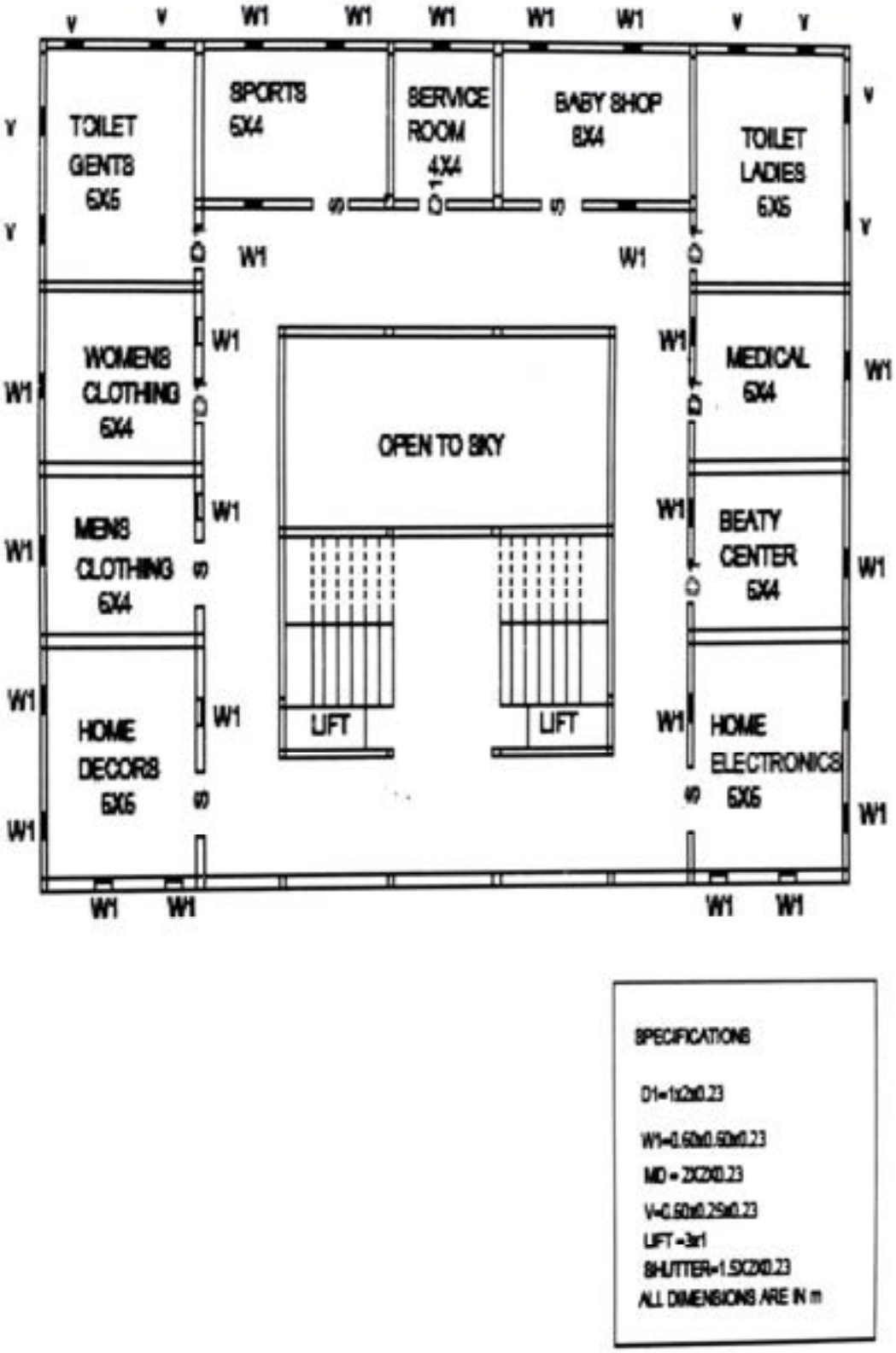


Figure 3.4 second Floor

CHAPTER 4

ANALYSIS USING STAAD Pro

Inputs:

Nodes

Node	X (m)	Y (m)	Z (m)
1	-4.415	44.107	0.000
2	19.355	44.107	0.000
3	25.355	44.107	-19.770
4	-4.415	44.107	-19.770
5	19.355	44.107	-14.985
6	1.585	44.107	-14.985
7	1.585	44.107	0.000
8	19.355	44.107	-1.015
9	25.355	44.107	-1.015
10	22.370	44.107	-14.985
11	22.370	44.107	-1.015
12	25.355	44.107	-14.985
13	-1.400	44.107	-14.985
14	-1.400	44.107	0.000
15	-4.415	44.107	-14.985
16	25.355	44.107	0.000
84	-4.415	48.607	0.000
85	19.355	48.607	0.000
86	25.355	48.607	-19.770
87	-4.415	48.607	-19.770
88	19.355	48.607	-14.985
89	1.585	48.607	-14.985
90	1.585	48.607	0.000
91	19.355	48.607	-1.015
92	25.355	48.607	-1.015
93	22.370	48.607	-14.985
94	22.370	48.607	-1.015
95	25.355	48.607	-14.985
96	-1.400	48.607	-14.985
97	-1.400	48.607	0.000
98	-4.415	48.607	-14.985
99	25.355	48.607	0.000
100	4.325	48.607	-2.885
101	16.607	48.607	-2.885
103	4.325	48.607	-12.886
104	1.325	48.607	-19.726
105	1.385	48.607	0.208
106	-4.415	48.607	-5.655

107	1.367	48.607	-5.655
108	-4.415	48.607	-9.540
109	1.356	48.607	-9.540
111	-4.415	48.607	-13.885
112	1.343	48.607	-13.885
113	16.585	48.607	-12.885
114	19.647	48.607	0.137
115	19.585	48.607	-19.540
116	25.393	48.607	-5.655
117	19.629	48.607	-5.655
118	25.382	48.607	-9.655
119	19.616	48.607	-9.655
120	19.603	48.607	-13.885
121	25.370	48.607	-13.885
122	8.440	48.607	-12.885
123	10.440	48.607	-12.885
124	8.326	48.607	-19.672
125	8.325	48.607	-15.902
126	12.334	48.607	-15.912
127	12.323	48.607	-19.641
128	8.210	48.607	-12.885
129	12.210	48.607	-12.885
130	4.325	48.607	-8.119
131	16.585	48.607	-8.115
132	19.596	48.607	-15.930
133	1.337	48.607	-15.885
134	-4.415	53.107	0.000
135	19.355	53.107	0.000
136	25.355	53.107	-19.770
137	-4.415	53.107	-19.770
138	19.355	53.107	-14.985
139	1.585	53.107	-14.985
140	1.585	53.107	0.000
141	19.355	53.107	-1.015
142	25.355	53.107	-1.015
143	22.370	53.107	-14.985
144	22.370	53.107	-1.015
145	25.355	53.107	-14.985
146	-1.400	53.107	-14.985
147	-1.400	53.107	0.000
148	-4.415	53.107	-14.985
149	25.355	53.107	0.000
150	4.325	53.107	-2.885
151	16.607	53.107	-2.885
152	4.325	53.107	-12.886
153	1.325	53.107	-19.726
154	1.385	53.107	0.208
155	-4.415	53.107	-5.655
156	1.367	53.107	-5.655

157	-4.415	53.107	-9.540
158	1.356	53.107	-9.540
159	-4.415	53.107	-13.885
160	1.343	53.107	-13.885
161	16.585	53.107	-12.885
162	19.647	53.107	0.137
163	19.585	53.107	-19.540
164	25.393	53.107	-5.655
165	19.629	53.107	-5.655
166	25.382	53.107	-9.655
167	19.616	53.107	-9.655
168	19.603	53.107	-13.885
169	25.370	53.107	-13.885
170	8.440	53.107	-12.885
171	10.440	53.107	-12.885
172	8.326	53.107	-19.672
173	8.325	53.107	-15.902
174	12.334	53.107	-15.912
175	12.323	53.107	-19.641
176	8.210	53.107	-12.885
177	12.210	53.107	-12.885
178	4.325	53.107	-8.119
179	16.585	53.107	-8.115
180	19.596	53.107	-15.930
181	1.337	53.107	-15.885
182	-4.415	57.607	0.000
183	19.355	57.607	0.000
184	25.355	57.607	-19.770
185	-4.415	57.607	-19.770
186	19.355	57.607	-14.985
187	1.585	57.607	-14.985
188	1.585	57.607	0.000
189	19.355	57.607	-1.015
190	25.355	57.607	-1.015
191	22.370	57.607	-14.985
192	22.370	57.607	-1.015
193	25.355	57.607	-14.985
194	-1.400	57.607	-14.985
195	-1.400	57.607	0.000
196	-4.415	57.607	-14.985
197	25.355	57.607	0.000
198	4.325	57.607	-2.885
199	16.607	57.607	-2.885

Beams:

Beam	Node A	Node B	Length (m)	Property	(degrees)
1	1	2	23.770	4	0
2	3	4	29.770	4	0
3	1	4	19.770	4	0
4	2	5	14.985	4	0
5	6	7	14.985	4	0
6	8	9	6.000	4	0
7	10	11	13.970	4	0
8	5	12	6.000	4	0
9	13	14	14.985	4	0
10	15	6	6.000	4	0
11	16	3	19.770	4	0
54	1	84	4.500	4	0
55	2	85	4.500	4	0
56	3	86	4.500	4	0
57	4	87	4.500	4	0
58	5	88	4.500	4	0
59	6	89	4.500	4	0
60	7	90	4.500	4	0
61	8	91	4.500	4	0
62	9	92	4.500	4	0
63	10	93	4.500	4	0
64	11	94	4.500	4	0
65	12	95	4.500	4	0
66	13	96	4.500	4	0
67	14	97	4.500	4	0
68	15	98	4.500	4	0
69	16	99	4.500	4	0
70	84	85	23.770	4	0
71	86	87	29.770	4	0
73	85	88	14.985	4	0
74	89	90	14.985	4	0
75	91	92	6.000	4	0
76	93	94	13.970	4	0
77	88	95	6.000	4	0
78	96	97	14.985	4	0
79	98	89	6.000	4	0
80	99	86	19.770	4	0
81	100	101	12.282	4	0
83	103	130	4.768	4	0

84	104	133	3.841	4	0
87	107	105	5.863	4	0
88	106	107	5.783	4	0
91	109	107	3.885	4	0
92	108	109	5.771	4	0
98	112	109	4.345	4	0
99	111	112	5.758	4	0
100	101	113	10.000	4	0
101	114	117	5.792	4	0
102	117	119	4.000	4	0
103	116	117	5.765	4	0
104	119	120	4.230	4	0
105	118	119	5.766	4	0
106	120	132	2.045	4	0
107	120	121	5.768	4	0
108	103	128	3.885	4	0
109	123	129	1.770	4	0
110	124	125	3.769	4	0
111	126	127	3.729	4	0
112	128	122	0.230	4	0
113	129	113	4.375	4	0
114	128	129	4.000	4	0
115	130	100	5.234	4	0
116	130	131	12.260	4	0
117	132	115	3.610	4	0
118	133	112	2.000	4	0
119	132	133	18.259	4	0
120	87	84	19.770	4	0
121	84	134	4.500	4	0
122	85	135	4.500	4	0
123	86	136	4.500	4	0
124	87	137	4.500	4	0
125	88	138	4.500	4	0
126	89	139	4.500	4	0
127	90	140	4.500	4	0
128	91	141	4.500	4	0
129	92	142	4.500	4	0
130	93	143	4.500	4	0
131	94	144	4.500	4	0
132	95	145	4.500	4	0
133	96	146	4.500	4	0
134	97	147	4.500	4	0
135	98	148	4.500	4	0
136	99	149	4.500	4	0
137	100	150	4.500	4	0
138	101	151	4.500	4	0
139	103	152	4.500	4	0
140	104	153	4.500	4	0
141	105	154	4.500	4	0

142	106	155	4.500	4	0
143	107	156	4.500	4	0
144	108	157	4.500	4	0
145	109	158	4.500	4	0
146	111	159	4.500	4	0
147	112	160	4.500	4	0
148	113	161	4.500	4	0
149	114	162	4.500	4	0
150	115	163	4.500	4	0
151	116	164	4.500	4	0
152	117	165	4.500	4	0
153	118	166	4.500	4	0
154	119	167	4.500	4	0
155	120	168	4.500	4	0
156	121	169	4.500	4	0
157	122	170	4.500	4	0
158	123	171	4.500	4	0
159	124	172	4.500	4	0
160	125	173	4.500	4	0
161	126	174	4.500	4	0
162	127	175	4.500	4	0
163	128	176	4.500	4	0
164	129	177	4.500	4	0
165	130	178	4.500	4	0
166	131	179	4.500	4	0
167	132	180	4.500	4	0
168	133	181	4.500	4	0
169	134	135	23.770	4	0
170	136	137	29.770	4	0
171	135	138	14.985	4	0
172	139	140	14.985	4	0
173	141	142	6.000	4	0
174	143	144	13.970	4	0
175	138	145	6.000	4	0
176	146	147	14.985	4	0
177	148	139	6.000	4	0
178	149	136	19.770	4	0
179	150	151	12.282	4	0
180	152	178	4.768	4	0
181	153	181	3.841	4	0
182	156	154	5.863	4	0
183	155	156	5.783	4	0
184	158	156	3.885	4	0
185	157	158	5.771	4	0
186	160	158	4.345	4	0
187	159	160	5.758	4	0
188	151	161	10.000	4	0
189	162	165	5.792	4	0
190	165	167	4.000	4	0

191	164	165	5.765	4	0
192	167	168	4.230	4	0
193	166	167	5.766	4	0
194	168	180	2.045	4	0
195	168	169	5.768	4	0
196	152	176	3.885	4	0
197	171	177	1.770	4	0
198	172	173	3.769	4	0
199	174	175	3.729	4	0
200	176	170	0.230	4	0

Plates:

Plate	Node A	Node B	Node C	Node D	Property
401	1	2	85	84	2
402	3	4	87	86	2
403	1	4	87	84	2
404	2	5	88	85	2
405	6	7	90	89	2
406	8	9	92	91	2
407	10	11	94	93	2
408	5	12	95	88	2
409	13	14	97	96	2
410	15	6	89	98	2
411	16	3	86	99	2
412	84	85	135	134	2
413	86	87	137	136	2
414	85	88	138	135	2
415	89	90	140	139	2
416	91	92	142	141	2
417	93	94	144	143	2
418	88	95	145	138	2
419	96	97	147	146	2
420	98	89	139	148	2
421	99	86	136	149	2
423	103	130	178	152	2
424	104	133	181	153	2
425	107	105	154	156	2
426	106	107	156	155	2
427	109	107	156	158	2
428	108	109	158	157	2
429	112	109	158	160	2
430	111	112	160	159	2
431	101	113	161	151	2
432	114	117	165	162	2
433	117	119	167	165	2
434	116	117	165	164	2
435	119	120	168	167	2
436	118	119	167	166	2
437	120	132	180	168	2

438	120	121	169	168	2
439	103	128	176	152	2
440	124	125	173	172	2
441	126	127	175	174	2
442	129	113	161	177	2
443	130	100	150	178	2
444	130	131	179	178	2
445	132	115	163	180	2
446	133	112	160	181	2
447	132	133	181	180	2
448	87	84	134	137	2
449	128	176	170	122	2
450	129	177	171	123	2
451	134	135	183	182	2
452	136	137	185	184	2
453	135	138	186	183	2
454	139	140	188	187	2
455	141	142	190	189	2
456	143	144	192	191	2
457	138	145	193	186	2
458	146	147	195	194	2
459	148	139	187	196	2
460	149	136	184	197	2
461	150	151	199	198	2
462	152	178	226	200	2
463	153	181	229	201	2
464	156	154	202	204	2
465	155	156	204	203	2
466	158	156	204	206	2
467	157	158	206	205	2
468	160	158	206	208	2
469	159	160	208	207	2
470	151	161	209	199	2
471	162	165	213	210	2
472	165	167	215	213	2
473	164	165	213	212	2
474	167	168	216	215	2
475	166	167	215	214	2
476	168	180	228	216	2
477	168	169	217	216	2
478	152	176	224	200	2
479	172	173	221	220	2
480	174	175	223	222	2
481	177	161	209	225	2
482	178	150	198	226	2
483	178	179	227	226	2
484	180	163	211	228	2
485	181	160	208	229	2
486	180	181	229	228	2

487	137	134	182	185	2
488	176	224	218	170	2
489	177	225	219	171	2
490	182	183	231	230	2
491	184	185	233	232	2
492	183	186	234	231	2
493	187	188	236	235	2
494	189	190	238	237	2
495	191	192	240	239	2
496	186	193	241	234	2
497	194	195	243	242	2
498	196	187	235	244	2
499	197	184	232	245	2
500	198	199	247	246	2
501	200	226	274	248	2

Section Properties:

Prop	Section	Area (cm^2)	Iyy (cm^4)	Izz (cm^4)	J (cm^4)	Material
4	Rect 0.23x0.26	598.000	33.7E 3	26.4E 3	49.7E 3	CONCRETE

Plate Properties:

Prop	Node A (cm)	Node B (cm)	Node C (cm)	Node D (cm)	Material
2	23.000	23.000	23.000	23.000	CONCRETE

Materials:

Mat	Name	E (kN/mm^2)	v	Density (kg/m^3)	α (/°C)
1	STEEL	205.000	0.300	7.83E 3	12E -6
2	STAINLESSSTEEL	197.930	0.300	7.83E 3	18E -6
3	ALUMINUM	68.948	0.330	2.71E 3	23E -6
4	CONCRETE	21.718	0.170	2.4E 3	10E -6

Supports:

Node	X (kN/mm)	Y (kN/mm)	Z (kN/mm)	rX (kN-m/deg)	rY (kN-m/deg)	rZ (kN-m/deg)
278	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
279	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
280	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
281	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
282	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
283	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
284	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
285	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
286	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
287	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
288	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
289	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

290	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
291	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
292	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
293	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

Releases

There is no data of this type.

Primary Load Cases

Number	Name	Type
1	LOAD CASE 1	Dead
2	LOAD CASE 2	Live

Combination Load Cases

There is no data of this type.

Load Generators

There is no data of this type.

LOAD CASE 1: Self weight

Direction	Factor	Assigned Geometry
Y	-1.000	1 - 11, 54 - 71, 73 - 81, 83, 84, 87, 88, 91, 92, 98 - 533

LOAD CASE 2: Beam Loads

Beam	Type	Direction	Fa	Da(m)	Fb	Db	Ecc.(m)
1	UNI kN/m	GY	-3.000	-	-	-	-
2	UNI kN/m	GY	-3.000	-	-	-	-
3	UNI kN/m	GY	-3.000	-	-	-	-
4	UNI kN/m	GY	-3.000	-	-	-	-
5	UNI kN/m	GY	-3.000	-	-	-	-
6	UNI kN/m	GY	-3.000	-	-	-	-
7	UNI kN/m	GY	-3.000	-	-	-	-
8	UNI kN/m	GY	-3.000	-	-	-	-
9	UNI kN/m	GY	-3.000	-	-	-	-
10	UNI kN/m	GY	-3.000	-	-	-	-
11	UNI kN/m	GY	-3.000	-	-	-	-
54	UNI kN/m	GY	-3.000	-	-	-	-
55	UNI kN/m	GY	-3.000	-	-	-	-
56	UNI kN/m	GY	-3.000	-	-	-	-
57	UNI kN/m	GY	-3.000	-	-	-	-
58	UNI kN/m	GY	-3.000	-	-	-	-

59	UNI kN/m	GY	-3.000	-	-	-	-
60	UNI kN/m	GY	-3.000	-	-	-	-
61	UNI kN/m	GY	-3.000	-	-	-	-
62	UNI kN/m	GY	-3.000	-	-	-	-
63	UNI kN/m	GY	-3.000	-	-	-	-
64	UNI kN/m	GY	-3.000	-	-	-	-
65	UNI kN/m	GY	-3.000	-	-	-	-
66	UNI kN/m	GY	-3.000	-	-	-	-

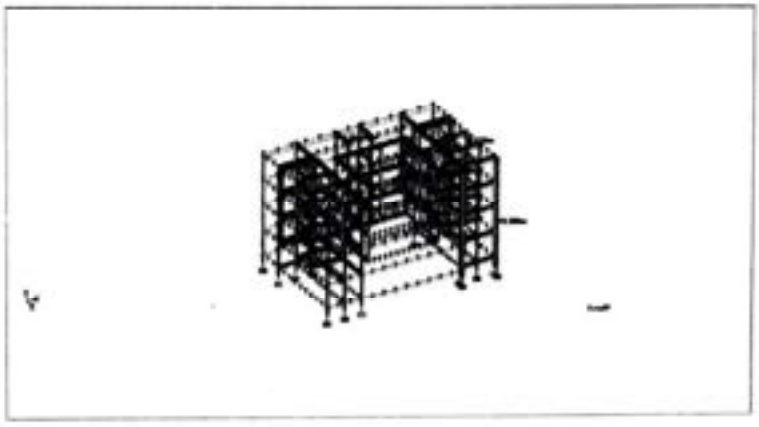


Figure 4.1 Whole Structure (Input data was modified after picture taken)

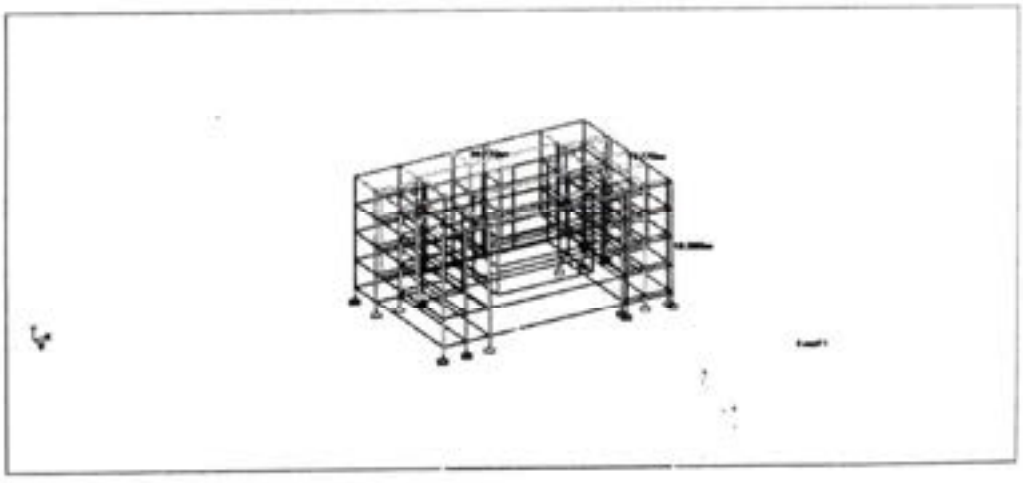


Figure 4.2 Whole Structure (Input data was modified after picture taken)

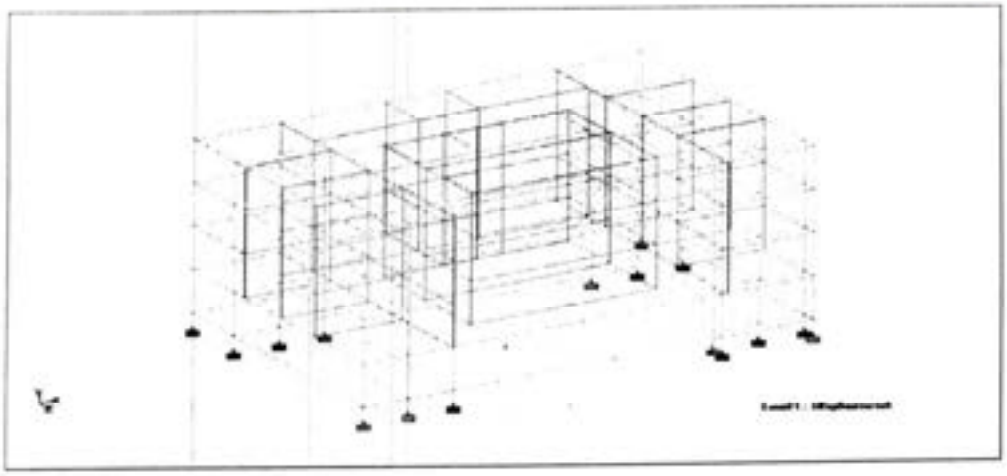


Figure 4.3 Whole Structure Displacements 1000mm:1m 1 LOAD CASE 1

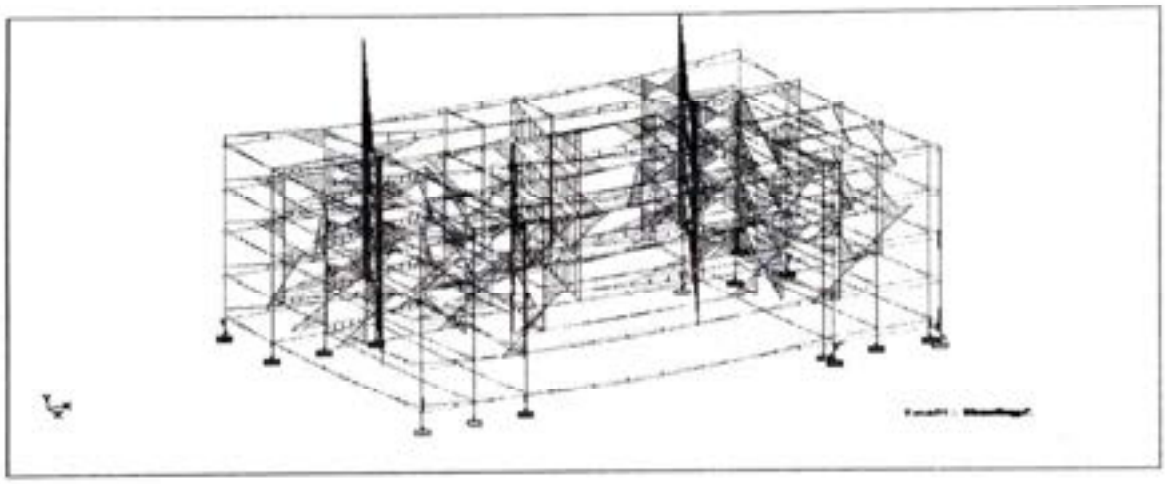


Figure 4.4 Whole Structure Mz 100kNm:1m 1 LOAD CASE 1

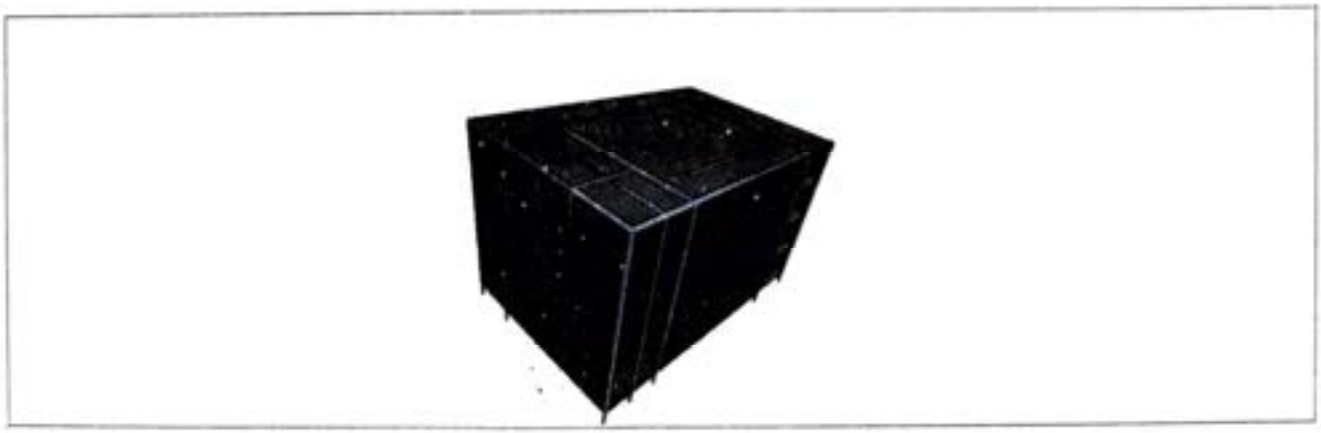


Figure 4.5 3D Rendered View

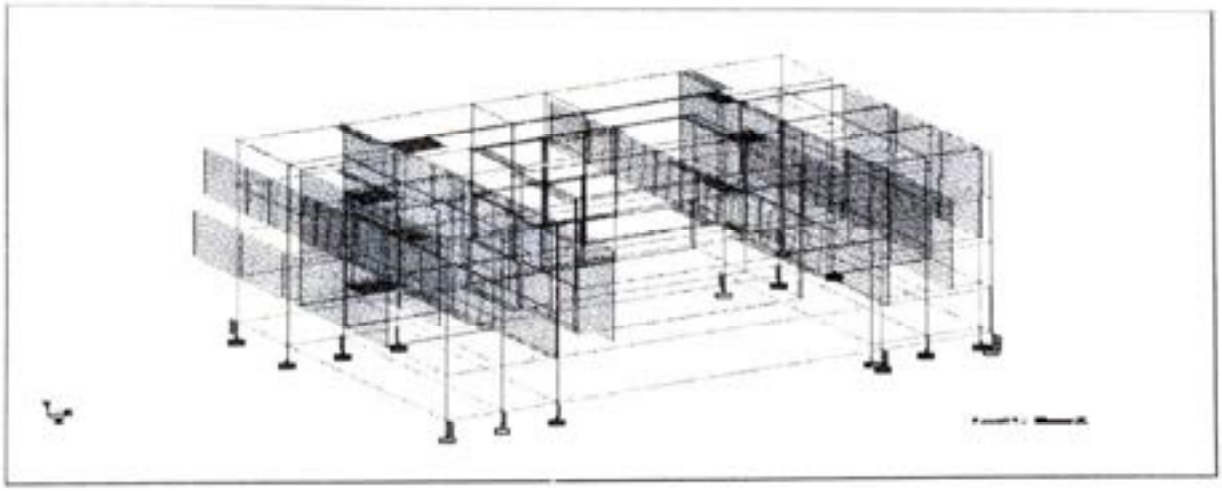


Figure 4.6 Whole Structure Fz 100kN:1m 1 LOAD CASE 1

CONCLUSION

A three storey R.C.C framed structure is designed as a shopping mall this design adopted in limit state method of design M_{20} grade of concrete and Fe_{415} grade of steel are used. All structural elements are designed as balanced section. Analysis of the frame is carried out by substitute frame method.

The Planning Analysis and Design of Apartment building are done carefully based upon the knowledge obtained from the theoretical studies and guide lines from IS 456:2000 and SP-16.The Planning of the building is made as per the guideline of NBC.

The design of slabs, beams, column pile foundation and staircase were done manually and the analysis is done by using STAAD Pro software. All the drawings presented in this project report were drafted using AUTOCAD 2012 software. The beams have been designed by taking both bending moment and shear force from the analysis result into consideration.

The shopping mall which we designed is good in economical as well as commercial.

REFERENCES

1. "Design of reinforced concrete structures" by N.Krishna Raju and R.N.Pranesh, published by New Age International (p) Ltd.
2. "Foundation engineering" by P.C.Varghese, published by Prentice-Hall of India pvt ltd.
3. IS 456: 2000 'Code of practice for Plain Cement and Reinforced Concrete', by Bureau of Indian Standards, New Delhi.
4. IS 875 (part 1-5): 1987 'Code of practice for Design Load for Structures', by Bureau of Indian Standards, New Delhi.
5. Standard Data Book (National Code – 2005) published by Bureau of Indian Standards.

PLANNING, ANALYSIS AND DESIGN OF RESIDENTIAL BUILDING

A PROJECT REPORT

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in

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(AUTONOMOUS)

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ABSTRACT

This Project work deals with the Planning Analysis and Design of Residential building. It is a RC framed structure consists of two storey. This plan includes all the requirements of residential building.

This structure is analyzed and designed by manual design. The code refers for this project are NBC, IS 456-2000.

The concrete mix used for slabs, beams, columns, column footing is of M_{25}. The steel strength for all members are high yield strength deformed bars of grade Fe_{415}

For the design of the slab, beams, columns, and footings LIMIT STATE METHOD of design has been adopted.

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CHAPTER 1

INTRODUCTION

The residential building means like house or home to the usage of living peoples in safely and create a healthy family.The study of ventilation in residential buildings is aimed at understanding the role that air leakage, infiltration, mechanical ventilation, natural ventilation and building use have on providing acceptable indoor air quality so that energy and related costs can be minimized without negatively impacting indoor air quality.

Risks to human health and safety caused by inappropriate changes to ventilation and air tightness can be a major barrier to achieving high performance buildings and must be considered. This research area focuses primarily on residential and other small buildings where the interaction of the envelope is important and energy costs are dominated by space conditioning energy rather than air transport energy. A building used for dwelling purposes is known as residential buildings.

Double bed room houses are more advantages such houses do not have limited budget.All bed rooms can be on Ground floor or can be designed on different floors.Sizes of various bed rooms depend on the plot area and personal likings of the users.

CHAPTER 2

SYNOPSIS

Planning analysis and designing of Residential building with double bed rooms is our project which is to propose at namakkal Dt.

SCOPE OF THE PROJECT:

The Residential building consists of a,

- Living and dining
- Master bed room 1
- Bed room 2
- Store room
- kitchen
- Bath & toilet

BRIEF METHODOLOGY:

Drafting method for design the plan is by Auto cad . The framed type of construction is used for the construction and the designing of structure is carried out by limit state method with the IS 456: 2000 code book. The analysis is carried out by using limit state method.

The center line method of estimation is carried out for calculating the quantity and the rates are adapted from the current government rates .The availability of men and materials is in local itself.

EXPECTED OUTCOME:

The plan and structural elements such as slab, beam, column and footings are designed using limit state method. This project helps us in exploring knowledge about planning, analyzing and designing a Residential Building with triple bed rooms.

CHAPTER 3

LIST OF NOTATIONS

The following letter symbols have the meaning indicated against each which is used in this project book.

B	=	Breadth of the beam or slab.
D	=	Overall depth of beam or slab.
d	=	Effective depth of beam or slab.
F_{ck}	=	Characteristic strength of the concrete.
F_y	=	Characteristic strength of the steel.
K	=	Constant of co-efficient of factor.
L_{ex}	=	Effective length of shorter side of slab.
L_{ey}	=	Effective length of longer side of slab.
SV	=	Spacing of stirrups.
V	=	Shear force.
Vu	=	Design Shear force.
W	=	total load.
Wu	=	Factored load.
σ_{cbc}	=	Compressive bending stress in concrete.
σ_{max}	=	Maximum shear stress in concrete with shear.
B_V	=	Basic value.
Mf	=	Modification factor.
F_U	=	Factored live load.
Le	=	Effective length.
A_{st}	=	Area of tension steel
A_{sc}	=	Area of compression steel
A_{CC}	=	Area of concrete
A_{SV}	=	Total cross sectional area of stripes
F.F.L	=	Floor finish load
D.L	=	Dead load

C.C	=	Cement concrete
C.M	=	Cement mortar
R.C.C	=	Reinforced cement concrete
P	=	Axial load
L	=	clear span
M.R	=	Moment of resistance
C/C	=	Center to center distance
S.F	=	Shear force
M	=	Modular ratio
MBM	=	Maximum bending moment
C.C	=	Clear cover
W.S	=	Width of support
N.C	=	Nominal cover
τ_v	=	Actual shear stress
$\tau_{c\,max}$	=	Maximum shear stress
τ_c	=	Permissible shear stress
Q_U	=	Moment of resistance co-efficient
Ag	=	Gross sectional area of column
Ast_{req}	=	Area of tension steel required
Ast_{prov}	=	Area of tension steel provided
#	=	Diameter of bars
S_C	=	Stress in concrete
S_s	=	Stress in steel

STAAD SYMBOLS:

M_z	=	Bending moment
F_y	=	Shear force
F_x	=	Axial shear force
M_{30}	=	Grade of concrete
V_Y	=	Shear strength

L_D	=	Length of beam
P_{UZ}	=	Strength of column
IR	=	Interaction ratio

CHAPTER 4

SPECIFICATION

I. FOUNDATION:-

Earth work excavation for foundation for all column footings will be excavated and will be in cement concrete 1:1:2 mix, 800 mm wide and 800 mm thick laid at 1250 mm below ground level. The masonry footings will be in brickwork in cement mortar 1:6. The footing size is 800 x 800 mm. The foundation concrete for framed structure ,all main wall and footing of cement concrete of 1:1:2 mix, will be provided .

II. BASEMENT:-

The basement will be in 1st class brick work in cement mortar 1:5, and 300 mm thick above ground level for all walls. The basement will be filled with clean sand to a depth of 200 mm. A damp proof course in cement mortar 1:3, 50 thick will be provided for all walls at basement level.

III. SAND FILLING IN BASEMENT:-

The basement filled up with clean sand to a depth of 300mm and it should be compacted with water as per standard specifications.

IV. DAMP PROOF COURSE:-

A Damp proof course using cement mortar 1:3 of 50mm thick will be Provide for all main walls at basement level.

V.FLOORING CONCRETE:-

The flooring concrete of 1:1:2 mix with suitable thick will be provided should be finished above the sand filling and it by mosaic tiles.

VI. SUPER STRUCTURE:-

All the walls will be in I class brick work in cement mortar 1:5, using first class bricks, and 230 mm thick. The height of all walls will be 3000 mm above floor level. All the walls including basement will be plastered smooth with cement mortar 1:4 externally and 1:6 internally for 12.5 thick. Parapet walls 230 mm thick and 1000 mm high will be provided all around. The beams and

columns sizes as 300mm x440 mm and 300x300mm will be provided all around.

VII. ROOFING:-

The roofing will be of R.C.C 1:1:2 mix, 150 mm thick flat slabs over all the rooms. A weathering course in brick jelly lime concrete plastered with combination mortar 1:1:2 mix, 75 mm thick will be provided over the slab.

VIII. LINTEL:-

All internal wall openings will be provided with R.C.C lintel 1:1:2mix, 120 mm thick and all external walls openings will be provided with lintel cum sunshade 1:1:2 mix, 120 mm thick and sunshade will be 600 mm wide.

IX. SUNSHADE:-

600mm wide projections with 150mm thick at fixed end and 50mm thick at free end will be provided for all external opening using R.C.C 1:1:2 mix.

X.PLASTERING FOR SUPER STRUCTURE:-

All walls will be plastered smooth surface with cement Mortar 1:3, 12 mm thick.

XI.SOUND PROOFING FOR CEILING & WALL:-

In ceiling of all rooms and walls are soundproofed with latest type soundproofing material.

XII. WEATHERING COURSE:-

A Weathering course using brick jelly concrete will be provided average 75 mm thick over the slab and finished with two course of hydraulic pressed Mangalore flat tiles using cement mortar 1:5 mixed with 10% of crude oil.

XIII. WHITE WASHING:-

One primer coat and two coats of colour wash to be done for all plastered wall surface.

XVI. STEPS:-

The step will be in brick work in cement mortar 1:5,

Rise =150 mm,

Tread =300 mm.

CHAPTER 5

STRUCTURAL DESIGN

5.1 DESIGN OF TWOWAY SLAB FOR BED ROOM 2

AVAILABLE DATA:

f_{ck} = 25 N/mm^2

f_y = 415 N/mm^2

Room size = 4.3 x 4.8 m

Support = 230 mm

Thickness of slab = 150 mm

TYPE OF SLAB:

l_y / l_x = 11/10

= 1.1 < 2

Hence designed as two way slab

DESIGN CONSTANT :

Basic value = 32 (continuous slab)

Q_u = 3.45

OVER ALL DEPTH:

Assume Clear cover 15 mm

Diameter of main bar = 10 mm

For Shorter span,

D = 150 mm

d_{eff} = 150 - 15 -10/2 = 130 mm

For Longer span,

d = 150 -10 = 140 mm

D = 140 + 15 + 10/2 = 160 mm

EFFECTIVE SPAN:

For shorter span,

i) Center to center of supports = 4300 + 230 = 4530 mm

ii) Clear span + effective depth = 4300 + 130 = 4430 mm

For longer span,

i) Center to center of supports = 4800 + 230 = 5030 mm

ii) Clear span + effective depth = 4800 + 130 = 4930 mm

LOAD CALCULATION:

Consider 1m width of slab

Live load = 2 KN/m^2

Self weight of slab = 1 x b x D x unit weight

= 1 x 1 x 0.15 x 25

= 3.75 KN/m^2

Weight of floor finish = 1x 1 x 0.05 x 20 = 1.0 KN/m^2

Total load = 6.75 KN/m

Design load = 6.75 x 1.5 = 10.125 KN/M

FACTORED MOMENT :

l_y / l_x = 4.93 / 4.43 = 1.11

-veαx	+veαx	-veαy	+veαy
0.053	0.040	0.047	0.035

For shorter span,

$-veM_x = \alpha x\ wlx^2 = 0.053 \times 10.125 \times (4.43)^2$

$= 10.53 \times 10^6$ N.mm

$+veM_x = \alpha x\ wlx^2 = 0.040 \times 10.125 \times (4.43)^2$

$= 7.94 \times 10^6$ N.mm

For longer span,

$-veM_y = \alpha y\ wlx^2 = 0.047 \times 10.125 \times (4.43)^2$

$= 9.33 \times 10^6$ N.mm

$+veM_y = \alpha y\ wlx^2 = 0.035 \times 10.125 \times (4.43)^2$

$= 6.95 \times 10^6$ N.mm

Maximum moment $= 10.53 \times 10^6$ N.mm

DEPTH REQUIRED :

$M_u = M_u \max$

$M_u = Q_u x b \times d^2$

$d = \sqrt{M_u / Q_u b}$

$= \sqrt{10.53 \times 10^6 / 3.45 \times 1000}$

$= 55.24$ (say) 60 mm D = 80 mm

$d_{req} = d_{pro}$ 60 mm < 130 mm

TYPE OF SECTION :

$M_{u\ limit} = Q_u \times b \times d^2$

$= 3.45 \times 1000 \times 130^2$

$= 58.30 \times 10^6$ N.mm^2

$M_u < M_{u\ limit}$

DISTRIBUTOR REINFORCEMENT

A_{st} min = 0.12 / 100 x B x D

$= 0.12 / 100 \times 1000 \times 150$

$= 180$ mm^2

SPACING:

Assume 10 mm dia of bars

1) $S = a_{st} / A_{st}$min x b = 78.54 / 180 x 1000

= 440 mm

2) 5d = 5 x 130 = 650 mm

3) 450 mm

Provide 10 mm dia bars @ spacing 440 mm c/c

MAIN REINFORCEMENT:

For shorter span (max mom in shorter span)

$M_x = 0.87\ f_y A_{st}\ d\ (1 - f_y A_{st} / f_{ck} bd)$

$10.53 \times 10^6 = 0.87 \times 415 \times A_{st} \times 130$

$(1 - 415 \times A_{st} / 25 \times 1000 \times 130)$

$5.99\ A_{st}^2 - 46.93 \times 10^3 A_{st} + 10.53 \times 10^6 = 0$

$A_{st}\ min = 231.20\ mm^2$

SPACING:

Assume 10 mm dia bars

1) $S = a_{st}/A_{st} \times b = 78.54 / 231.20 \times 1000$

   $= 340$ mm

2) $3d = 3 \times 130 = 390$ mm

3) 300 mm c/c

Provide 10 mm dia bars @ spacing 300 mm c/c distance.

For longer span:

$M_y = 0.87\ fy A_{st}\ d\ (1 - fy A_{st} / bd\ fck)$

$9.33 \times 10^6 = 0.87 \times 415 \times A_{st} \times 130\ (1 - 415 \times A_{st} / 25 \times 1000 \times 130)$

$5.99\ A_{st}^2 - 46.93 \times 10^3 A_{st} + 9.33 \times 10^6 = 0$

$A_{st}\ min = 204.12\ mm^2$

SPACING:

Assume 8 mm dia bars

1) $S = 50.26 / 204.12 \times 1000 = 250$ mm

2) $3 \times d = 3 \times 130 = 390$ mm

3) 300 mm

Provide 8 mm Ø bar at spacing 250 mm c/c

CURTAILMENT:

Alternated bars are curtailed at 0.1leff from face of support

(0.1 x 4.43 = 0.443 m). The full length bars are taken to top and extended from face of support for a distance $0.1l_{eff}$ to take negative.

CHECK FOR SHEAR:

It is sufficient to check for shear along shorter span only

Nominal shear force $V_u = 10.125 \times 4.43 / 2$

$= 22.42$ KN

Nominal shear force $\tau c = V_u/bd$

$= 22.42 \times 10^3 / 1000 \times 130$

$\tau_c = 0.18$ N/mm^2

A_{st} at support $= (a_{st}/2 \times$ spacing$) \times b$

$= (78.54 / 2 \times 300) \times 1000$ (a_{st}= 10 mm dia)

$= 130.9$ mm^2

$\% A_{st} = A_{st}/ bd \times 100$

$= (130.9 / 1000 \times 130) \times 100$

$\%A_{st} = 0.1\ \%$

$\tau_c = 0.29$ N/mm^2 & $k = 1.3$

$K\tau_c = 1.3 \times 0.29$

$K\tau_c = 0.29$ N/mm^2

$\tau_c max/2 = 3.1/2 = 1.55$ N/mm^2

$\tau_c < k\tau_c < \tau_c max/2$

Hence safe in the shear

CHECK FOR DEFLECTION

Assume 10 mm dia

$Ast_{pro} = (a_{st}/ s) \times b = (78.54 / 300) \times 1000$

$= 261.8$ mm^2

% of steel $= 100\ A_{st}/ bd$

$= 100 \times 261.8 / 1000 \times 130$

$= 0.20\ \%$

$fs = 0.58 \times f_y A_{streq} / A_{stpro}$

$= 0.58 \times 415 \times 231.20 / 261.8$

$= 240$

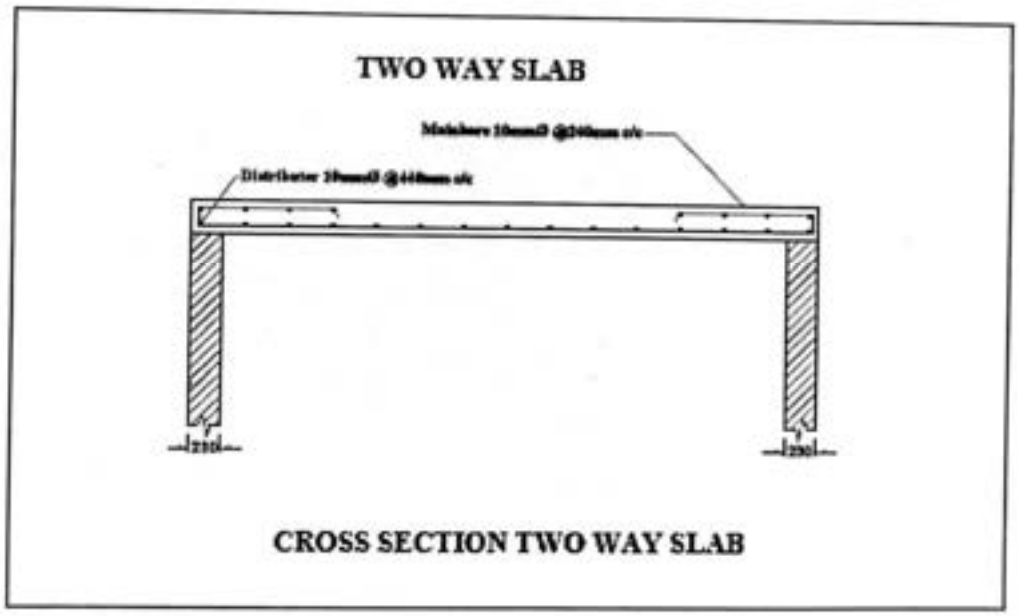
M.F =1.8

d_{avi} = span / (B_V x MF)

$= 4430 / 32 \times 1.8 = 80$ mm

$d_{req} < d_{pro}$

Hence Design Is Safe



5.2 DESIGN OF SIMPLY SUPPORTED BEAM FOR BED ROOM 2

AVAILABLE DATA:

Center to center distance l_{eff}= 5.03 m

B = 300 mm, d = 360 mm & D = 400 mm (assumption)

F_y = 415 N/mm^2 & f_{ck} = 25 N/mm^2

Q=3.45 & % A_{st} = 1.197 %

LOAD CALCULATION:

Self weight of beam = b x D x unit wt

= 0.3 x 0.4 x 25 = 3.0 KN/m

Slab floor finish = perpendicular distance x tk x unit wt

= 2.4 x 0.05 x 20 = 2.4 KN/m

Slab self wt = 2.4 x 0.15 x 25 = 9 KN/m

Wall load = 0.23 x 3.0 x 19 = 13.11 KN/m

Total load = 27.51 KN/M

Factored load = 27.51 x 1.5 F_d= 42 KN/m

FACTORED MOMENT

$M_u = (F_d \times l_{eff}^2)/8 = (42 \times 5.03^2)/8$

M_u = 132.83 KNm

SIZE OF BEAM

Equating $M_u = M_u lim$

$M_u = Q_u \times b \times d^2$ (b=2/3d)

$d = 3 \times M_u / 2 \times Q_u)^{1/3}$

$= (3 \times 132.83 \times 10^6/(2 \times 3.45))^{1/3}$

d = 400 mm > 360 mm

D = 440 mm

TYPE OF SECTION

$M_{ulim} = Q_u b\, d^2 = 3.45 \times 300 \times 360^2$

$M_{ulim} = 134.136 \times 10^6$ N.mm

$M_{ulim} > Mu$

Hence the section shall be designed as singly reinforced section

AREA OF REINFORECEMENT

$Mu = 0.87\ f_y A_{st}(d-f_y A_{st} / f_{ck} \times b)$

$132.83 \times 10^6 = 0.87 \times 415 \times A_{st} x\ 360\ (1-415A_{st} / 25 \times 300 \times 360)$

$19.97\ A_{ST}^2 - 129.97 \times 10^3 A_{ST} + 132.83 \times 10^6 = 0$

$A_{st} = 1269.71\ mm^2$

CHECK

$Xumax/d = 0.87x\ f_y x\ A_{st} / 0.36 \times f_{ck} \times b\ d$

$0.48 = (0.87 \times 415 \times A_{st}) / (0.36 \times 25 \times 300 \times 360)$

$A_{st} = 1292.23\ mm^2$

$\%Ast = Ast / bd \times 100$

$Ast = \%Ast \times bd / 100$

$= 1.197 \times 300 \times 360 / 100$

$= 1292.76\ mm^2$

Assume 20 mm dia of bars

$No.of\ bars = A_{st}/a_{st} = 1292.76 / 314.16 = 5\ nos$

No of bars = 5 nos

$A_{st} = 5 \times 314.16 = 1570.80\ mm^2$

Ast for hanger bar = 20% of Ast

$= 20 / 100 \times 1570.8$

$= 314.16\ mm^2$

Ast for negative reinforcement @ top of supports

$= 35\%\ of\ A_{st}$

$= 35/100 \times 1570.8$

$= 549.78\ mm^2$

These bars are provided @ 0.25 le

$0.25x\ 5030 = 1257.5\ mm$

CURTAILMENT:

a) 50% bars of tension reinforcement are curtailed at

0.08 x l= 0.08 x 5030 = 402.4 mm from the face support.

b) 50% bars of compression reinforcement are curtailed at

0.08 x l = 0.08 x 5030 = 402.4 mm from the face support.

CHECK FOR SHEAR REINFORCEMENT:

$V_u = F_d \times l_{eff}/2 = 42 \times 5.03 / 2$

$= 105.63$ KN

$\tau_v = V_u/bd = 105.63 \times 10^3 / (300 \times 360)$

$\tau_v = 0.97$ N/mm^2

PERMISSIBLE SHEAR STRESS, τ_c

A_{st} @ support = 1570.80 / 2 = 785.40 mm^2

$\% A_{st} = A_{st} / bd \times 100$

$= 785.40 / 300 \times 360 \times 100$

$\% A_{st} = 0.72$ %

$\tau_c = 0.57$ N/mm^2

$\tau_v \geq \tau_c$

0.97 N/mm^2 $\geq$ 0.57 N/mm^2

Provide Shear Reinforcement,

$V_{us} = V_u - \tau_c bd$

$= 105.63 \times 10^3 - (0.57 \times 300 \times 360)$

$V_{us} = 44.07 \times 10^3$ N.

Assume 8mm dia 2 legged vertical stirrups

$1.Sv = 0.87 \times Fy \times A_{sv} \times d / V_{us}$

$= 0.87 \times 415 \times 2 \times \pi/4 \times 8^2 \times 360 / 44.07 \times 10^3$

$= 300$ mm.

$2.S_v = 300$ mm.

$3.S_v = 0.75d = 0.75 \times 360 = 270$ mm.

4.Sv = 0.87 x Fy x Asv/0.4b

= 0.87 x 415 x 2 x π/4 x 8^2/ 0.4 x 300

= 300 mm.

Provide 2 legged 8 mm dia stirrups @ 300 mm c/c.

CHECK FOR STIFFNESS:

%Ast @ mid span = 1570.80 x 100 / 300 x 360

= 1.45 %

Stress in tension reinforcement,

Fs = 0.58 Fy (Astreq / Astpro)

= 0.58 x 415 x (1269.71 / 1570.80)

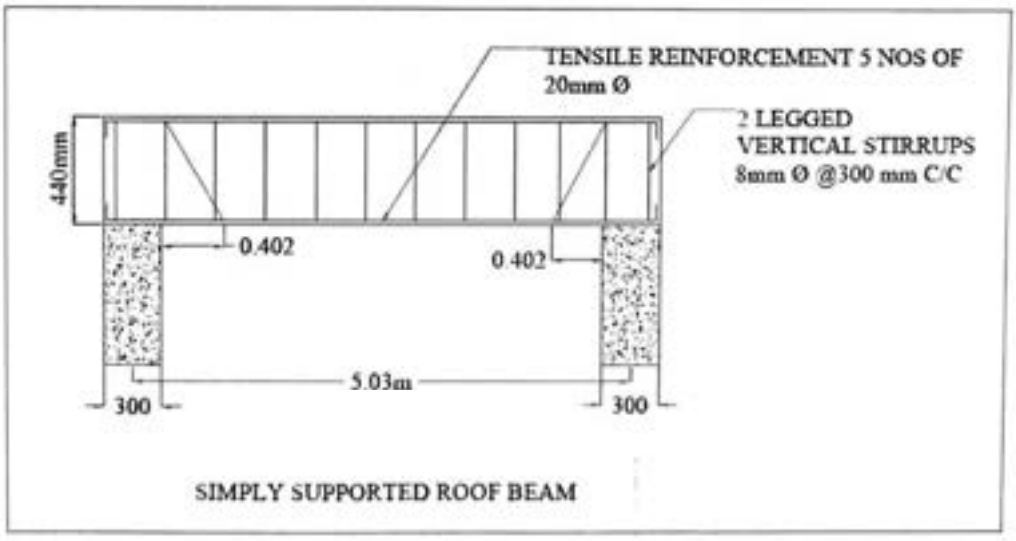
= 190 Curve

MF = 1.1

d = 5030 / 32 x 1.1

= 150 mm < 360 mm

Hence It Is Safe



SIMPLY SUPPORTED ROOF BEAM

5.3 DESIGN OF LINTEL FOR DOORS AND WINDOWS OPENING

AVAILABLE DATA:

Size of lintel = 230 mmx150 mm

Wall base = 230 mm

Assuming clear cover of 25 mm and 12 mm dia bars

d = 150-25-12/2 = 119 mm

EFFECTIVE SPAN:

Clear span + d = 1.5 + 0.119

l_{eff}= 1.619 m

Height of masonry above the opening = 1.2 m

Height of masonry above the lintel = 1.2 -0.15

= 1.05 m

0.866 x ht = 0.866 x 1.2 = 1.04 m

L_{eff}> 0.86 x l

LOADING CALCULATION:

Self weight of lintel= 1 x 0.23 x 0.15 x 25 = 0.863 KN/m

Weight of masonry = 1 x 0.23 x 1.05 x 19 = 4.588 KN/m

Total weight, W = 5.45 KN/m

Factored load = W x 1.5 = 5.45 x 1.5

= 8.175 KN/m

FACTORED MOMENT

$M_u = F_d \times l_{eff}^2 / 8$

$= 8.175 \times 1.919^2 / 8$

M_u= 3.335 KNM

AREA OF STEEL:

$M_u = 0.87 f_y A_{st} d (1- f_y A_{st} / f_{ck} bd)$

$3.34 \times 106 = 0.87 \times 415 \times A_{st} \times 119(1- 415 \times A_{st} / 25 \times 1000 \times 119)$

$5.99\ A_{st}^2 - 42.96 \times 103\ A_{st} + 3.34 \times 106 = 0$

$A_{st}min = 78.60$ mm2

Provide 2 nos of 10 mm dia bars at bottom and 2 nos of 8 mm dia bars at top as hanger bars

5.4 DESIGN OF SUNSHADE OVER DOORS & WINDOWS OUTSIDE

AVAILABLE DATA:

$f_{ck} = 25\ N/mm^2$

$f_y = 415\ N/mm^2$

Projection = 600 mm

Sunshade thickness D = 50 mm & d = 32 mm

DESIGN CONSTANT:

Basic value = 32

$Q_u = 3.45$

.LOAD CALCULATION:

Consider 1m width of sunshade

Live load = 1 x 0.6 x 0.75= 0.45 KN

Self weight of sunshade = 1 x b x D x unit weight

= 1 x 0.6 x 0.05 x 25

= 0.75 KN

Total load = 1.2 KN/m

Design load = 1.2 x 1.5 = 1.8 KN/m

FACTORED MOMENT:

$M_u = F_d \times L_{eff}/2$

$= 1.8 \times 0.6/2$

$= 0.54$ KNm

$M_u = 0.54 \times 10^6$ N.mm

DEPTH REQUIRED:

$M_u = M_{ulim}$

$$d = \sqrt{\frac{Mu}{Qub}}$$

$$= \sqrt{\frac{240}{3.45 \times 1}}$$

d_{req} = 13 mm & D = 13+15+6/3 = 31 mm

$d_{req} < d_{pro}$

Adopt greater value further design

d = 32 mm & D = 50 mm

TYPE OF SECTION:

$M_{u\ limit} = Q_u b\ d^2$

$= 3.45 \times 1000 \times 32^2$

$= 3.53 \times 10^6$ N.mm^2

$M_u < Mu_{limit}$ Hence it is under reinforced section

MAIN REINFORCEMENT:

$M_u = 0.87\ f_y A_{st}\ d\ (1 - f_y A_{st} / f_{ck} bd)$

$0.54 \times 10^6 = 0.87 \times 415 \times A_{st} \times 32\ (1 - 415 \times A_{st} / 25 \times 1000 \times 32)$

$5.99 A_{st}^2 - 11.55 \times 10^3 A_{st} + 0.54 \times 10^6 = 0$

$A_{st}min = 47.95$ mm^2

SPACING:

Assume 6 mm dia bars

1) $S = a_{st}/A_{st} \times b = 28.27/47.95 \times 1000$

$= 590$ mm

2) 3d = 3 x 32= 96 mm

3) 300 mm c/c

Provide 6 mm dia bars @ spacing 95 mm c/c distance.

DISTRIBUTOR REINFORCEMENT

A_{st} min= 0.12 / 100 x B x D

$= 0.12 /100 \times 1000 \times 50$

$= 60 \text{ mm}^2$ per meter width

$= 60 \times 0.6 = 36 \text{ mm}^2$

SPACING:

Assume 6mm dia of distribution steel

1) $S = a_{st} / A_{st}\text{min} \times b = (28.27/36) \times 1000$

$= 785$ mm

2) $5d = 5 \times 32 = 160$ mm

3) 450 mm

Provide 6 mm dia bars @ spacing 160 mm c/c

DEVELOPMENT LENGTH:

$L_d = 0.87 f_y \text{ dia}/4\tau_{bd}$

$= 0.87 \times 415 \times 6 / (4 \times 1.4)$

$= 386.83$ mm

$L_d$required inside the support = 386.83 mm say 385 mm.

CHECK FOR SHEAR:

It is sufficient to check for shear along shorter span only

Nominal shear force $V_u = 1.2$ KN

Nominal shear force $\tau_v = V_u/bd$

$= 1.2 \times 10^3/1000 \times 32$

$\tau_v = 0.037$ N/mm2

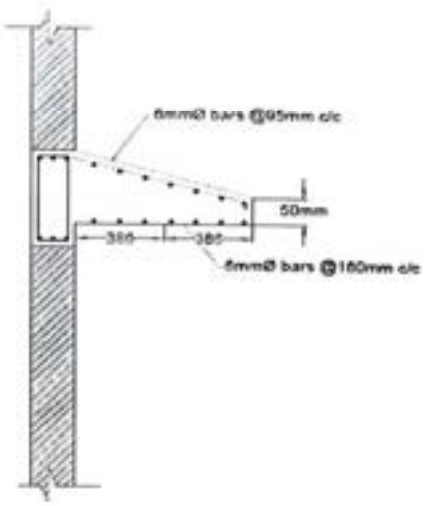
$\tau c_{min} = 0.29 \text{ N/mm}^2$ & K=1.3

$K\tau_c = 1.3 \times 0.29$

$K\tau_c = 0.37 \text{ N/mm}^2$

$\tau_c\text{max}/2 = 3.1/2 = 1.55 \text{ N/mm}^2$

DESIGN OF SUNSHADE



CROSS SECTION OF SUNSHADE

5.5 DESIGN OF SQUARE COLUMN TO SUPPORT BEAMS

AVAILABLE DATA:

Size of column = 300 X 300 mm

f_{ck} = 25 N/mm^2

f_y = 415 N/mm^2

LOAD CALCULATION:

SLAB:

Wt of slab (1) = L x B x D x unit wt

= 2.15 x 2.4 x 0.15 x 25 = 19.35KN

Wt of slab ff (1) = L x B x D x unit wt

= 2.15 x 2.4 x 0.05 x 20 = 5.16 KN

Live load (1) = 2.0 x 2.15 x 2.40 = 10.32 KN

BEAM

Beam (1) = L x B x D x unit wt

= 2.15 x 0.3 x 0.4 x 25 = 6.45 KN

Beam (2) = 2.4 x 0.3 x 0.40 x 25 = 7.2 KN

WALL

Wall load (1) = L x B x H x unit wt

= 2.15 x 0.23 x 3.0 x 19 = 28.20 KN

Wall load (2) = 2.40 x 0.23 x 3.0 x 19 = 31.46 KN

COLUMN

Self weight of column = L x B x H x unit wt

= 0.3 x 0.3 x 3.0 x 25 = 6.75 KN

Sum of all above loads = 114.90 KN

No of floor consideration = 115 x 1 = 115 KN

DESIGN LOAD:

P_u = W x 1.5 = 115 x 1.5

P_u = 172.50 KN

AREA OF COLUMN

A_g = l x b = 300 x 300 = 90 x 10^3 mm^2

SLENDERNESS RATIO

S.R = L_{eff} / b

= 3000 / 300

S.R = 10 < 12

Slenderness ratio is less than 12

Hence short column

MINIMUM ECCENTRICITY

e_{min} = L_{eff}/500+b/30

= 3000/500 + 300/30

e_{min} = 16 mm

e_{max} = 0.05 b

= 0.05 x 300

= 15 mm

LONGITUDINAL REINFORCEMENT

Let assume $A_{sc} = 1\% A_g$

$= 0.01 A_g$

$= 0.01 \times 90 \times 10^3$

$= 900 \text{ mm}^2$

Area of concrete $A_c = A_g - 0.01 A_g = 0.99 A_g$

$= 0.99 \times 90 \times 10^3$

$= 89.10 \times 10^3$

$P_u = 0.4 f_{ck} A_c + 0.67 f_y A_{sc}$

$P_u = 0.4 \times 25 \times 89.10 \times 10^3 + 0.67 \times 415 \times 900$

$P_u = 1140$ KN

Say $P_u = 1140$ KN > 172.50 KN

Hence safe

$\% A_{sc} = 100 A_{sc}/A_g$

$= 100 \times 900 / (90 \times 10^3)$

$\% A_{sc} = 1\% > 0.8\% < 6\%$

HENCE OK

Let us provide 5 nos of 16 mm dia bars

$Asc = 5 \times \pi \times 16^2/4 = 1005.30 \text{ mm}^2$

COVER

Clear cover shall be greater of

a) 40 mm

b) Dia = 16 mm

Provide a clear cover of 40 mm

SPACING

1) Longer side S = 300- (40+40+16/2+16/2) / 2

S = 252 mm < 300mm

TRANSVERSE REINFORCEMENT

MINIMUM DIAMETER

1) 1/4 x dia = 1/4 x 16 = 4 mm

2) Not less than 6 mm

PITCH

1) LLD = 300 mm

2) 16 x 16 = 260 mm

3) 300 mm

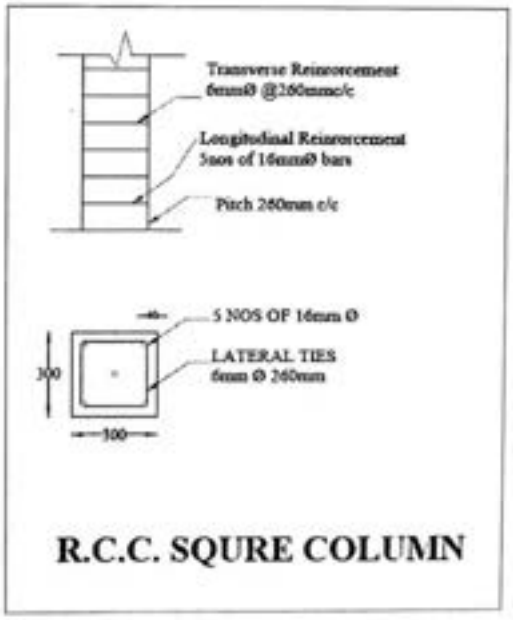
Provide 6 mm dia laterals at 260 mm c/c

RESULT

Size of column = 300 x 300 mm

Longitudinal reinforcement = 5 nos of 16 mm dia bars

Transverse reinforcement = 6 mm dia at 260 mm c/c



R.C.C. SQURE COLUMN

5.6 DESIGN OF SIMPLY SUPPORTED PLINTH BEAM

AVAILABLE DATA:

Clear to center distance l_{eff}= 5.03 m

B = 300 mm, D = 400 mm & d = 360 mm (assumption)

f_y = 415 N/mm^2& f_{ck} = 25 N/mm^2

Q = 3.45 & %A_{st} = 1.197%

LOAD CALCULATION:

Self weight of beam = b x D x unit wt

= 0.30 x 0.4 x 25 = 3 KN/m

Wall load = 0.23 x 3.0 x 19 = 13.11 KN/m

Total load = 17 KN/M

Factored load = 17 x 1.5 F_d= 25.50 KN/m

FACTORED MOMENT

$M_u = (F_d \times l_{eff}^2)/8 = (25.50 \times 5.03^2) / 8$

M_u = 80.64 KNm

SIZE OF BEAM

Equating $M_u = M_u lim$

$M_u = Q_u x\ b \times d^2$ (b=2/3d)

$d = (3 \times M_u/2 \times Q_u)^{1/3}$

$= (3 \times 80.64 \times 10^6/(2 \times 3.45))^{1/3}$

d = 330 mm

d = 330 mm < 360 mm

D = 370 mm

TYPE OF SECTION

$M_{ulim} = Q_u bd^2 = 3.45 \times 300 \times 360^2$

M_{ulim}= 134.13 × 10^6 N.mm

M_{ulim}> Mu

Hence the section shall be designed as singly reinforced section

AREA OF REINFORCEMENT

$Mu = 0.87\ f_y A_{st}(d - f_y A_{st} / f_{ck} \times b)$

$80.64 \times 10^6 = 0.87 \times 415 \times A_{st} \times 360\ (1 - 415A_{st} / 25 \times 300 \times 360)$

$19.97\ A_{ST}^2 - 129.97 \times 10^3 A_{ST} + 80.64 \times 10^6 = 0$

$A_{st} = 694.57\ mm^2$

CHECK

$Xumax/d = 0.87x\ f_y x\ A_{st} / 0.36 \times f_{ck} \times b\ d$

$0.48 = (0.87 \times 415 \times A_{st}) / (0.36 \times 25 \times 300 \times 360)$

$A_{st} = 1292.23\ mm^2$

$\%Ast = Ast / bd \times 100$

$Ast = \%Ast \times bd / 100$

$= 1.197 \times 300 \times 360 / 100$

$= 1292.76\ mm^2$

Assume 16 mm dia of bars

No.of bars = $A_{st}/a_{st} = 1292.76 / 113.09 = 12$ nos

No of bars = 12 nos

$A_{st} = 12 \times 113.09 = 1357.16\ mm^2$

Ast for hanger bar = 20% of Ast

$= 20 / 100 \times 1357.16$

$= 271.43\ mm^2$

Ast for negative reinforcement @ top of supports

$= 35\%$ of A_{st}

$= 35/100 \times 1357.16$

$= 475\ mm^2$

These bars are provided @ 0.25 le

$0.25x\ 5030 = 1257.50$ mm

CURTAILMENT:

a) 50% bars of tension reinforcement are curtailed at

0.08 x l= 0.08 x 5030 = 402.40 mm from the face support.

b) 50% bars of compression reinforcement are curtailed at 0.08 x l = 0.08 x 5030 = 402.40 mm from the face support.

CHECK FOR SHEAR REINFORCEMENT:

$V_u = F_d \times l_{eff}/2 = 25.50 \times 5.03 / 2$

$= 64.13$ KN

$\tau_v = V_u/bd = 64.13 \times 10^3 / (300 \times 360)$

$\tau_v = 0.60$ N/mm^2

PERMISSIBLE SHEAR STRESS, τ_c

A_{st} @ support = 1357.16 / 2 = 678.58 mm^2

$\% A_{st} = A_{st} / bd \times 100$

$= 678.58 / 300 \times 360 \times 100$

$\% A_{st} = 0.62$ %

$\tau_c = 0.52$ N/mm^2

$\tau_v \geq \tau_c$

0.65 N/mm$^2 \geq$ 0.52 N/mm^2

Provide Shear Reinforcement,

$V_{us} = V_u - \tau_c bd$

$= 64.13 \times 10^3 - (0.52 \times 300 \times 360)$

$V_{us} = 7.97 \times 10^3$ N.

Assume 8mm dia 2 legged vertical stirrups

$1.Sv = 0.87 \times Fy \times A_{sv} \times d / V_{us}$

$= 0.87 \times 415 \times 2 \times \pi/4 \times 8^2 \times 360 / 7.97 \times 10^3$

$= 1630$ mm.

$2.S_v = 300$ mm.

3.S_v = 0.75d = 0.75 x 360 = 270 mm.

4.Sv = 0.87 x Fy x Asv/0.4b

= 0.87 x 415 x 2 x π/4 x 8^2/ 0.4 x 300

= 300 mm.

Provide 2 legged 8 mm dia stirrups @ 270 mm c/c.

CHECK FOR STIFFNESS:

%Ast @ mid span = 1357.16 x 100 / 300 x 360

= 1.25 %

Stress in tension reinforcement,

Fs = 0.58 Fy (Ast_{req} / Ast_{pro})

= 0.58 x 415 x (694.57 / 1357.16)

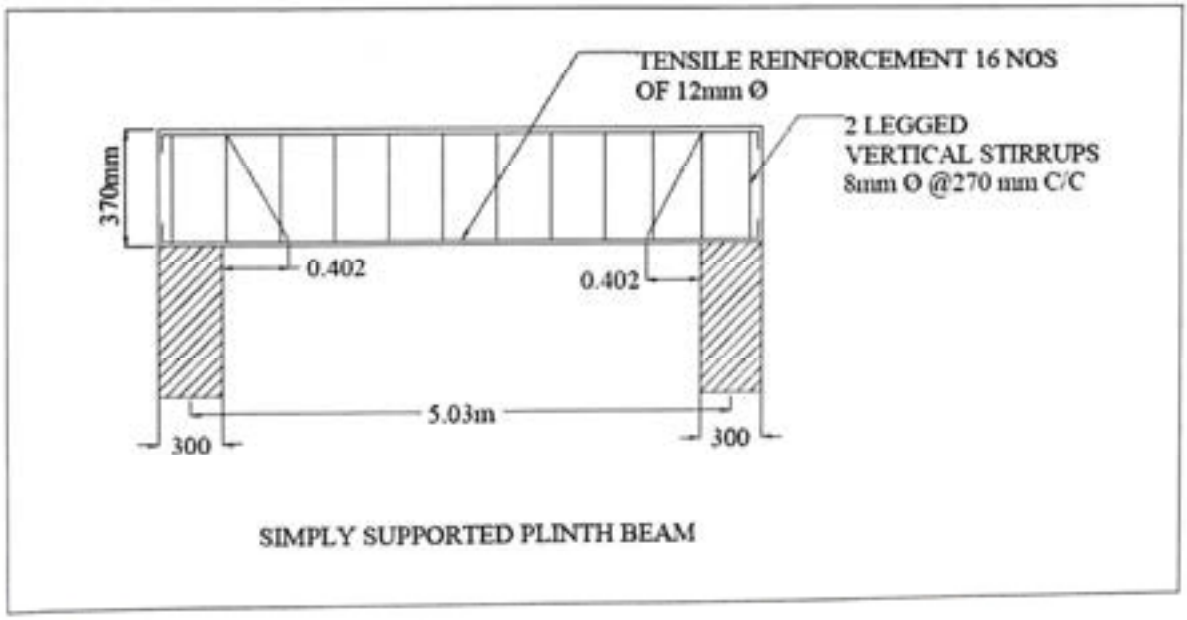
= 120 Curve

MF = 1.5

d = 5030 / 32 x 1.5

= 110 mm < 360 mm

Hence it is safe



SIMPLY SUPPORTED PLINTH BEAM

5.7 DESIGN OF DOG LEGGED STAIR CASE

AVAILABLE DATA

Vertical height of floor = 3000 mm

Rise = 150 mm & thread = 300 mm

Size of room = 3.5 x 1.5 m

SIZES OF STAIRCASE

No of riser = height/rise = 3000/150 = 20 nos

No of flight = 2

Riser per flight = 20/2 =10 nos

No of tread = 10-1 = 9 nos

Length of going = thread x nos of tread

= 300 x 9 = 2700 mm

Width of landing = (3500-2700)/2 = 400 mm

EFFECTIVE SPAN

L_{eff} = 2.7+0.4+0.4+0.23/2+0.23/2

= 3.73 m

Thickness of waist slab = span/20 = 3730/20 = 190

Overall depth D = 190 mm

d = 165 mm

LOAD CALCULATION

Assume waist slab thickness 150 mm

Self weight of waist slab = 1 x 0.15 x 25 (sloped area)

Ws = 3.75 KN/m

Plain area = Ws x $[(R^2 + T^2)/T^2]^{1/2}$

= 3.75 x $[(0.15^2 + 0.3^2)/ 0.3^2]^{1/2}$

= 2.795 KN/m

Weight of steps per m^2 = 0.5 x 0.15 x 0.3 x 25

= 0.56 KN/m

Load of step per meter length = 0.56 x 1000/300

= 1.86 KN/m

Finishes = 0.53 KN/m

Total dead load = 2.795+1.86+0.53 = 5.185 KN/m

Service live load (liable for overcrowding) = 5 KN/m^2

Total service load = 5.185+5 = 10.185 KN/m

Factored load = 10.185 x 1.5 = 15.3 KN/m

FACTORED MOMENT:

M_u = Fd x $leff^2/8$ = 15.3 x $3.73^2/8$

= 26.6 KNM

$M_u = 26.6 \times 10^6$ $N.mm^2$

DEPTH REQUIRED:

$M_u = M_{ulim}$

$$d = \sqrt{\frac{Mu}{Qub}}$$

$$= \sqrt{\frac{26600}{3.45 \times 1}}$$

d_{req} = 87.8 say 90 mm <dpro

$d_{req} < d_{pro}$

Adopt greater value further design

d = 165 mm & D = 190 mm

TYPE OF SECTION:

$M_{u\ limit} = Q_u x b \times d^2$

$= 3.45 \times 1000 \times 165^2$

$= 93.92 \times 10^6$ $N.mm^2$

$M_u < Mu_{limit}$

Hence it is under reinforced section

MAIN REINFORCEMENT:

Mu = 0.87 fyAst d (1- fyAst / fckbd)

26.6 x 106 = 0.87 x 415 x Ast x 165 (1- 415 x Ast / 25 x 1000 x 165)

5.99Ast2 – 59.57 x 103Ast + 26.6 x 106 = 0

Ast min = 468.61 mm2

SPACING:

Assume 10 mm dia bars

1) S = ast / Ast x b = 78.54/468.61 x 1000

= 160 mm

2) 3d = 3 x 165 = 495 mm

3) 300 mm c/c

Provide 10 mm dia bars @ spacing 160 mm c/c distance.

DISTRIBUTOR REINFORCEMENT

A_{st} min= 0.12 / 100 x B x D

= 0.12 /100 x 1000 x 190

= 228 mm^2

SPACING:

Assume 8 mm dia of distribution steel

1) S = a_{st} /A_{st}min x b= 50.26/228 x 1000

= 220 mm

2) 5d = 5 x 165 = 825 mm

3) 450 mm

Provide 8 mm dia bars @ spacing 220 mm c/c

CURTAILMENT:

Alternated bars are curtailed at 0.1leff from face of support (0.1 x 3.73=0.373 m) . The full length bars are taken to top and extended from face of support for a distance 0.1leff to take negative.

CHECK FOR SHEAR:

It is sufficient to check for shear along shorter span only

Nominal shear force V_u = 15.3 x 3.73/2

= 28.53 KN

Nominal shear force $\tau_v = V_u/bd$

$= 28.53 \times 10^3/1000 \times 165$

τ_v= 0.17 N/mm2

A_{st} at support = (a_{st} / 2 x spacing) x b

= (78.54/2 x 160) x 1000 (a_{st}=10 mmdia)

= 245.43 mm^2

% A_{st} = $A_{st}/bd \times 100$

= (245.43/1000 x 165) x 100

%Ast= 0.14 %

τ_c = 0.29 N/mm^2 & K=1.22

$K\tau_c$ = 1.22 x 0.29

$K\tau_c$ = 0.35 N/mm^2

$\tau_c max/2 = 3.1/2 = 1.55$ N/mm^2

$\tau_v < K\tau_c < \tau_c max/2$

Hence safe in the shear

CHECK FOR DEFLECTION

Assume 10 mm dia

$A_{stpro} = (a_{st}/s) \times b = (78.54/160) \times 1000$

= 490.87 mm^2

% of steel = $100A_{st}/bd$

$= 100 \times 490.87 /1000 \times 165$

= 0.2 %

$f_s = 0.58 \times f_y Ast_{req}/Ast_{pro}$

$= 0.58 \times 415 \times 468.61/490.87$

= 240

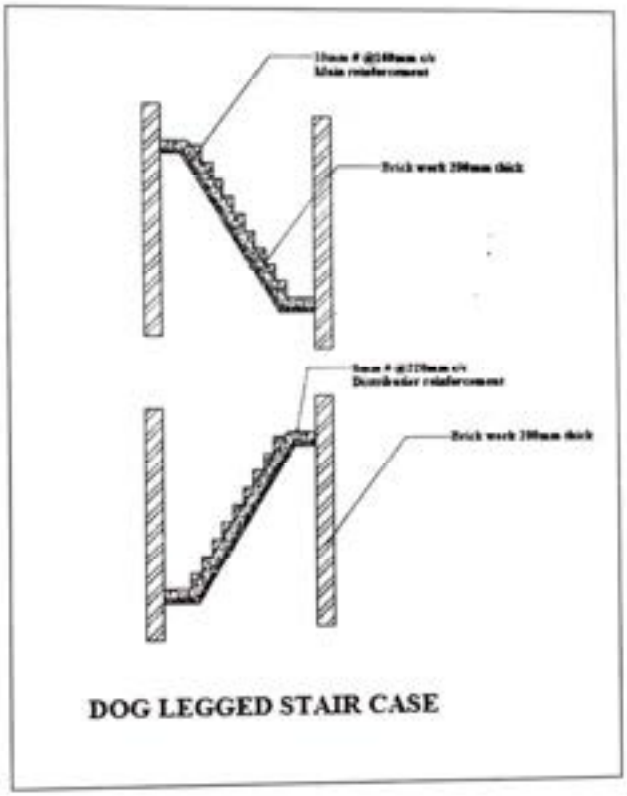
M.F = 1.4 (by using 240 curve in graph)

d_{avi}= span/(B_V x MF)

= 3730/32 x 1.4 = 83.25 mm

$d_{req} < d_{pro}$

Hence design is safe



DOG LEGGED STAIR CASE

5.8 DESIGN OF ISOLATED SQUARE FOOTING FOR SQUARE COLUMN

AVAILABLE DATA:

Size of column = 300 x 300 mm

Safe bearing capacity = 200 KN/m^2

f_{ck} = 30 N/mm^2

f_y = 415 N/mm^2

SIZE OF FOOTING

Axial load of footing = 115 KN

Assume the self wt of footing as10%of the column load

W1 = 10/100 x 115

= 11.5 KN

Total load on soil = 115 + 11.5 = 126.5 KN

Area of footing required = total load /sbc

= 130 / 200

= 0.65 m^2

Since it is a square column

B x L = 0.65 m^2

B x (B) = 0.65 m^2

B^2 = 0.65

= $\sqrt{0.65}$ = 0.806

B = 0.80 & L= 0.80 m

Area of footing = 0.80 x 0.80 = 0.64 m^2

NET UPWARD DESIGN PRESSURE

Fo = 115 x 1.5 / 0.64

= 270 KN/m^2

PROJECTION OF FOOTING

Projection of footing from face of column = 0.80 - 0.3 / 2 = 0.65 m

FACTORED MOMENT

Maximum factored moment occurs at the face of column for design purpose consider over hang on both sides

M_u= fo x projection area x prj.dis/2

= 270 x 0.80 x 0.65 x 0.65 / 2

= 45.63 x 10^6

DEPTH REQUIRED FOR FOOTING

$$d_{req} = \sqrt{\frac{Mumax}{Qu \times b}}$$

$$dreq = \sqrt{\frac{45630}{4.14 \times 0.80}} = 117.37$$

Say d_{req} = 150 mm

Considering the effect of shear provide an effective depth of 300 mm practically the effective depth of 150 mm may not sufficient to take care off shear , hence let us increase the depth two time.

d = 300 mm

Provide 50mm as effective cover

D = 300 + 50

D = 350 mm

TENSION REINFORCEMENT

M_U= 0.87 $f_y A_{st}$ d (1- $f_y A_{st}$ / f_{ck}bd)

45.63 x 10^6 = 0.87 x 415 x A_{st} x 300 (1- 415 x A_{st} / 30 x 800 x 300)

6.24 A_{st}^2 – 108.315 x $10^3 A_{st}$ + 45.63 x 10^6 = 0

A_{stL} = 432.02 mm^2

A_{stmin} = 0.12/100 x (b x D)

= (0.12/100) x 800 x 350

Ast_{min} = 336 mm^2

$a_{st} = \pi \times 10^2/4 = 78.54\ mm^2$

NOS = A_{stL} / a_{st} = 432.02 / 78.54 = 6 nos

Provide 6 nos of 10 mm dia bars in long direction at uniform spacing

$A_{st} = 6 \times \pi \times 10^2/4 = 471.23\ mm^2$

CHECK FOR DEVELOPMENT LENGTH

L_d=0.87 Fyxdia / 4 x τ_{bd}=0.87 x 415 x 10/(4 x 1.5)

L_d= 601.75 mm

Length of bars beyond the face of column in long direction

800 -50= 750 mm >601.75 mm

Hence ok

.Hooks are not necessary at end of bars.

CHECK FOR SHEAR

TRANSVERSE SHEAR

V_u= fo x length x (0.65 -0.3)

= 270 x 0.80 x 0.35

= 75.6 KN

$\tau_v = V_u/bd = 75.6 \times 10^3 / 800 \times 300$

$\tau_v = 0.32\ N/mm^2$

$\%A_{st} = 100A_{st} / bd = 100 \times 471.23 / (800 \times 300)$

= 0.20 %

$\tau_c = 0.37\ N/mm^2$

$K\tau_c = 1 \times 0.37 = 0.37\ N/mm^2$

$\tau_v < K\tau_c$ Safe in shear

CHECK FOR PUNCHING SHEAR

At d/2 around the column. The critical section for punching shear is at a distance of d/2= 300 /2= 150 mm

From the face of column around

Side of section = (150 + 300 + 150) x (150 + 300 + 150)

= 600 x 600 mm

PUNCHING SHEAR ACROSS SECTION

Vz = fo x (outer area – inner cutting area)

= 270 x (0.8 x 0.80 – 0.6 x 0.6)

$Vz = 75.6 \times 10^3$ N

NOMINAL SHEAR STRESS

$\tau z = 75.6 \times 10^3 / 2(600 + 600) \times 300$

$\tau z = 0.105$ N/mm^2

PERMISSIBLE SHEAR STRESS IN CONCRETE

$\tau_{cz} = K s \tau cz$

Bc = 300 / 300 = 1.0

Ks = 0.5 + 1.0 = 1.50 limited to 1

$\tau_{cz} = 0.25 \sqrt{fck} = 0.25 \sqrt{30} = 1.37$

$K s \tau cz = 1 \times 1.37 = 1.37$ N/mm^2

$\tau z < K s \tau cz$

safe in punching shear .

Hence ok

CHECK FOR BEARING STRESS

Size of the base of frustum of pyramid= (b+4d) x (D+4d)

= (300 + 4 x 300) x (300 + 4 x 300)

= 1500 x 1500

But limited to 1500 x 1500 mm

Supporting area $A_1 = 0.80 \times 0.80 = 0.64$ m^2

Loaded area $A_2 = 0.30 \times 0.30 = 0.09\ m^2$

$\sqrt{A1/A2} = \sqrt{0.64/0.09} = 2.67$ but restricted to 2

Permissible bearing stress = 0.45 x fck x $\sqrt{A1/A2}$

$= 0.45 \times 30 \times 2 = 27\ N/mm^2$

Actual bearing stress $= \frac{Pu}{Area\ of\ column} = \frac{115 \times 1.5}{0.30 \times 0.30}$

$= 1.91\ N/mm^2$

$1.91 < 27$

Hence safe

CHECK FOR SBC OF SOIL

Column load = 115 KN

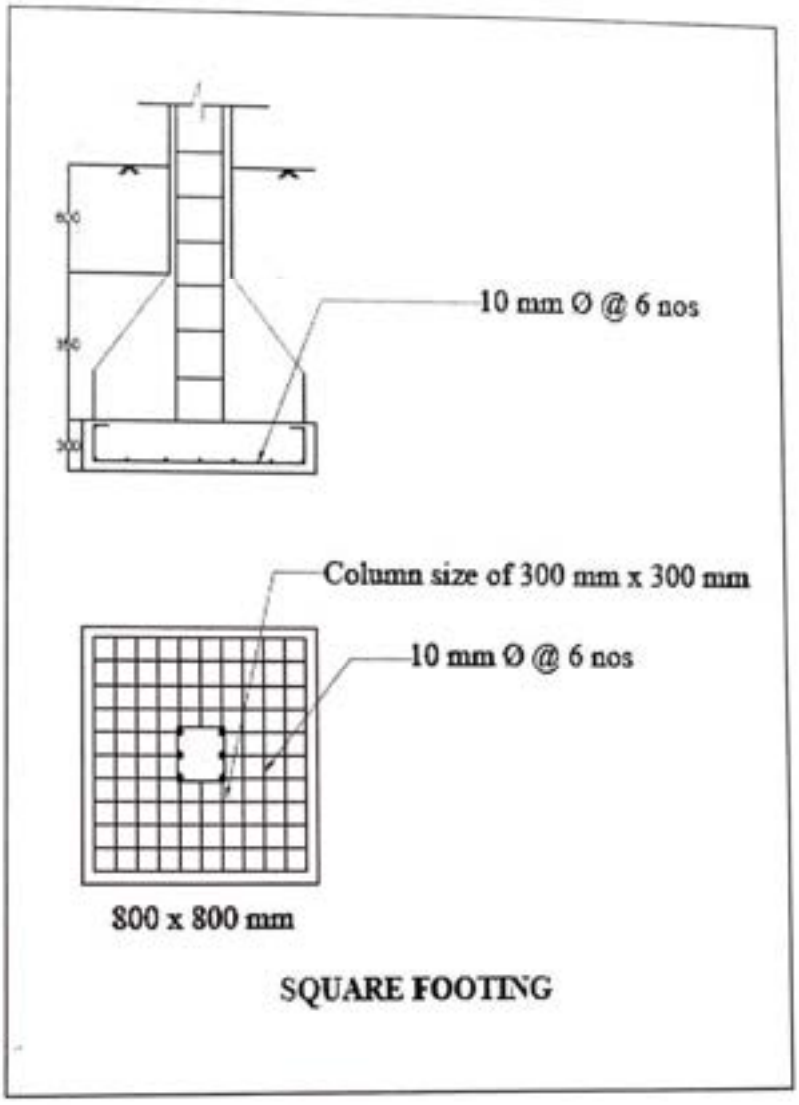
Weight of footing = 0.80 x 0.80 x 0.35 x 25 = 5.6 KN

Total load on soil = 125 KN

Pressure on soil = 125 / (0.80 x 0.80) = 195.31 KN/m^2

195.31 $KN/m^2 <$ 200 KN/m^2

Hence safe



SQUARE FOOTING

CHAPTER 6

STAAD REPORT

STAAD or (STAAD.Pro) is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda, CA. The commercial version STAAD.Pro is one of the most widely used structural analysis and design software. It supports several steel, concrete and timber design codes.

STAAD.Pro Report

Job Information

	Engineer	Checked	Approved
Name:			
Date:			

Structure Type SPACE FRAME

Number of Nodes	45	Highest Node	49
Number of Elements	74	Highest Beam	113
Number of Plates	14	Highest Plate	120

Number of Basic Load Cases	1
Number of Combination Load Cases	0

Included in this printout are data for:

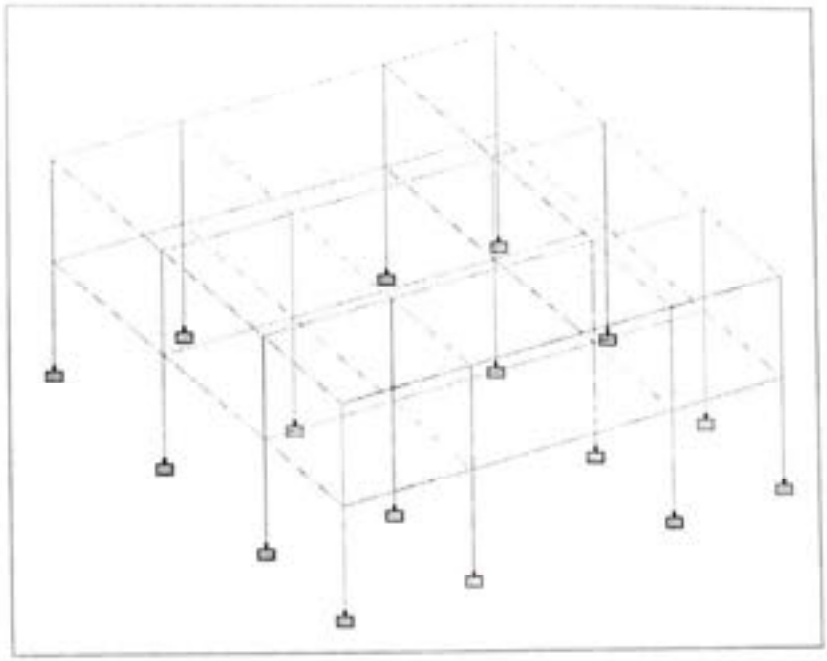
All The Whole Structure

Included in this printout are results for load cases:

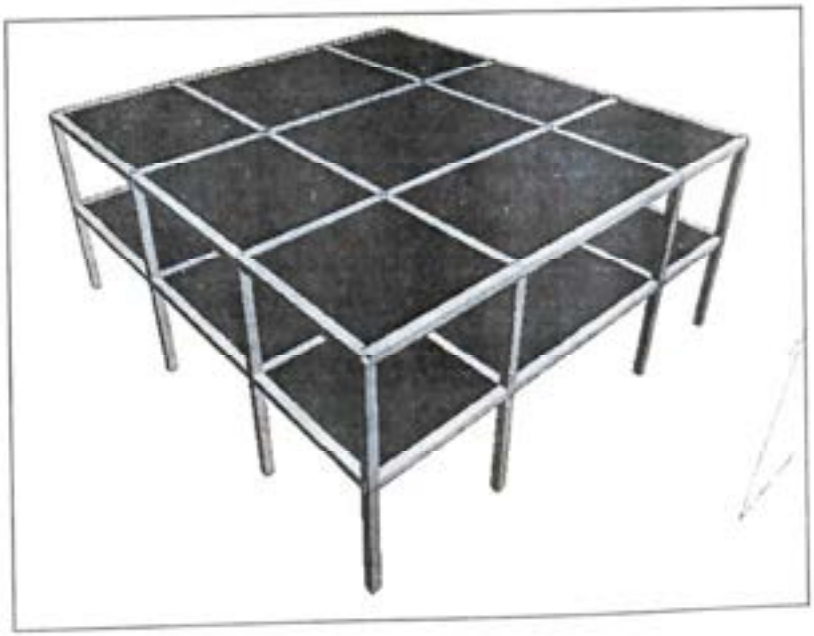
Type	L/C	Name
Primary	1	LOAD CASE 1

44. ELEMENT PROPERTY
45. 70 TO 76 114 TO 120 THICKNESS 0.15
46. DEFINE MATERIAL START
47. ISOTROPIC CONCRETE
48. E 2.17185E+007
49. POISSON 0.17
50. DENSITY 23.5616
51. ALPHA 1E-005
52. DAMP 0.05
53. END DEFINE MATERIAL
54. MEMBER PROPERTY AMERICAN
55. 33 TO 69 77 TO 113 PRIS YD 0.23 ZD 0.23
56. CONSTANTS
57. MATERIAL CONCRETE ALL
58. SUPPORTS
59. 5 TO 19 FIXED
60. LOAD 1 LOADTYPE NONE TITLE LOAD CASE 1
61. SELFWEIGHT Y -1.5
62. MEMBER LOAD
63. 48 TO 69 UNI GY -5
64. ELEMENT LOAD
65. 70 TO 76 PR -5

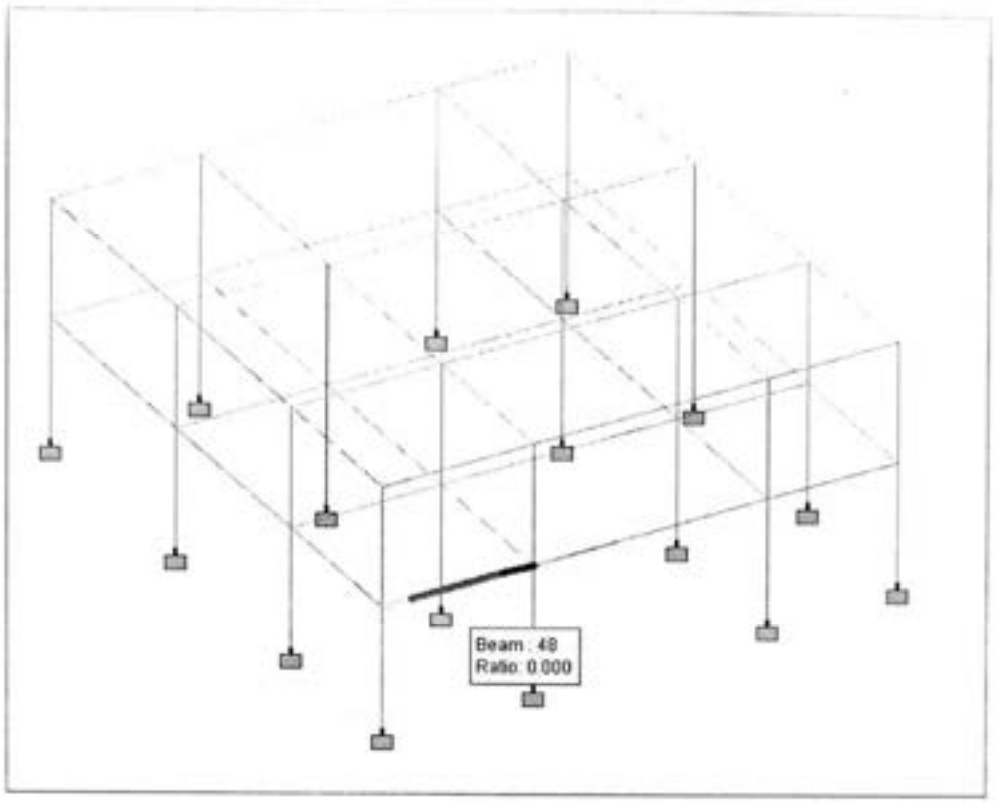
66. PDELTA 1 ANALYSIS PRINT BOTH



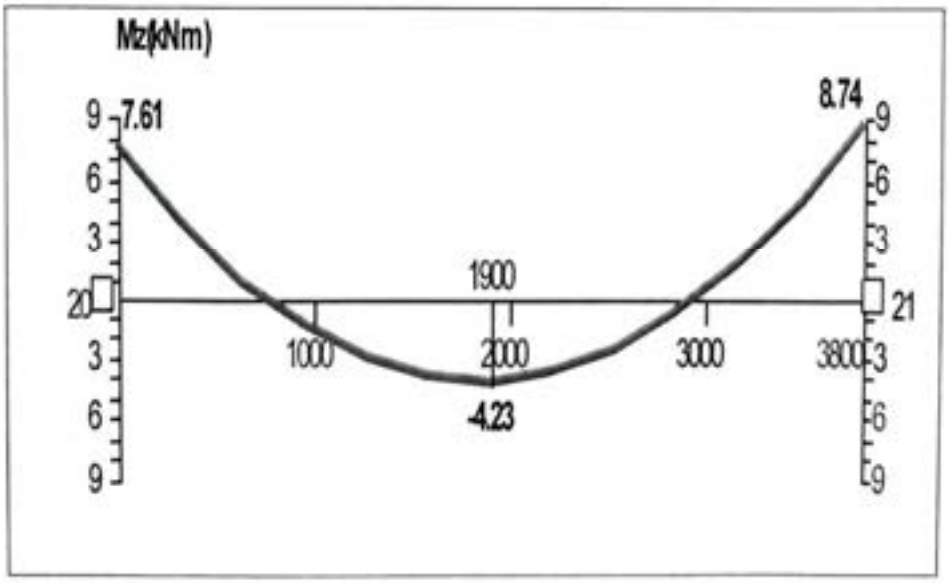
2D STRUCTURE



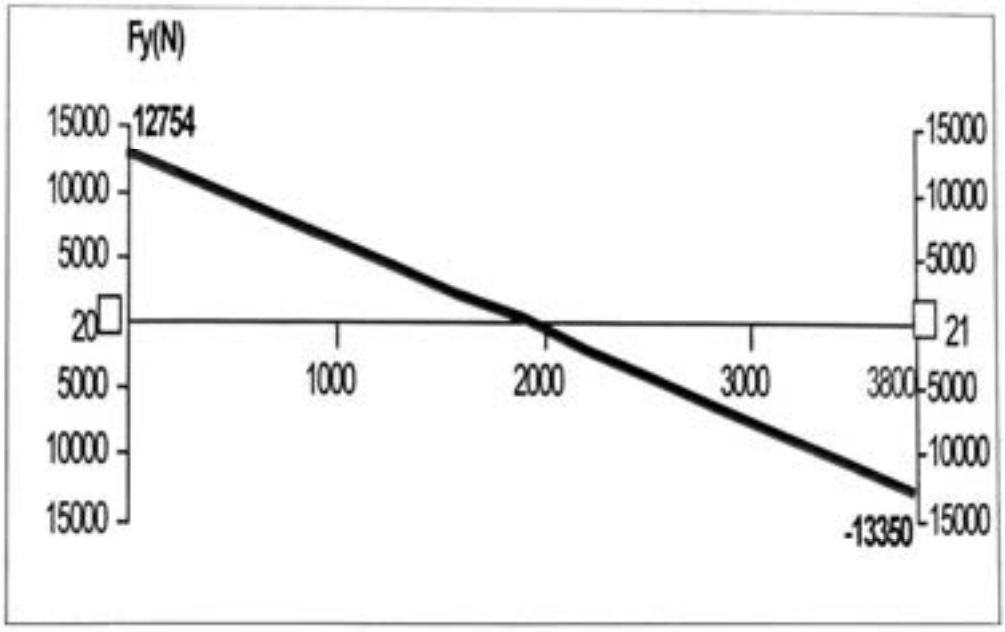
3D STRUCTURE



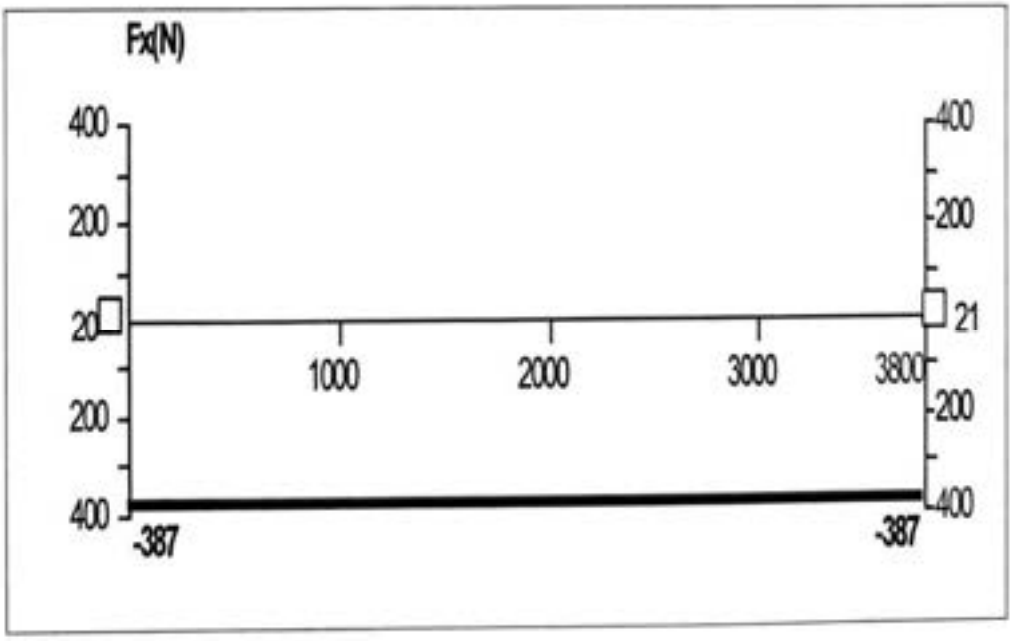
BEAM IDENTIFICATION DIAGRAM



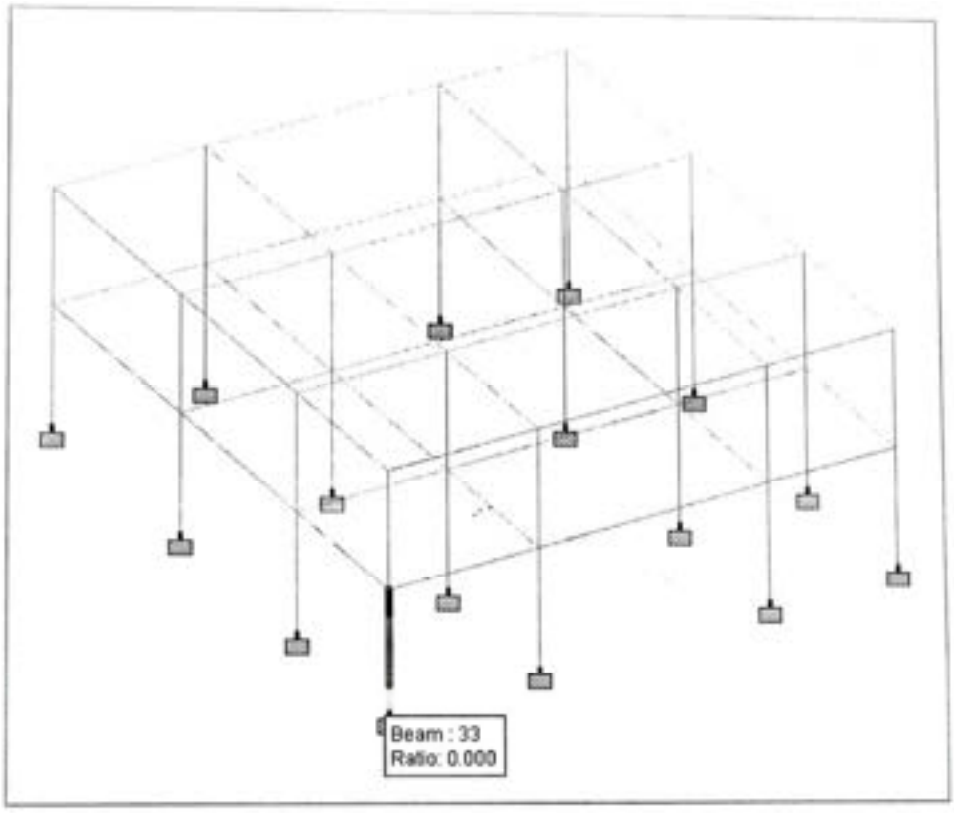
BEAM 48 BENDING MOMENT



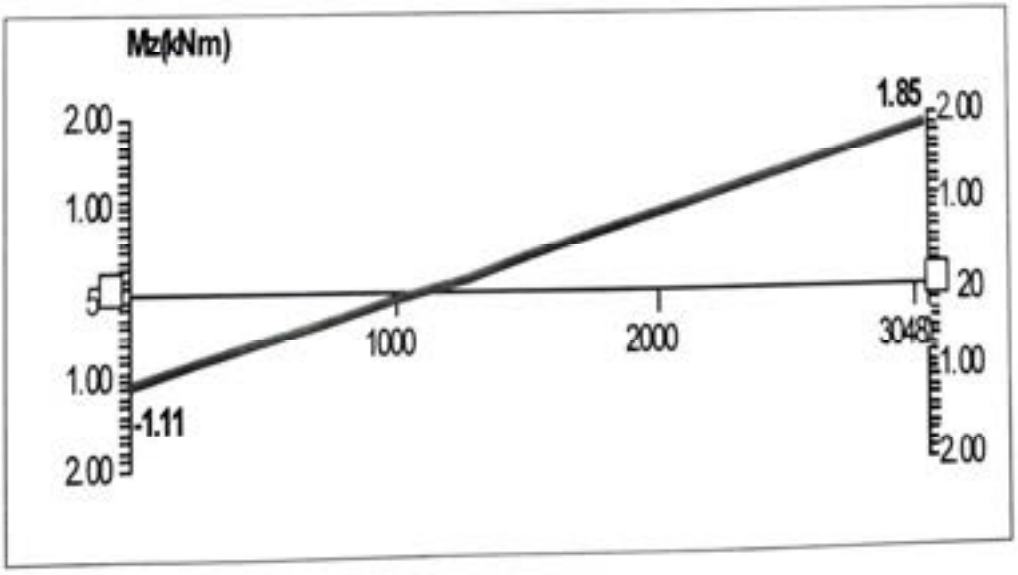
BEAM 48 SHEAR FORCE



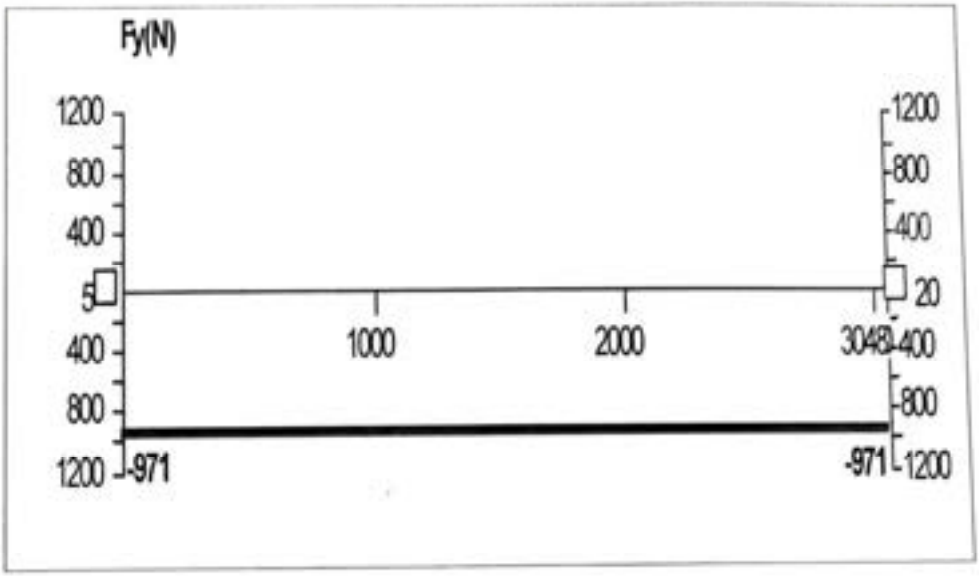
BEAM 48 AXIAL SHEAR FORCE



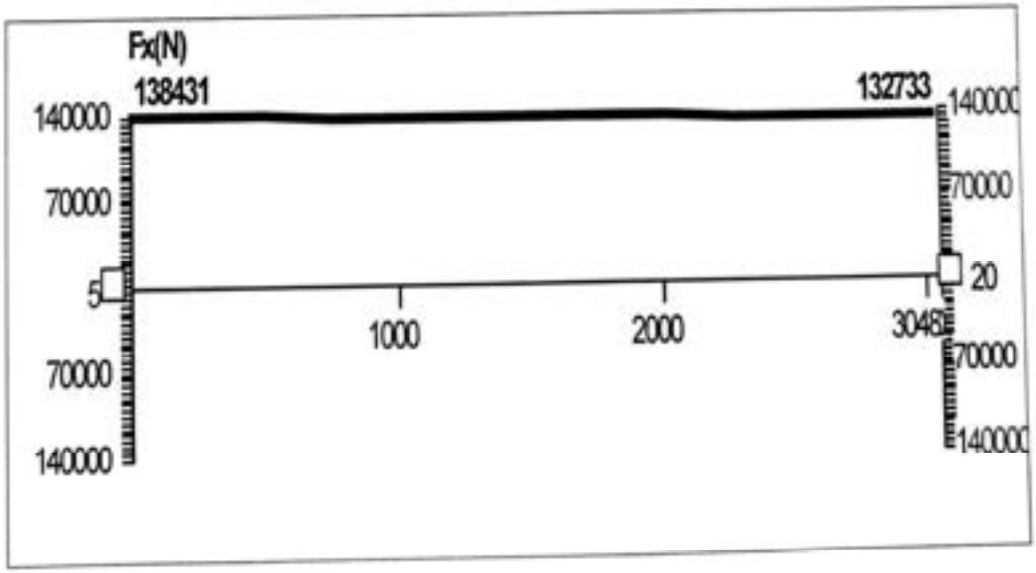
COLUMN IDENTIFICATION DIAGRAM



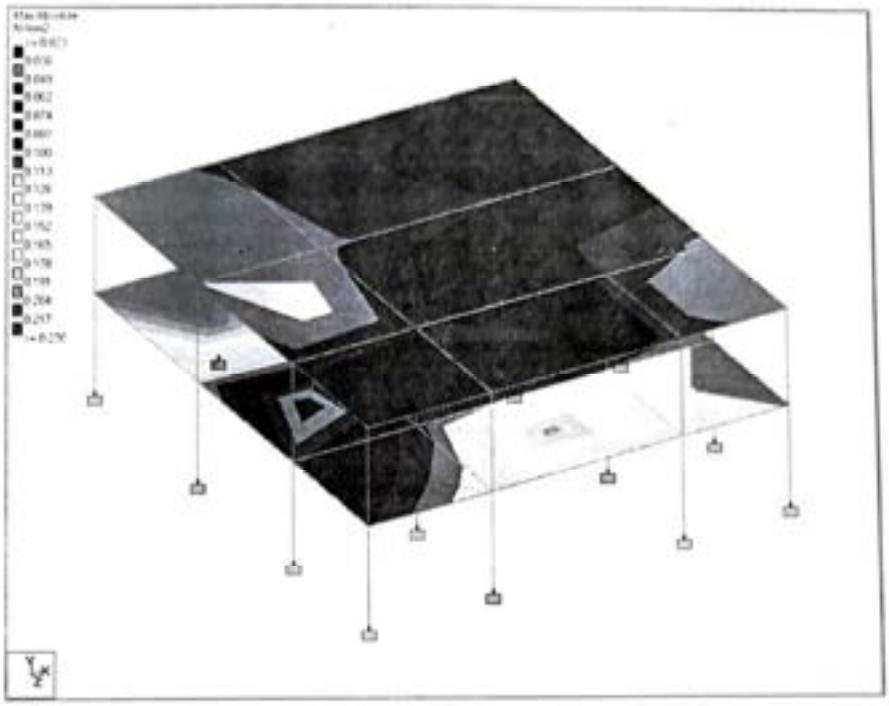
COLUMN 33 BENDING MOMENT



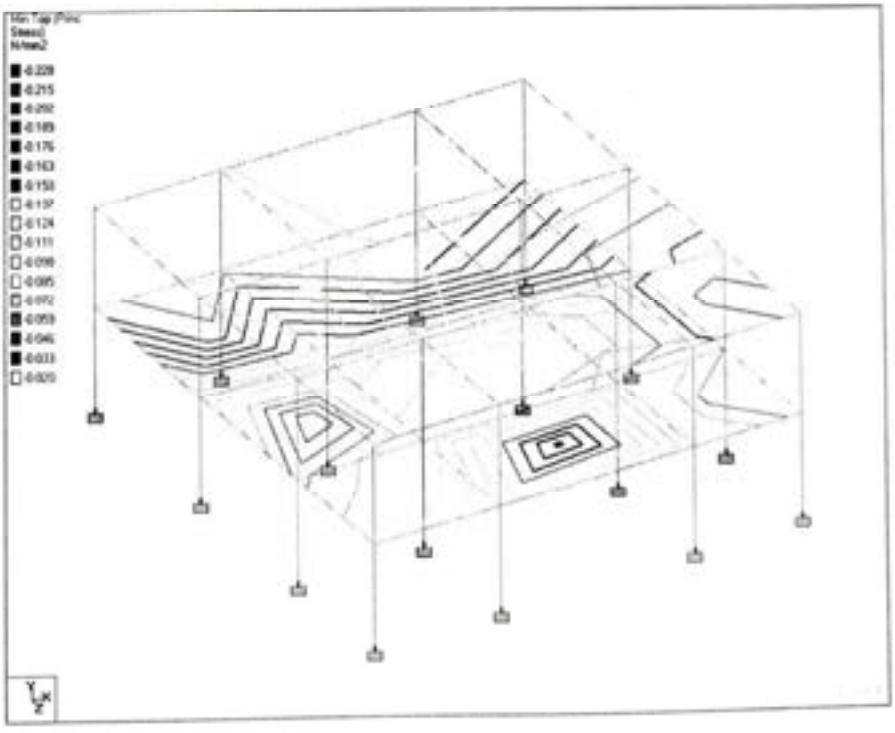
COLUMN 33 SHEAR FORCE



COLUMN 33 AXIAL SHEAR FORCE



SLAB STRESS NORMAL FILL



SLAB STRESS NORMAL LINE

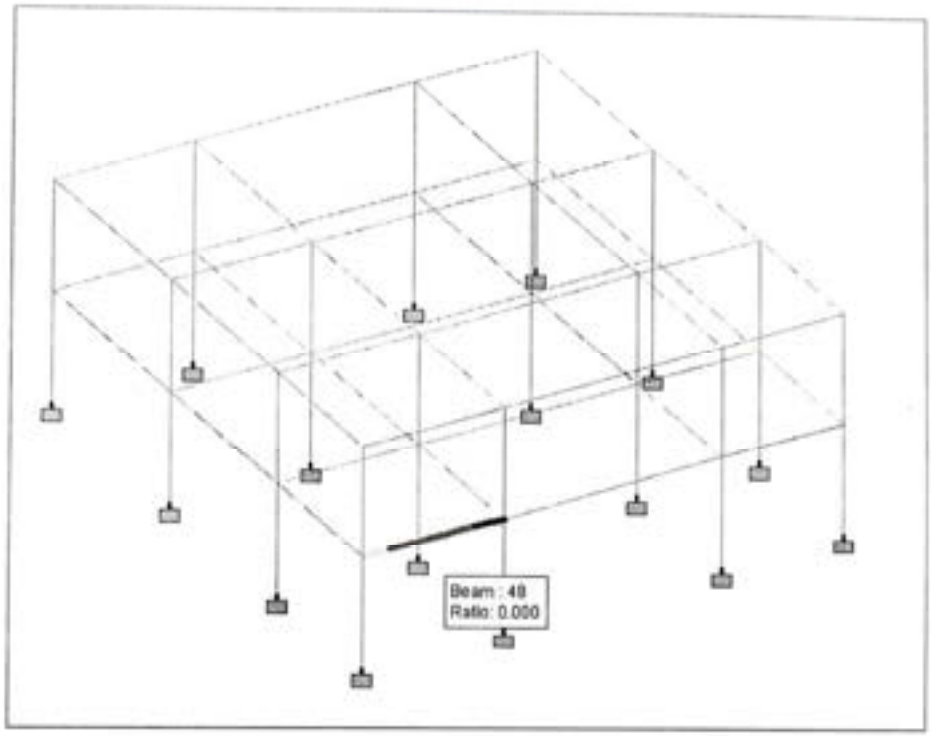
Design Report | Moment Diagram

Panel: Panel1

Section	Start X (cm)	Start Z (cm)	End X (cm)	End Z (cm)	Face	Moment (kNm)	Area Reqd. (cm2)	Area Prod. (cm2)	Bar details	Reinf ID
CS-L1	-716.483	-476.388	-336.483	-476.388	Bottom	-0.003	1.800	1.810	#8@280mm c	CB-1
CS-T1	-383.983	-828.888	-383.983	-428.888	Top	0.004	1.800	1.810	#8@280mm c	CT-1
CS-L2	-716.483	-781.388	-336.483	-781.388	Bottom	-0.002	1.800	1.810	#8@280mm c	CB-1
CS-T2	-868.983	-828.888	-868.983	-428.888	Top	0.004	1.800	1.810	#8@280mm c	CT-1
MS-L	-716.483	-628.888	-701.243	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-701.243	-628.888	-686.003	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-686.003	-628.888	-670.763	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-670.763	-628.888	-655.523	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-655.523	-628.888	-640.283	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-640.283	-628.888	-625.043	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-625.043	-628.888	-609.803	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-609.803	-628.888	-594.563	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-594.563	-628.888	-579.323	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1
	-579.323	-628.888	-564.083	-628.888	Top	0.000	1.800	1.810	#8@280mm c	MT-1

SLAB DESIGN REPORT

BEAM DESIGN RESULTS



B E A M N O. 48 D E S I G N R E S U L T S

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3800.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	950.0 mm	1900.0 mm	2850.0 mm	3800.0 mm
TOP	110.56	0.00	0.00	0.00	127.82

REINF.	(Sq. mm)	(Sq. mm)	(Sq. mm)	(Sq. mm)	(Sq. mm)
BOTTOM	0.00	93.75	93.75	93.75	0.00
REINF.	(Sq. mm)	(Sq. mm)	(Sq. mm)	(Sq. mm)	(Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	950.0 mm	1900.0 mm	2850.0 mm	3800.0 mm

TOP	2-12í	2-12í2-12í2-12í2-12í			
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
BOTTOM	2-12í	2-12í2-12í2-12í2-12í			
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR REINF.	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c

---

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

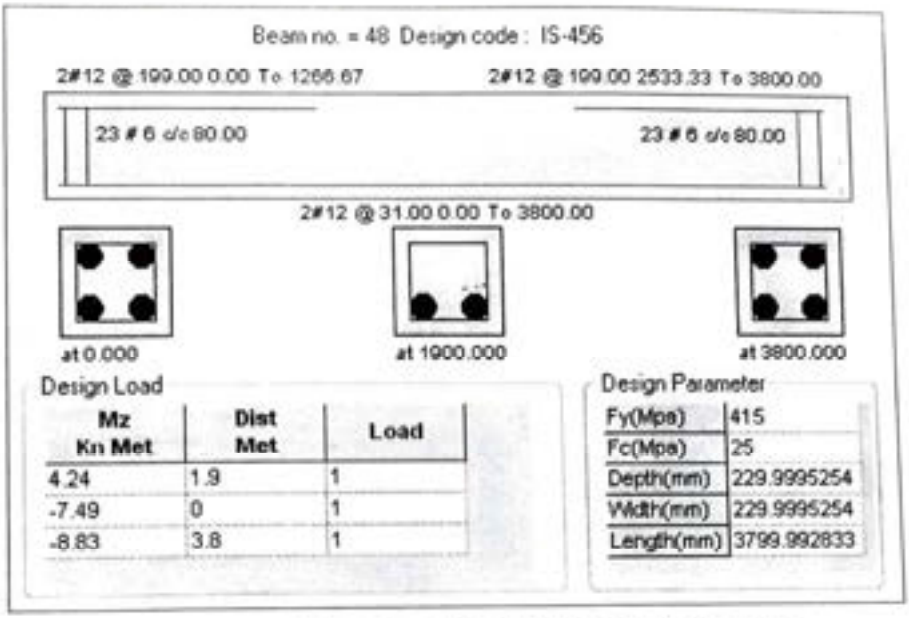
VY = 10.62 MX = -0.01 LD= 1

Provide 2 Legged 6í @ 80 mm c/c

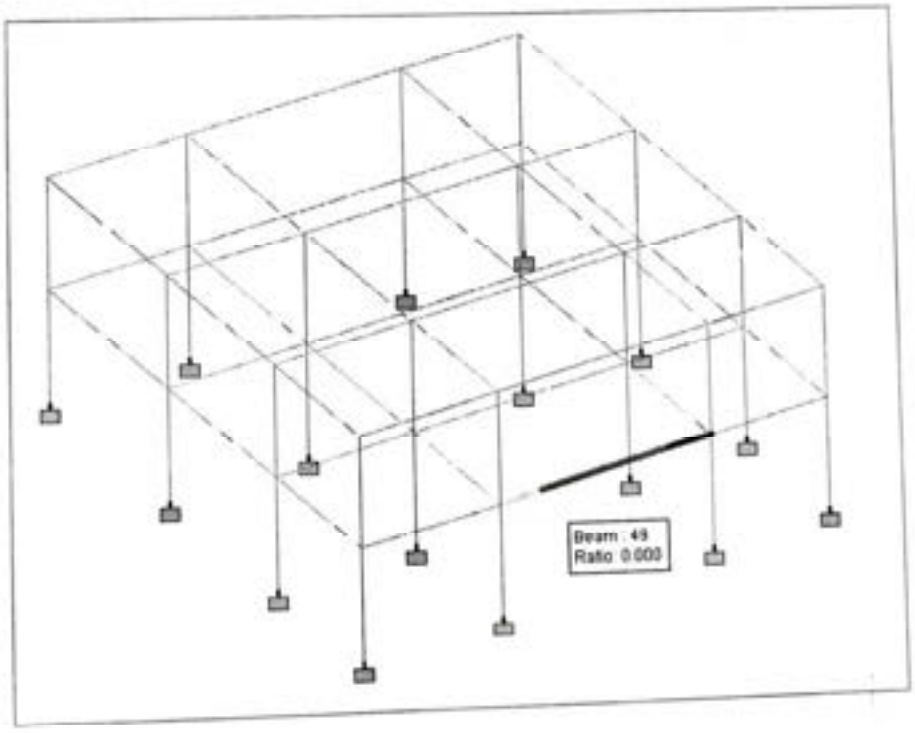
SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

VY = -11.22 MX = -0.01 LD= 1

Provide 2 Legged 6í @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM



BEAM NO. 49 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 5900.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1475.0 mm	2950.0 mm	4425.0 mm	5900.0 mm
TOP REINF.	316.61 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	301.56 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	93.75 (Sq. mm)	155.92 (Sq. mm)	93.75 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1475.0 mm	2950.0 mm	4425.0 mm	5900.0 mm
TOP REINF.	3-12í 1 layer(s)	2-12í 1 layer(s)	2-12í2-12í 1 layer(s)	1 layer(s)	3-12í 1 layer(s)
BOTTOM REINF.	2-12í 1 layer(s)	2-12í2-12í2-12í2-12í 1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR REINF.	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

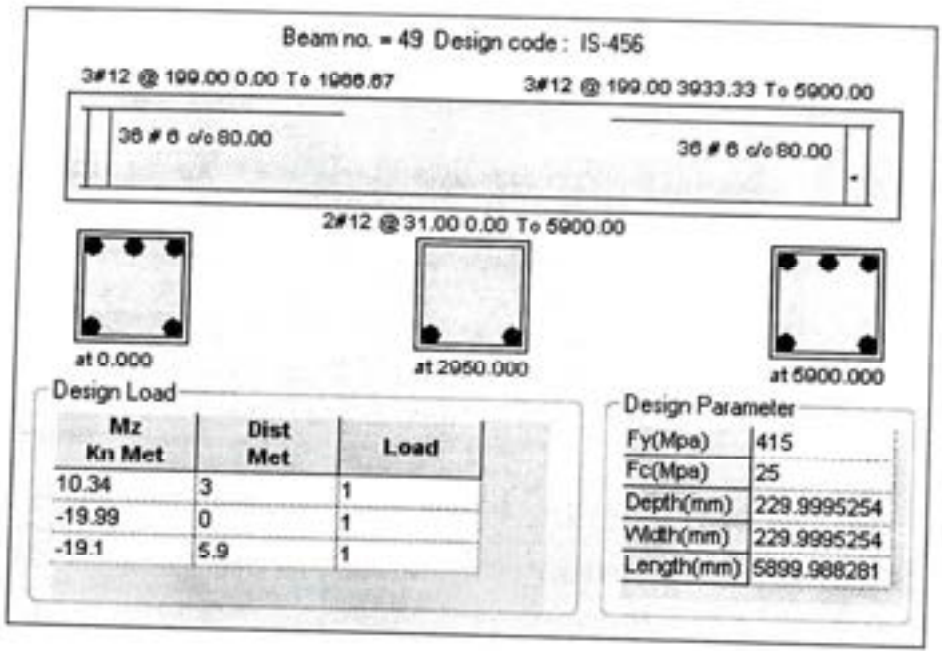
VY = 18.28 MX = -0.15 LD= 1

Provide 2 Legged 6i @ 80 mm c/c

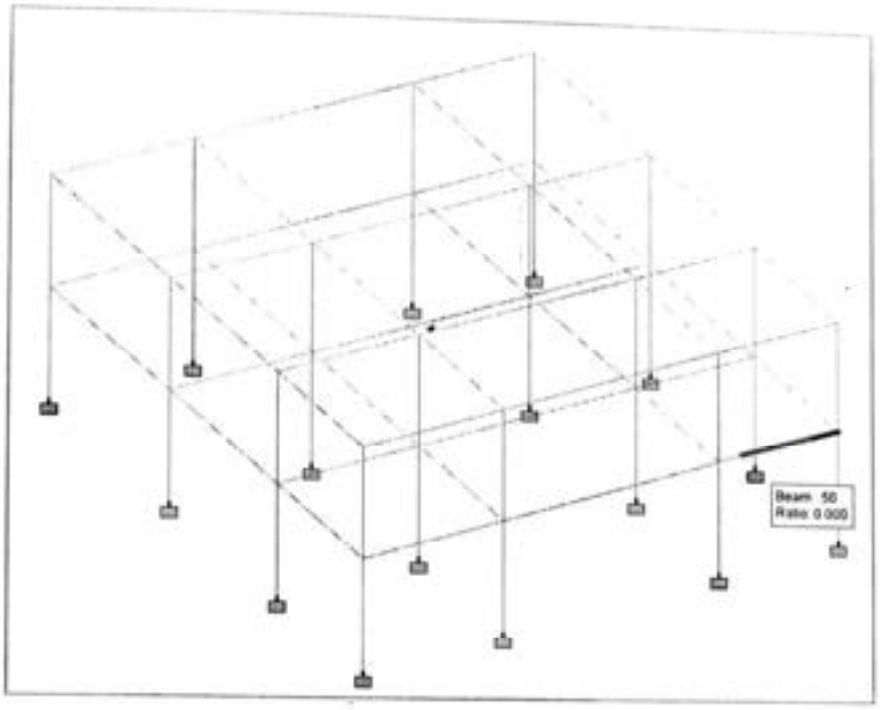
SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

VY = -17.99 MX = -0.15 LD= 1

Provide 2 Legged 6i @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM



BEAM NO. 50 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3300.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	825.0 mm	1650.0 mm	2475.0 mm	3300.0 mm
TOP REINF.	104.62 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	93.75 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	93.75 (Sq. mm)	93.75 (Sq. mm)	93.75 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	825.0 mm	1650.0 mm	2475.0 mm	3300.0 mm
TOP	2-12í	2-12í2-12í2-12í2-12í			
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
BOTTOM	2-12í	2-12í2-12í2-12í2-12í			
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR REINF.	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

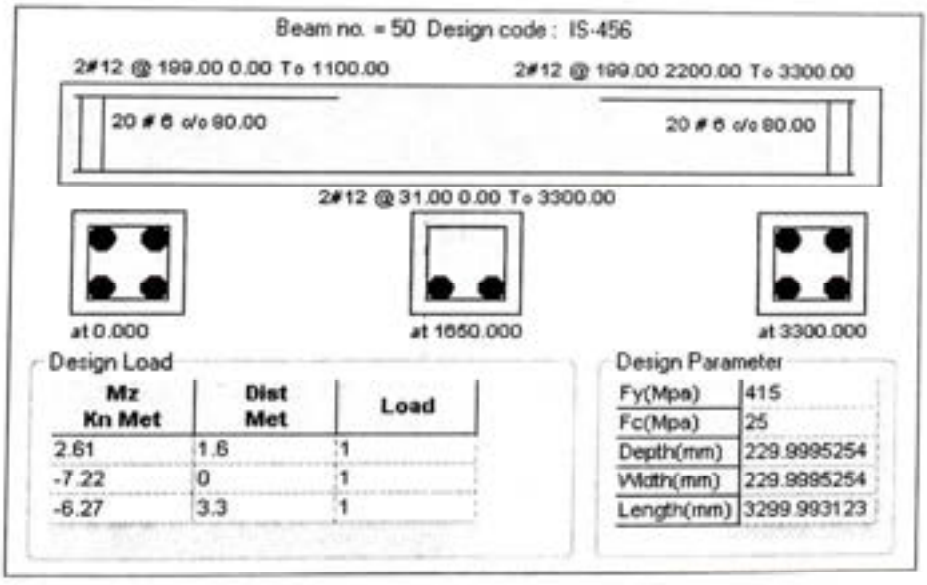
VY = 9.55 MX = 0.00 LD= 1

Provide 2 Legged 6í @ 80 mm c/c

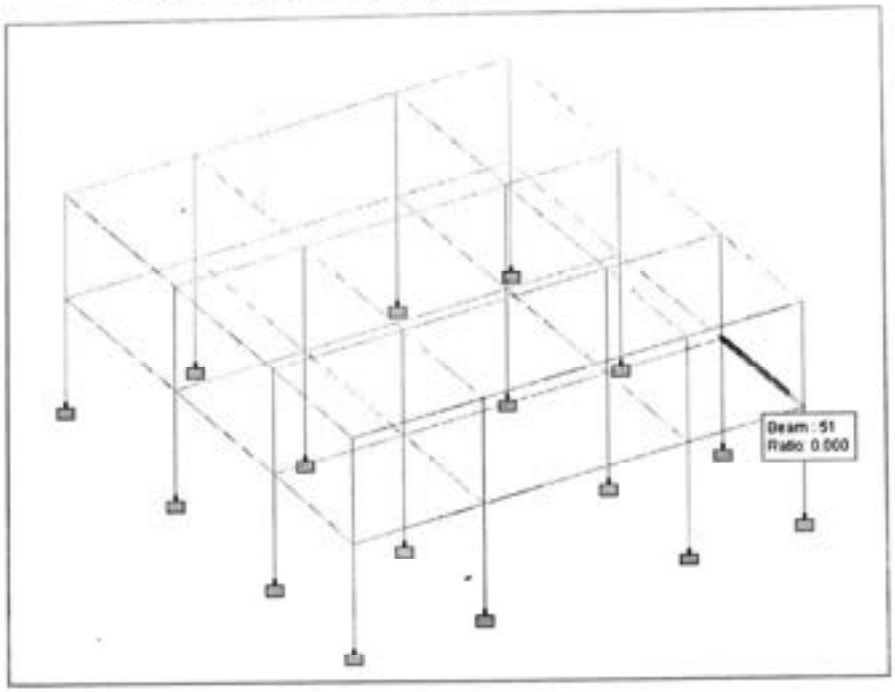
SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

VY = -8.86 MX = 0.00 LD= 1

Provide 2 Legged 6í @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM



BEAM NO. 51 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 4000.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1000.0 mm	2000.0 mm	3000.0 mm	4000.0 mm
TOP REINF.	148.41 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	139.84 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	93.75 (Sq. mm)	93.75 (Sq. mm)	93.75 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1000.0 mm	2000.0 mm	3000.0 mm	4000.0 mm

	TOP	2-12i	2-12i2-12i2-12i2-12i		
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
	BOTTOM	2-12i	2-12i2-12i2-12i2-12i		
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR	2 legged 6i	2 legged 6i	2 legged 6i	2 legged 6i	2 legged 6i
REINF.	@ 80 mm c/c	@ 80 mm c/c	@ 80 mm c/c	@ 80 mm c/c	@ 80 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

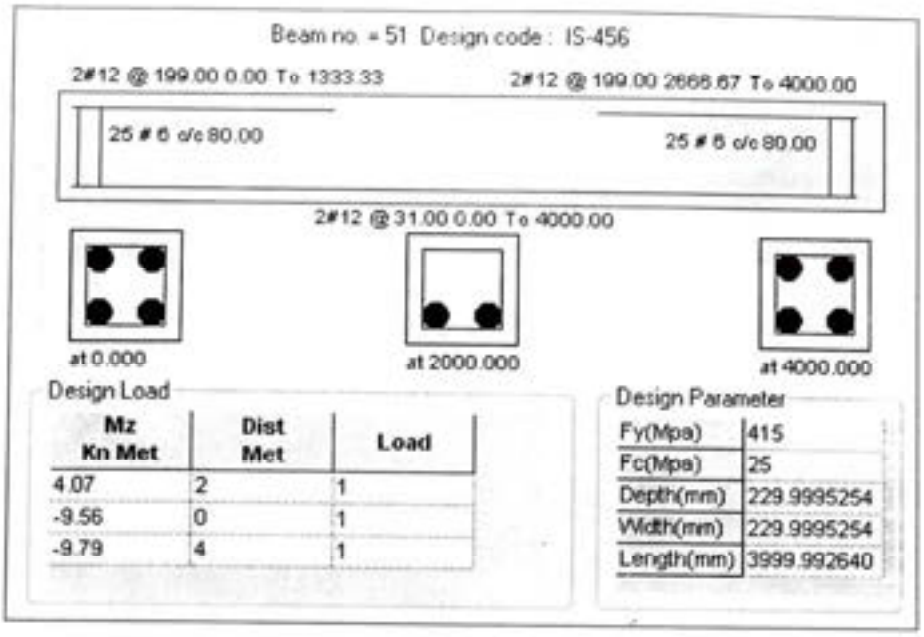
VY = 11.75 MX = 0.14 LD= 1

Provide 2 Legged 6i @ 80 mm c/c

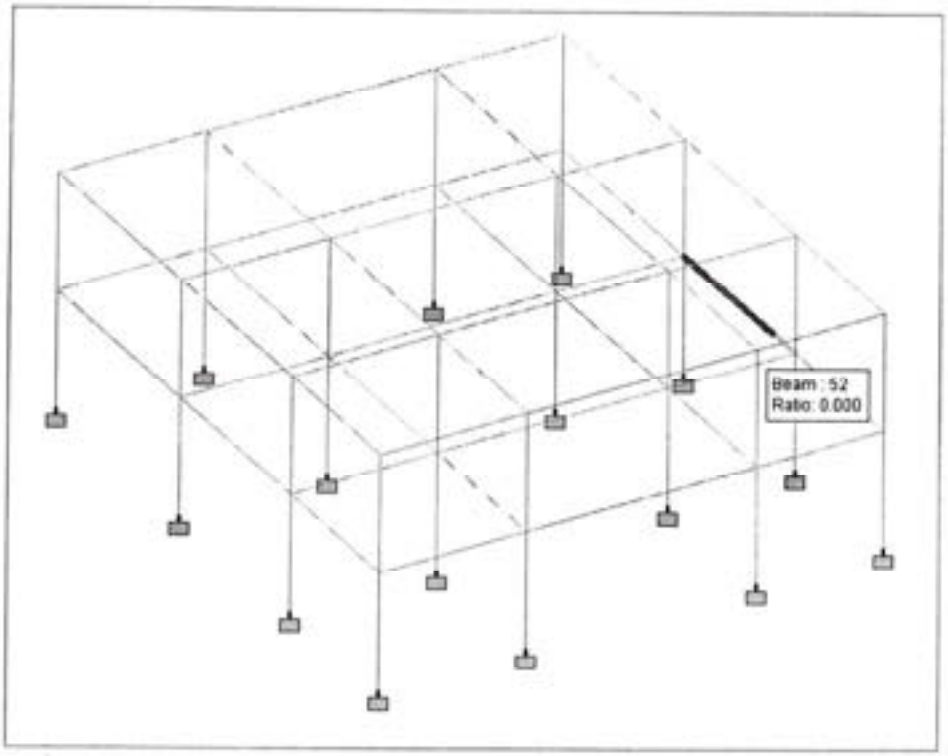
SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

VY = -11.47 MX = 0.14 LD= 1

Provide 2 Legged 6i @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM



BEAM NO. 52 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 5000.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	221.21 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	236.21 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	93.75 (Sq. mm)	123.08 (Sq. mm)	93.75 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	2-12í 1 layer(s)	2-12í2-12í2-12í 1 layer(s)	1 layer(s)	3-12í 1 layer(s)	1 layer(s)
BOTTOM REINF.	2-12í 1 layer(s)	2-12í2-12í2-12í2-12í 1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR REINF.	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

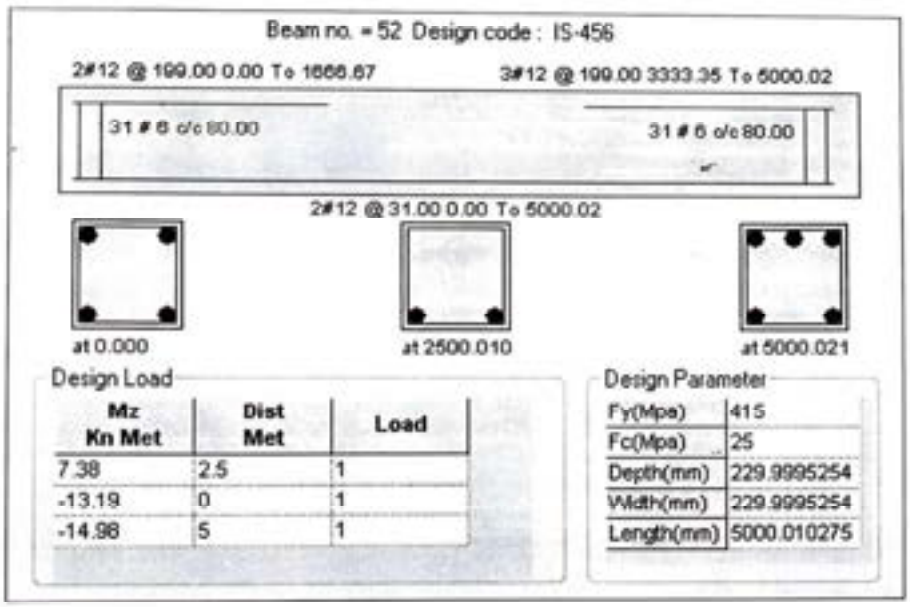
VY = 14.87 MX = 0.86 LD= 1

Provide 2 Legged 6i @ 80 mm c/c

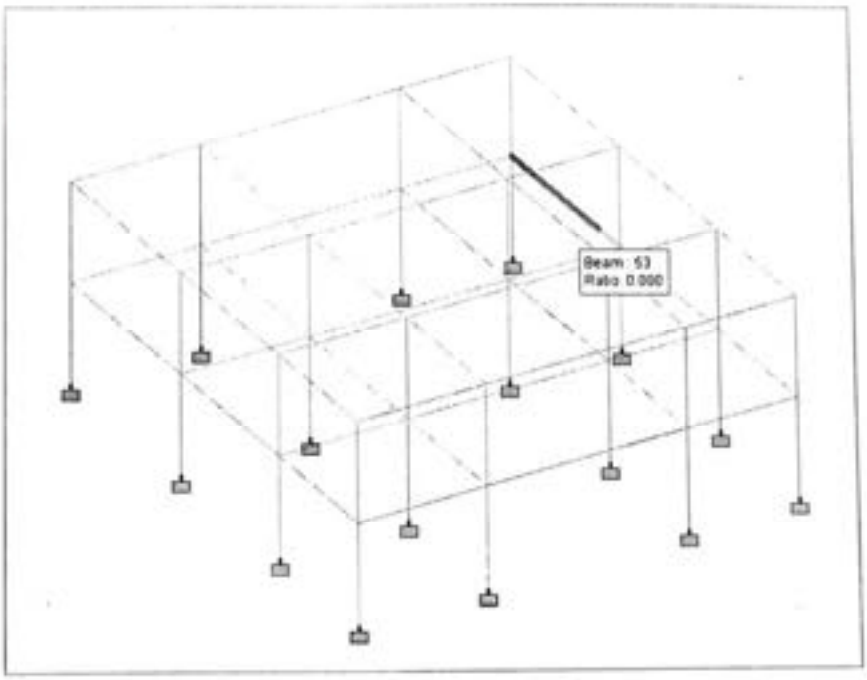
SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

VY = -15.22 MX = 0.86 LD= 1

Provide 2 Legged 6i @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM



BEAM NO. 53 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 5500.0 mm SIZE: 230.0 mm X 230.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1375.0 mm	2750.0 mm	4125.0 mm	5500.0 mm
TOP REINF.	297.29 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	238.59 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	93.75 (Sq. mm)	156.81 (Sq. mm)	93.75 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1375.0 mm	2750.0 mm	4125.0 mm	5500.0 mm
TOP	3-12í	2-12í	2-12í2-12í		3-12í
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
BOTTOM	2-12í		2-12í2-12í2-12í2-12í		
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR REINF.	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c	2 legged 6í @ 80 mm c/c

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM START SUPPORT

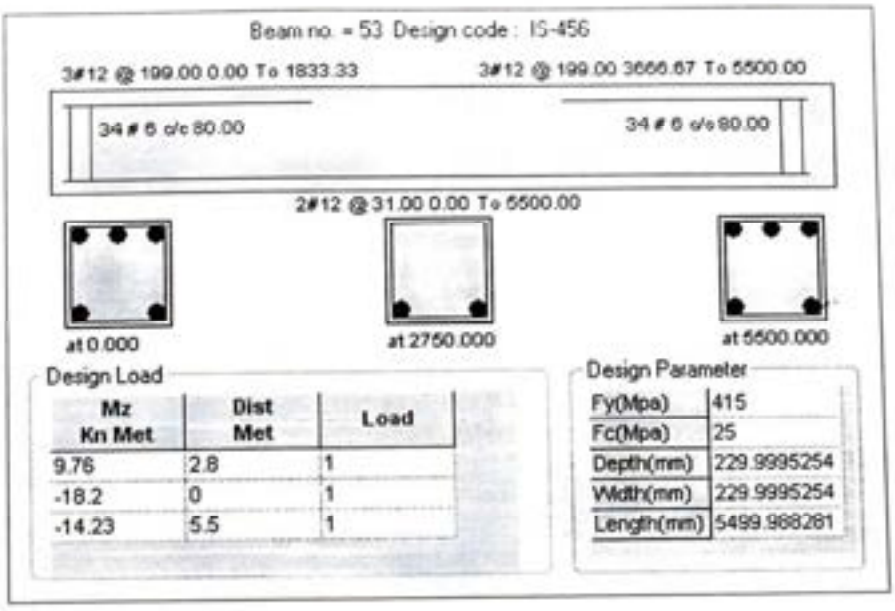
VY = 17.38 MX = -0.84 LD= 1

Provide 2 Legged 6í @ 80 mm c/c

SHEAR DESIGN RESULTS AT 310.0 mm AWAY FROM END SUPPORT

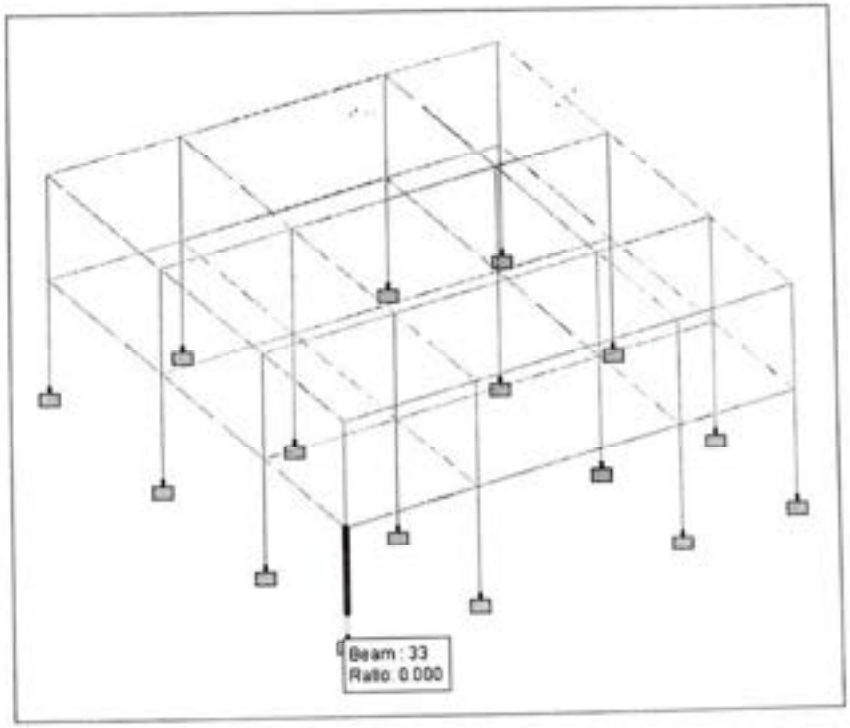
VY = -16.15 MX = -0.84 LD= 1

Provide 2 Legged 6í @ 80 mm c/c



BEAM REINFORCEMENT DIAGRAM

COLUMN DESIGN RESULTS



COLUMN NO.33 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm
COVER: 40.0 mm

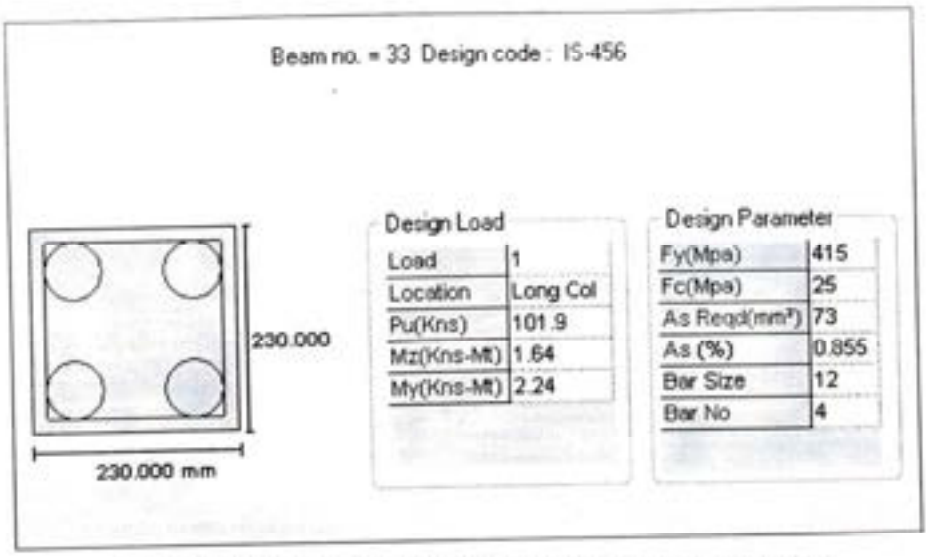
** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 99.32 Sq.mm.
REQD. CONCRETE AREA: 52800.68 Sq.mm.
MAIN REINFORCEMENT : Provide 4 - 12 dia. (0.86%, 452.39 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 190 mm c/c

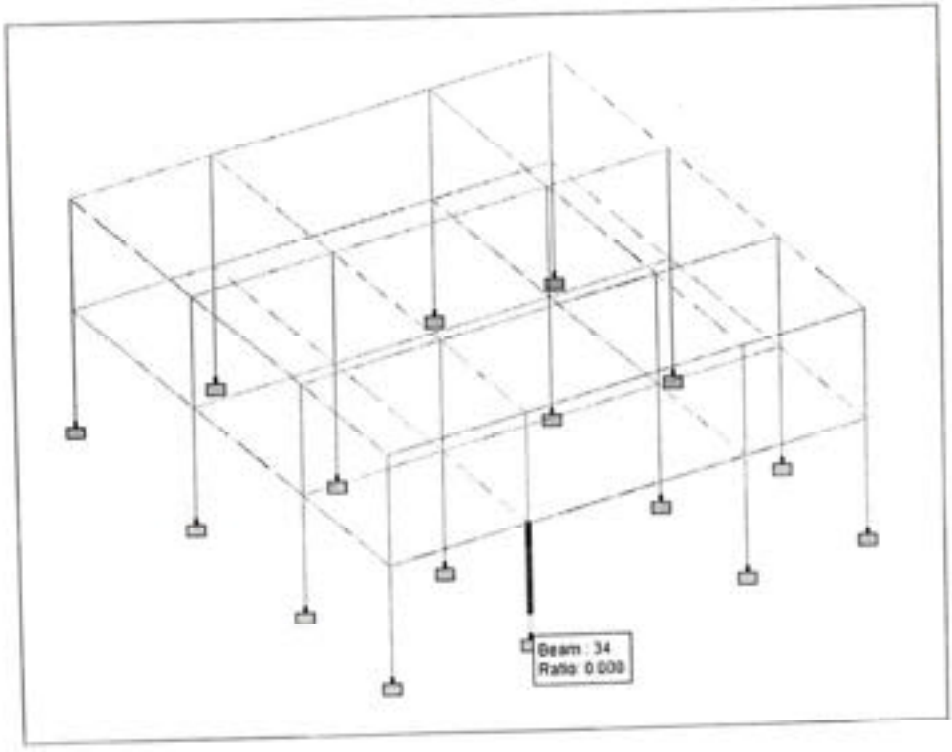
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 624.92 Muz1 : 14.30 Muy1 : 14.30

INTERACTION RATIO: 0.75 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM



COLUMN NO.34 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm

COVER: 40.0 mm

** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 217.78 Sq.mm.

REQD. CONCRETE AREA: 52682.23 Sq.mm.

MAIN REINFORCEMENT : Provide 4 - 12 dia. (0.86%, 452.39 Sq.mm.)

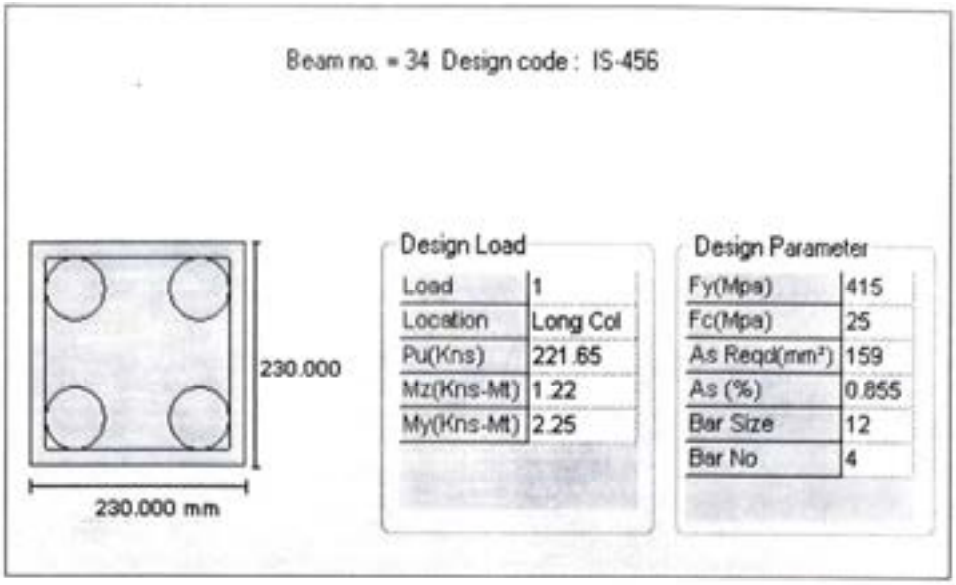
(Equally distributed)

TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 190 mm c/c

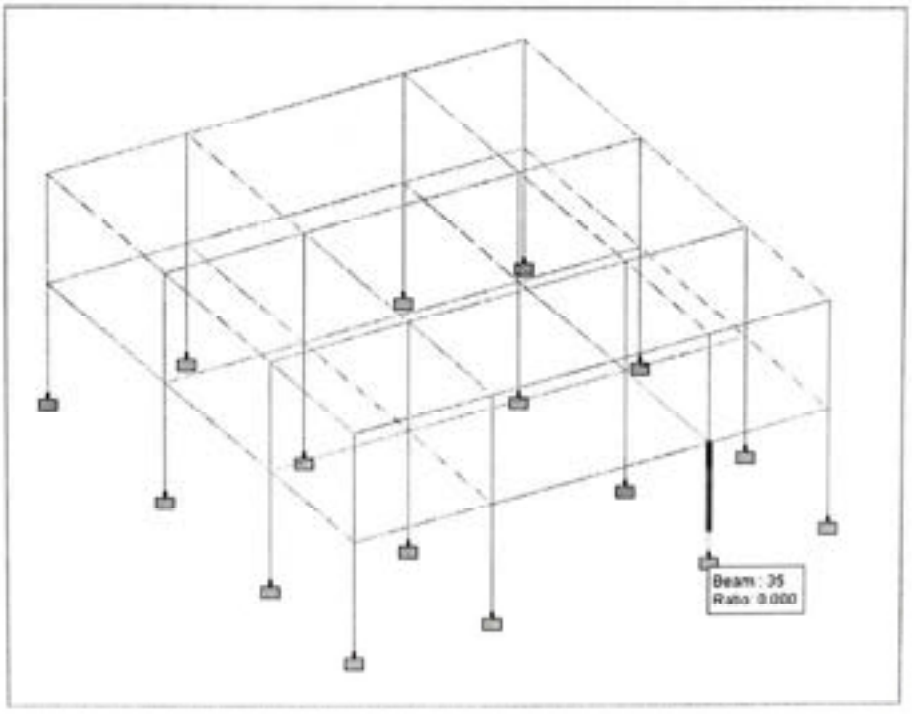
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 660.46 Muz1 : 19.48 Muy1 : 19.48

INTERACTION RATIO: 0.93 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM



COLUMN NO.35 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm

COVER: 40.0 mm

** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 203.44 Sq.mm.

REQD. CONCRETE AREA: 52696.56 Sq.mm.

MAIN REINFORCEMENT : Provide 4 - 12 dia. (0.86%, 452.39 Sq.mm.)

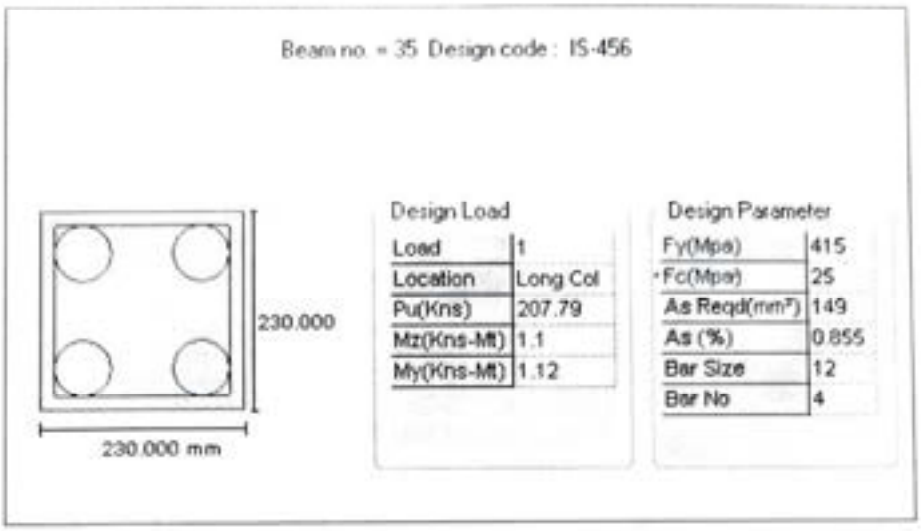
(Equally distributed)

TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 190 mm c/c

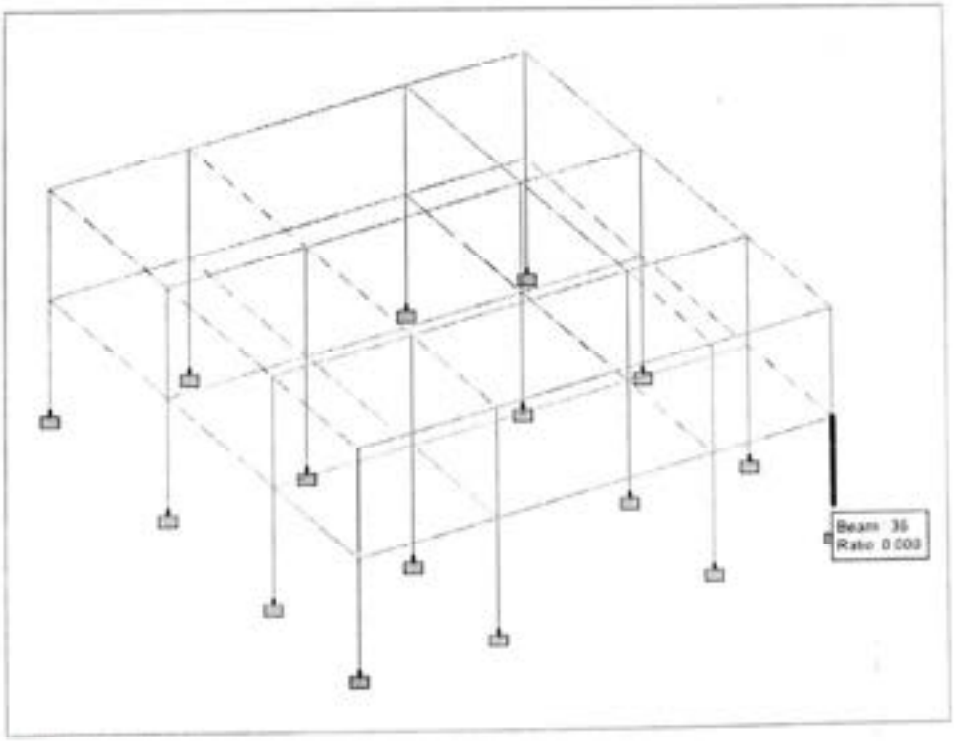
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 656.16 Muz1 : 19.45 Muy1 : 19.45

INTERACTION RATIO: 0.90 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM



COLUMN NO.36 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm
COVER: 40.0 mm

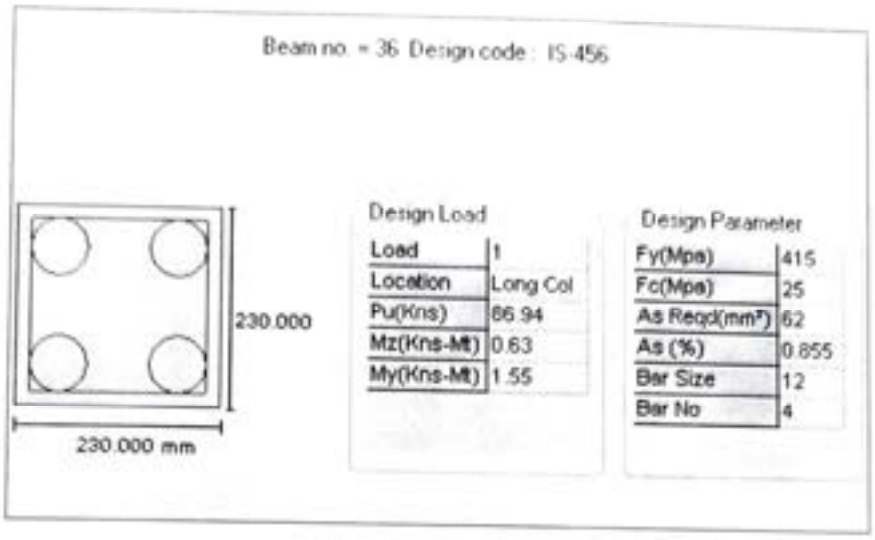
** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 83.68 Sq.mm.
REQD. CONCRETE AREA: 52816.33 Sq.mm.
MAIN REINFORCEMENT : Provide 4 - 12 dia. (0.86%, 452.39 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 190 mm c/c

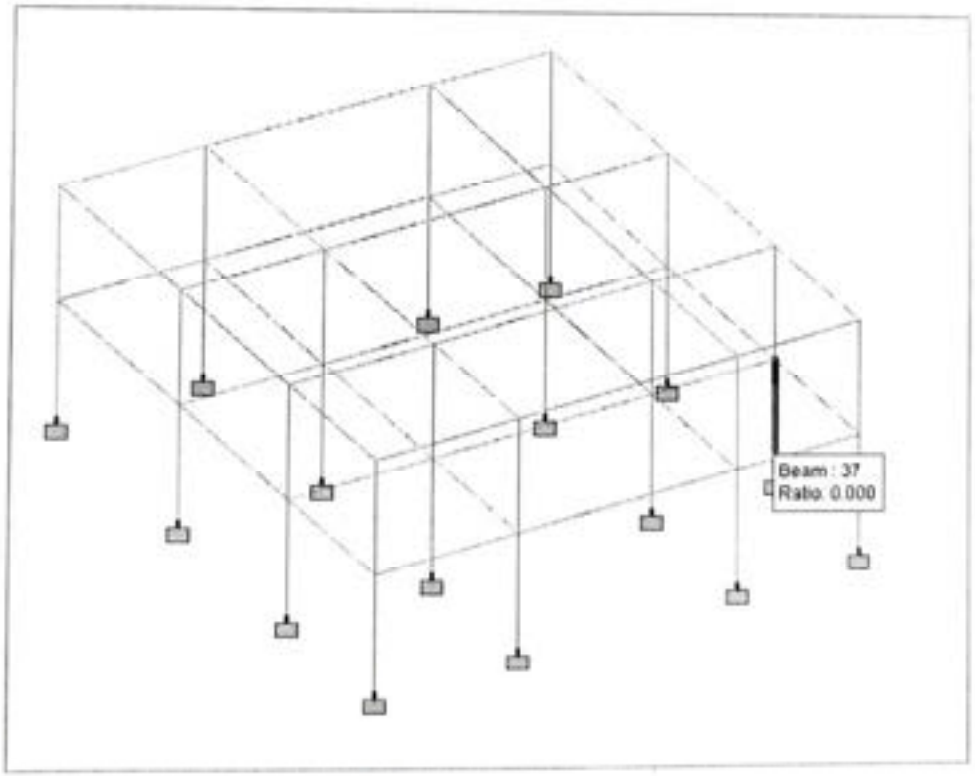
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 620.23 Muz1 : 12.71 Muy1 : 12.71

INTERACTION RATIO: 0.74 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM



COLUMN NO.37 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm
COVER: 40.0 mm

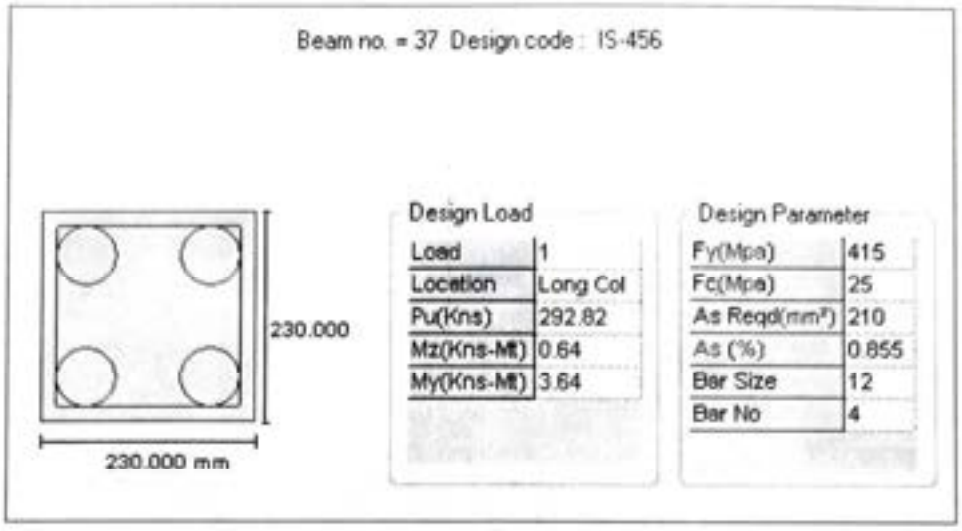
** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 482.53 Sq.mm.
REQD. CONCRETE AREA: 52417.47 Sq.mm.
MAIN REINFORCEMENT : Provide 4 - 16 dia. (1.52%, 804.25 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 230 mm c/c

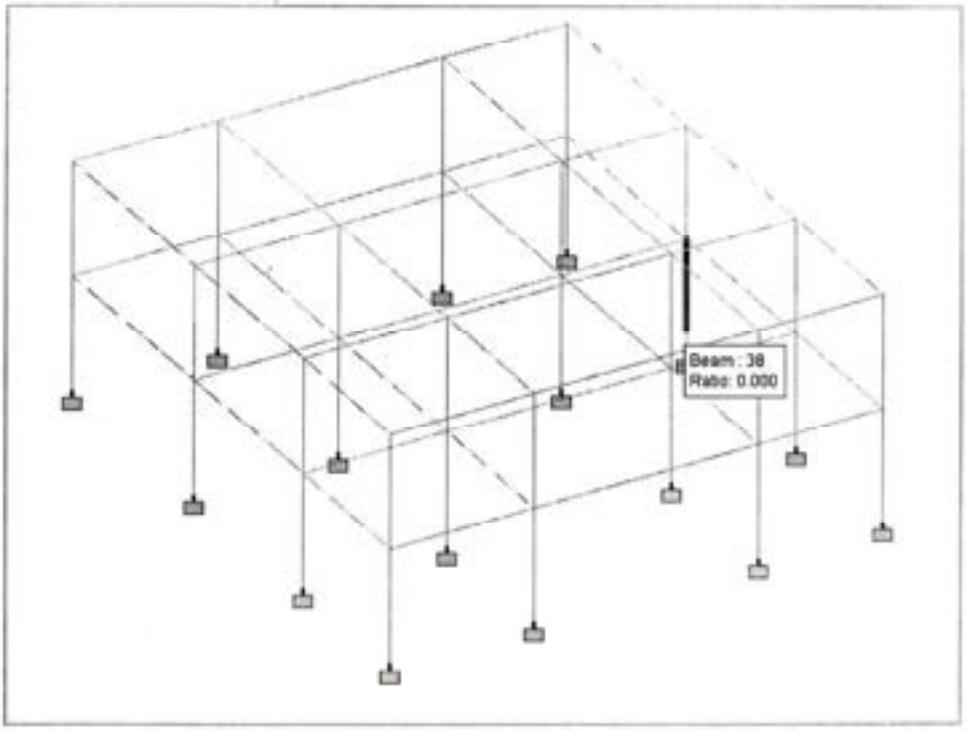
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 739.89 Muz1 : 21.39 Muy1 : 21.39

INTERACTION RATIO: 0.98 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM



COLUMN NO.38 DESIGN RESULTS

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3048.0 mm CROSS SECTION: 230.0 mm X 230.0 mm
COVER: 40.0 mm

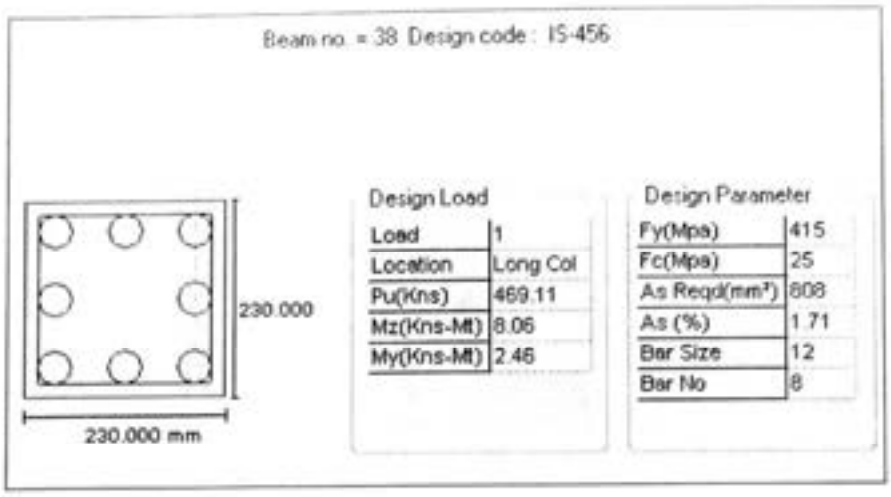
** GUIDING LOAD CASE: 1 BRACED LONG COLUMN

REQD. STEEL AREA : 1650.48 Sq.mm.
REQD. CONCRETE AREA: 51249.53 Sq.mm.
MAIN REINFORCEMENT : Provide 4 - 25 dia. (3.71%, 1963.50 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT : Provide 8 mm dia. rectangular ties @ 230 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1090.27 Muz1 : 30.38 Muy1 : 30.38

INTERACTION RATIO: 0.98 (as per Cl. 39.6, IS456:2000)



COLUMN REINFORCEMENT DIAGRAM

********** CONCRETE TAKE OFF **********

(FOR BEAMS AND COLUMNS DESIGNED ABOVE)

TOTAL VOLUME OF CONCRETE = 21.18 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
6	4308.24
8	2009.70
12	10995.19
16	6380.65
20	294.90
25	921.65
*** TOTAL=	24910.33

COMPARISON BETWEEN MANUAL DESIGN AND STAAD DESIGN REPORTS

ELEMENT	TYPE OF RESULTS	MAUAL DESIGN REPORT		STAAD DESIGN REPORT	
BEAM	SIZE	300 x 440 mm		230 x 230 mm	
	DESCRIPTION	DIAMETER	NO OF RODS	DIAMETER	NO OF RODS
	REINFORCEMENT	20	5	12	3
COLUMN	SIZE	300 x 300 mm		230 x 230 mm	
	DESCRIPTION	DIAMETER	NO OF RODS	DIAMETER	NO OF RODS
	LONGITUDINAL REINFORCEMENT	16	5	4	16
	TRANSVERSE REINFORCEMENT	6	260 mm c/c spacing	8	230 mm c/c spacing

CHAPTER 7

DRAWING

GROUND FLOOR PLAN

CHAPTER 8

CONCLUSION

Through our project we conclude that application of software in civil industry plays important role in our study. In our project Residential building with triple bed rooms we adopt limit state method for analysis and design of our structure.

Time taken for doing this project is very less due to the application of the software. We bring extra accuracy in dimension and analysis part through our project. Hence we conclude that application software in our filed is quite good and comprehensive for further study of structural parameter.

CHAPTER 9

REFERENCES

The following books are referred for the design purpose for completion of our project work.

TEXT BOOKS:

Structural engineering	-	A.P.ARULMANIKAM
Quantity surveying	-	N.MURALIKRRISHNAIYA
Structural drawing	-	MURUGESAN
Estimate and costing	-	B.N.DUTTA
Principles of architecture	-	G.MUTHU, SHOBA, MOHAN

CODE BOOKS:

Concrete code	-	IS 456 – 2000
Steel code	-	IS 800:2007

HOME CONTROL SYSTEM USING ARTIFICIAL INTELLIGENCE

A MINI PROJECT REPORT

Submitted by

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in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

OCTOBER-2019

ABSTRACT

A proposal for home control using voice via Google Assistant. There are home automation technologies introduced over these years from ZigBee automation, Amazon Echo, Google home etc., It describes the implementation of such a system. The system is implemented using ordinary household appliances Natural language voice commands are given to the Google Assistant and with the help of IFTTT (If This Then That) application and the Adafruit the commands are decoded and then sent to the microcontroller, the microcontroller in turn controls the relays connected to it as required, turning the device connected to the respective relay On or OFF as per the users request to the Google Assistant. The microcontroller used is NodeMCU (ESP8266) and the communication between the microcontroller and the application is established via Wi-Fi (Internet).

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LIST OF ABBREVIATION

ACRONYMS	ABBREVIATION
GACHAS	Google Assistant Controller Home Automation
GSM	Global System for Mobile
IC	Integrated Circuit
IDE	Integrated Development Environment
IFTTT	If This Then That
IOT	Internet of Things
MQTT	Message Queuing Telemetry Transportation
Node MCU	Node Micro Controller Unit
SDK	Software Development Kit

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

Home, it is the place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable.

Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel cosier and rather, feel homelier. Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit. Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. It uses the Google Assistant, the IFTTT Web interface, the Adafruit Web Interface and the NodeMCU microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT.

1.2 OBJECTIVES

The aim is to provide a cheap home automation system to assist common man's life to make his schedule more efficient and help conserve energy; it will also be of great use to handicapped and elderly members of our society.

The system has two modules in totality; the first module consists of control of lights, blinds and fans which will be switched on and off using voice commands on Google assistant. The second module consists of control of common household appliances such as television, projector, air conditioners etc. Intend to attach four loads in this work and the control of the appliances will be done using two methods in particular; they are App and voice control. Voice control can easily be achieved on an Android mobile using Google Assistant.

1.3 PROBLEM STATEMENTS

The main problems that a home automation system faces are high cost of the system, strenuous configuration and set up process and security of the system. This developed system will be much cheaper than the available systems in the market and cover the control of most of the commonly used home appliances in a house using an Android App and voice control using Google Assistant on the user's mobile. The system is wireless and will be using Bluetooth as well as Wi-Fi to allow the user to control various appliances using their mobile phones, personal computers/ Laptops etc. It has never been easier or more affordable to purchase and install smart devices and home control systems. The drawback, however, is that systems are regularly being installed incrementally without a central control point. And that can lead to home automation problems.

CHAPTER 2
LITERATURE SURVEY

2.1 Smart Home Using Wi-Fi

NiharikaShrotriya et al., [1] proposed the system allows the people think about home automation, most of them may imagine living in a smart home: One remote controller for every household appliance, cooking the rice automatically, starting air conditioner automatically, heating water for bath automatically and shading the window automatically during night. To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast. Early home automation began with labour-saving machines. Self-contained electric or gas powered home appliance became viable in the 1900s with the introduction of electric power distribution led to the introduction of washing machine (1904), water heater (1889), refrigerator, sewing machines, dishwashers and clothes dryers. As per the survey currently there exists system neither at cheaper rates nor easy to handle. Various systems are hard to install, difficult to use and maintain.

2.2 Development of Internet Based System:

Tan, et al., [2] proposed the development of an Internet-based system to allow monitoring of important process variables from a distributed control system (DCS). The hardware and software design considerations which enable the user to access the process variables on the DCS, remotely and effectively rent designations.

The use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition. It is one of the difficult system to process it.

2.3 A System for Smart-Home Control of Appliances Based on Time and Speech Interaction:

S. M. AnamulHaque et al., [3] proposed a system entitled "A System for Smart-Home Control of Appliances Based on Time and Speech Interaction" that controls the home appliances using the personal computer. The system is developed by using the Visual Basic 6.0 as programming language and Microsoft voice engine tools for speech recognition purpose. Appliances can be either controlled by timer or by voice command. The remote monitoring through mobile phone involving the use of spoken commands. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS and it takes the difficult for decision a particular task.

2.4 Home Automation and Security using Android ADK:

DeepaliJavale et al., [4], proposed the design of home automation and security system using android ADK. The design is based on Standalone embedded system board android ADK (Accessory Development Kit) at home. Home appliances are connected to the ADK and communication is established between the ADK and android mobile device or tablet. The home appliances are connected to the input/output ports of embedded system board and their status is passed to ADK. They have developed an authentication to the system for authorized person to access home appliances. The device with high cost and scalable to less modification to the core is used. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

2.5 Safe and Secure PIC Based Remote Control Application for Intelligent Home:

E. Yavuz et al., [5] proposed the secure PIC based remote control system for intelligent houses has been presented. With this implemented system, it is possible to safely control electricity operated domestic devices by the help of public or mobile phones from any places all over the world. Developed remote control device has been optically and electrically isolated to secure the system.

2.6 Bluetooth Based Home Automation System:

N. Sriskanthan et al., [6] proposed the Journal of Microprocessors and Microsystems, the "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, architecture and computing (Huidobro and Millan, 2004). HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and old aged due to their complexity and cost, do not always accept these systems. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, ZIGBEE, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, Bluetooth is being chosen with its suitable capability. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class.

2.7 Home Automation Using Internet of Things:

Kusuma [7] proposed a Home Automation system that employs the integration of multi-touch mobile devices, cloud networking, wireless communication, and power-line communication to provide the user with remote control of various lights and appliances within their home. This system uses a consolidation of a mobile phone application, handheld wireless remote, and PC based program to provide a means of user interface to the consumer.

The main objective is to design and implement a control and monitor system for smart house. Smart house system consists of many systems that controlled by LAB VIEW software as the main controlling system. Also, the smart house system was supported by remote control system as a sub controlling system. The system also is connected to the internet to monitor and control the house equipment's from anywhere in the world using LAB VIEW.

Deepali Javale [4], also proposed the prime objective is to assist handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using Android phone/tab. The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors.

A new design for the smart home using the wireless sensor network and the biometric technologies. The system employs the biometric in the authentication for home entrance which

enhances home security as well as easiness of home entering process. The structure of the system is described and the incorporated communications are analyzed, also an estimation for the whole system cost is given which is something lacking in a lot of other smart home designs offers. WB-SH is designed to be capable of incorporating in a building automation system and it can be applied to offices, clinics, and other places. It ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form. It ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form.

CONCLUDING REMARKS:

The various literature survey has published here which the systems are hard to install, difficult to maintain. The proposed system were not in optimized and user friendly.

Our Proposed system is easily accessible from mobile itself and provides access anywhere from the world and there is no need of any separate interface to run it. Current systems are generally proprietary, closed and user friendly Based on Arduino and low cost home automation system.

CHAPTER 3
SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The IoT is used in order to control the home appliances where the home appliances are remotely controlled using a web page buttons, where the user have to go to the particular link and from there to press buttons in order to control the home appliance. It involves the control the lighting, heating, ventilation, air conditioning and security, as well as home appliances. Remote or sensors are used for controlling Home devices, Modern systems generally consists of switches and sensors connected to a central hub called a gateway from which the system is controlled with a user interface that is interacted either with a mobile phone software ,tablet, computers or a web interface often but not always via internet cloud services.

To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast. Early home automation began with labour-saving machines. Self-contained electric or gas powered home appliance became viable in the 1900s with the introduction of electric power distribution led to the introduction of washing machine water heater refrigerator, sewing machines, dishwashers and clothes dryers. As per the survey currently there exists system neither at cheaper rates nor easy to handle. Various systems are hard to install, difficult to use and maintain. Current systems are generally proprietary, closed and not very user friendly Based on Arduino or GSM or low cost home security system and home automation system.

3.1.1 DISADVANTAGE OF EXISTING SYSTEM

- The operating is difficult.
- A separate web page is required.
- For every switching on and off user want to login into web page.

3.2 PROPOSED SYSTEM

The idea is to integrate the concept of Google Assistant into Arduino and control the appliances in the home that the device is installed. Google recently released an API for Google Assistant, for platforms other than Android, such as Linux and Windows, using Python language.

When the user sends command through Google assistant it first goes to the IFTTT there the given set statements that states he IF THIS THEN THAT can understand this when the architecture

of our system. From there it goes to the Adafruit is cloud service it is like MQTT broker which interacts with the NodeMCU. The Control Unit comprises of the microcontroller- Node MCU and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet.

The system has the capabilities to control the following components in user's home and monitor the following alarms: Temperature and humidity Motion Detection Light level and Lights on/off/dim Fan on/off On/off different appliance and also Provide a more user-friendly interaction Various issue are solved like sending notification by providing the data monitoring system so it can be control the sensors data. Very simple and provide interaction with Google assistant.

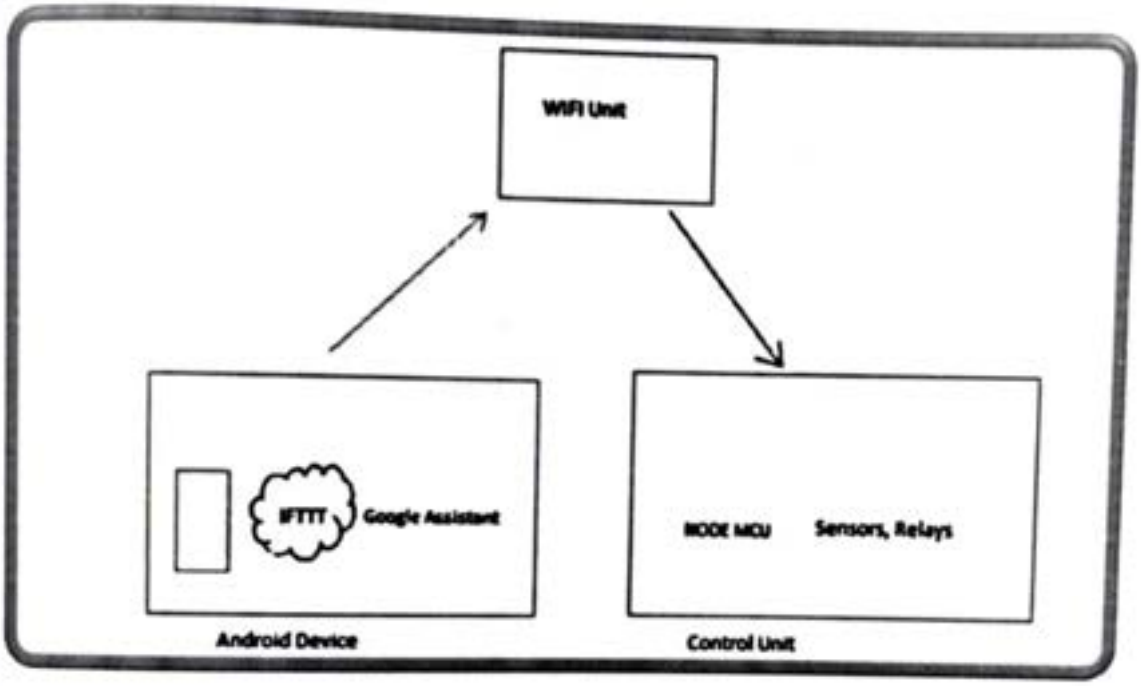

Fig 3.1 Overall Design

The system which has WI-FI as the control unit. It enhances the data from Microcontroller to web interfaces and also from web interfaces to microcontroller. The IFTTT and Google Assistant are used as an android devices and NodeMCU, Sensors, Relay are used as the control unit in the Home control system.

Voice controlled home automation is a step further in easing the control of appliances. This helps the handicapped as well as elderly people to access the home appliances with ease. As technology grows and expands with every single moment, automations have also taken leaps and bounds. Earlier a niche field which was accessible to only a select few, Home Automation is now becoming economically accessible to a much larger market. Through this system is intend to make

home automation economically accessible to every family. An automation system for home which makes use of cloud computing and wireless communication has been studied. This is found to be cheaper. The internet of things is intended to bring everything in the universe under a single framework. This provides greater control of the stuff while updating the user on the status of things. Communication was also made possible through Bluetooth to automate home appliances. New schemes for smarter homes were discussed and advancements were introduced. Home appliances can also be controlled by using RP along with the concept of relay circuit by adopting a web page.

3.2.1ADVANTAGES OF PROPOSED SYSTEM

- System can be easily accessible from mobile itself.
- It provides Access from anywhere the system is connected to server.
- The system no need of any interface for communication. Google assistance is enough.

3.2.2 SYSTEM ARCHITECTURE

The Home Automation system will have about two modules.

- The first module consists of control of lighting, fans etc. using an Android phone App as well as voice commands using Google Assistant.
- The second module consist of control of various heavy power Household appliances such as television, air conditioner, Iron box etc.

Different types of applications using android platform with Wi-Fi can be further developed. In this work a four channel 12V relay is used to connect the appliances and control their switching. A 30A relay is also used for the control of heavy loads such as air conditioners, refrigerators, heaters etc. Android mobile phones are used to control the system as they are the most popular ones in the market, also it has an open source operating system. Therefore, it can be used free of cost on mobile phones. The App has provisions for supporting Wi Fi network by allowing the device to exchange data with other devices wirelessly using Router. For voice control of light loads Google Assistant is used. Initially Applets are created for switching on and switching off of the relay on the forum IFTTT (If this then that). With the relay board using jumper wires. The code is uploaded to the NodeMCU. Authentic token is added in the code as well as the name of the Wi-Fi hotspot which is used. Then the password of the Wi-Fi hotspot is added to access the hotspot. Now the NodeMCU is connected to the Wi-Fi. For hardware assembly the NodeMCU is connected appropriate request to the App which in turn sends the request to the NodeMCU board and controls the relay.

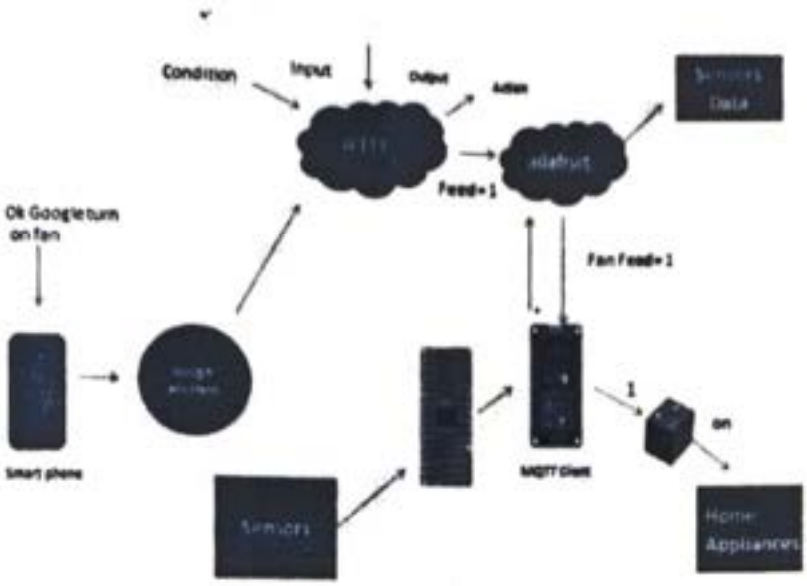

Fig 3.2 System Architecture for Home Control System

3.2.3 FLOWCHART

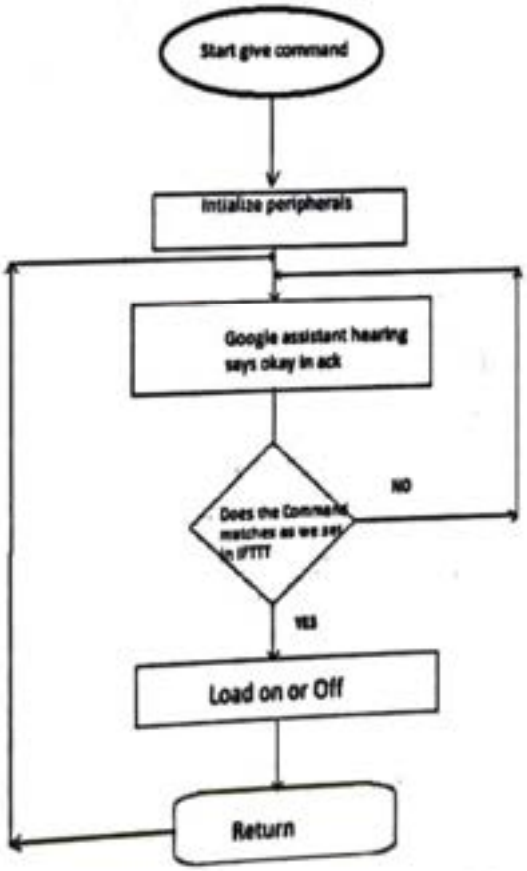

Fig 3.3 Flowchart for Home Control System

The Home control system which wok based on the user Commands

- First the User enter into the Google Assistant and Gives the command as Turn ON light.
- The Commands are send to the IFTTT interface where the commands are preprogrammed in IFTTT.
- Then IFTTT the user commands are triggered to Adafruit based on the commands given to Adafruit in IFTTT Applet.
- Then in Adafruit the created dashboard and feed is activated and turned ON and send to the Microcontroller (esp8266) through WI-FI.
- Finally, the Light is turned on.

CHAPTER 4
SYSTEM SPECIFICATION

4.1 HARDWARE REQUIREMENTS:

System : Pentium IV 2.4 GHz.
Hard Disk : 250 GB.
Monitor : 15 VGA Colour.
Mouse : Optical.
Ram : 1 GB.
Mobile : Android.

4.2 SOFTWARE REQUIREMENTS:

Operating System : Windows 7/8/10.
IDE : Arduino.
Platform : Adafruit, IFTTT.
Speech Interface : Google Assistant.

4.3 SOFTWARE ENVIRONMENT

4.3.1 ARDUINO IDE

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consist of only two functions.

- Setup (): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.
- Loop (): After setup () has been called, function loop () is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions. A typical program for a beginning Arduino programmer blinks a LED repeatedly. This program uses the functions pin Mode (), digital Write (), and delay (), which are provided by the internal libraries included in the IDE environment. The program is usually loaded in the Arduino by the manufacturer. Arduino IDE and C language allow the programming of the low level registers in the atmega328P.

Instructions like DDRB=0b00000001 for changing PORTB input/output pins are allowed. Fig 4.1 shows the basic program of Arduino IDE.

Fig 4.1 Arduino IDE

4.3.2 Adafruit

Adafruit Industries is an open-source hardware company based in New York City. It was founded by Limor Fried in 2005. The company designs, manufactures and sells a number of electronics products, electronics components, tools and accessories. It also produces a number of learning resources, including live and recorded videos related to electronics, technology, and programming. MQTT, or message queue telemetry transport, is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client can publish and subscribe to a feed to send and receive feed data.

Fig 4.2 Adafruit Feeds

Integrating IoT features into projects is all fine and good, but this is usually only half the work! The other half involves processing the data and getting some kind of user input.

Blocks

The Adafruit IO dashboard works with units called blocks that can be used to either display IoT information or obtain user input. The dashboard can also be accessed using common web browsers, which allows for just about any device to use the dashboard. This is really helpful in situations where developing a specific app for a mobile or tablet would be either too difficult or take too long to complete. Luckily, browser-based programs are cross-platform.

Toggle

The toggle block allows to add a toggle button to dashboard that can be used to set the value of a feed. This can be helpful when creating IoT devices such as smart lights, doors, curtains, toasters, and even windows. These devices can be turned on and off using the toggle switch.

Fig 4.3 Toggle Button

4.3.3 IFTTT

IFTTT derives its name from the programming conditional statement if this, then that. IFTTT is both a website and a mobile app that launched in 2010 and has the slogan "Put the Internet to work for". The idea is the use IFTTT to automate everything from user favourite apps and websites to app - enabled accessories and smart devices. What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services. Here, IFTTT application is used to bridge the gap between the Google Assistant commands and the Smart phone. Setting up the IFTTT application first requires logging in after which user need to create an applet and then the trigger, 16 here is select Google Assistant and then type in the commands to which the Google Assistant should respond and to this command it should control the appliance/relay associated with it. The response

command from the Goggle Assistant can also be typed in as desired. After configuring the trigger, the application user need to configure. What should be done once the Google Assistant hears the command just configured? This is decided by setting that of the app. communication is done via the internet and since the microcontroller, NodeMCU comes with inbuilt WI - FI module, it is programmed to connect to the desired network once plugged in. C language is used to program the microcontroller and is programmed in the Arduino IDE

Fig 4.4 IFTTT

IFTTT is both a website and a mobile app. The free service launched in 2010 with the following slogan: "Put the Internet to work for". It's changed a lot in recent years, however. Currently, with IFTTT, user can connect all the "services" together so that tasks are automatically completed. There are numerous ways user can connect all services and the resulting combinations are called "Applets".

Applets essentially automate user daily workflow, whether it's managing smart home devices or apps and websites. So, for instance, the Philips Hue smart lighting system, user could use IFTTT to automatically turn on a light every time tagged in a Facebook photo. In another example, user could use IFTTT to automatically email readers when they comment on Word Press blog.

Services

IFTTT currently supports more than 360 services. User will find integrations for everything from iRobot vacuums to Facebook.

Applets

Applets are specific things that can happen when connect services. For instance, by use an Applet to sync Amazon Alexa to-dos with Google Calendar, or use one that lets create events in

iPhone Calendar via Google Assistant. There are tonnes of Applets to choose from IFTTT says there are 11 million users running more than a billion Applets a month.

Steps involved in IFTTT Applet Creation:

1. Login to IFTTT's website.
2. Create New Applet.
3. Select the + This in the "If This Then That" logo toward the centre-top of the page. This will allow user to look for the "trigger" that will tell the Applet when to run.
4. User can then search for and select a service. In this example, user use Google Assistant. User need to connect to it and authorize access to Google account.
5. User will then see a choice of triggers. Pick one. In this example, "Turn On light". This command is given to Google Assistant by the user.
6. Now, user need to select the + That in the "If This Then That" logo toward the centre-top of the page. This is where user will specify what to happen next.
7. Choose an action service. For instance, select the Adafruit. This will trigger the Light Feed to ON in the Adafruit.
8. Review Applet and click Finish when done.
9. It will now be live. To view the Applet, select My Applets from the top of IFTTT dashboard.

CHAPTER 5
PROJECT DESCRIPTION

5.1 PROBLEM STATEMENT

The IoT is used in order to control the home appliances where the home appliances are remotely controlled using a web page buttons, where user have to go to the particular link and from there user can press buttons in order to control the home appliance. By using this system user can be accessed Home devices or appliances anywhere from the world with the help of internet.

5.1.1 OVERVIEW OF THE PROJECT

The place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable. Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel costlier and rather, feel homelier.

Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit. Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. This proposes such inexpensive system. It uses the Google Assistant, the IFTTT application, the Adafruit and the Node MCU microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT.

An important usability goal when the user sends command through Google assistant it first goes to the IFTTT there we given set statements that states he IF THIS THEN THAT user can understand this system. From there it goes to the adafruit is cloud service it is like MQTT broker which interacts with the Node MCU The Control Unit comprises of the microcontroller- Node MCU

and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet.

5.2 MODULE DESCRIPTION

5.2.1 NodeMCU (esp8266)

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Express, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for this system design. The NodeMCU aims to simplify ESP8266 development. It has two key components.

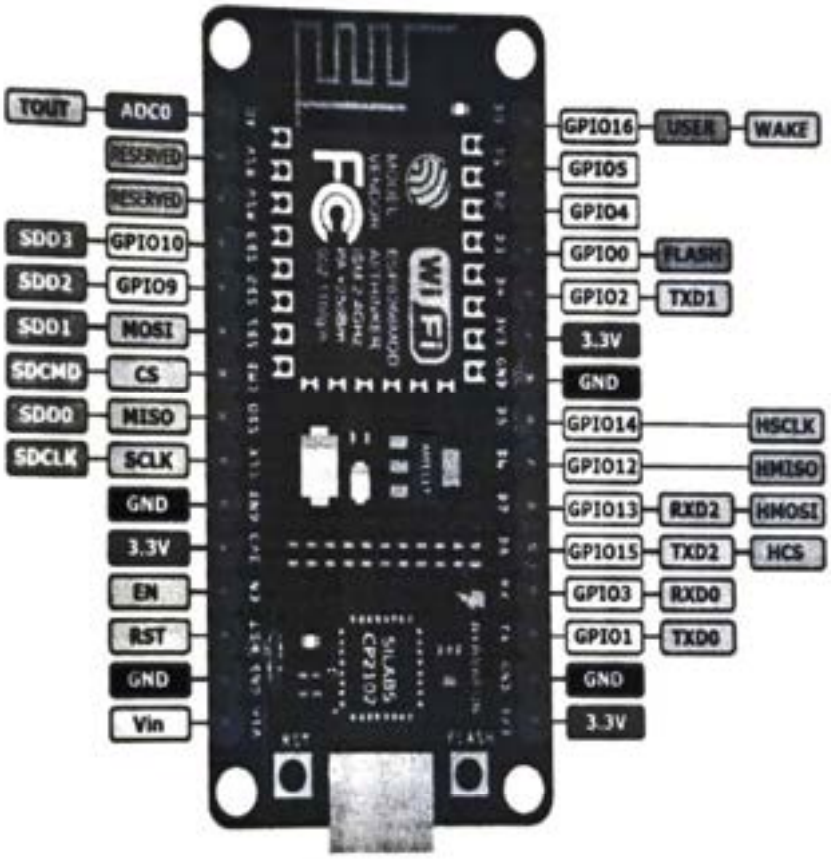

Fig 5.1 Node MCU

i. An open source ESP8266 firmware that is built on top of the chip manufacturer's Proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn. And to add on NodeMCU can be programmed with the Android IDE too.

ii. A development kit board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

5.2.2 RELAY BOARD

A relay is an electromagnetic switch. It is activated when a small current of some microampere is applied to it. Normally a relay is used in a circuit as a type of switch, an automatic switch. There are different types of relays and they operate at different voltages. When a circuit is built the voltage that will trigger it has to be considered. In this system the relay circuit is used to turn the appliances ON/OFF. The high/low signal is supplied from the NodeMCU microcontroller. When a low voltage is given to the relay of an appliance it is turned off and when a high voltage is given it is turned on. The relay circuit to drive four appliances in the Home automation. The number of appliances can be modified according to the user's requirements

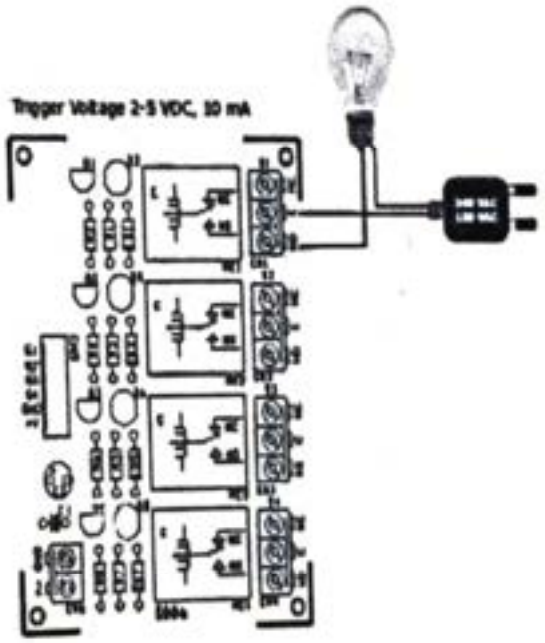

Fig 5.2 Relay module

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The aim is to propose a cost effective voice controlled (Google Assistant) home automation controlling general appliances found in one's home. The approach discussed was successful as GACHA's (Google Assistant Controlled Home Automation) design was successfully implemented. This system is highly reliable and efficient for the aged people and differently abled person on a wheel chair who cannot reach the switch for the switching ON/OFF the device and are dependent on others and also it provides centralized control of many equipment such as lights, blinds, Television, Air conditioners, security and surveillance system, kitchen appliances etc. This system can be expanded to control a large number of appliances and effectively cover not only the bedroom and kitchen but the entire house. The voice control using IFTT also facilitates control of appliances over the web. Hence the constraint of proximity concerned with Google Assistant.

6.2 FUTURE ENHANCEMENT

There are a variety of enhancements that could be made to this system to achieve Greater accuracy in sensing and detection.

a) There are a lot of other sensors that can be used to increase the security and control of the home like pressure sensor that can be put outside the home to detect that someone will enter the home.

b) Changing the way of the automated notifications by using the GSM module to make this system more professional.

c) A smart garage that can measure the length of the car and choose which block to put the car into it and it will navigate the car through the garage to make the parking easy for the homeowner in his garage.

The future scope for GACHA can be huge. There are many factors to improve on to make GACHA more powerful, intelligent, scalable, and to become better overall for home automation. For example, controlling the speed of the fan, more number of devices can be integrated, like a coffee machine, air conditioner etc. To make the system respond faster by use of Google Assistant can be made. Well, no system is ever perfect. It always has a scope for improvement. One just needs to put on a thinking cap and try and make the system better.

APPENDIX

CODING

```
#define LED1 D0
#define LED2 D2
AdafruitIO_Feed *led1 = io.feed("led1");
AdafruitIO_Feed *led2 = io.feed("led2");
void setup()
{
 pinMode(LED1, OUTPUT);
 pinMode(LED2, OUTPUT);
 Serial.begin(115200);
 while(! Serial);
Serial.print("Connecting to Adafruit IO");
io.connect();
led1->onMessage(handleMessage);
led2->onMessage(handleMessage1);
while(io.status() < AIO_CONNECTED)
{
Serial.print(".");
delay(500);
 }
 Serial.println();
 Serial.println(io.statusText());
 led1->get();
 led2->get();
 }
void loop()
{
 io.run();
 }
 void handleMessage(AdafruitIO_Data *data) {
  Serial.print("received <- ");
```

```
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED1, data->toPinLevel());
}
void handleMessage1(AdafruitIO_Data *data)
{
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED2, data->toPinLevel());
}
void handleMessage2(AdafruitIO_Data *data)
{
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED2, data->toPinLevel());
}
void handleMessage3(AdafruitIO_Data *data)
{
int reading = data->toInt();
Serial.print("received <- ");
Serial.println(reading);
#if defined(ARDUINO_ARCH_ESP32)
Led Write(1, reading); // ESP32 analogWrite()
#else
digitalWrite(LED2, reading);
#endif}
```

CONFIG.H

```
#define IO_USERNAME  "sundar2409"
#define IO_KEY       "c489a31ccab84a37b229062b35cecfe4"

 AdafruitIO_WiFi client will work with the following boards:
- HUZZAH ESP8266 Breakout -> https://www.adafruit.com/products/2471
- Feather HUZZAH ESP8266 -> https://www.adafruit.com/products/2821
- Feather HUZZAH ESP32 -> https://www.adafruit.com/product/3405
- Feather M0 WiFi -> https://www.adafruit.com/products/3010
- Feather WICED -> https://www.adafruit.com/products/3056
- Adafruit PyPortal -> https://www.adafruit.com/product/4116
- Adafruit Metro M4 Express AirLift Lite -> https://www.adafruit.com/product/4000
- Adafruit AirLift Breakout -> https://www.adafruit.com/product/4201

#define WIFI_SSID   "Samsung A30"
#define WIFI_PASS   "sundar1998"
#include "AdafruitIO_WiFi.h"

 #ifdef USE_AIRLIFT
 Configure the pins used for the ESP32 connection
 #if !defined(SPIWIFI_SS) // if the wifi definition isnt in the board variant
 #define SPIWIFI SPI
 #define SPIWIFI_SS 10  // Chip select pin
 #define SPIWIFI_ACK 9  // a.k.a BUSY or READY pin
 #define ESP32_RESETN 6 // Reset pin
 #define ESP32_GPIO0 -1 // Not connected
 #endif
AdafruitIO_WiFi    io(IO_USERNAME,    IO_KEY,    WIFI_SSID,    WIFI_PASS,
SPIWIFI_SS, SPIWIFI_ACK, ESP32_RESETN, ESP32_GPIO0, &SPIWIFI);
#else
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);
#endif
```

SCREEN SHOTS

Adafruit Data

Fig. 1 Adafruit light Interface

Description:

In Adafruit data the Blinking led is the feed created for controlling two lights. When commands receive from IFTTT the Toggle of light is on and off.

Adafruit Feed Monitor

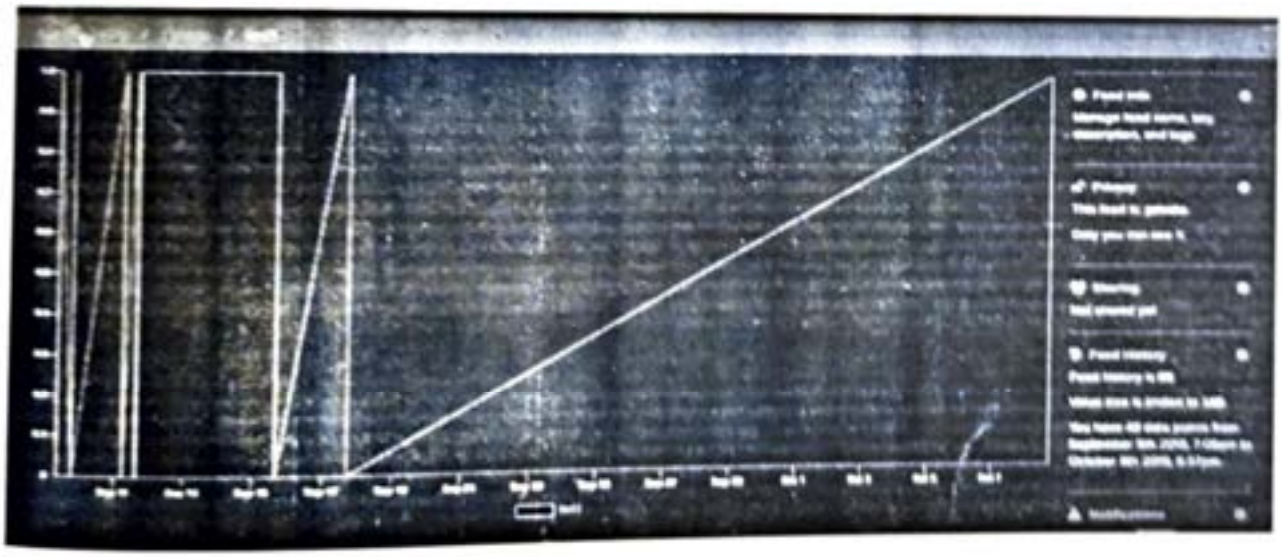

Fig. 2 Adafruit Feed for bulb 1 data

Description:

Here the Adafruit light feed are monitored for light 1. It includes the date and time and how many times the light turned ON and OFF.

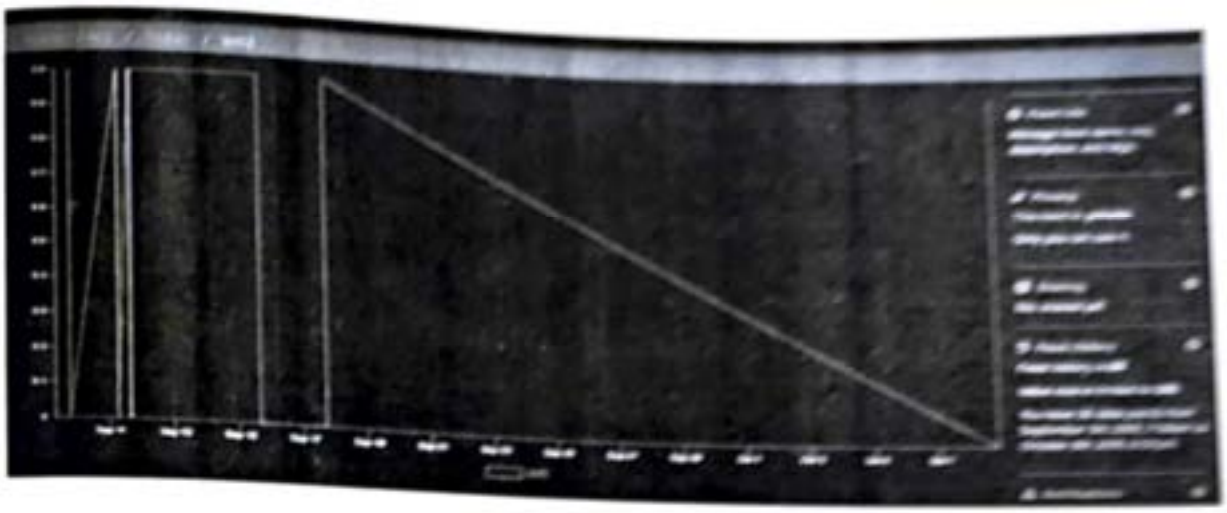

Fig. 3 Adafruit feed for both 2 data

Description:

Here the Adafruit light feed are monitored for light 2. It includes the date and time and how many times the light turned ON and OFF.

IFTTT interface

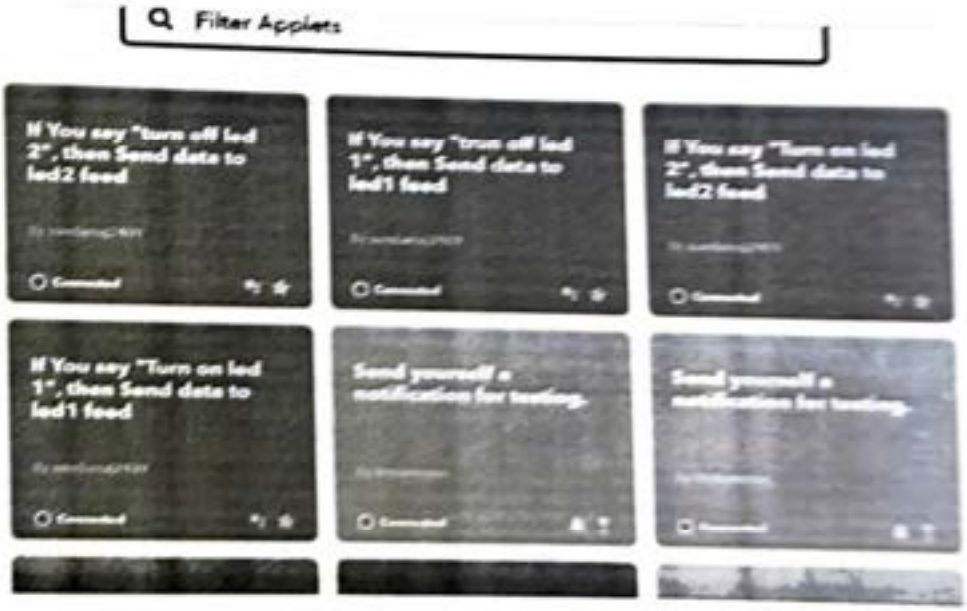

Fig. 4 IFTTT Interface connection between Google Assistant and Adafruit

Description:

The applets are created here it also act as an Interface between Google Assistant and adafruit. The both triggers are created in this

Overall design

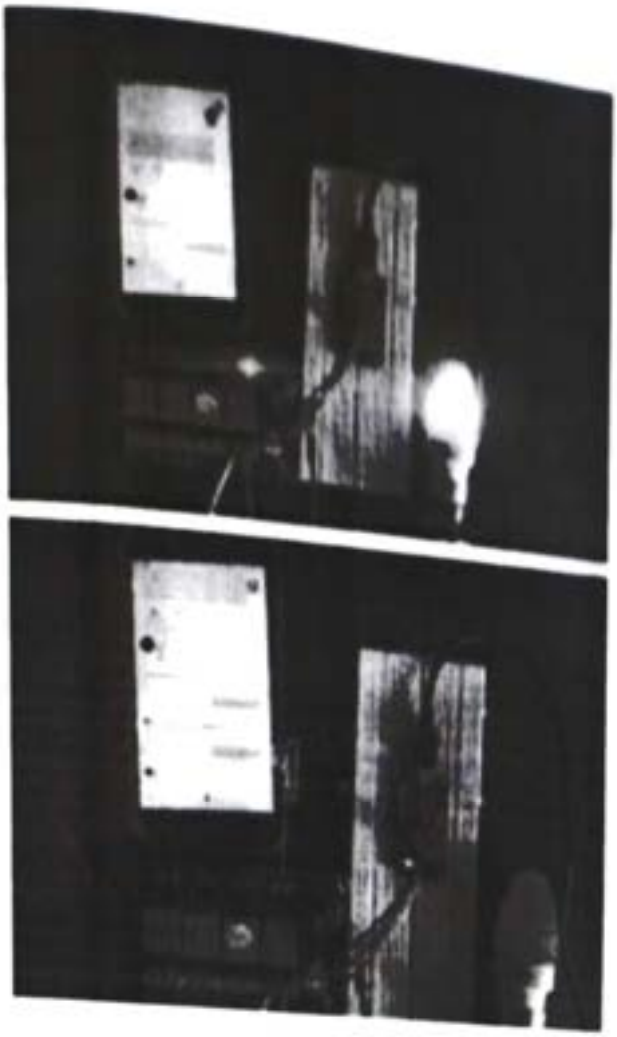

Fig. 5 Project Design

Description:

Here the overall project design is shown is Fig. 5. In first image the light is turned on based on user commands and in second image the light is turned off based on user commands. The user commands are given through Google Assistant.

REFERENCES

[1] VibhavkaShrotriya, Anjali Kulkarni, PritiGadhave proposed the "Smart Home Using Wi-Fi" International Journal of Science, Engineering and Technology Research (IJSETR), December 2016.

[2] Tan, Lee and Soh proposed the "Internet-based system", in the year (2002).

[3] S. M. AnamulHaque, S. M. Kamruzzaman and Md. Ashraful Islam proposed a system "A System for Smart-Home Control of Appliances Based on Time and Speech Interaction" entitled, in the year 2006.

[4] DeepaliJavale, Mohd. Mohsen, Shreerang Nandewar, MayurShingate, proposed a system on "Home Automation and Security using Android ADK", March, 2013.

[5] E. Yavuz, B. Hasan, I. Serkan and K. Duygu published"Safe and Secure PIC Based Remote Control Application for Intelligent Home", May-2007 .

[6] N. Sriskanthan and Tan Karand. "Bluetooth Based Home Automation System" Journal of Microprocessors and Microsystems, March 2002.

[7] Kusuma S M, Assistant Professor, Department of telecommunication, proposed the system on "Home Automation Using Internet of Things" July 1999.

HOME CONTROL SYSTEM USING ARTIFICIAL INTELLIGENCE

A MINI PROJECT REPORT

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in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

CCTOBER-2019

ABSTRACT

A proposal for home control using voice via Google Assistant. There are home automation technologies introduced over these years from ZigBee automation, Amazon Echo, Google home etc., It describes the implementation of such a system. The system is implemented using ordinary household appliances Natural language voice commands are given to the Google Assistant and with the help of IFTTT (If This Then That) application and the Adafruit the commands are decoded and then sent to the microcontroller, the microcontroller in turn controls the relays connected to it as required, turning the device connected to the respective relay On or OFF as per the users request to the Google Assistant. The microcontroller used is NodeMCU (ESP8266) and the communication between the microcontroller and the application is established via Wi-Fi (Internet).

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LIST OF ABBREVIATION

ACRONYMS	ABBREVIATION
GACHAS	Google Assistant Controller Home Automation
GSM	Global System for Mobile
IC	Integrated Circuit
IDE	Integrated Development Environment
IFTTT	If This Then That
IOT	Internet of Things
MQTT	Message Queuing Telemetry Transportation
Node MCU	Node Micro Controller Unit
SDK	Software Development Kit

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

Home, it is the place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable.

Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel cosier and rather, feel homelier. Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit. Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. It uses the Google Assistant, the IFTTT Web interface, the Adafruit Web Interface and the NodeMCU microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT.

1.2 OBJECTIVES

The aim is to provide a cheap home automation system to assist common man's life to make his schedule more efficient and help conserve energy; it will also be of great use to handicapped and elderly members of our society.

The system has two modules in totality; the first module consists of control of lights, blinds and fans which will be switched on and off using voice commands on Google assistant. The second module consists of control of common household appliances such as television, projector, air conditioners etc. Intend to attach four loads in this work and the control of the appliances will be done using two methods in particular; they are App and voice control. Voice control can easily be achieved on an Android mobile using Google Assistant.

1.3 PROBLEM STATEMENTS

The main problems that a home automation system faces are high cost of the system, strenuous configuration and set up process and security of the system. This developed system will be much cheaper than the available systems in the market and cover the control of most of the commonly used home appliances in a house using an Android App and voice control using Google Assistant on the user's mobile. The system is wireless and will be using Bluetooth as well as Wi-Fi to allow the user to control various appliances using their mobile phones, personal computers/ Laptops etc. It has never been easier or more affordable to purchase and install smart devices and home control systems. The drawback, however, is that systems are regularly being installed incrementally without a central control point. And that can lead to home automation problems.

CHAPTER 2
LITERATURE SURVEY

2.1 Smart Home Using Wi-Fi

NiharikaShrotriya et al., [1] proposed the system allows the people think about home automation, most of them may imagine living in a smart home: One remote controller for every household appliance, cooking the rice automatically, starting air conditioner automatically, heating water for bath automatically and shading the window automatically during night. To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast. Early home automation began with labour-saving machines. Self-contained electric or gas powered home appliance became viable in the 1900s with the introduction of electric power distribution led to the introduction of washing machine (1904), water heater (1889), refrigerator, sewing machines, dishwashers and clothes dryers. As per the survey currently there exists system neither at cheaper rates nor easy to handle. Various systems are hard to install, difficult to use and maintain.

2.2 Development of Internet Based System:

Tan, et al., [2] proposed the development of an Internet-based system to allow monitoring of important process variables from a distributed control system (DCS). The hardware and software design considerations which enable the user to access the process variables on the DCS, remotely and effectively rent designations.

The use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition. It is one of the difficult system to process it.

2.3 A System for Smart-Home Control of Appliances Based on Time and Speech Interaction:

S. M. AnamulHaque et al., [3] proposed a system entitled "A System for Smart-Home Control of Appliances Based on Time and Speech Interaction" that controls the home appliances using the personal computer. The system is developed by using the Visual Basic 6.0 as programming language and Microsoft voice engine tools for speech recognition purpose. Appliances can be either controlled by timer or by voice command. The remote monitoring through mobile phone involving the use of spoken commands. The spoken commands are generated and sent in the form of text SMS to the control system and then the microcontroller on the basis of SMS and it takes the difficult for decision a particular task.

2.4 Home Automation and Security using Android ADK:

DeepaliJavale et al., [4], proposed the design of home automation and security system using android ADK. The design is based on Standalone embedded system board android ADK (Accessory Development Kit) at home. Home appliances are connected to the ADK and communication is established between the ADK and android mobile device or tablet. The home appliances are connected to the input/output ports of embedded system board and their status is passed to ADK. They have developed an authentication to the system for authorized person to access home appliances. The device with high cost and scalable to less modification to the core is used. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

2.5 Safe and Secure PIC Based Remote Control Application for Intelligent Home:

E. Yavuz et al., [5] proposed the secure PIC based remote control system for intelligent houses has been presented. With this implemented system, it is possible to safely control electricity operated domestic devices by the help of public or mobile phones from any places all over the world. Developed remote control device has been optically and electrically isolated to secure the system.

2.6 Bluetooth Based Home Automation System:

N. Sriskanthan et al., [6] proposed the Journal of Microprocessors and Microsystems, the "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, architecture and computing (Huidobro and Millan, 2004). HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and old aged due to their complexity and cost, do not always accept these systems. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, ZIGBEE, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, Bluetooth is being chosen with its suitable capability. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class.

2.7 Home Automation Using Internet of Things:

Kusuma [7] proposed a Home Automation system that employs the integration of multi-touch mobile devices, cloud networking, wireless communication, and power-line communication to provide the user with remote control of various lights and appliances within their home. This system uses a consolidation of a mobile phone application, handheld wireless remote, and PC based program to provide a means of user interface to the consumer.

The main objective is to design and implement a control and monitor system for smart house. Smart house system consists of many systems that controlled by LAB VIEW software as the main controlling system. Also, the smart house system was supported by remote control system as a sub controlling system. The system also is connected to the internet to monitor and control the house equipment's from anywhere in the world using LAB VIEW.

Deepali Javale [4], also proposed the prime objective is to assist handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using Android phone/tab. The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors.

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enhances home security as well as easiness of home entering process. The structure of the system is described and the incorporated communications are analyzed, also an estimation for the whole system cost is given which is something lacking in a lot of other smart home designs offers. WB-SH is designed to be capable of incorporating in a building automation system and it can be applied to offices, clinics, and other places. It ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form. It ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form.

CONCLUDING REMARKS:

The various literature survey has published here which the systems are hard to install, difficult to maintain. The proposed system were not in optimized and user friendly.

Our Proposed system is easily accessible from mobile itself and provides access anywhere from the world and there is no need of any separate interface to run it. Current systems are generally proprietary, closed and user friendly. Based on Arduino and low cost home automation system.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The IoT is used in order to control the home appliances where the home appliances are remotely controlled using a web page buttons, where the user have to go to the particular link and from there to press buttons in order to control the home appliance. It involves the control the lighting, heating, ventilation, air conditioning and security, as well as home appliances. Remote or sensors are used for controlling Home devices, Modern systems generally consists of switches and sensors connected to a central hub called a gateway from which the system is controlled with a user interface that is interacted either with a mobile phone software ,tablet, computers or a web interface often but not always via internet cloud services.

To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast. Early home automation began with labour-saving machines. Self-contained electric or gas powered home appliance became viable in the 1900s with the introduction of electric power distribution led to the introduction of washing machine water heater refrigerator, sewing machines, dishwashers and clothes dryers. As per the survey currently there exists system neither at cheaper rates nor easy to handle. Various systems are hard to install, difficult to use and maintain. Current systems are generally proprietary, closed and not very user friendly Based on Arduino or GSM or low cost home security system and home automation system.

3.1.1 DISADVANTAGE OF EXISTING SYSTEM

- The operating is difficult.
- A separate web page is required.
- For every switching on and off user want to login into web page.

3.2 PROPOSED SYSTEM

The idea is to integrate the concept of Google Assistant into Arduino and control the appliances in the home that the device is installed. Google recently released an API for Google Assistant, for platforms other than Android, such as Linux and Windows, using Python language.

When the user sends command through Google assistant it first goes to the IFTTT there the given set statements that states he IF THIS THEN THAT can understand this when the architecture

of our system. From there it goes to the Adafruit is cloud service it is like MQTT broker which interacts with the NodeMCU. The Control Unit comprises of the microcontroller- Node MCU and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet.

The system has the capabilities to control the following components in user's home and monitor the following alarms: Temperature and humidity Motion Detection Light level and Lights on/off dim Fan on/off On/off different appliance and also Provide a more user-friendly interaction Various issue are solved like sending notification by providing the data monitoring system so it can be control the sensors data. Very simple and provide interaction with Google assistant.

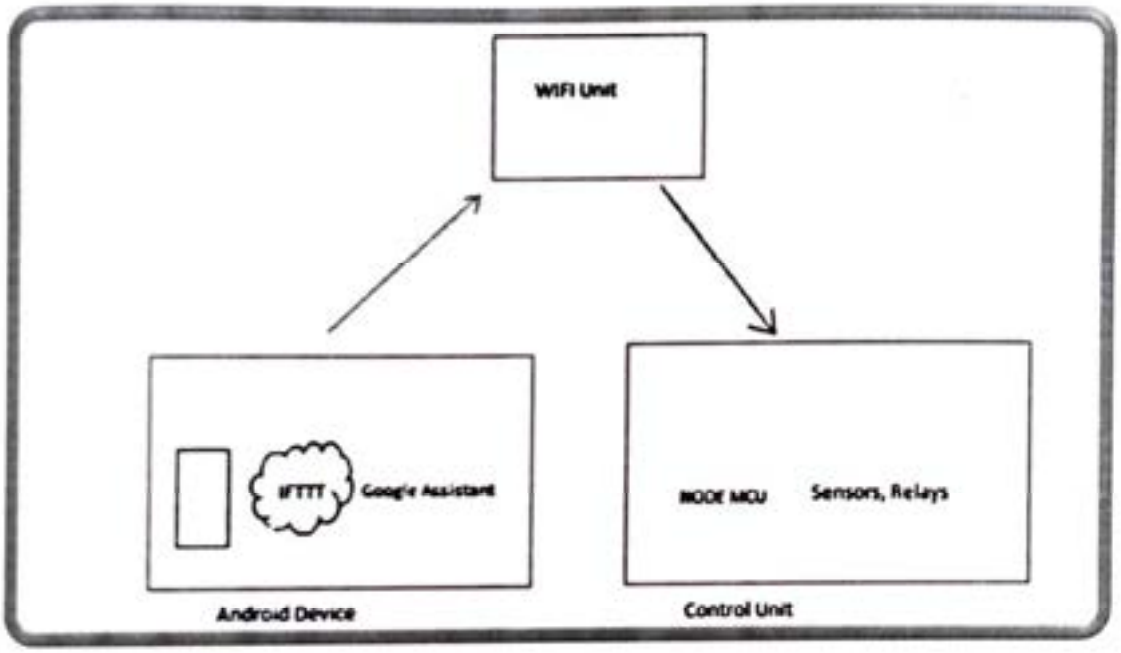

Fig 3.1 Overall Design

The system which has WI-FI as the control unit. It enhances the data from Microcontroller to web interfaces and also from web interfaces to microcontroller. The IFTTT and Google Assistant are used as an android devices and NodeMCU, Sensors, Relay are used as the control unit in the Home control system.

Voice controlled home automation is a step further in easing the control of appliances. This helps the handicapped as well as elderly people to access the home appliances with ease. As technology grows and expands with every single moment, automations have also taken leaps and bounds. Earlier a niche field which was accessible to only a select few, Home Automation is now becoming economically accessible to a much larger market. Through this system is intend to make

home automation economically accessible to every family. An automation system for home which makes use of cloud computing and wireless communication has been studied. This is found to be cheaper. The internet of things is intended to bring everything in the universe under a single framework. This provides greater control of the stuff while updating the user on the status of things. Communication was also made possible through Bluetooth to automate home appliances. New schemes for smarter homes were discussed and advancements were introduced. Home appliances can also be controlled by using RP along with the concept of relay circuit by adopting a web page.

3.2.1ADVANTAGES OF PROPOSED SYSTEM

- System can be easily accessible from mobile itself.
- It provides Access from anywhere the system is connected to server.
- The system no need of any interface for communication. Google assistance is enough.

3.2.2 SYSTEM ARCHITECTURE

The Home Automation system will have about two modules.

- The first module consists of control of lighting, fans etc. using an Android phone App as well as voice commands using Google Assistant.
- The second module consist of control of various heavy power Household appliances such as television, air conditioner, Iron box etc.

Different types of applications using android platform with Wi-Fi can be further developed. In this work a four channel 12V relay is used to connect the appliances and control their switching. A 30A relay is also used for the control of heavy loads such as air conditioners, refrigerators, heaters etc. Android mobile phones are used to control the system as they are the most popular ones in the market, also it has an open source operating system. Therefore, it can be used free of cost on mobile phones. The App has provisions for supporting Wi Fi network by allowing the device to exchange data with other devices wirelessly using Router. For voice control of light loads Google Assistant is used. Initially Applets are created for switching on and switching off of the relay on the forum IFTTT (If this then that). With the relay board using jumper wires. The code is uploaded to the NodeMCU. Authentic token is added in the code as well as the name of the Wi-Fi hotspot which is used. Then the password of the Wi-Fi hotspot is added to access the hotspot. Now the NodeMCU is connected to the Wi-Fi. For hardware assembly the NodeMCU is connected appropriate request to the App which in turn sends the request to the NodeMCU board and controls the relay.

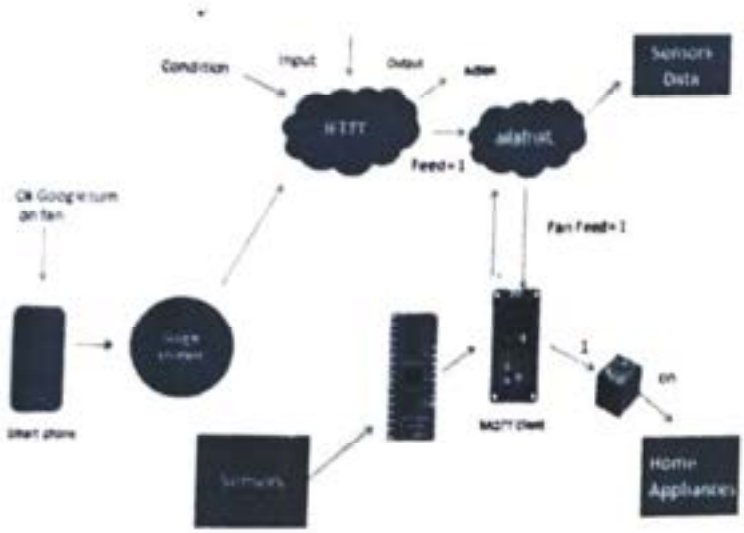

Fig 3.2 System Architecture for Home Control System

3.2.3 FLOWCHART

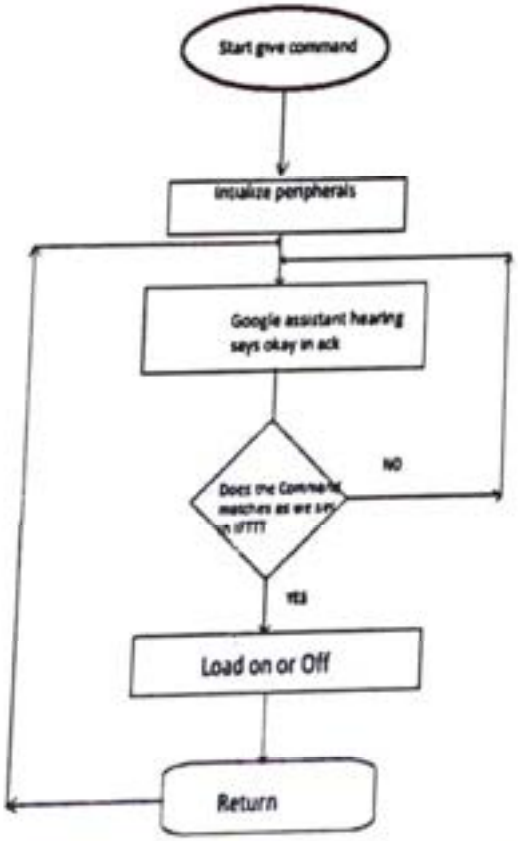

Fig 3.3 Flowchart for Home Control System

The Home control system which wok based on the user Commands

- First the User enter into the Google Assistant and Gives the command as Turn ON light.
- The Commands are send to the IFTTT interface where the commands are preprogrammed in IFTTT.
- Then IFTTT the user commands are triggered to Adafruit based on the commands given to Adafruit in IFTTT Applet.
- Then in Adafruit the created dashboard and feed is activated and turned ON and send to the Microcontroller (esp8266) through WI-FI.
- Finally, the Light is turned on.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 HARDWARE REQUIREMENTS:

System : Pentium IV 2.4 GHz.

Hard Disk : 250 GB.

Monitor : 15 VGA Colour.

Mouse : Optical.

Ram : 1 GB.

Mobile : Android.

4.2 SOFTWARE REQUIREMENTS:

Operating System : Windows 7/8/10.

IDE : Arduino.

Platform : Adafruit, IFTTT.

Speech Interface : Google Assistant.

4.3 SOFTWARE ENVIRONMENT

4.3.1 ARDUINO IDE

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consist of only two functions.

• Setup (): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.

• Loop (): After setup () has been called, function loop () is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions. A typical program for a beginning Arduino programmer blinks a LED repeatedly. This program uses the functions pin Mode (), digital Write (), and delay (), which are provided by the internal libraries included in the IDE environment. The program is usually loaded in the Arduino by the manufacturer. Arduino IDE and C language allow the programming of the low level registers in the atmega328P.

Instructions like DDRB=0b00000001 for changing PORTB input/output pins are allowed. Fig 4.1 shows the basic program of Arduino IDE.

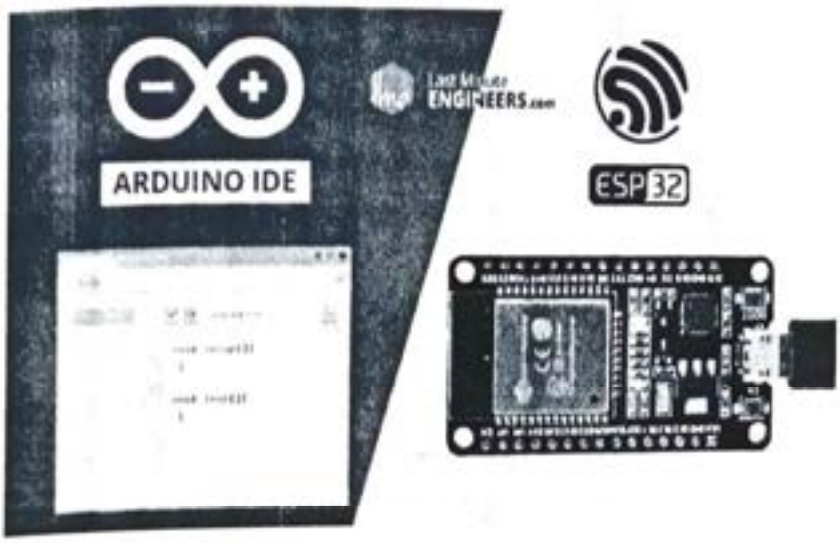

Fig 4.1 Arduino IDE

4.3.2 Adafruit

Adafruit Industries is an open-source hardware company based in New York City. It was founded by Limor Fried in 2005. The company designs, manufactures and sells a number of electronics products, electronics components, tools and accessories. It also produces a number of learning resources, including live and recorded videos related to electronics, technology, and programming. MQTT, or message queue telemetry transport, is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client can publish and subscribe to a feed to send and receive feed data.

Fig 4.2 Adafruit Feeds

Integrating IoT features into projects is all fine and good, but this is usually only half the work! The other half involves processing the data and getting some kind of user input.

Blocks

The Adafruit IO dashboard works with units called blocks that can be used to either display IoT information or obtain user input. The dashboard can also be accessed using common web browsers, which allows for just about any device to use the dashboard. This is really helpful in situations where developing a specific app for a mobile or tablet would be either too difficult or take too long to complete. Luckily, browser-based programs are cross-platform.

Toggle

The toggle block allows to add a toggle button to dashboard that can be used to set the value of a feed. This can be helpful when creating IoT devices such as smart lights, doors, curtains, toasters, and even windows. These devices can be turned on and off using the toggle switch.

Fig 4.3 Toggle Button

4.3.3 IFTTT

IFTTT derives its name from the programming conditional statement if this, then that. IFTTT is both a website and a mobile app that launched in 2010 and has the slogan "Put the Internet to work for". The idea is the use IFTTT to automate everything from user favourite apps and websites to app - enabled accessories and smart devices. What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services. Here, IFTTT application is used to bridge the gap between the Google Assistant commands and the Smart phone. Setting up the IFTTT application first requires logging in after which user need to create an applet and then the trigger, 16 here is select Google Assistant and then type in the commands to which the Google Assistant should respond and to this command it should control the appliance/relay associated with it. The response

command from the Goggle Assistant can also be typed in as desired. After configuring the trigger, the application user need to configure. What should be done once the Google Assistant hears the command just configured? This is decided by setting that of the app. communication is done via the internet and since the microcontroller, NodeMCU comes with inbuilt WI - FI module, it is programmed to connect to the desired network once plugged in. C language is used to program the microcontroller and is programmed in the Arduino IDE

Fig 4.4 IFTTT

IFTTT is both a website and a mobile app. The free service launched in 2010 with the following slogan: "Put the Internet to work for". It's changed a lot in recent years, however. Currently, with IFTTT, user can connect all the "services" together so that tasks are automatically completed. There are numerous ways user can connect all services and the resulting combinations are called "Applets".

Applets essentially automate user daily workflow, whether it's managing smart home devices or apps and websites. So, for instance, the Philips Hue smart lighting system, user could use IFTTT to automatically turn on a light every time tagged in a Facebook photo. In another example, user could use IFTTT to automatically email readers when they comment on Word Press blog.

Services

IFTTT currently supports more than 360 services. User will find integrations for everything from iRobot vacuums to Facebook.

Applets

Applets are specific things that can happen when connect services. For instance, by use an Applet to sync Amazon Alexa to-dos with Google Calendar, or use one that lets create events in

iPhone Calendar via Google Assistant. There are tonnes of Applets to choose from IFTTT says there are 11 million users running more than a billion Applets a month.

Steps involved in IFTTT Applet Creation:

1. Login to IFTTT's website.
2. Create New Applet.
3. Select the + This in the "If This Then That" logo toward the centre-top of the page. This will allow user to look for the "trigger" that will tell the Applet when to run.
4. User can then search for and select a service. In this example, user use Google Assistant. User need to connect to it and authorize access to Google account.
5. User will then see a choice of triggers. Pick one. In this example, "Turn On light". This command is given to Google Assistant by the user.
6. Now, user need to select the + That in the "If This Then That" logo toward the centre-top of the page. This is where user will specify what to happen next.
7. Choose an action service. For instance, select the Adafruit. This will trigger the Light Feed to ON in the Adafruit.
8. Review Applet and click Finish when done.
9. It will now be live. To view the Applet, select My Applets from the top of IFTTT dashboard.

CHAPTER 5
PROJECT DESCRIPTION

5.1 PROBLEM STATEMENT

The IoT is used in order to control the home appliances where the home appliances are remotely controlled using a web page buttons, where user have to go to the particular link and from there user can press buttons in order to control the home appliance. By using this system user can be accessed Home devices or appliances anywhere from the world with the help of internet.

5.1.1 OVERVIEW OF THE PROJECT

The place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable. Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel costlier and rather, feel homelier.

Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit. Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. This proposes such inexpensive system. It uses the Google Assistant, the IFTTT application, the Adafruit and the Node MCU microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT.

An important usability goal when the user sends command through Google assistant it first goes to the IFTTT there we given set statements that states he IF THIS THEN THAT user can understand this system. From there it goes to the adafruit is cloud service it is like MQTT broker which interacts with the Node MCU The Control Unit comprises of the microcontroller- Node MCU

and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet.

5.2 MODULE DESCRIPTION

5.2.1 NodeMCU (esp8266)

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Express, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for this system design. The NodeMCU aims to simplify ESP8266 development. It has two key components.

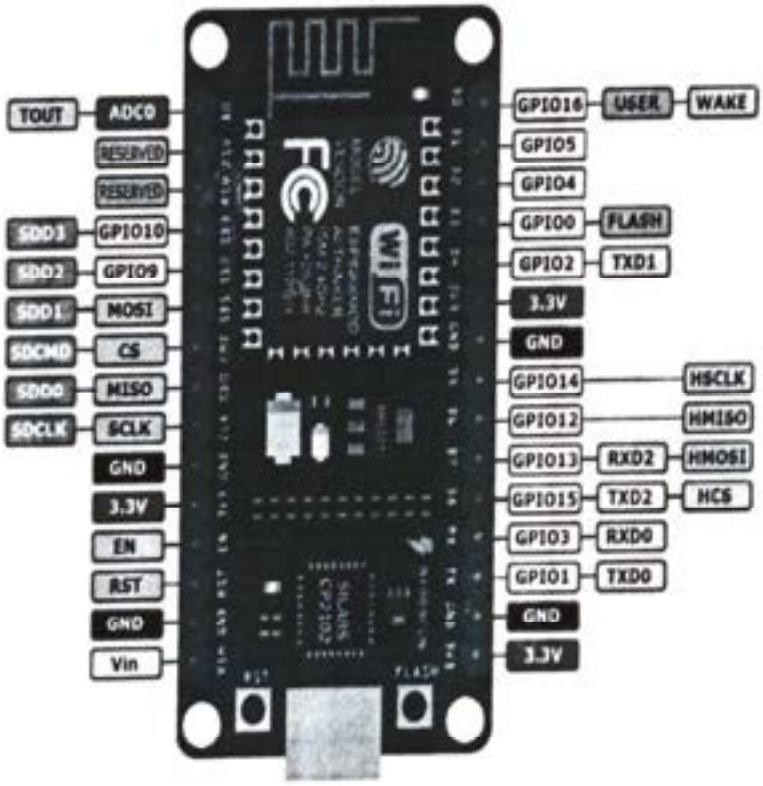

Fig 5.1 Node MCU

i. An open source ESP8266 firmware that is built on top of the chip manufacturer's Proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn. And to add on NodeMCU can be programmed with the Android IDE too.

ii. A development kit board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

5.2.2 RELAY BOARD

A relay is an electromagnetic switch. It is activated when a small current of some microampere is applied to it. Normally a relay is used in a circuit as a type of switch, an automatic switch. There are different types of relays and they operate at different voltages. When a circuit is built the voltage that will trigger it has to be considered. In this system the relay circuit is used to turn the appliances ON/OFF. The high/low signal is supplied from the NodeMCU microcontroller. When a low voltage is given to the relay of an appliance it is turned off and when a high voltage is given it is turned on. The relay circuit to drive four appliances in the Home automation. The number of appliances can be modified according to the user's requirements

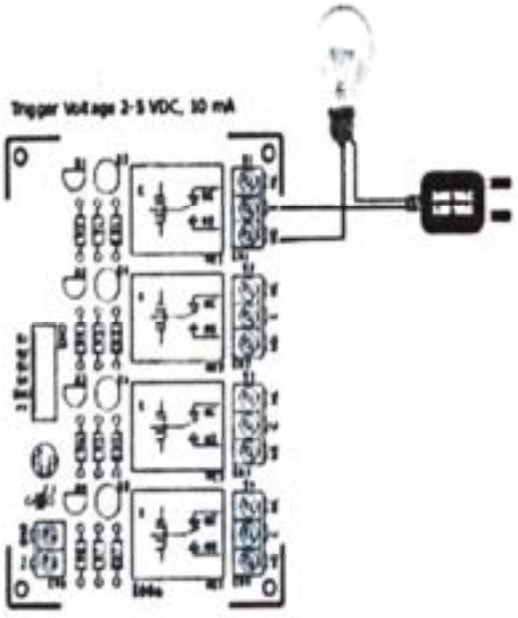

Fig 5.2 Relay module

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The aim is to propose a cost effective voice controlled (Google Assistant) home automation controlling general appliances found in one's home. The approach discussed was successful as GACHA's (Google Assistant Controlled Home Automation) design was successfully implemented. This system is highly reliable and efficient for the aged people and differently abled person on a wheel chair who cannot reach the switch for the switching ON/OFF the device and are dependent on others and also it provides centralized control of many equipment such as lights, blinds, Television, Air conditioners, security and surveillance system, kitchen appliances etc. This system can be expanded to control a large number of appliances and effectively cover not only the bedroom and kitchen but the entire house. The voice control using IFTT also facilitates control of appliances over the web. Hence the constraint of proximity concerned with Google Assistant.

6.2 FUTURE ENHANCEMENT

There are a variety of enhancements that could be made to this system to achieve Greater accuracy in sensing and detection.

a) There are a lot of other sensors that can be used to increase the security and control of the home like pressure sensor that can be put outside the home to detect that someone will enter the home.

b) Changing the way of the automated notifications by using the GSM module to make this system more professional.

c) A smart garage that can measure the length of the car and choose which block to put the car into it and it will navigate the car through the garage to make the parking easy for the homeowner in his garage.

The future scope for GACHA can be huge. There are many factors to improve on to make GACHA more powerful, intelligent, scalable, and to become better overall for home automation. For example, controlling the speed of the fan, more number of devices can be integrated, like a coffee machine, air conditioner etc. To make the system respond faster by use of Google Assistant can be made. Well, no system is ever perfect. It always has a scope for improvement. One just needs to put on a thinking cap and try and make the system better.

APPENDIX

CODING

```
#define LED1 D0
#define LED2 D2
AdafruitIO_Feed *led1 = io.feed("led1");
AdafruitIO_Feed *led2 = io.feed("led2");
void setup()
{
 pinMode(LED1, OUTPUT);
 pinMode(LED2, OUTPUT);
 Serial.begin(115200);
 while(! Serial);
Serial.print("Connecting to Adafruit IO");
io.connect();
led1->onMessage(handleMessage);
led2->onMessage(handleMessage1);
while(io.status() < AIO_CONNECTED)
{
Serial.print(".");
delay(500);
 }
 Serial.println();
 Serial.println(io.statusText());
 led1->get();
 led2->get();
}
void loop()
{
 io.run();
}
void handleMessage(AdafruitIO_Data *data) {
 Serial.print("received <- ");
```

```
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED1, data->toPinLevel());
}
void handleMessage1(AdafruitIO_Data *data)
{
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED2, data->toPinLevel());
}
void handleMessage2(AdafruitIO_Data *data)
{
 Serial.print("received <- ");
 if(data->toPinLevel() == HIGH)
 Serial.println("HIGH");
 else
 Serial.println("LOW");
 digitalWrite(LED2, data->toPinLevel());
}
void handleMessage3(AdafruitIO_Data *data)
{
int reading = data->toInt();
Serial.print("received <- ");
Serial.println(reading);
#if defined(ARDUINO_ARCH_ESP32)
Led Write(1, reading); // ESP32 analogWrite()
#else
digitalWrite(LED2, reading);
#endif}
```

CONFIG.H

```
#define IO_USERNAME  "sundar2409"
#define IO_KEY       "c489a31ccab84a37b229062b35ceefe4"

 AdafruitIO_WiFi client will work with the following boards:
- HUZZAH ESP8266 Breakout -> https://www.adafruit.com/products/2471
- Feather HUZZAH ESP8266 -> https://www.adafruit.com/products/2821
- Feather HUZZAH ESP32 -> https://www.adafruit.com/product/3405
- Feather M0 WiFi -> https://www.adafruit.com/products/3010
- Feather WICED -> https://www.adafruit.com/products/3056
- Adafruit PyPortal -> https://www.adafruit.com/product/4116
- Adafruit Metro M4 Express AirLift Lite -> https://www.adafruit.com/product/4000
- Adafruit AirLift Breakout -> https://www.adafruit.com/product/4201

#define WIFI_SSID   "Samsung A30"
#define WIFI_PASS   "sundar1998"
#include "AdafruitIO_WiFi.h"

 #ifdef USE_AIRLIFT
 Configure the pins used for the ESP32 connection
 #if !defined(SPIWIFI_SS) // if the wifi definition isnt in the board variant
 #define SPIWIFI SPI
 #define SPIWIFI_SS 10  // Chip select pin
 #define SPIWIFI_ACK 9  // a.k.a BUSY or READY pin
 #define ESP32_RESETN 6 // Reset pin
 #define ESP32_GPIO0 -1 // Not connected
 #endif
AdafruitIO_WiFi     io(IO_USERNAME,     IO_KEY,     WIFI_SSID,     WIFI_PASS,
SPIWIFI_SS, SPIWIFI_ACK, ESP32_RESETN, ESP32_GPIO0, &SPIWIFI);
#else
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);
#endif
```

SCREEN SHOTS

Adafruit Data

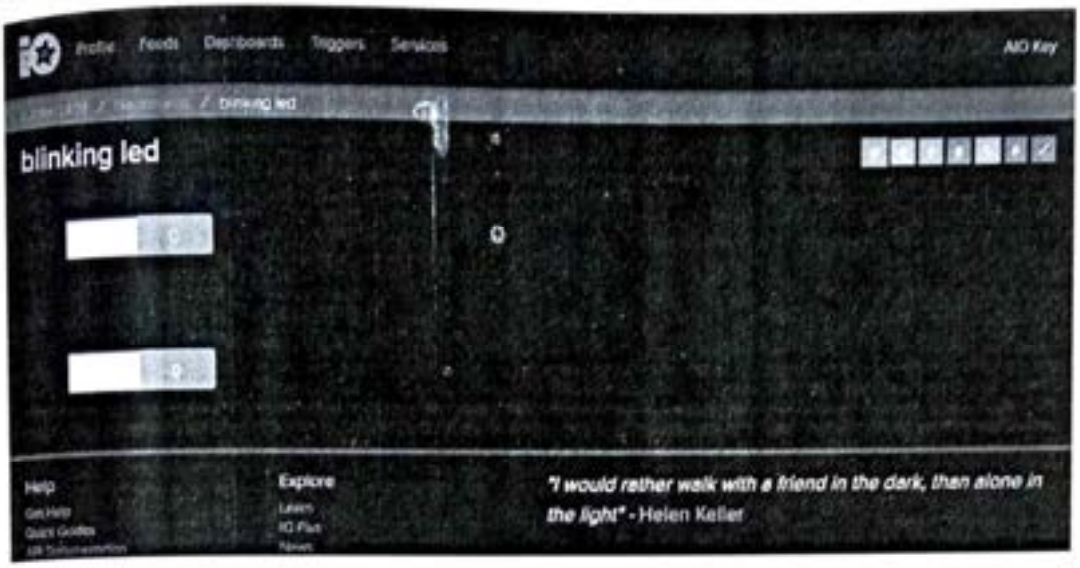

Fig 1 Adafruit light Interface

Description:

In Adafruit data the Blinking led is the feed created for controlling two lights. When commands receive from IFTTT the Toggle of light is on and off.

Adafruit Feed Monitor

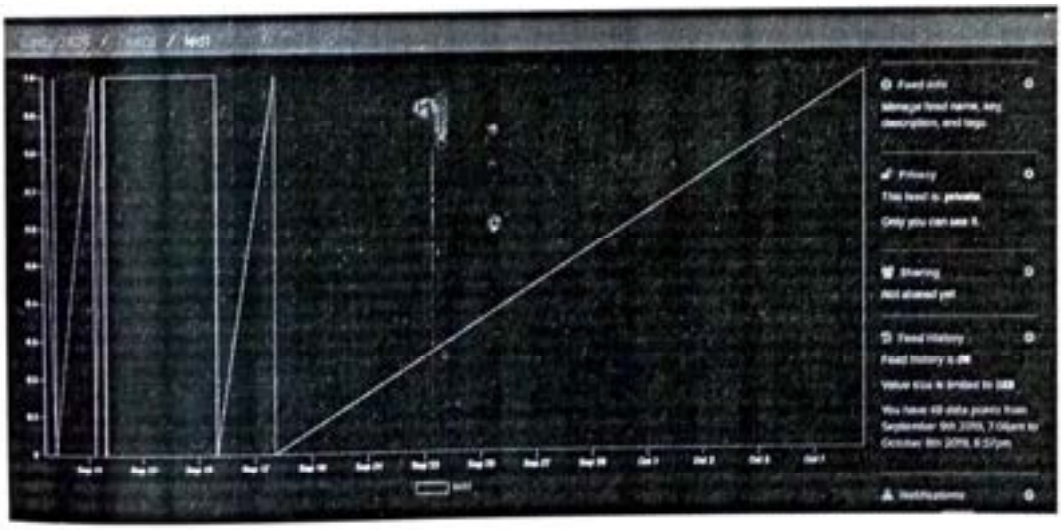

Fig. 2 Adafruit Feed for bulb 1 data

Description:

Here the Adafruit light feed are monitored for light 1. It includes the date and time and how many times the light turned ON and OFF.

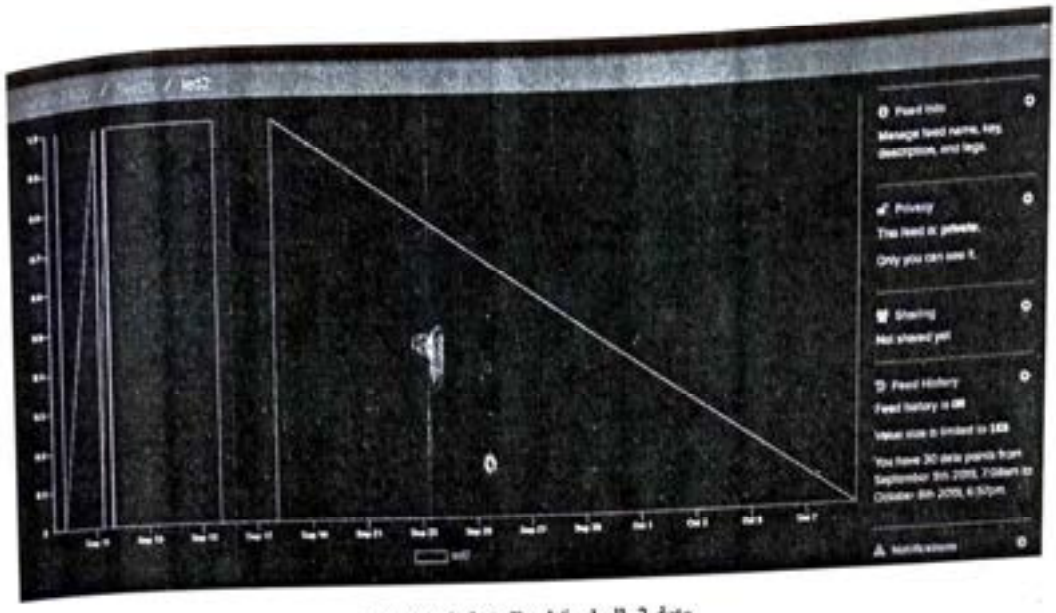

Fig. 3 Adafruit Feed for bulb 2 data

Description:

Here the Adafruit light feed are monitored for light 2. It includes the date and time and how many times the light turned ON and OFF.

IFTTT interface

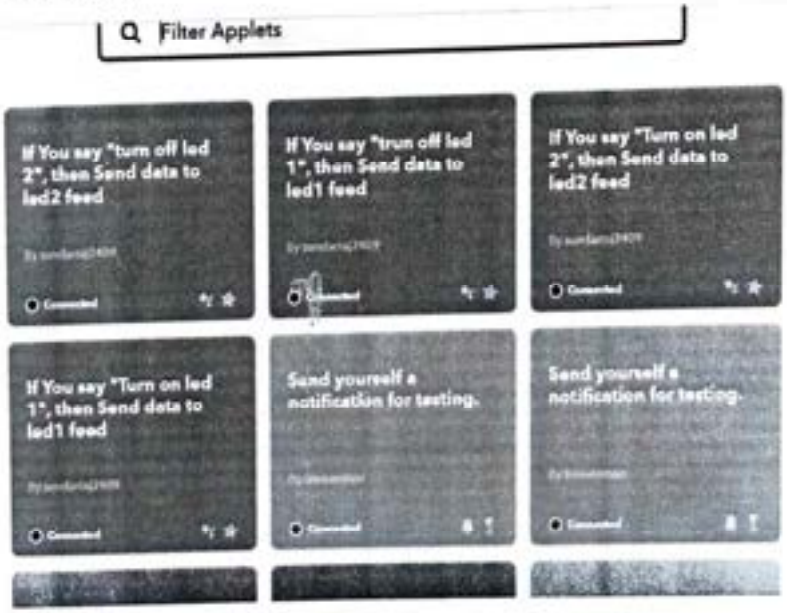

Fig. 4 IFTTT Interface connection between Google Assistant and Adafruit

Description:

The applets are created here it also act as an Interface between Google Assistant and adafruit. The both triggers are created in this.

Overall design

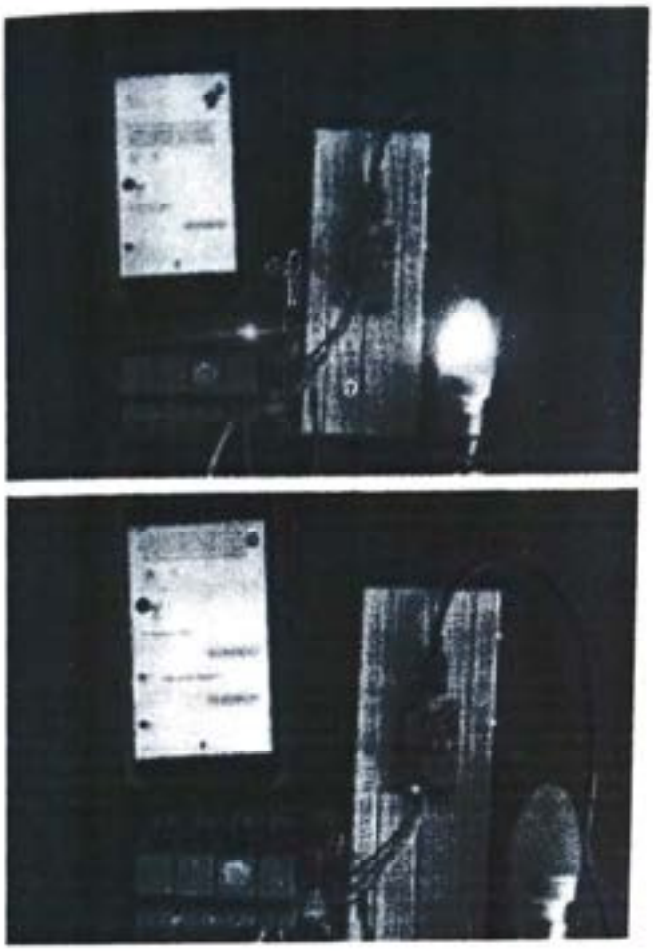

Fig. 5 Project Design

Description:

Here the overall project design is shown is Fig. 5. In first image the light is turned on based on user commands and in second image the light is turned off based on user commands. The user commands are given through Google Assistant.

OPTICAL CHARACTER RECOGNITION

A MINI PROJECT REPORT

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ABSTRACT

There is a growing demand for the software systems to recognize characters in computer systems when information is scanned through paper documents as it is known, that there are number of newspapers and books which are in printed format related to different subjects. In these days, there is a huge demand in storing the information available in these paper documents in to a computer's storage disk and then later reusing this information by searching process. One simple way to store information from these paper documents in to computer system is to first scan the documents and then store them as images. But to reuse this information it is very difficult to read the individual content and searching the contents form these documents line-by-line and word-by-word. The reason for this difficulty is the font characteristics of the characters in paper documents are different than the font of the characters in computer system. Optical Character Recognition (OCR) system based on a grid infrastructure to perform Document Image Analysis, document processing of electronic document formats converted from paper formats more effectively and efficiently is proposed.

LIST OF ABBREVATIONS

S.NO	ACRONYMS	ABBREVATION
1	OCR	Optical Character Recognition
2	GUI	Graphical User Interface
3	API	Application Program Interface
4	DFD	Data Flow Diagram

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CHAPTER 1

INTRODUCTION

1.1 Overview

The advancements in pattern recognition has accelerated recently due to the many emerging applications which are not only challenging, bu. also computationally more demanding, such evident in Optical Character Recognition (OCI.), Document Classification, Computer Vision, Data Mining, Shape Recognition, and Biometric Authentication. The area of OCR is becoming an integral part of document scanners, and is used in many applications such as postal processing, script recognition, banking, security and language identification [1]. The research in this area has been ongoing for over half a century and the outcomes have been astounding with successful recognition rates for printed characters exceeding 99%, with significant improvements in performance for handwritten cursive character recognition where recognition rates have exceeded the 90% mark. Many organizations are depending on OCR systems to eliminate the human interactions for better performance and efficiency [2]. Optical Character Recognition also referred to as OCR is a system that provides a full alphanumeric recognition of printed or handwritten characters at electronic speed by simply scanning the document. Documents are scanned using a scanner and are given to the OCR systems which recognizes the characters in the scanned documents and converts them into ASCII data.

OCR a database is used at the back end for recognition .The document scanning step, a scanner is used to scan the handwritten or printed documents. The quality of the scanned document depends up on the scanner [3]. So, a scanner with high speed and color quality is desirable. The recognizing process includes several complex algorithms and previously loaded templates and dictionary which are crosschecked with the characters in the document and the corresponding machine editable ASCII characters.

CHAPTER 2

LITERATURE SURVEY

2.1 Handwritten Chinese Character Recognition Based On Chinese Character Prototype

Jiang Shan (2000)

This paper discusses three kinds of Chinese character representations in a computer and two traditional analytical methods of Chinese character structure. By applying fundamental principles of topology and geometry to Chinese character structure and their constrained relations, four catalogues which contain basic relations to Chinese character structures are defined and Chinese character prototypes are constructed. Finally, an experiment is given to show how to use the prototypes in recognizing handwritten Chinese characters.

2.2 Optical Character Recognition: An Illustrated Guide To The Frontier

Thomas a. Nartker(2003)

ISRI had to develop new methodology for conducting large-scale tests of commercial systems. A large sample of documents was digitized scanned at several spatial sampling rates and both gray-scale and quantization. The page images were manually zoned to demarcate columns of text. The next step was the creation of groundtruth, an accurate transcription of each test document, against which the OCR outputs could be compared. A systematic protocol was established to guide more than forty key-entry operators to cope with non-ASCII symbols, foreign words, mathematical notation, strange layouts, and illustrations.

Each document was keyed in twice, and the results compared and reconciled. Next, a master program running on a unix platform was crafted to control a dozen PC's which ran the OCR software of the participating vendors. Perhaps the greatest technical challenge was the development of the algorithms required to compare the stream of characters produced by each OCR program with the ground truth files.

Columns, lines and words of text are not segmented reliably by OCR systems, line and character counts could not be depended upon for error detection. Nor could the position of the characters on the page, which is subject to distortion during the digitization process and not provided by many of the commercial systems. The solution finally selected was based on string matching techniques that determined the minimum number and the location of additions, deletions and substitutions necessary to correct the OCR output to match the ground truth.

2.3 An English Language OCR

Muhammad Umair Naru (2010)

Growing technology and fast living, business card are very much in demand. Most of the cards have fixed font size and style. That's why the OCR required for such documents does not need to be so expensive (computational cost) and complex (Artificial Neural Network). This paper presents a simple, efficient, and less costly approach to construct OCR for cards reading or any document that has fix font size and style. As English is an international language and almost every card have English characters on them. To achieve efficiency and less computational cost, OCR in this paper uses database instead of ANN (Artificial Neural Network) to recognize English characters which makes this OCR very simple to manage. As this paper is about English character recognition, so author is naming this OCR as α-soft, pronounced as "alpha soft". We have developed a prototype for this system. Different experiments are conducted to show that 100% accuracy is possible in OCR.

2.4 Character Recognition in practice Today and Tomorrow

Udo Miletzki(1996)

Handwriting recognition has been one of the most interesting and challenging research areas in field of image processing and pattern recognition in the recent years. This paper describes the techniques for converting textual content from a paper document into machine readable form. The computer actually recognizes the characters in the document through a revolutionizing technique called Optical Character Recognition. Several techniques like OCR using correlation method and OCR using neural networks are reviewed in this paper.

2.5 Prototype Extraction and Adaptive OCR

Yihong XU(1999)

To maintain OCR accuracy with decreasing quality of page image composition, production, and digitization, it is essential to tune the system to each document. We propose a prototype extraction method for document-specific OCR systems. The method automatically generates training samples from unsegment text images and the corresponding transcripts. It is tolerant of transcription errors, so a transcript produced automatically by an imperfect Omni font OCR system can be used. The method is based on new algorithms for estimating character widths, character locations in a word, and match/nonmatching probabilities from unsegment text. An experimental word recognition system is designed and developed to combine prototype extraction algorithms and segmentation-free word recognition. The system can adapt itself to different page images and achieve high recognition accuracy on heavily degraded print,

CHAPTER 3
SYSTEM ANALYSIS

3.1 Existing System

Cam scanner is a popular android application used to scan and save a printed document. An OCR is an inbuilt facility integrated with the application but it does not produce accurate result.

Printed documents in to electronic documents for maintaining the security of their data was done. Hence the basic OCR system was invented to convert the data available on papers in to computer process able documents. So, that the documents can be editable and reusable. The existing system/the previous system of OCR on a grid infrastructure is just OCR without grid functionality. That is the existing system deals with the homogeneous character recognition or character recognition of single language.

3.2 Drawback of Existing System

The drawback in the early OCR systems is that they only have the capability to convert and recognize only the documents of English or a specific language only. That is, the older 4 OCR system is uni-lingual.

3.3 Proposed System

The proposed system is also similar cam scanner but we have integrated auto spell check and auto grammar correction functionalities are added. Hence 90% of accurate result will be produced.

3.4 Advantages

- Optical Character Recognition (OCR) is one of the most widely implemented types of data entry methods.
- OCR involves digitized scanning and recognition of written or printed text.
- Text is first photo scanned, analyzed, and is finally translated into character codes. This machine-encoded text can be easily searched and edited electronically.
- OCR has greatly improved the process of data entry. This software tool enables quick conversion of scanned documents to searchable text files.
- The need for the documents to be scanned is on a constant rise as it enables these documents to be viewed conveniently when required. The scanned documents can also be shared easily through the electronic medium.

CHAPTER 4

SYSTEM REQUIREMENTS

4.1 Hardware Requirements

- Intel Pentium Processor
- 2GB of RAM
- 250GB ROM (Hard Disk)

4.2 Software Requirements

- Python 3
- PyQt5 for GUI
- Computer Vision API

CHAPTER 5
PROJECT DESCRIPTION

5.1 PROBLEM STATEMENT

The problem here is for the software systems to recognize characters in computer systems when information is scanned through paper documents as we know that we have number of newspapers and books which are in printed format related to different subjects. Whenever the documents are scanned through the scanner, the documents are stored as images such as jpeg, gif etc., in the computer system. These images cannot be read or edited by the user. But to reuse this information it is very difficult to read the individual contents and search the contents from these documents line-by-line and word-by-word. In these days, there is a huge demand in storing the information available in these paper documents in to a computer storage disk and then later editing or reusing this information by searching process.

5.2 System Model

An Optical Character Recognition is a conversion of images of typed, handwritten or printed text into machine-encoded text. The project using Google Cloud Vision API (Application Program Interface) by integrating with python programming language. For GUI (Graphical User Interface) PyQt5 package is used. The main functionality of the project is to recognize various types of handwritten documents and translating into multiple languages.

5.2.1 PyQt :

PyQt is a Python binding of the cross-platform GUI toolkit Qt, implemented as a Python plug-in. PyQt supports Microsoft Windows as well as various flavors of UNIX, including Linux and MacOS. PyQt5 is version 5 which is used in design GUI. It is licensed under GNU General Public License and commercial license.

5.2.2 Google vision API

Google Cloud's Vision API offers powerful pre-trained machine learning models through REST and RPC APIs. Assign labels to images and quickly classify them into millions of predefined categories.

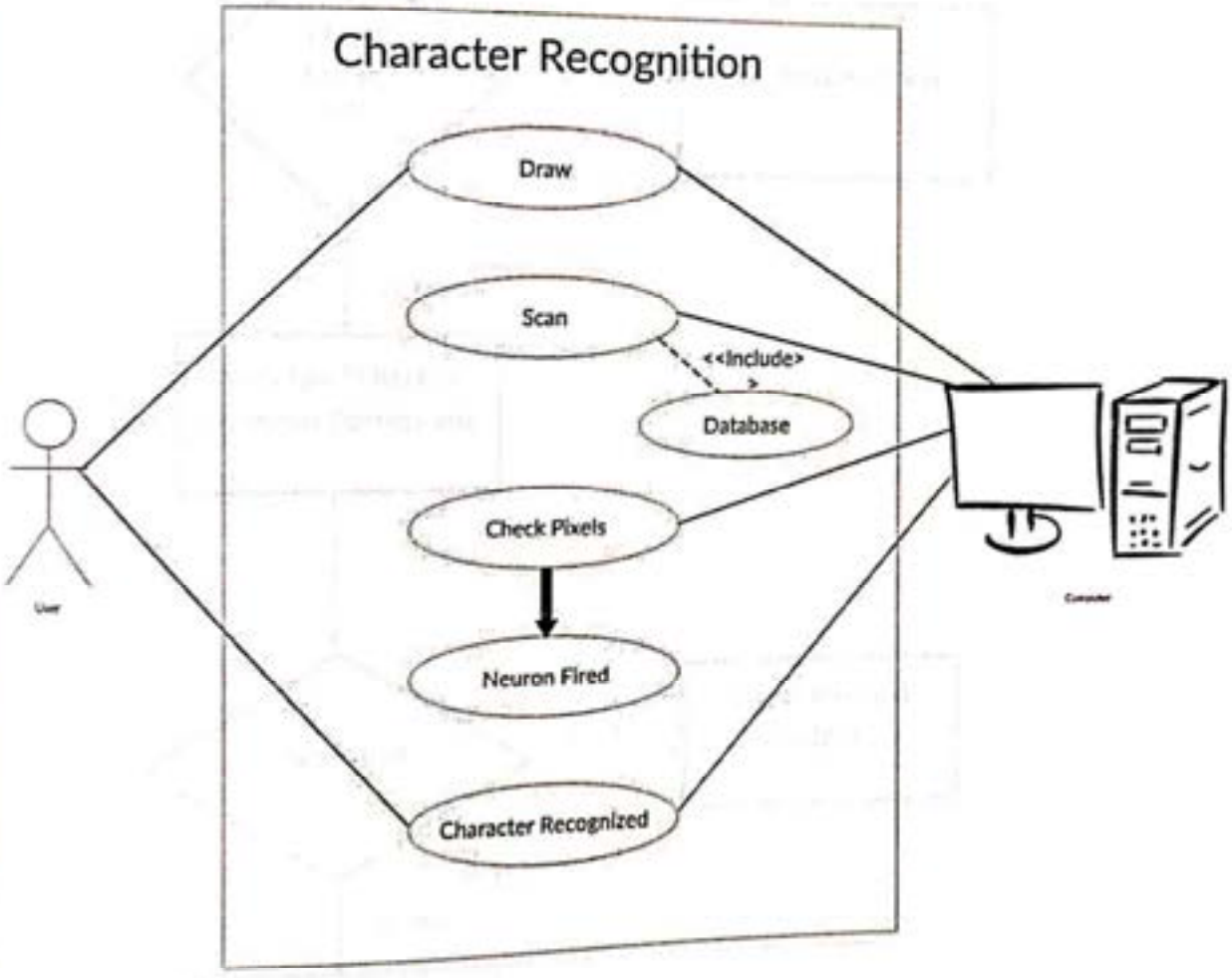

Figure 5.1 UML Diagram

DESCRIPTION: UML diagram for Optical Character Recognition

5.3 Working Process

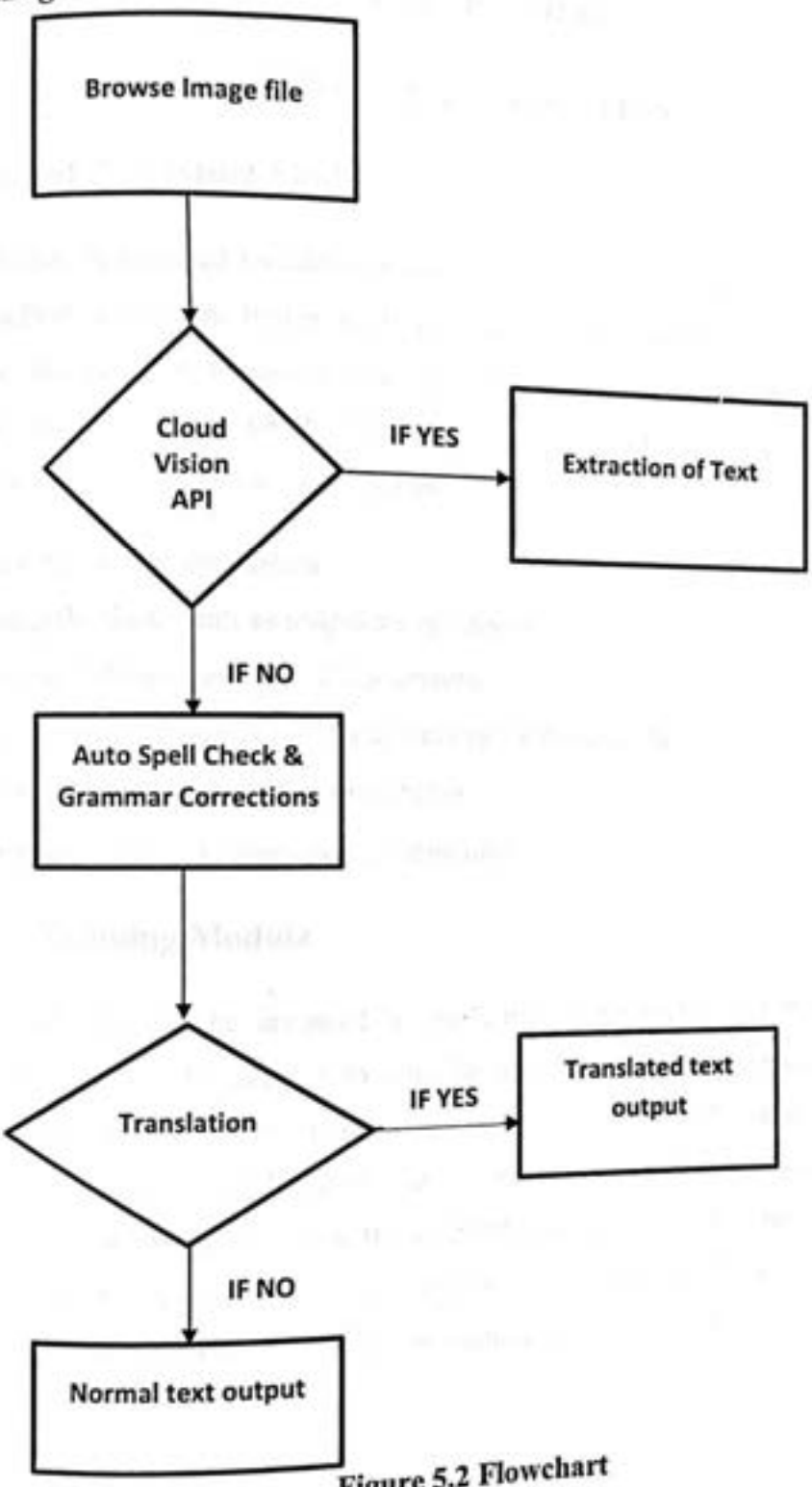

Figure 5.2 Flowchart

DESCRIPTION: Converting image into text

CHAPTER 6

MODULE DESCRIPTION

6.1 Document Processing Module

This Module is accessed by administrator whose role in this application is a librarian. This module perform certain activities such as scanning documents, Storing them as images, recognizing characters in images to transfer them into word format. During the recognition process, this module uses the OCR methodology in support of grid infrastructure data structure. This module supports the following activities,

- Scanning printed documents.
- Storing the documents as snapshots or images.
- Processing those image based documents.
- Converting the image based documents into e-documents.
- Recognizing the character in documents.
- Generating grid infrastructure data structure

6.2 System Training Module

This Module can be accessed by both the administrator and the end user. Before converting the printed document into editable and searchable documents, the first and the mandatory step is providing training to the system. Here training in the sense the font followed in this scanned document should be identified by the user. Then the user types all the characters that are required for recognition from the scanned documents as an image file. This image file should be provided as an input during the training process. The user then clicks the train button provided in the recognition module. Then the training gets completed.

This module supports:

- Training the system with the pre-defined fonts.
- Training the system with the new fonts that are not present in the system and that cannot be identified by the system.

6.3 Document Recognition Module

This module can be accessed by both the administrator and the end-user. Once the printed documents are converted into structured documents, any user can recognize the characters present in the document. That means the user can recognize the characters of any language he chooses which makes OCR more flexible. This flexibility is due to the adaptation of grid infrastructure. This is the module where the main functionality of OCR is tested. Under this module, there are two types of recognition. Thus handwritten document recognition recognizes the human handwriting. In scanned document recognition, the system is first trained with the font characters in the document in the training module itself.

Hence the document recognition module on a whole supports the following services:

- Converts the document into specific format.
- Recognizes the characters.
- Heterogeneous character Recognition

6.4 Document Editing Module

This module can be accessed by both the administrator and the end-user during document editing to implement the character recognition process. Once the scanned documents are stored, they reside in computer memory. This data resides in the form of an image that is just viewable in an image viewer. Hence, the document is first converted into a form such that it is editable. The desired form of the document may be MS-Word, Text as specified by the user.

The objective of this module is to let the user perform :

- Addition of specific content to the documents
- Deletion of certain content from documents

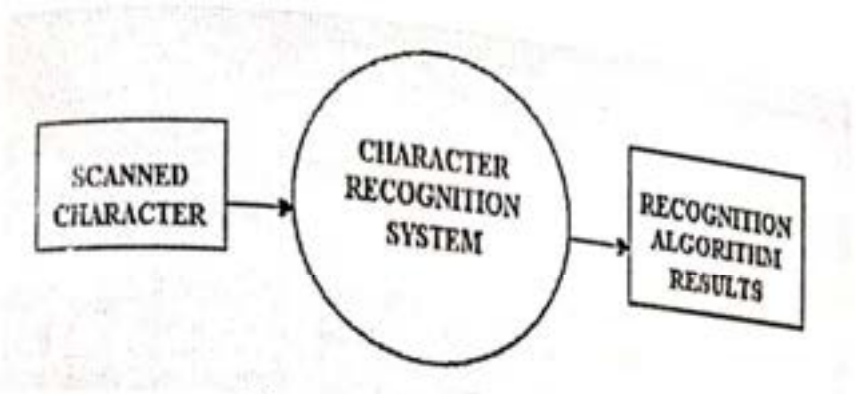

Figure 6.1 Zero Level DFD

DESCRIPTION: Conversion of character using Recognition Algorithm

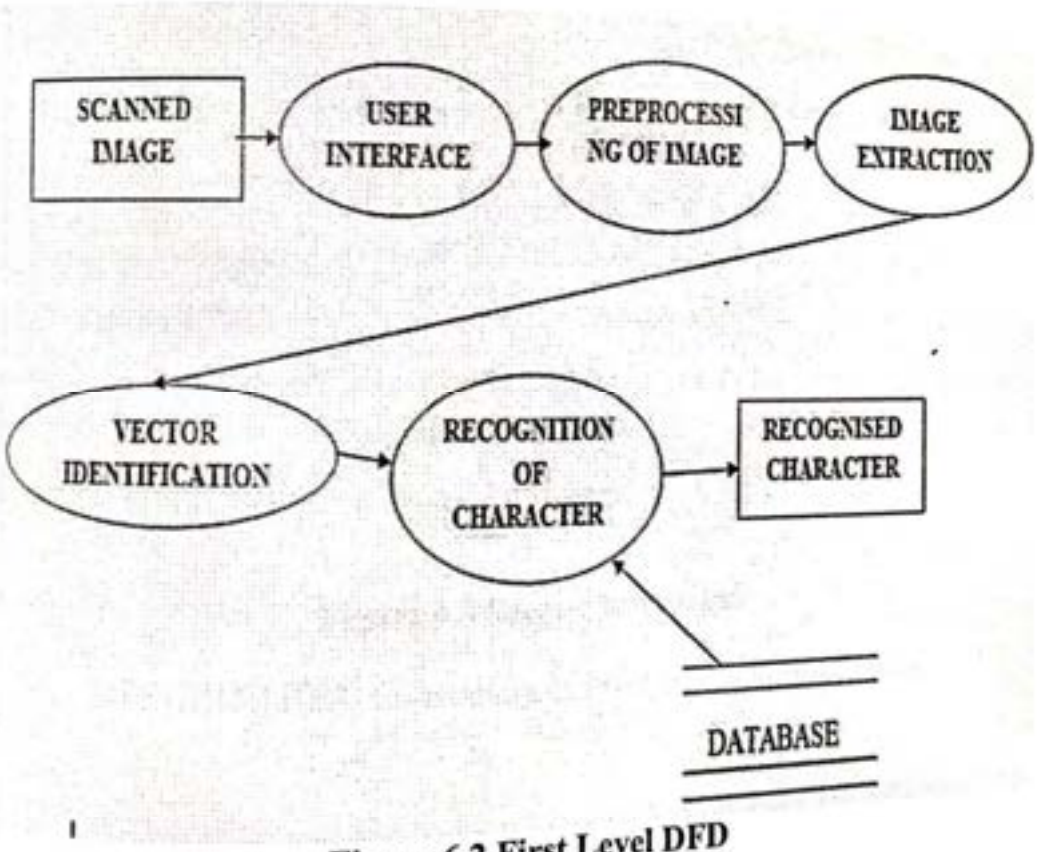

Figure 6.2 First Level DFD

DESCRIPTION: Conversion of Scanned image to Recognized Character

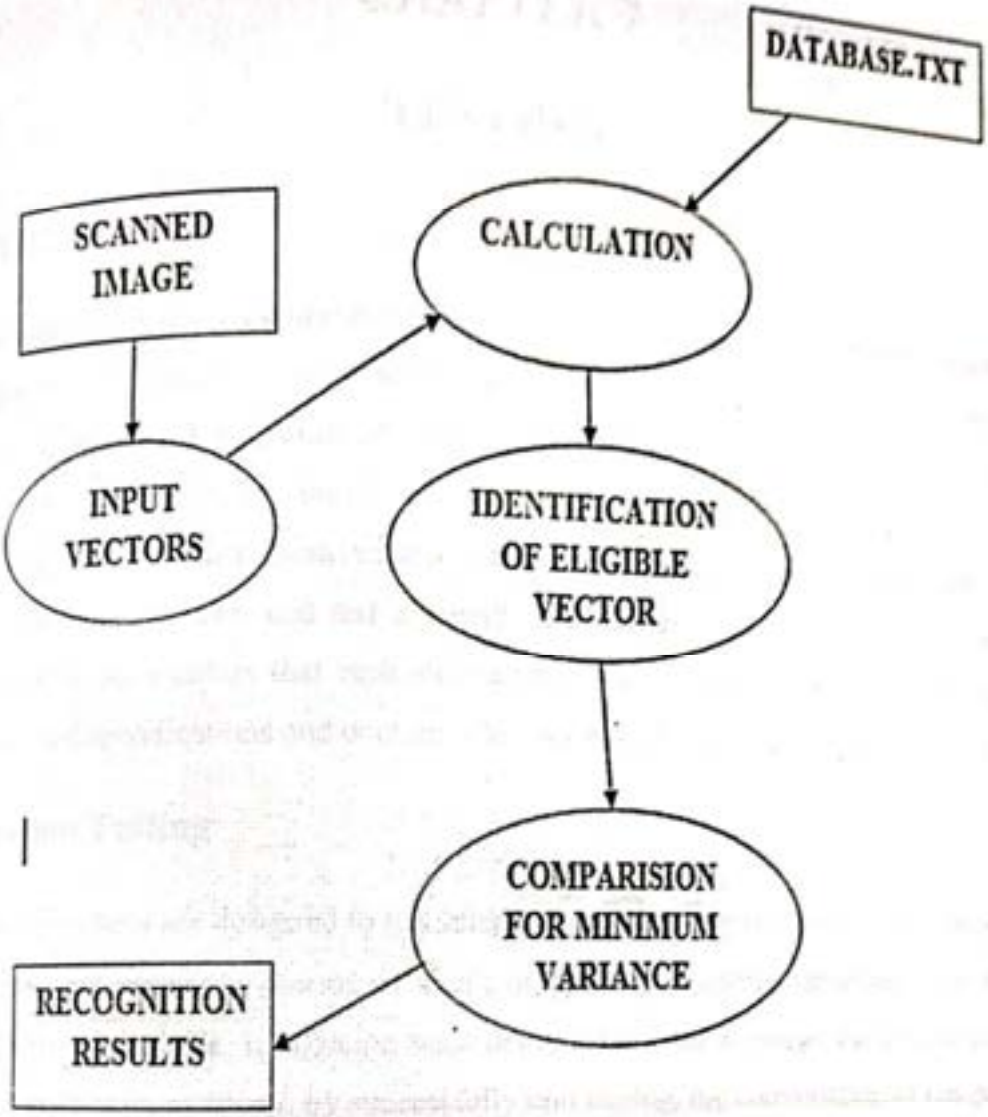

Figure 6.3 Second level DFD

DESCRIPTION: Conversion of image through input vector

CHAPTER 7

TESTING

7.1 Unit Testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program input produces valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

7.2 Integration Testing

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfaction, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

7.3 ACCEPTANCE TESTING

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements. Test Results: All the test cases mentioned above passed successfully. No defects encountered.

CHAPTER 8
CONCLUSION

OCR can become a powerful tool for future data entry applications for the entrepreneurial designers and sufficient research and development dollars. The limited availability of funds in a capital-short environment could restrict the growth of this technology. But, given the proper impetus and encouragement, a lot of benefits can be provided by the OCR system. The automated entry of data by OCR is one of the most attractive, labor reducing 85 technology. The recognition of new font characters by the system is very easy and quick. The information of the documents more conveniently can reuse the edited information as and when required. The Grid infrastructure used in the implementation of Optical Character Recognition system can be efficiently used to speed up the translation of image based documents into structured documents that are currently easy to discover, search and process.

CHAPTER 9

APPENDIX

9.1 Coding

 # Source code for conversion of image to text

```
import os, io
from google.cloud import vision
from google.cloud.vision import types
import pandas as pd
os.environ['GOOGLE_APPLICATION_CREDENTIALS'] = r'Key.json'
client = vision.ImageAnnotatorClient()
FOLDER_PATH = r'C:\Users\RAGUL\Desktop\IMReader'
IMAGE_FILE = 'test.jpg'
FILE_PATH = os.path.join(FOLDER_PATH, IMAGE_FILE)
with io.open(FILE_PATH, 'rb') as image_file:
    content = image_file.read()
image = vision.types.Image(content=content)
response = client.document_text_detection(image=image)
docText = response.full_text_annotation.text
print(docText)
```

 # Sample source code for image browsing

```
import sys
from PyQt5.QtWidgets import QApplication, QWidget, QInputDialog, QLineEdit, QFileDialog
from PyQt5.QtGui import QIcon


class App(QWidget):

  def __init__(self):
    super().__init__()
    self.title = 'PyQt5 file dialogs - pythonspot.com'
    self.left = 10
    self.top = 10
    self.width = 640
    self.height = 480
    self.initUI()


  def initUI(self):
    self.setWindowTitle(self.title)
    self.setGeometry(self.left, self.top, self.width, self.height)


    self.openFileNameDialog()
```

```
        self.openFileNamesDialog()
        self.saveFileDialog()

        self.show()

    def openFileNameDialog(self):
        options = QFileDialog.Options()
        options |= QFileDialog.DontUseNativeDialog
        fileName, _ = QFileDialog.getOpenFileName(self,"QFileDialog.getOpenFileName()",
"","All Files (*);;Python Files (*.py)", options=options)
        if fileName:
            print(fileName)

    def openFileNamesDialog(self):
        options = QFileDialog.Options()
        options |= QFileDialog.DontUseNativeDialog
        files, _ = QFileDialog.getOpenFileNames(self,"QFileDialog.getOpenFileNames()", "","All
Files (*);;Python Files (*.py)", options=options)
        if files:
            print(files)

    def saveFileDialog(self):
```

```
    options = QFileDialog.Options()
    options |= QFileDialog.DontUseNativeDialog
    fileName, _ = QFileDialog.getSaveFileName(self,"QFileDialog.getSaveFileName()","","All Files (*);;Text Files (*.txt)", options=options)
    if fileName:
        print(fileName)

if __name__ == '__main__':
    app = QApplication(sys.argv)
    ex = App()
    sys.exit(app.exec_())
```

9.2 Screenshots

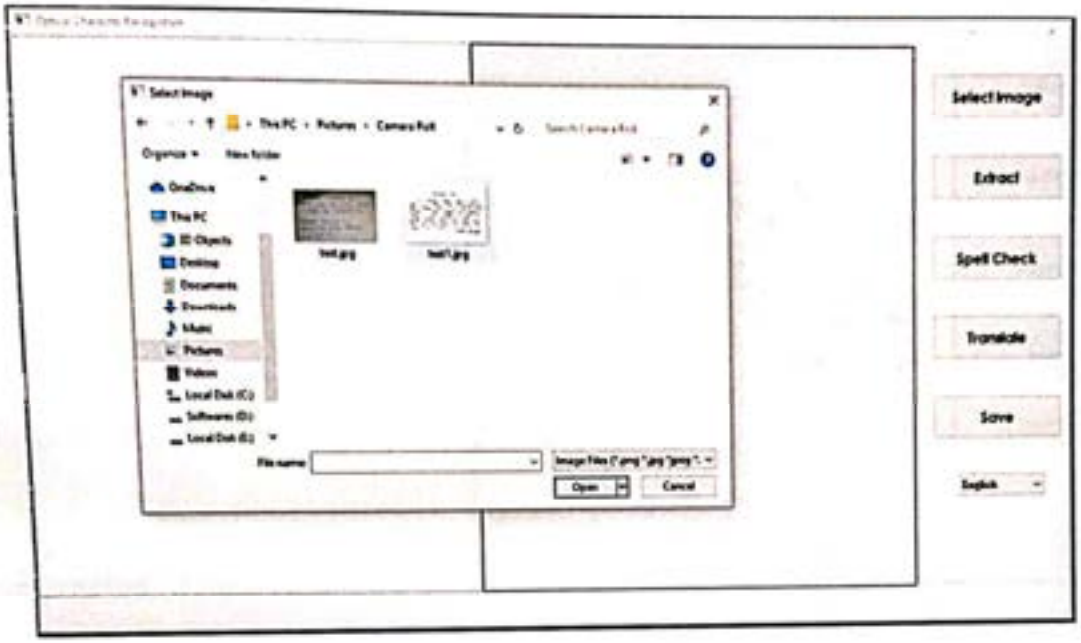

Figure 9.1 Selecting the desired Image

DESCRIPTION: Browsing of image.

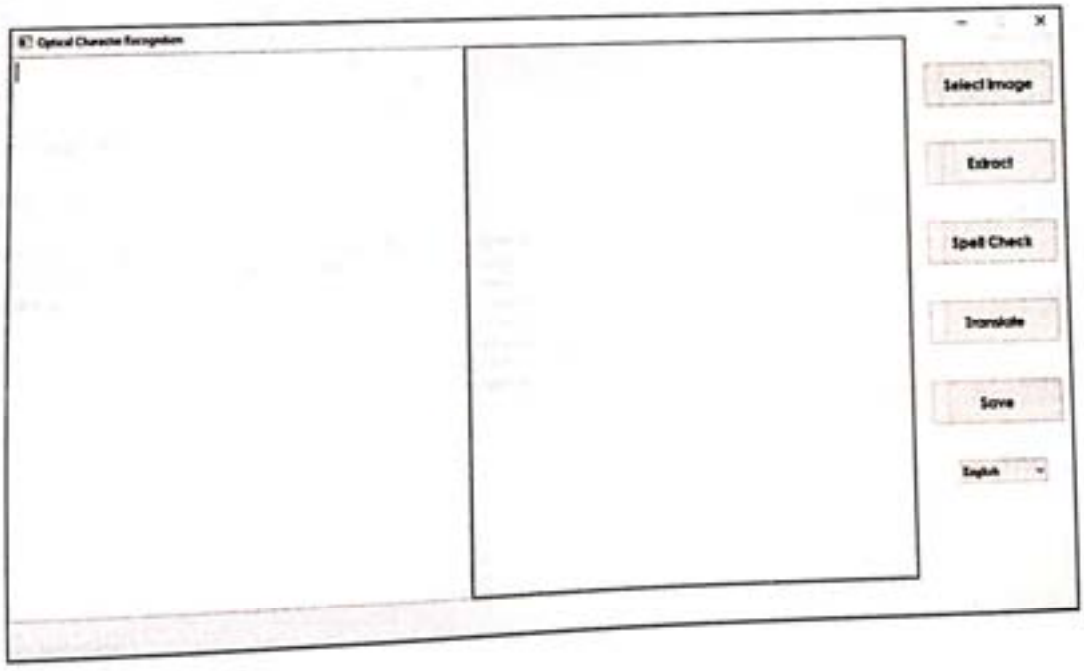

Figure 9.2 Getting into OCR Application

DESCRIPTION: Optical Character Recognition GUI windows

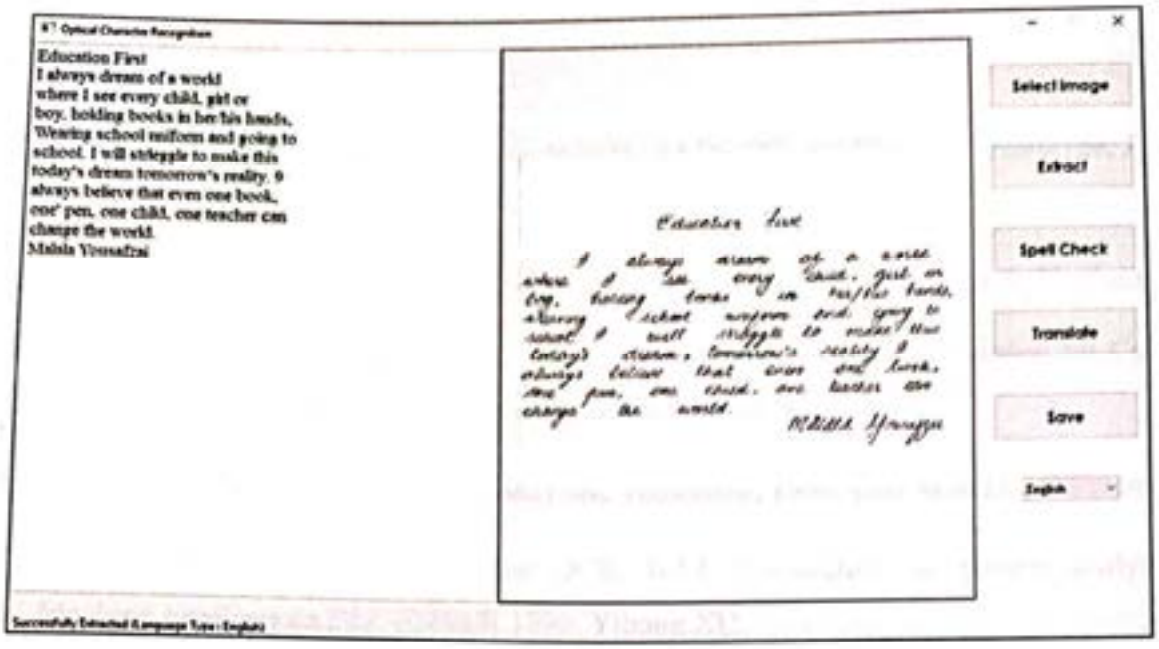

Figure 9.3 Extracting Progress

DESCRIPTION: Extraction of text from images

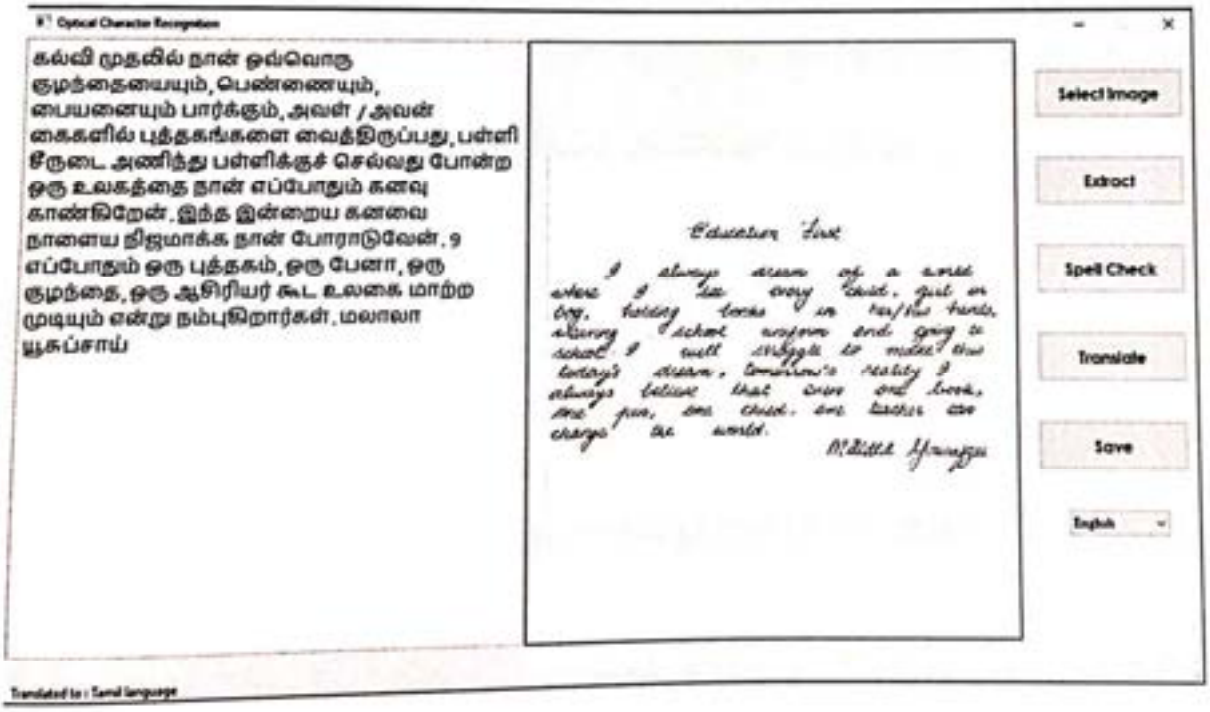

Figure 9.4 Translation of one language to another

DESCRIPTION: Translation of text from images

References

[1] Handwritten Chinese Character Recognition Based On Chinese Character Prototype, Jiang Shan (2000), China

[2] Optical Character Recognition: An illustrated guide to the frontier,Thomas A. Nartker(2003)

[3] α-Soft: An English Language OCR, 2010 Second International Conference on Computer Engineering and Applications. Junaid Tariq, Muhammad. Umair Naru.

[4] Character Recognition in practice Today and Tomorrow, 1996, Udo Miletzki, Germany.

[5] Prototype Extraction and Adaptive OCR, IEEE Transaction on pattern analysis and Machine Intelligence,DECEMBER 1999, Yihong XU.

SPEED CONTROL OF PERMANENT MAGNET SYNCHRONOUS MOTOR FOR THE RATE CONTROL OF WEAPON (GUN)

A PROJECT PHASE-I REPORT

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in partial fulfillment for the award of the degreeof

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ABSTRACT

The main objective of the project is to stabilize the gun against the disturbances and to position the gun precisely against the target as well as to control the rate of the gun. All ac electrical gun control system is composed of permanent magnetic synchronous machine driven control system and ball-screw by replacing the complicated electro hydraulic systems. At the same time, the variable-structure system sliding modes makes the gun control system to have higher performances using the only rate flexure gyroscope. Elevation axis model of a barrel stabilization system is constructed. The nonlinearities which are considered in the model are orifice flow characteristics, coulomb friction, hard-stop limits, kinematics of the system and unbalance on the barrel. A Simulink model for the servo valve, actuation system and barrel is constructed. Servo valve identification is made via the actual test data. Compressibility of the hydraulic fluid is taken into consideration while modeling the actuation system. Friction model is simulated for different cases. Controller of the system is constructed by two PIDs, one for each of the velocity and the position loops. Velocity feed forward can reduce the time to make a quick move by the system. The disturbance is evaluated from a given road profile and disturbance feed forward is applied to the system.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATION
MBT	Main Battle Tank
WCS	Weapon Control Systems
PID	Proportional-Integral-Derivative
DC	Direct Current
LVDT	Linear Variable Differential Transducer
ASELSAN	Askeri Elektroniks Sanayi
MATLAB	Matrix Laboratory
MRS	Muzzle Reference System
FE	Fine Element
TCP	Twisted and Coiled Polymer
SCP	Super Coiled Polymer

CHAPTER 1

INTRODUCTION

Weapons used in the battlefield are demanded to be lighter, more mobile, easily controllable and able to shoot with a high accuracy. One of these weapons used in land is the Main Battle Tank (MBT). MBT is probably the most important weapon because of its being mobile, armoured and having heavy-fire capacity. Developments of MBT are parallel to the improvements in heavy weaponry, Weapon Control Systems (WCS) and hull mobility. Heavy weapons have became more effective with the improvements in material science and chemistry. Mounting of these weapons to the hull produces some problems. Control systems become more important while the system become larger and more complex. Drive technology and control systems determine the size of the MBT. Hull mobility depends on the vehicle technology to overcome the problems of cross-country movement. Mobility demands in battlefield lead to the requirement of firing while moving instead of stopping at each time the MBT engages a target. This demand can be achieved by WCS by minimizing the tank's hull movement effects on the barrel.

Director-type system based on the independently stabilized gunner's sight was first developed in 1960s by the Delco Electronic Divisions of General Motors. Chrysler version of this system stabilized position of the gun only in elevation. A simpler alternative to this system was developed by Bofors Aerotronics in Sweden and by Marconi Command and Control Systems in England in the form of a pseudo-director system. The advantage of this system is that it provides a highly stabilized aiming mark without the complexity of an independently stabilized sight and can be applied readily to existing tanks with simple telescopic or periscopic sights mechanically linked to tank guns.

In early tanks used in World War I, free elevation type of mounting was used and it was controlled by a shoulder strap. The disadvantages of this setup are the insufficiently precise control, more human power and very low speed while steering the barrel. This is followed by the use of hydraulic drive systems. After electrical motors were used for slewing the barrel, rapid and precise control has been satisfied. Improvements in traversing the turret were applied to the powered control of the elevation control of tank guns. This adoption has led to the stabilization of the barrel.

1.1 Stabilization of Barrel on a Main Battle Tank

Motion of vehicles causes some unwanted movements on the barrel. These movements must be minimized in order to hit a target while moving. Gunners are expected to minimize this effect especially in elevation by rotating the barrel in the opposite direction of the hull's motion. But the frequency of this kind of motion varies from 0 to 3-4 Hz while the response of the human operators is not more than 0.5 Hz.

In this situation, the effects of vehicle motion on the barrel can be minimized by stabilization systems which are designed to maintain the barrel position according to the earth. Figure 1 and Figure 2 illustrate the problem in detail.

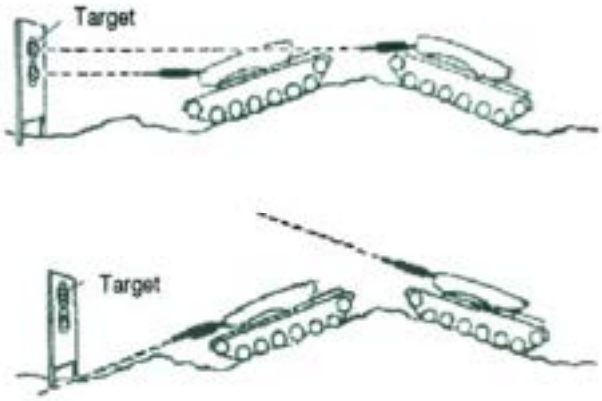

Figure 1.1 Barrel Motion in Elevation

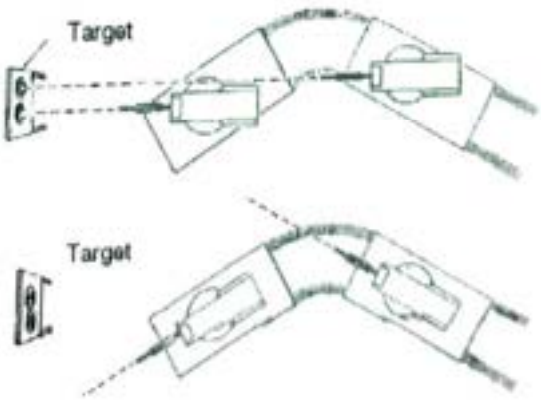

Figure 1.2 Barrel Motion in Azimuth

In 1998, Purdy enhanced the stabilization ratio by using the hull rate gyroscope for feed forward. This study gave the results of the simulations of linear and nonlinear model with and without disturbance feed forward and nonlinear model with feed forward and friction compensation. In another study in 1999, Purdy made a simple elevation model and examined the out of balance effect on WCS. These studies deal about the electrical drive technology. They also have no model in a computer program revealed in the publications.

Systems aimed to do this stabilization basically closed loop servo systems which control the movement of the barrel relative to the earth by using gyroscopes and feedback signals produced by them. Simplest stabilization systems are assigned to cope with the elevation changes and made up of a single closed loop system with a rate gyroscope mounted on the barrel to sense its angular velocity.

Achieving high hitting accuracy for a main battle tank is challenging while the tank is on the move. This can be reached by proper design of a weapon control and gun system. In order to design an effective gun system while the tank is moving, better understanding of the dynamic behaviour of the gun system is required. In this study, the dynamic behaviour of a gun system is discussed in this respect. Both experimental and numerical applications for the determination of the dynamic behaviour of a tank gun system are investigated. Methods such as the use of muzzle reference system (MRS) and vibration absorbers, and active vibration control technology for the control and the reduction of the muzzle tip deflections are also reviewed. For the existing gun systems without making substantial modifications, MRS could be useful in controlling the deflections of gun barrels with estimation/prediction algorithms. The vibration levels could be cut into half by the use of optimised vibration absorbers for an existing gun. A new gun system with a longer barrel can be as accurate as the one with a short barrel with the appropriate structural modifications.

Tank stabilizer is a control system keeping the bore axis in the desired sighting angle. For the control problem of the stabilizer in the case of uncertain parameters, the adaptive control method is introduced to design the vertical tank stabilizer with the nonlinear dynamic model of vertical stabilizer given in the paper. In the design, the multiple parameter uncertainties of the hydraulic servo system are fully considered and the linear feedback control is used to improve the asymptotic stability of the system. The vertical stabilizer of tank is simulated in MATLAB/Simulink environment. In addition, a

numerical structural dynamic characteristics usually show considerable discrepancies with the measured ones because structural details are commonly simplified in the FE models. To identify such discrepancies, FE models of them have been calibrated using the measured dynamic characteristics in previous researches. In this study, the dynamic characteristics were measured for a historic cathedral and the FE model of it was calibrated using the measured results as a reference. Finally, a procedure of the FE model construction for the unreinforced masonry cathedral was tentatively proposed.

1.2 Aims of the Study

In this study, the stabilization of the barrel on a MBT in elevation axis is considered. Only the elevation axis is considered because it is affected much more than the azimuth axis from the road profile. Since a stabilization system improve an ability of hitting targets while the tank is moving without stopping, the effects of disturbances on the barrel should be taken into account. Unbalance caused by mounting the barrel off centre of mass, friction at joint, hydraulic actuator as the driving unit and control system are the causes of using a stabilization system. In this study, all of these components are modelled and simulated under specified conditions.

The brain of the stabilization system is the controller. PID controllers are used to control the position and the velocity of the system. To be able to tune the parameters of the controller, either an experimental setup should be used or a model should be constructed. The use of experimental setup may cause trouble and may be dangerous for the setup. To prevent from these undesired situations such as damaging the system elements, operator injury etc., a model will be constructed and controller parameter tuning and system modifications will be realized by using this model. Since a stabilization system improve an ability of hitting targets while the tank is moving without stopping, the effects of disturbances on the barrel should be taken into account. Finally, the whole system or the elements of it can be used for other design and modernization studies.

1.3 Scope of the Study

It is intended in the study to model the elevation axis of a barrel completely in Simulink 5.0 in Matlab6.5 environment and simulate the disturbance effects on it. This model includes barrel, hydraulic actuator as driving unit, an electro-hydraulic servo valve to manipulate the actuator and controller unit. The properties of the servo valve used to

control flow are explained. System identification is made for the servo valve by using its experimental test outputs to determine the valve gain and the time constant. The nonlinear flow characteristics of the servo valve are derived and modelled.

The actuation system as a slider-crank mechanism is modelled. Inverse kinematics is used to solve the relation between the barrel's angular position and the actuator position while the motion is transformed from translational movement to rotational. There are a lot of parameters which define the barrel's motion such as frictions in the barrel joint, the compressibility of the hydraulic fluid, unbalance caused from mounting point of the barrel to the hull and inertia. The controller is made up of two PID's one for each loop feeding back the velocity and the position of the barrel. The disturbance caused by the road and transferred over the hull is modelled. The stabilization method to overcome the disturbance which can be measured by means of gyroscopes is examined.

To provide appropriate feed forward signals two gyroscopes are mounted one to the hull and the other to the barrel. The use of the feed forward control was pioneered by the Cadillac Cage Company in the late 1950s. This stabilization system was demonstrated in 1962 and firstly adopted to the Leopard I Tanks in 1969-1970 by German and Belgian Armies. Feed forward control application was seen in Soviet Army with a difference from the others. The stabilization systems include rate integrating gyros which provide a memory for the barrel position. So the barrel can be driven to the old position just before the disturbance.

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CHAPTER 2

LITERATURE REVIEW

2.1 System modelling

Modelling is the starting point of design, production, test and control. A good modelling will settle most of the problems in the design step. Also in the production case, modelling will help to define many of the criteria. The test and control stages are also critical. Because of many restrictions, the control and the test stages are realized in a tight manner. On the other hand with a well designed model, tests can be made on the model without any damage risk to the system. All critical values can be tested and determined in this way. While modelling, it should not be forgotten that the more the properties introduced to the model the more the problems occur. If all the parameters of the real system were tried to be included in the model, this would probably generate many problems such as the increase in the number of the logical operators, time spent for the evaluation, solver errors caused by the time step and more computer capabilities need etc. Sometimes modelling so many details becomes harmful instead of being helpful as the system may not be settled with the desired accuracy because of the problems mentioned above. While modelling, critical case is to determine the modelling criteria and assumptions. While constructing the elevation axis model, the following assumptions are made:

- There is a stable source of hydraulic fluid supply at constant pressure.
- Effects of hydraulic fluid inertia are negligible.
- Gage pressures are used.
- No temperature change exists.
- There is no leakage.

2.1.1 System Model

In this study, the "system" will represent the union of the servo valve, the actuator and the barrel. Hull dynamics is not included in the system mentioned in this study. While it is assumed that road profile is known and correctly transformed via the gyroscopes on

the hull, it is included in the system as disturbance representing the hull motion. Input of the system is the velocity command to the servo valve.

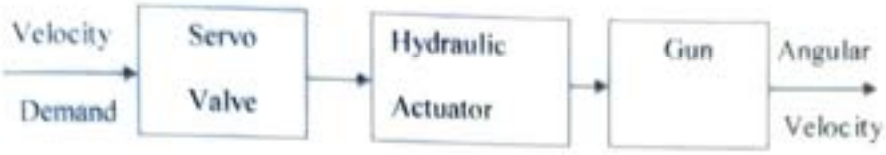

Figure 2.1 Block Diagram Representation of Barrel

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2.1.2 Servo Valve Model

A classical four way, zero-lapped valve is used to excite the actuator. The servo valve has 3 stages: flapper as first, spools as second and third stages. A schematic representation of the valve used in this study is seen in Figure 4.

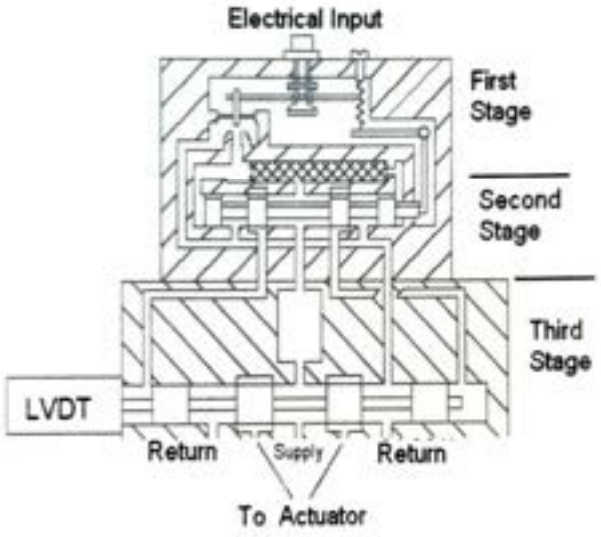

Figure 2.2 Schematic Representation of Servo Valve Block

The first stage is an electrically driven flapper nozzle type. The flapper moves by the force generated from the induction of two coils by DC current. In the first stage the input is the current and the output is the flapper position. The flow characteristics are nonlinear but there is no chance to determine the position and the exact flow. By assuming that the force acting on the spool caused by the pressure in the chamber is proportional to the flapper position, it can be illustrated by a constant which will be the gain of the transfer function between the flapper and the spool position. In this block diagram, valve dynamics represents all three stages together. While the parameters of the electrical stages cannot be evaluated, only the nonlinearity in the third stage is taken into account and the rest of the

system is included in the transfer function of the plant. The output of the LVDT is measured and the flow rate is calculated from this value via orifice equation.

$$Q = C_d W X_3 \sqrt{2/p}\,(p1 - p2) \qquad \ldots (2.1)$$

In second stage, the input is the flapper position and the output is the spool position. In this case, also there is no chance to determine the position of the spool and the exact flow. At the third stage the position of the second stage spool is the input and third stage spool position is the output this is clearly illustrated through diagrammatic representation. But a modelling servo valve is almost impossible while the parameters like mass, friction and stiffness of the stages separately are unknown. There is no chance to make individual tests for each stages of the valve. But, it is possible to determine the overall characteristics of the valve considering all three stages together. In these tests realized in ASELSAN just Linear Variable Differential Transducer (LVDT) outputs can be measured and recorded. LVDT is a device which determines the position of the spool.

A Servo Stabilizer is a Servo motor controlled stabilization system that performs optimum voltage supply using a Buck\Boost transformer booster that captures voltage fluctuations from input and regulates current to the correct output. An AC synchronous motor adjusts voltage in clockwise or anticlockwise direction and manages the output voltage with components like control card, dimmer, comparator, transistors, etc. The Servo stabilizer has definitely an edge over traditional stabilizers. Basically there are two types of stabilizers, one is relay based and the other is Servo based. In relay stabilizer, a switch corrects the output voltage accuracy at ±10%. But in Servo, the primary Servo motor corrects supply using buck-boost function. This type of stabilizer is beneficial for high output voltage accuracy. It provides ±1 % voltage output where input voltage alters up to ± 50 %. This type supports up to 5000 KVA & above so it has a higher load capacity. Ultimately, the major difference between the two is performance as Servo is a step less correction technologically superior to traditional relay transformers and gives accurate output. A servo stabilizer is a popular replacement for low high rating appliances used in both commercial and residential places, homes and industries that provides unmatched voltage supply to protect your fragile equipments. Servo has both single-phase and three-phase systems coming in Oil cooled and Air-cooled units.

2.1.2.1 System Identification

Computer simulations of systems give the opportunity to the users to study on the computer to make the design instead of constructing real systems. But it should not be expected that the response of the simulations will be the same as the real system even parameters of the real system are known.

Matlab and similar programs introduce us many methods to identify the systems. System Identification. The output plots can be seen in the figure. The valve was controlled by a PID while the position of the third stage spool (LVDT) is fed back.

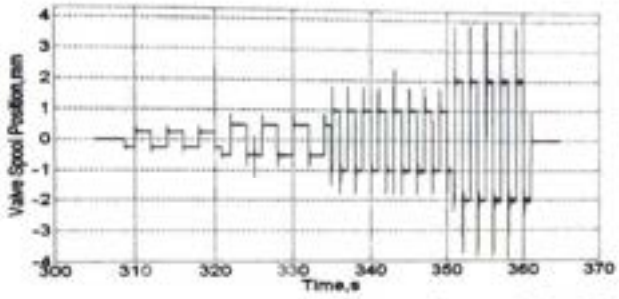

Figure 2.3 The LVDT Output of Servo Valve Test

In this study, this identification is repeated while taking the input as the position demand corresponding to the electrical input in mm. As seen in figure 5there are transition periods and some disturbances which cannot be used in identification. By omitting the transient periods and extraordinary fluctuations, step responses are obtained and plotted on the same graph in Figure 14 for one second duration, which is an enough period for settling.

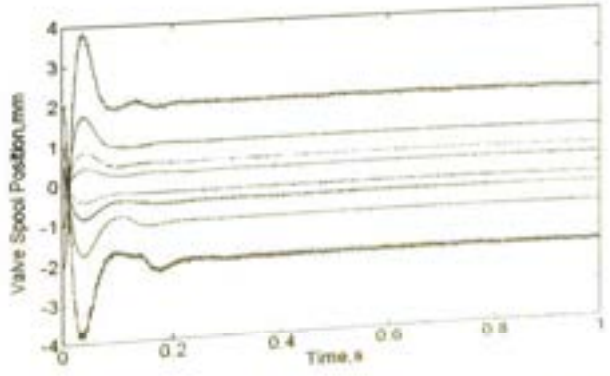

Figure 2.4 Servo Valve Step Responses for Different Input Values

As can be seen in figure 2.4, valve step responses differ from each other. Valve shows different dynamic behaviours at different amplitudes. In this situation, although identification will fit exactly to one of the step response, it would not be the optimum solution for the other magnitudes. Thus, the solution differs also at each amplitude. Anyone of the valve gain and time constant pairs for these step responses could not represent all of the step responses with the same accuracy. "m" files used in the simulations and calculation

2.1.2.2 Load Pressure Feedback

The servo valve is used to control the velocity of the actuator. Pressure feedback is a way of adding damping to this subsystem. Pressure feedback is able to increase damping based on the fact that the cylinder pressure is related to the derivative of the cylinder velocity. Feeding back the derivative of the cylinder velocity increases the damping of the system, thus improves the transient performance. The only problem with this strategy is that the pressure information also contains the effect of external forces. A high-pass pressure filter is introduced to deal with this problem. A high-pass pressure filter is introduced to deal with this problem.

Fluid power systems are inherently nonlinear and typically suffer from very poor damping. Despite these characteristics, it is not uncommon that traditional linear type controllers are applied. This typically results in conservative adjustment of the controllers, or when more advanced controllers are applied, that they do not benefit from the possibilities for improving the damping by applying (internal) pressure feedback in the systems. In both cases, the result will be degraded performance compared with what may be obtained. Pressure feedback, also referred to as active damping, is not a new method. However, it is an often overlooked method, and when it is applied, it is not adjusted optimally to also account for model uncertainties, unmodelled system dynamics, and parameter variations. The focus of this paper is to explain various types of pressure feedback that may be applied; how these affect a given system, and how to adjust the parameters of the pressure feedback to obtain the best results. This is done for both a traditional symmetric cylinder servo system and a system with a differential cylinder using both pressure and non pressure compensated proportional valves. Based on the presented models, the analysis yields results for how to properly adjust the parameters.

The mechanism usually includes an angular reference device such as a mechanical or optical gyro and servo mechanisms. In the case of a tank, there is one servo stabilizing the turret and another for the elevation of the gun. The aiming is then done by control input to the mechanism, rather than directly on the gun. The control mechanism usually has other functions, such as applying super-elevation and leading the target according to its velocity, making it a fire-control system, and some guns are entirely automatic.

The G value can be set through a wide range. Mostly, this parameter is selected for each specific system application separately and influenced by various system requirements such as system frequency, response and stiffness generally corresponds to a corner frequency of about 1/3 of resonant load frequency, f_c. Vibration tests were made for MBT to determine the critical frequencies. For the MBT the tests are made in a project in ASELSAN. Barrel's natural frequency is determined in these tests as 10.73 Hz.

2.1.2.3 Dither Signal

Behaviour of a hydraulic servo valve can be unpredictable because of striation which keeps the valve spool from moving when input signal changes are small. When the signal finally becomes large enough to initiate a movement, the spool will tend to overshoot the position required for accurate control. Dither is a rapid, small movement of the spool around the desired position. It is intended to keep the spool moving to avoid striation. Dither amplitude must be large enough and the frequency slow enough for the spool to respond, and yet small and fast enough to avoid creating a noticeable pulsation in the hydraulic output of the valve.

The amplitude of the ripples determines whether, or how far, the spool will move at a given frequency. Dither is utilized in many different fields where digital processing and analysis are used. If that error is correlated to the signal, the result is potentially cyclical or predictable. In some fields, especially where the receptor is sensitive to such artifacts, cyclical errors yield undesirable artifacts. In these fields introducing dither converts the error to random noise. The field of audio is a primary example of this. The human ear functions much like a Fourier transform, wherein it hears individual frequencies. The ear is therefore very sensitive to distortion, or additional frequency content, but far less sensitive to additional random noise at all frequencies such as found in a dithered signal. Dither is added before any quantization or re-quantization process, in

order to de-correlate the quantization noise from the input signal and to prevent non-linear behaviour (distortion). Quantization with lesser bit depth requires higher amounts of dither. The result of the process still yields distortion, but the distortion is of a random nature so the resulting noise is, effectively, de-correlated from the intended signal.

If the signal being dithered is to undergo further processing, then it should be processed with a triangular-type dither that has an amplitude of two quantisation steps; for example, so that the dither values computed range from, say, −1 to +1, or 0 to 2. This is the "lowest power ideal" dither, in that it does not introduce noise modulation (which would manifest as a constant noise floor), and completely eliminates the harmonic distortion from quantisation. If a coloured dither is used instead at these intermediate processing stages, then frequency content may bleed into other frequency ranges that are more noticeable, which could become distractingly audible. If the signal being dithered is to undergo no further processing if it is being dithered to its final result for distribution then a coloured dither or noise shaping is appropriate. This can effectively lower the audible noise level, by putting most of that noise in a frequency range where it is less critical.

Dithering is used in computer graphics to create the illusion of colour depth in images with a limited colour palette - a technique also known as colour quantization. In a dithered image, colours that are not available in the palette are approximated by a diffusion of coloured pixels from within the available palette. The human eye perceives the diffusion as a mixture of the colours within it. Dithered images, particularly those with relatively few colours, can often be distinguished by a characteristic graininess or speckled appearance.

By its nature, dithering introduces pattern into an image the theory being that the image will be viewed from such a distance that the pattern is not discernible to the human eye. Unfortunately this is often not the case, and often the patterning is visible. In these circumstances it has been shown that a blue noise dither pattern is the least unsightly and distracting. The error diffusion techniques were some of the first methods to generate blue noise dithering patterns. However, other techniques such as ordered dithering can also generate blue noise dithering without the tendency to degenerate into areas with artifacts.

The dither signal can be applied to the system by adding this signal to the control command. It is usually about 25-300 Hz and magnitude is the 10 % of the reference control signal. In addition to this property, the dither signal prevents the contamination

near the orifices inlets which work very little openings. Command signal used in the system is 10 V for the full opening of the servo valve. The 10 % of this value corresponds to the peak-to-peak value of the amplitude of the dither signal. Dither signal used in this model is a sine wave with amplitude 0.5 V at 140 Hz.

2.1.3 Actuator Model

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a mover. An actuator requires a control signal and a source of energy. The control signal is relatively low energy and may be electric voltage or current, pneumatic or hydraulic pressure, or even human power. Its main energy source may be an electric current, hydraulic fluid pressure, or pneumatic pressure. When it receives a control signal, an actuator responds by converting the signal's energy into mechanical motion. An actuator is the mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.

This electromechanical linear actuator is designed to improve stabilization and pointing accuracy for existing and new turret applications. This series of linear actuators is designed to meet and exceed the demanding requirements of modern main battle tanks or Howitzer gun laying systems. Features include a built-in integrated equilibrator for highly unbalanced weapons, roller screw linear output, brushless DC motor, and 24 volt clutch and maintenance motor for remote operation.

A hydraulic actuator consists of cylinder or fluid motor that uses hydraulic power to facilitate mechanical operation. The mechanical motion gives an output in terms of linear, rotatory or oscillatory motion. As liquids are nearly impossible to compress, a hydraulic actuator can exert a large force. The drawback of this approach is its limited acceleration.

The hydraulic cylinder consists of a hollow cylindrical tube along which a piston can slide. The term single acting is used when the fluid pressure is applied to just one side of the piston. The piston can move in only one direction, a spring being frequently used to give the piston a return stroke. The term double acting is used when pressure is applied on

each side of the piston; any difference in pressure between the two sides of the piston moves the piston to one side or the other.

Pneumatic actuators enable considerable forces to be produced from relatively small pressure changes. A pneumatic actuator converts energy formed by vacuum or compressed air at high pressure into either linear or rotary motion. Pneumatic energy is desirable for main engine controls because it can quickly respond in starting and stopping as the power source does not need to be stored in reserve for operation. Moreover, pneumatic actuators are safer, cheaper, and often more reliable and powerful than other actuators. These forces are often used with valves to move diaphragms to affect the flow of air through the valve

Hydraulic actuator used in the system in this study is a double acting type. The flow from the valve fills the actuator and pressurizes one side of the cylinder. Force required for the motion is produced by this pressurized liquid acting on the piston. Actuator motion, fluid compressibility, actuator stiffness and the leakage in the actuator define the flow rate directly. Finally the assumptions made while modelling the actuator is as follows.

- Temperature change in the fluid is neglected.
- Cylinder and pressurized lines are absolutely rigid.
- Piston mass is negligible. (Because barrel mass is too large)
- There is no internal leakage in the actuator.
- Compressibility is taken into consideration while volumes in the cylinder and its lines are too big compare to the servo valve.

The compressibility is taken into consideration only while modelling the actuator because volumes in the actuator and pressurized lines are too large than the volumes in the servo valve. The output of the system is the barrel's angular position: input is the desired angular position of the barrel relative to the hull. On the other hand slider-crank has a translational input and a rotational output. The unknown parameter which is the variable edge of the triangle for this mechanism is the length of the actuator.

An electric actuator may provide the actuation force/torque in one of several ways. Electromechanical actuators may be used to power a motor that converts electrical energy into mechanical torque. Another approach is an electro hydraulic actuator, where

the electric motor remains the prime mover, but provides torque to operate a hydraulic accumulator that is then used to transmit actuation force in much the same way that diesel engine/hydraulics are typically used in heavy equipment. Electrical energy is used to actuate equipment such as multi-turn valves, or electric-powered construction and excavation equipment.

Additionally, a brake is typically installed above the motor to prevent the media from opening valve. If no brake is installed, the actuator will uncover the opened valve and rotate it back to its closed position. If this continues to happen, the motor and actuator will eventually become damaged. Electric actuators are one of the cleanest and most readily available forms of actuator because it does not directly involve oil or other fossil fuels. An electric actuator may provide the actuation force/torque in one of several ways. Electromechanical actuators may be used to power a motor that converts electrical energy into mechanical torque. Another approach is an electro hydraulic actuator, where the electric motor remains the prime mover, but provides torque to operate a hydraulic accumulator that is then used to transmit actuation force in much the same way that diesel engine/hydraulics are typically used in heavy equipment.

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Twisted and Coiled Polymer (TCP) actuator also known as Super Coiled Polymer (SCP) actuator is a coiled polymer that can be actuated by electric power. A TCP actuator looks like a helical spring. TCP actuators are usually made from silver coated Nylon. TCP actuators can also be made from other electrical conductance coat such as gold. TCP actuator should be under a load to keep the muscle extended. The electrical energy transforms to thermal energy due to electrical resistance, which is also known as Joule heating, ohmic heating and resistive heating. As the temperature of the TCP actuator increases by Joule heating, the polymer contracts and it causes the actuator contraction. A mechanical actuator functions to execute movement by converting one kind of motion,

such as rotary motion, into another kind, such as linear motion. An example is a rack and pinion. The operation of mechanical actuators is based on combinations of structural components.

Soft actuators are being developed to handle fragile objects like fruit harvesting in agriculture or manipulating the internal organs in biomedicine that has always been a challenging task for robotics. Unlike conventional actuators, soft actuators produce flexible motion due to the integration of microscopic changes at the molecular level into a macroscopic deformation of the actuator materials.

The majority of the existing soft actuators are fabricated using multistep low yield processes such as micro-moulding, solid freeform fabrication, and mask lithography. However, these methods require manual fabrication of devices, post processing/assembly, and lengthy iterations until maturity in the fabrication is achieved. To avoid the tedious and time-consuming aspects of the current fabrication processes, researchers are exploring an appropriate manufacturing approach for effective fabrication of soft actuators. Therefore, special soft systems that can be fabricated in a single step by rapid prototyping methods, such as 3D printing, are utilized to narrow the gap between the design and implementation of soft actuators, making the process faster, less expensive, and simpler. They also enable incorporation of all actuator components into a single structure eliminating the need to use external joints, adhesives, and fasteners.

These result in a decrease in the number of discrete parts, post-processing steps, and fabrication time. 3D printed soft actuators are classified into two main groups namely "semi 3D printed soft actuators" and "3D printed soft actuators". The reason for such classification is to distinguish between the printed soft actuators that are fabricated by means of 3D printing process in whole and the soft actuators whose parts are made by 3D printers and post processed subsequently. This classification helps to clarify the advantages of 3D printed soft actuators over the semi 3D printed soft actuators due to their capability of operating without the need of any further assembly.

The output of the system is the barrel's angular position; input is the desired angular position of the barrel relative to the hull. On the other hand slider-crank has a translational input and a rotational output. The unknown parameter which is the variable edge of the triangle for this mechanism is the length of the actuator.

2.1.4 Barrel Model

Rifled barrels introduce ambiguity to measurement of caliber. A rifled bore consists of alternating grooves and lands. The distance across the bore from groove to groove is greater than the distance from land to land. Projectiles fired from rifled barrels must be of the full groove to groove diameter to be effectively rotated by the rifling, but the caliber has sometimes been specified as the land to land diameter before rifling grooves were cut. The depth of rifling grooves (and the consequent ambiguity) increases in larger calibers. Steel artillery projectiles may have a forward bourrelet section machined to a diameter slightly smaller than the original land to land dimension of the barrel and a copper driving band somewhat larger than the groove to groove diameter to effectively seal the bore as it becomes enlarged by erosion during prolonged firing. United States Navy guns typically used rifling depth between one-half and one percent of caliber. Projectile bourrelet diameter specification was 0.015 inches (0.38 mm) less than land to land diameter with a minus manufacturing tolerance so average clearance was about 0.012 inches (0.30 mm). Driving band diameter was groove to groove diameter plus 0.02 inches (0.51 mm).

Early gun barrels were short and thick, typically no more than 26 calibers, as the gunpowder propellant they used burned very quickly and violently, and hence its acceleration time was short. Slower-burning brown powder formulations of gunpowder allowed gun barrel length to increase slightly in the 1880s but enormous quantities of brown powder were required. New slower-burning smokeless powder propellants available from the 1880s onwards such as Poudre B, cordite and nitrocellulose allowed a gentler prolonged acceleration, hence gun barrels were made progressively longer and thinner. The new formulations were far more powerful propellants than gunpowder and far less was needed by weight as they transformed almost entirely to gasses when burned. Muzzle velocity became limited only by the length of barrel that was feasible, both in terms of the construction methods of the day and in terms of any practical constraints imposed by the gun's manner of use.

The practical effect of long barrels for modern guns is that the projectile spends more time in the barrel before it exits, and hence more time is available for expanding gas from the controlled burning of the propellant charge to smoothly accelerate the projectile, bringing about a higher velocity without placing undue strain on the gun. In internal ballistics terms, if the base of a projectile is thought of as a piston propelled by the

expanding gas, then as barrel length increases the volume swept by the piston also increases, and hence the amount of energy that can be extracted from the gas's burning increases. A longer barrel allows more propellant to be used: the propellant is all burned fairly early in the projectile's journey along the barrel, except in the very common instance where combustion is still occurring as the projectile leaves the muzzle and a visible muzzle flash is produced.

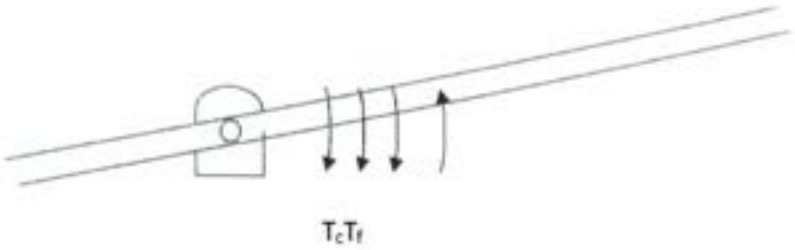

Figure 2.5 Torques acting on the Barrel

There are two hard-stops which limit the rotation of the barrel with respect to the hull at +20° and -10°. Hence these limits are relative to the hull. Also the joint between the barrel and the hull is not located at the centre of gravity of the barrel and has both Coulomb and viscous friction. Geometrical structure of the actuation system, frictions and unbalance cause nonlinearity. In addition to the general assumptions, the barrel is assumed to be absolutely rigid. While modelling, causality must be carefully followed. To be able to start the motion, static friction, T_c, must be overcame. Thus, in determining the situation whether "stick" or "move", coulomb friction will be the first check point.

Another decision should be made about whether the barrel continues its motion or stops. Relative velocity and the position of the barrel are criteria for this case. Barrel sticks to the hull when any of the two conditions are satisfied. These two conditions are considered at the same time. One is the position check of the barrel whether it touches the hard-stops or not and the other is the velocity comparison of the inner part with the outer oneIn this case, outer part has an angular velocity and it is known. There is viscous friction, represented by b_g, and static friction, T_c between the outer and the inner part. Resultant torque, T_c^*, was defined before.

The projectile continues to accelerate as long as the pressure behind it is sufficient to overcome bore friction. The excess energy will continue to accelerate the projectile until

it exits the muzzle. If the pressure behind the projectile drops sufficiently before the projectile leaves the bore, the projectile can and will slow while still within the barrel, despite residual bore pressure behind the projectile. A light charge with insufficient pressure to expel the projectile will result in a squib, or projectile lodged in the bore. This pressure is reduced by the increasing barrel volume the gas has to fill, and in order to achieve maximum muzzle velocity with the shortest barrel length, the projectile should exit the barrel as the gas pressure reduces to a small fraction of the maximum, although unlike chamber maximum chamber pressure, the small fraction desired is impossible to measure. In modern guns, increased muzzle velocities can be produced by altering powder composition and/or using duplex charges containing two different powders in order to extend the pressure curve further down the bore. By exposing the projectile base to a given pressure for a longer length of time, velocity can be increased without elevating the pressure level generated.

2.1.4.1. Unbalance Effect

The unbalance is the result of the mounting the barrel to the hull from anywhere except its centre of mass. Its effect on the barrel is an additional torque proportional to the displacement between the centre of mass and the mounting and the angular position of the barrel with respect to the hull. The hull is assumed always parallel to the ground.

However, this is not the only factor which cause torque on the barrel in vertical axis. While the tank moves on a curved surface, it rotates around an instantaneous center of rotation of ground profile. This affects the barrel as disturbance which is an angular velocity. The rate of change of the angular velocity, □$_d$ is the acceleration and causes torque in the system in the opposite direction with the angular velocity.

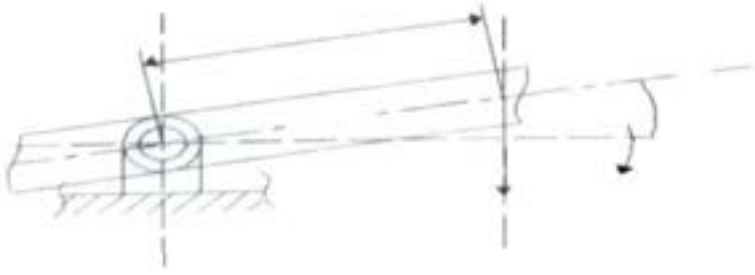

Figure 2.6 Unbalance Effect on the Barrel

Having achieved a breakthrough of the enemy's line, units comprising the Schwerpunkt were not supposed to become decisively engaged with enemy front line units to the right and left of the breakthrough area. Units pouring through the hole were to drive upon set objectives behind the enemy front line. In World War II, German Panzer forces used motorised mobility, to paralyse the opponent's ability to react. Fast-moving mobile forces seized the initiative, exploited weaknesses and acted before opposing forces could respond. Central to this was the decision cycle . Through superior mobility and faster decision-making cycles, mobile forces could act quicker than the forces opposing them. Directive control was a fast and flexible method of command. Rather than receiving an explicit order, a commander would be told of his superior's intent and the role which his unit was to fill in this concept. The method of execution was then a matter for the discretion of the subordinate commander. Staff burden was reduced at the top and spread among tiers of command with knowledge about their situation. Delegation and the encouragement of initiative aided implementation, important decisions could be taken quickly and communicated verbally or with brief written orders.

Close air support was provided in the form of the dive bomber and medium bomber. They would support the focal point of attack from the air. German successes are closely related to the extent to which the German Luftwaffe was able to control the air war in early campaigns in Western and Central Europe, and the Soviet Union. However, the Luftwaffe was a broadly based force with no constricting central doctrine, other than its resources should be used generally to support national strategy. It was flexible and it was able to carry out both operational-tactical and strategic bombing. Flexibility was the Luftwaffe's strength in 1939–1941. Paradoxically, from that period onward it became its weakness. While Allied Air Forces were tied to the support of the Army, the Luftwaffe deployed its resources in a more general, operational way. It switched from air superiority missions, to medium-range interdiction, to strategic strikes, to close support duties depending on the need of the ground forces. In fact, far from it being a specialist panzer spearhead arm, less than 15 percent of the Luftwaffe was intended for close support of the army in 1939.

CHAPTER 3

CONTROL STRATEGIES FOR DISTURBANCE REJECTION

Although different systems are designed to perform different functions, all of them have to meet some common requirements. Main characteristics of typical system concern accuracy speed of response and output sensitivity to component and environmental changes. The priority of importance of these characteristics is defined by the designer based on the system nature and its application. These characteristics are used to measure the performance of the system. But the primary concern is the stability of the system.In this study, all of the criteria were tried to be satisfied but according to this specific application most important performance criteria is disturbance rejection in other words stabilization of the barrel in the elevation axis when the MBT moves on a bumpy road.

3.1. Controller

System has two outputs to be controlled namely the angular velocity and the position. Each loop, which are constructed by feeding back the system output to the comparison with the desired value, is controlled by a PID controller. The position and the velocities in the system are measured by different devices. The device used for measuring the velocity is a classical mechanical gyroscope both for the barrel and the hull. The position of the barrel is measured by an inclinometer. At first look, it seems meaningless but the feedback signals are supplied from different sources. The gyro-scopes used in the system have a bandwidth of 30 Hz and a damping ratio of 0.7. Although they are relevant, in industrial applications controllers could be used in this way.

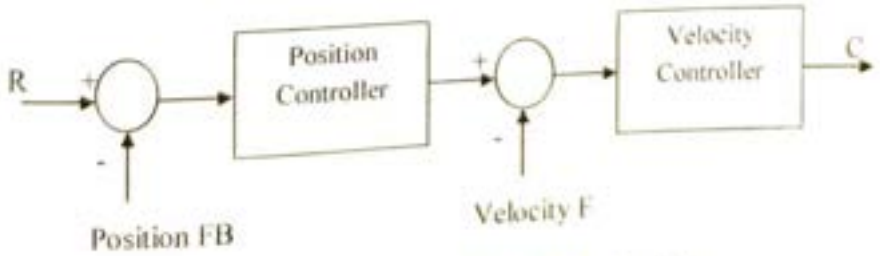

Figure 3.1 Classical Control Algorithm

3.2. Disturbance Feed Forward

Many process control loops are affected by large disturbances. Feedback control can act only on the result of a disturbance, which means feedback control cannot do anything until the process variable has been affected by the disturbance. Changes in process flow rate will be a major source of disturbances to the outlet temperature. If the process flow rate through the heater is increased, the original steam flow rate will not be enough to heat up the increased amount of process liquid and the outlet temperature will decrease. Feedback control will eventually increase the steam flow rate and bring the outlet temperature back to its set point, but not until there has been a significant deviation in temperature. Review your controller documentation and take special care with scaling the feed forward signal. Many PID controllers expect the feed forward signal to be scaled between -100% and +100%.

As the definition of disturbance, it is unwanted that adversely affect the desired output. Although the effect of disturbances on the system cannot be eliminated completely, it can bereduced. Frequency response of the system is analyzed to be able define the transfer function, G_u, between the command signal and the output.

Identification of the disturbance transfer function, G_d, and the transfer function of the nominal plant are made by using the frequency response. This identification is made on the Simulink model. In tests, system is separated from the controller and naturally from the loops. System is used as open loop. Only servo valve position feedback, LVDT is closed. Coulomb friction is neglected. Both input command to the open loop system and disturbance. Feed forward and feedback control is often combined with cascade control, to ensure that their control actions manipulate the physical process linearly, eliminating control valve nonlinearities and mechanical problems. If several major disturbances exist, a feed forward controller can be implemented for each of them. The outputs of all the feed forward controllers can be added together to produce one final feed forward signal. Feed forward, sometimes written feed forward, is a term describing an element or pathway within a control system that passes a controlling signal from a source in its external environment to a load elsewhere in its external environment. This is often a command signal from an external operator.

A control system which has only feed-forward behaviour responds to its control signal in a pre-defined way without responding to how the load reacts; it is in contrast with a system that also has feedback, which adjusts the output to take account of how it affects the load, and how the load itself may vary unpredictably; the load is considered to belong to the external environment of the system. In a feed-forward system, the control variable adjustment is not error-based. Instead it is based on knowledge about the process in the form of a mathematical model of the process and knowledge about or measurements of the process disturbances.

Some prerequisites are needed for control scheme to be reliable by pure feed-forward without feedback: the external command or controlling signal must be available, and the effect of the output of the system on the load should be known (that usually means that the load must be predictably unchanging with time). Sometimes pure feed-forward control without feedback is called ballistic, because once a control signal has been sent, it cannot be further adjusted; any corrective adjustment must be by way of a new control signal. In contrast, 'cruise control' adjusts the output in response to the load that it encounters, by a feedback mechanism.

3.3 Feed forward in Voltage loops

There are three types of control systems: open loop, feed-forward, and feedback. An example of a pure open loop control system is manual non-power-assisted steering of a motor car; the steering system does not have access to an auxiliary power source and does not respond to varying resistance to turning of the direction wheels; the driver must make that response without help from the steering system. In comparison, power steering has access to a controlled auxiliary power source, which depends on the engine speed. When the steering wheel is turned, a valve is opened which allows fluid under pressure to turn the driving wheels. A sensor monitors that pressure so that the valve only opens enough to cause the correct pressure to reach the wheel turning mechanism. This is feed-forward control where the output of the system, the change in direction of travel of the vehicle, plays no part in the system. See Model predictive control.

Feed forward control is distinctly different from open loop control and teleoperator systems. Feed forward control requires a mathematical model of the plant (process and/or machine being controlled) and the plant's relationship to any inputs or feedback the system might receive. Neither open loop control nor teleoperator systems

require the sophistication of a mathematical model of the physical system or plant being controlled. Control based on operator input without integral processing and interpretation through a mathematical model of the system is a teleoperator system and is not considered feed forward control.

CHAPTER 4

SIMULATION

In this chapter, Simulink models of the system components will be constructed and explained. Especially, servo valve identification and the friction model are handled in detail. Finally the complete system will be simulated for different cases. The simulations are made with a fixed time step of $5x10^{-4}$ s and the ODE5 (Dormant-Prince) solver is used. Because the fastest component of the system is the servo valve and its time constant is 0.0032 s. Since time step is very small, solution method also is selected 5^{th} order to be able to prevent the valuation error.

4.1. Valve Model and Identification Results

As explained in Chapter 2, the valve is separated into 2 parts. First part is made up of the linearized section which has the transfer function between the input voltage and the output valve's third stage spool position. Second part is the section where the flow is determined which maintains the nonlinearity of the orifices. By combining these two blocks complete servo valve block is constructed. At this time, load pressure feedback is added to the valve. Load Pressure is fed back via a pressure transducer and high pass filter. High pass filter time constant is determined according to the load resonant frequency is 0.445 s. Scale for the input rad/s to mm is found by simulating the complete system with different inputs and takes the ratios with the angular velocity output. Corresponding valve openings are determined and the scale is obtained.

By combining these two blocks complete servo valve block is constructed. At this time, load pressure feedback is added to the valve. Load Pressure is fed back via a pressure transducer and high pass filter. High pass filter time constant is determined according to the load resonant frequency which is mentioned as 0.445 s. Scale for the input rad/s to mm is found by simulating the complete system with different inputs and takes the ratios with the angular velocity output. Corresponding valve openings are determined and the scale is obtained. At this time, load pressure feedback is added to the valve. Load Pressure is fed back via a pressure transducer and high pass filter. Since time step is very small, solution method also is selected 5^{th} order to be able to prevent the valuation error.

4.1.1. Valve Identification

Servo valve is made up of three stages but there were the LVDT output and the command voltage as the input. The number of the step responses in Figure 14 was not equal for each amplitude. While the mean value will be determined, this inequality gives wrong weigh to the magnitudes. Identification is made by using the cost function via an "m" file which calculates the error between the simulation and the actual response by simulating the servo valve model with different gain and time constant parameters. In this calculation two actual step response data are used for each amplitude. Minimum error surface and the simulations with the parameters found in this case were plotted.

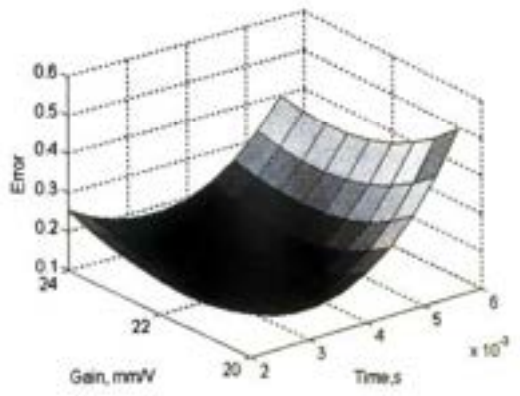

Figure 4.1 Error Surface for Servo Valve Identification

After these calculations, gain value, K, is found 21.8 and time constant, T, is found 0.0032 s. Identification is made by using the cost function via an "m" file which calculates the error between the simulation and the actual response by simulating the servo valve model with different gain and time constant parameters. Servo valve is made up of three stages but there were the LVDT output and the command voltage as the input. The number of the step responses in Figure 14 was not equal for each amplitude. Load Pressure is fed back via a pressure transducer and high pass filter. High pass filter time constant is determined according to the load resonant frequency is 0.445 s.

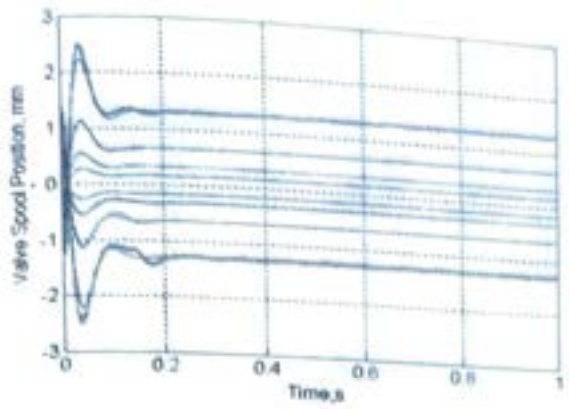

Figure 4.2 Servo Valve Simulation and Experiment Comparison

4.2. Actuator Model

In actuator, there are two important components which must be considered. One of them is compressibility of the hydraulic fluid and the other is the inverse kinematics of the slider-crank mechanism i.e., determination of the piston position and velocity. While finding the position of the actuator, initial condition is found by the position of the barrel. Also actuator stroke length is considered. Although the piston areas are equal, the model is designed to solve any actuator which has different areas. Finally it is assumed that the stroke will never touch the cylinder wall. So the corresponding dead volume in cylinder is considered in solution.

4.3. Friction Test Results

Friction model is considered to be done separately. The frictions and the mechanical limits are considered. Unbalance effect is not included. In this example, parameters are not the same as the original system. These are just for the representation for different cases. In this model, to determine the acceleration of the barrel, the classical derivative block is not used. Instead of it, derivative is calculated by the help of the memory blocks in Simulink. Also another problem is the determining the point of zero cross of the relative velocity of the barrel. While the solution is made with fixed time steps "Zero Cross Detection" block cannot be used increment found by the derivative of the relative velocity and the time step. The sign change is detected between the relative velocities at the present and the next time step.

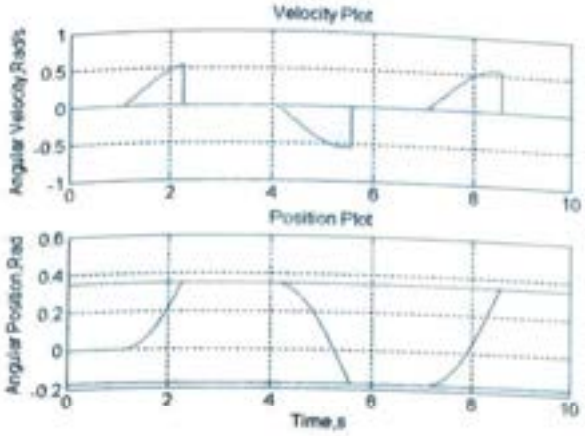

Figure 4.3 Velocity and the Position of Simplified Barrel

At first simulations, only torque was applied to the system while the disturbance is zero. Then only disturbance was applied to the system. The disturbance is an angular velocity at the joint which mounts the barrel to the hull. A series of torques and disturbances are selected to simulate. Disturbance is applied and friction is sometimes much more than the friction torque and caused the barrel rotates without touching the mechanical limits and be stuck when the friction decreases to a level less than the friction. In this situation velocity graphs have no jumps.

4.4. Barrel Model

The last component of the system is the barrel and it contains a logic block. This block checks the conditions which explained in Chapter 2 Section 4. According to the conditions, logic block decides whether the barrel moves or stops at the next time step and selects the corresponding friction torque to this motion. By controlling the relative velocity and the physical limits, it defines the stop conditions and resets the integral block after this decision. Inertial torque is taken into consideration. Disturbance originates from the road profile is also used in this part of the model. The mechanical limits which are relative to the hull are demonstrated by the limited integrals.

The position and the velocities of the barrel for two cases explained before can be seen in the figures. The deviation of the barrel position from the zero point is differing but the best ones are the cases in which the disturbance feed forwards are used. Stabilization accuracy is about $1x10^{-3}$ rad while the V=20 km/h and □d□ 0.016 rad/s and $6x10^{-4}$ while the V=40 km/h and □d□ 0.008 rad/s. The minimum stability accuracy determined in [3] with basic, second generation and director type stabilization systems is 1.0 mil, 0.5 mil and 0.2 mil respectively. While a circle is 6280 milirad or 6400 mil, stabilization accuracy of

the model will be equal to 0.1 milirad or 0.102 mil. Compare to these values, model has an accuracy same as the basic stabilization system.

4.5. System Simulation

Controller of the system consists of two PIDs. Velocity and position of the barrel are fed back. Each loop is controlled by one PID controller. In addition to this, for disturbance rejection, disturbance is fed forward to the controller.

Control strategy mentioned before is used by adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal.

Controller parameters are tuned while a step command which does not cause the barrel hit to the hard-stops is applied to the system. Tuning process used in controller is as follows.

- Set all gains zero.
- Apply a step command.
- Raise proportional gain until the system begins overshoot.
- Raise integral gain until overshoot is approximately 15 %.
- Raise derivative gain to remove some of the overshoot

Control strategy mentioned before is used by adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal. Control strategy mentioned before is used by adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal.

CHAPTER 5

CONCLUSION

5.1. Summary and Conclusion

In this study, stabilization of a Main Battle Tank is considered. System elements are examined one by one and modelled in Matlab, Simulink environment. Modelling is a difficult problem itself and to be able to model the systems assumptions for undetermined facts and nonlinearities must be done. System controller, electro hydraulic servo valve, actuating system (slider-crank mechanism), barrel are elements of the Main Battle Tank system.

Control system is constructed by using PID controllers. Velocity feed forward is used to make the system more rapid. It has two PID controllers one for position loop and the other for the velocity loop. Disturbances which come from the ground via the hull were embedded to the system from the control signal to make the system more sensitive to the changes in hull motion. Stabilization, disturbance rejection, is tried to be improved by adding disturbance compensation. The transfer function between the disturbance and the output of the system is determined. Frequency response is examined and the contents of the feed forward strategy are determined.

Servo valve is a zero-lapped, classical four way valve. It has three stages. The valve is modelled as second order system. Valve dynamics are identified by the help of the actual system's step response records. Simulations and comparisons with the actual system are made with the model parameters found with identification. Nonlinearity in the servo valve is considered. Actuation system is a double-acting hydraulic cylinder coupled with a slider-crank mechanism which transforms the translational motion to the rotational. Inverse kinematics is considered in the solution while modelling. The cylinder and the pressurized lines are assumed to be absolutely rigid. Compressibility in the actuation system is considered. Piston areas are equal in the system but it is considered that they may be different for other systems while modelling.

Angular position of the barrel is the output of the system. Inertial effects, Coulomb and viscous frictions, hard-stops define the motion of the barrel. A simplified model of the

barrel is constructed to define the possible cases with the effects of inertia, friction and hard-stops. The way of effecting of disturbance caused from the road profile is as an angular velocity at the joint which mounts the barrel to the hull. The source of this velocity, acceleration and unbalance affect the barrel in vertical axis.

The measurement devices used in the actual systems are also modelled. These are LVDT in servo valve, gyroscopes on the hull and gyroscope and encoder on the barrel. LVDT is represented in the system model as a gain, gyroscope as a second order transfer function and encoder as a quantization block. Simulations are made for the stabilization system. They are made with two different constant velocities but the model can also solve the situation with variable velocities. Model which was constructed for Main Battle Tank gives the opportunity to use any of the elements included in the system without risk of hazard for machines and users separately. Also, they can be used to design the possible future systems.

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CHAPTER 6

WORK TO BE DONE IN PHASE II

System modelled in this study will be satisfactory to examine the main cases included and will be helpful for users. For future work, other probable components can be added to the model such as pipes, hydraulic fluid temperature, leakage etc.PID controllers are very common in industry. However, there is not a common method for tuning these controllers. PID controllers are dominant, effective, simple and applicable for all kinds of systems. Other controller strategies may be tried such as intelligent control, full state feedback etc.

LVDT is represented in the system model as a gain, gyroscope as a second order transfer function and encoder as a quantization block. Simulations are made for the stabilization system. They are made with two different constant velocities but the model can also solve the situation with variable velocities. Model which was constructed for Main Battle Tank gives the opportunity to use any of the elements included in the system without risk of hazard for machines and users separately.

Hull dynamics is neglected in this study and output of the hull gyro is used directly. Hull model may be constructed and actual road profiles may be used. The servo valve is identified in this study with very limited data. A better valve can be used or may be done additional tests on the valve to make a better model of the servo valve. Coulomb and viscous frictions are modelled but it is assumed that they exist only in the joint which mounts the barrel to the hull. The other mountings such as the one between the piston and the barrel and the one between the cylinder and the hull, actuation system have also frictions.

REFERENCES

[1] Balaman, M. R., (1984), "Time Optimal Control of a Manipulator with Two Angular Degrees of Freedom", METU Mechanical Engineering Department, Ankara.

[2] Batu, U., Gürcan, M. B., Balkan, T., "Hidrolik Servo Valfler in Dinamik Modellerive Performans Testleri", III. Ulusal Hidrolik Pnömatik Kongresive Sergisi, 4-7 Aralýk 2003, Ýzmir, pp. 13-26.

[3] Çelik, M., Aykan, M., (2004), "Tank Namlusunun Operasyonelve"

[4] De Boer, C. C., Yao, B., (2001), "Velocity Control of Hydraulic Cylinders with Only Pressure Feedback", Proceedings of IMECE'01, ASME, 11-16 November 2001, New York.

[5] Ogorkiewicz, R. M., (1991), "Technology of Tanks", Vol.1, Jane's Information Group Limited.

[6] Ogorkiewicz, R. M., (1978), "Stabilised Tank Gun Controls", International Defence Review, pp. 725-728.

[7] Purdy, J. D., (1999), "On the Stabilization of Out-Of-Balance Guns", Journal of Battlefield Technology, Vol. 2, No. 3, pp. 1-7.

[8] Şahin, S., (2001), "Stabilization and Orientation of Tank Gun", M.S.Thesis, METU Mechanical Engineering Department, Ankara.

[9] Thayer, W. J., (1965), "Technical Bulletin I03", MOOG Inc. Control Division, East Aurora.

AUGMENTED REALITY AND VIRTUAL REALITY MAP

A PROJECT PHASE I REPORT

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ELECTRONICS AND COMMUNICATION ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

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ABSTRACT

Augmented Reality (AR) is the technology that overlaps virtual objects onto the real world objects. It has three main features: the combination of the real world and the virtual world, real-time interaction, and 3D registration. It is a technology that works on computer vision based recognition algorithms to augmented sound, video, graphics and other sensor based inputs on real world objects using the camera of your device. The shortest route and graphics information in 3D are not notified in normal maps to avoid such problems we have developed a 3D virtual environment that gives graphics and contain more information about a particular place. This project is done by using "UNITY" application, the engine can be used to create three-dimensional, two-dimensional which helps to view all these graphics and routes in 3D view.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATIONS
AR	Augmented Reality
GSM	Global System For Mobile
HMD	Head Mounted Display
IOT	Inter Of Things
LCD	Liquid Crystal Display
LED	Light Emitting Diode
SMS	Short Message Service
VR	Virtual Reality

CHAPTER 1

INTRODUCTION

1.1 Introduction

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real-world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities,

Including visual, auditory, haptic, somatosensory and olfactory. The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment). This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality.

The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations, which are perceived as natural parts of an environment. The earliest functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Laboratory in 1992. Commercial augmented reality experiences were first introduced in entertainment and gaming businesses. Subsequently, augmented reality applications have spanned commercial industries such as education, communications, medicine, and entertainment. In education, content may be accessed by scanning or viewing an image with a mobile device or by using marker less AR techniques. An example relevant to the construction industry is an AR helmet for construction workers which displays information about construction sites.

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CHAPTER 2

LITERATURE REVIEW

2.1 Location-based services

Tom Hulme - 1559316 Department of Electrical and Computer Engineering in 2010.

2.1.1 Introduction

Due to the ever increasing popularity of mobile devices, Location-based services can be easily created and used to interact with the areas around us. Mobile devices with cameras can be used to navigate through areas using virtual or augmented reality; where an image is captured through the camera, and then overlaid with information to help a user navigate. Being that this field of user interaction is fairly new, this paper reviews three existing research papers in their exploration of the area, and how mobile devices can be used to recognize the world around abuser and change how they interact it. The papers cover the use of a mobile device's camera, wireless, and GPS systems to approximate the user's location, and provide feedback through Augmented and Virtual Reality methods.

2.1.2 Objective

This paper looks into the ways in which Location-Based Services are able to change the way we interact with the world around us. Using Augmented and Virtual Reality, and combining them with the camera, Wireless, and GPS systems in mobile devices; or combining them with external devices, we are able to create navigation systems to assist users in finding their way around both indoor and outdoor settings.

2.1.3 Technology

Indoor Navigation the idea of navigating through indoors paces with mobile devices is not a new one, but constant advancements in both the technological capabilities and availability of the eMobile devices has meant the ability to easily set up systems to navigate indoors is much easier. In later sections we will cover how indoor navigation is accomplished. Outdoor Navigation Navigation with the use of maps has existed for thousands of years, but with mobile devices users are now able to find their way through technological means such as GPS. Location

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Based Services are able to build upon this foundation to provide more extensive assistance in the area of outdoor navigation.

2.1.4 Result

The paper a mobile indoor navigation system interface adapted to vision-based localization, explained how Moller et al. were able to approximate a user's location then provide them with a functional navigation service. The authors used the mobile device's camera exclusively, approximating the location with visual localization, and applied an Augmented or Virtual Reality overlay to provide information to the user.

2.1.5 Conclusion

There are a number of different applications for Location Based Services, as well as a number of different methods to provide them. If we are to use Augmented Reality, we need to be sure that we correctly and reliably get the direction a user is facing, as an incorrect heading has more of a negative impact on usability. The camera on a mobile device, coupled with Wi-Fi and GPS positioning seems to be most accurate when approximating a user's location, and may even be coupled with Google Street View, or additional external devices. These methods can be used to provide users with a new way to interact with the world around them, and allow anybody to easily navigate unfamiliar territory.

2.1.6 Drawbacks

Position of the object decides the output.

Lack of privacy.

Expensive to develop and maintain.

2.2 Review and analysis of augmented reality

Sara Rankohi & Lloyd Waugh, Visualization Engineering in 2013.

2.2.1 Introduction

The complex nature of the architecture, engineering, construction, and facility management (AEC/FM) industry and its high demand for access to information for evaluation, communication and collaboration, increases the industry's need for information

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technologies. Recent visualization technologies such as virtual and augmented reality technologies are ideal in this environment.

2.2.2Objective

Augmented reality gives a view of the real world where elements are superimposed by computer generated files such as graphics, sounds, videos, or digital information.

2.2.3 Technology

Augmented reality technology, which typically layers virtual information on a real scene, utilizes different hardware (personal computers (PC), laptops, head mounted displays (HMD), GPS, data gloves, smart boards, etc.) and software (AutoCAD, Photoshop, AC3D, 3D Studio, building information model (BIM), etc.). From a technology perspective articles are classified into three categories: (1) user experience: (a) immersive or (b) non-immersive, i.e., desktop-based; (2) device: (a) mobile, (b) stationary or non-mobile; (3) delivery: (a) web-based, (b) standalone.

Devices such as HMD and data-gloves create immersive AR systems, in which users feel immersed in a virtual environment just as they usually feel in a real environment. Due to the improving performance of handheld devices and recent solutions to technical difficulties such as tracking, there is an opportunity for augmented reality systems to become portable, as well there is a growing interest in the use of mobile AR applications. Web-based augmented reality technologies can deliver project information to remote locations and are very useful to manage virtual projects around the globe. Finally, due to the wide range of AR applications, these technologies can be used both on-site for progress monitoring and in an office (not-on-site) for design control. From the user experience perspective, 32 articles have a principal focus on immersive AR technologies, 76 articles (57%) have a principal focus on non-immersive or desktop-based AR technologies, while 25 articles were not applicable. The number of articles with immersive and non-immersive technologies as a principal focus by year.

2.2.4 Result

AR technologies provide proven benefits especially in the areas of visualization simulation and communication/collaboration, however these benefits are not yet widely adopted by AEC industry participants nor have they been incorporated into industry-wide workflow processes. As a result, industry participants choose to pilot (i.e., system development

and application) AR technologies on a few projects rather than adopting or piloting the technology across their organization.

2.2.5 Conclusion

A structured methodology was used to identify 133 articles on the topic of augmented reality from eight prominent AEC industry journals. The first article was published in 1999; a significant increase in the number of articles on this topic occurred during the year 2008. In addition to statistics on the counts of articles by year and the first author's country of residence, ten interpreted dimensions were developed for classification of these articles. Literature show field workers and project managers have high interests in using non-immersive and desk-top standalone (individual) AR technologies during construction phase of a project to compare as-planned versus as-built statuses to monitor progress and defect detection. Whereas, it is predicted that future trend, is more toward using collaborative and internet based mobile AR systems which have applications not only in construction phase, but also in procurement and maintenance phases of a project. Due to various benefits of AR technology for construction industry, the application of AR systems for initiation and procurement phase of a project to compare model vs. model and reality vs. reality is recommended. Moreover, lightweight mobile and immersive AR systems are also recommended for field personnel due to dynamic environment of construction fields.

2.2.6 Drawbacks

Low GUI (graphical user interface)

Could not find very small remote area.

2.3 Augmented reality tracking techniques

IOSR Journal of Computer Engineering (IOSRJCE) Ihsan Rabbi ,Sehat UllahS,iffat Ullah Khan (July-Aug. 2012)

2.3.1 Introduction

Augmented Reality (AR) is a technology through which the view of real world environment is augmented by computer generated elements/objects. AR is related to a mediated reality, in which a view of reality is modified using a computer system. By contrast, virtual reality replaces the real world with a simulated one. In the Reality-Virtuality Continuum by Milgram et al (1994), augmented reality lies between the virtual world and real world.

This paper describes the systematic literature review (SLR) protocol which will be used to explore the challenges during tracking objects in the augmented reality system, the proposed solutions presented and their limitations. The goal of our research is to gain in depth understanding of challenges that faced during augmented reality tracking. Tracking and registration are the most critical issues for AR applications. The proper alignment of virtual objects to the real world environment is called registration.

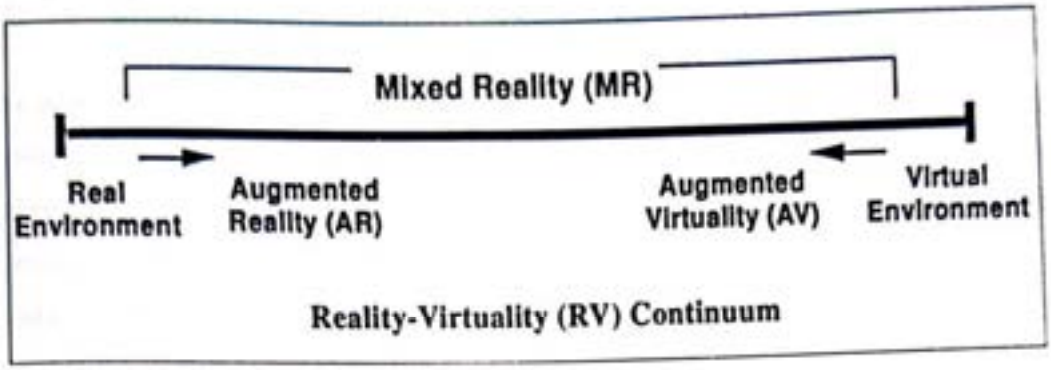


Figure 2.1 Simplified Representation of a Reality Virtuality Continuum

Tracking is the main issue for outdoor augmented reality applications. Calibration is another challenge for augmented reality system. Interaction Techniques and User Interfaces are problems for AR system that need to be addressed. Portability of AR system is also a challenge as a wearable system needs to be carried out a whole set of heavy equipment for a long time. The virtual objects and real world environment are required to be of same Illumination. Another issue is occlusion, that is a process to determine which surface or its parts are not visible from a certain view-point.

2.3.2 Objective

This research paper aims to perform a Systematic Literature Review (SLR) for the identification of challenges during tracking an object in augmented reality environment and how these challenges can be overcame.

2.3.3 Technology

STEP-A Use the Research Questions for the derivation of major terms, by identifying population, intervention and outcome.

STEP-B For these major terms, find the alternative spellings and synonyms.

STEP-C Verify the key words in any relevant paper.

STEP-D Use of Boolean Operators for conjunction if the database allows, in such a way, to use 'OR' operator for the concatenation of alternative spellings and synonyms whereas 'AND' for the concatenation of major terms.

2.3.4 Result

The expected outcomes of the review will be the identification of a list of challenges and its proposed solutions while tacking objects in augmented reality environment.

2.3.5 Conclusion

Tracking and registration are the most important issues for AR applications that need to be properly addressed. Various studies have shed light on the augmented reality tracking process. However, so far, no systematic literature review process has been conducted for the identification of challenges and limitations for augmented reality tracking process. We presented our study plan in the form of the SLR protocol. We have developed the SLR protocol and currently we are in the process of its implementation. The findings of this research will provide the challenges and limitations in augmented reality tracking techniques, which will be then addressed to provide a complete solution for tracking objects in augmented reality system.

2.3.6 Drawbacks

Privacy is loss.

High cost to implementation.

2.4 Navigation in augmented reality

Bivas Biswas, published by vocational education and training school in 2014, Retrieved September 2016

2.4.1 Introduction

A lot of the technology that we see today as normal has come from science fiction. Mobile handheld devices, such as smartphones and tablets, is one of those things that we use today in our everyday life that people only imagined before. Being able to see an edited world where the real and the virtual blends is another one of those ideas that has flourished in science fiction. Today it is real and it is called augmented reality

Augmented reality (AR) is described as a view of the real world modified by a computer. It is a subset of virtual reality (VR), but differs in the way that AR brings the virtual into the real world whilst VR substitutes it. This distinction between AR and VR gives the users

different experiences, whereas AR offers the user a greater sense of realism than VR does. The concept of augmented reality was first pioneered by Ivan Sutherland (1968), who developed a head-mounted 3D display, but the term was not coined until 1992 by Thomas Caudell and David Mizell (Caudell and Mizell, 1992).

Figure 2.2 The swords of Damocles

Even though the technology has been around for more than two decades it is still not out of its infancy. The Gartner's Hype cycle is a methodology which helps enterprises to decide on innovation investments by showing how mature technologies are (Gartner, 2014). As can be seen, augmented reality has passed its initial hype and is now in the state of maturing into a lasting technology. When a technology is in this state, only successful technologies will start to climb towards and finally emerge into the plateau of productivity. According to the cycle, AR is estimated to reach the plateau of productivity within five to ten years. There are a lot of possibilities offered by the AR technology that is being developed. The areas of use stretches from industry and military to medical use and computer games. The development and spread of smart phones and small handheld devices is continuously increasing and the research on AR technology have had to adapt and increase with it (Azuma et al., 2001). As with a lot of research in the area of computer science, and which has been pointed out by many usability researchers, most of the research done on AR is technology driven and the user experience tend to come in second place if considered at all (Ko et al., 2013).

2.4.2 Objective

An AR prototype was developed and tested against a standard map, in the form of Google Maps, both used on a smart phone. The experiments were performed using think aloud during the tests and questionnaires before and after to collect both quantitative and qualitative

data. The experiment was performed using possible users of AR as test subjects. The results were very similar for both applications but in favor of Google Maps.

2.4.3 Technology

By gathering user information, tests, as well as a post-test questionnaire a lot of different data were gathered to accommodate all the usability metrics needing an answer. Since the type of test were chosen at an early stage the findings from the literature study helped in choosing the SDK to use in making the prototype. By using a finished SDK the limitations on graphics and functionality, such as accurate GPS position, were already in place and the prototype had to be created around those limitations. When users became uncertain if they were doing the task right they would turn to me as a moderator for answers, which could influence the results. One potential problem that was identified before the tests through the survey study was that all the test subjects were already familiar with the Google maps application. This removed the learning factor for the application and might have had an unfair impact on the results.

2.4.4 Result

The most important results from the test sessions, both problems and benefits. Among these are the question on whether or not it is more useable with augmented reality, the lack of GPS accuracy and the choice of method and setting.

2.4.5 Conclusion

In this thesis an AR prototype was developed for navigational purposes and tested against Google Maps in an experimental study with the focus on the usability requirements learnability, When the prototype was evaluated the results showed that for navigation when walking, Google Maps might be more suitable as the world looks today with the technology at hand but for navigation when driving, an AR application will probably benefit the driver more than using a standardized map application such as Google Maps. When looking at the separate usability requirements the prototype performed as expected on learnability, whilst the usability requirement was negligible for Google Maps since all the test subjects had already used it. There were negligible differences in efficiency, there were some differences in effectivity that favoured Google Maps and lastly, Google Maps performed better in user satisfaction. Even though the prototype did not perform as well as hypothesized based on the literature review, the test gave indication on that there is a lot of future work that can be done in this field and

that the concept of augmented reality is highly current in the strive of bringing the virtual into our lives and in the concept of the technology adapting to the user and not the other way around.

2.4.6 Drawbacks

It lack of GPS accuracy and the choice of method and setting.

Query is not useable with augmented reality & Maintenance is low.

2.5 Indoor navigation using augmented reality

Nahush Narendra Bhanage Electrical Engineering and Computer Sciences University of California, Berkeley May 2014

2.5.1 Introduction

Indoor Positioning refers to locating objects or spaces inside a building. Global Positioning System (GPS) does not work accurately indoors due to signal attenuation and reflection caused by roofs and walls. Hence in most situations, GPS based location tracking does not produce useful results. As a result, most of the popular indoor positioning systems work on technologies such as Wi-Fi, Bluetooth, Radio beacons which are more accurate than GPS. Furthermore, accurate location determination of indoor spaces could have numerous interesting applications if integrated with augmented reality. Indoor navigation systems have started incorporating augmented reality techniques to visually help the user in navigating indoors. User experience is critical in indoor navigation systems. Maps can only be useful in tracking the location of a person or object whereas with augmented reality, a lot of relevant information can be displayed along with the location information.

There is a strong untapped potential in augmented reality techniques, with respect to indoor navigation. This is possible if his relative location in the museum is known. In this paper, we demonstrate how augmented reality can enhance the utility of indoor positioning systems. The Literature Review section gives an overview of the various technologies used in indoor positioning systems and the existing landscape (key players) in this market. It is followed by the Methodology section, which describes how we targeted a specific user scenario and the technologies we used to develop an augmented reality based prototype. We then discuss the user study results in the Results section. Finally, the Conclusion section summarizes the paper and briefly discusses possible future work in this area.

2.5.2 Objective

Indoor positioning systems help in the localization of objects or spaces inside a building, where Global Positioning System (GPS) and cellular network don't work effectively. It also describes our application development process, right from target user interviews to an interactive high-fidelity prototype development in Android. Localization is achieved by creating a location API simulator and using the orientation sensors in the phone/tablet.

2.5.3 Technology

We decided to develop an Android application (Augmented Lab) to demonstrate the usefulness of combining augmented reality with indoor positioning. We needed access to an existing indoor positioning API to accurately determine the smartphone's location and a 2D map of the indoor space.

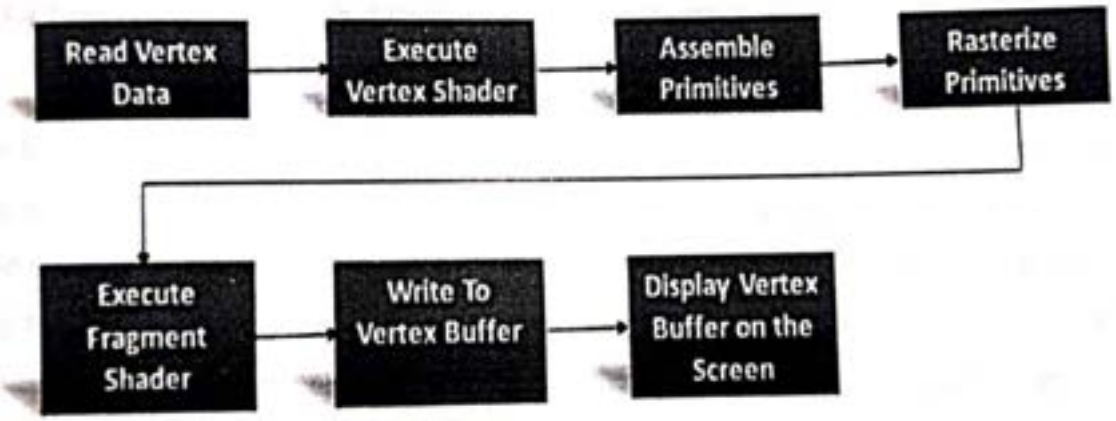


Figure 2.3 Block for navigation system

As such, our application could accommodate any in door position our industrial sponsor was Qualcomm Research Silicon Valley and we started working on this project hoping to use their indoor positioning platform.

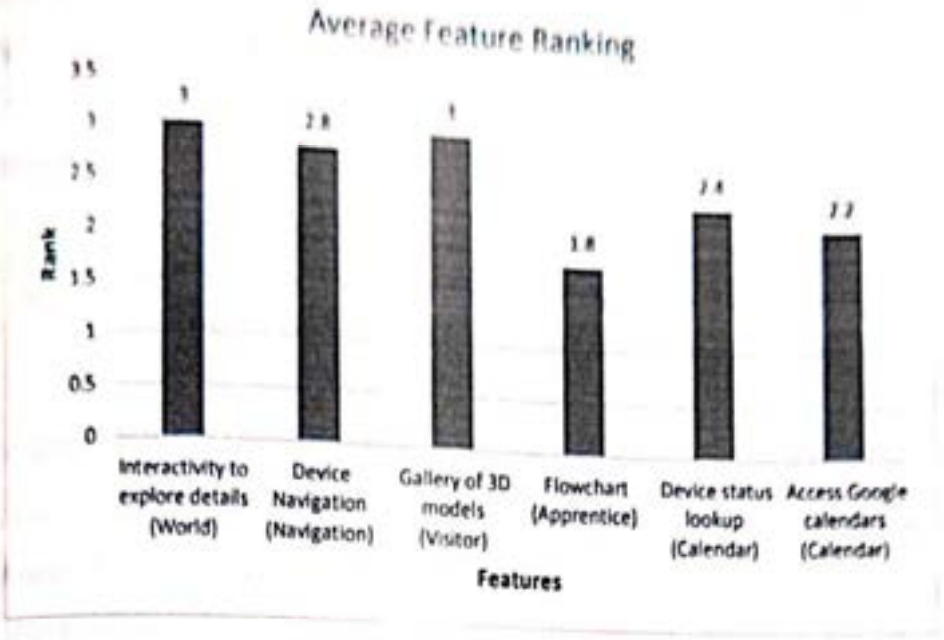


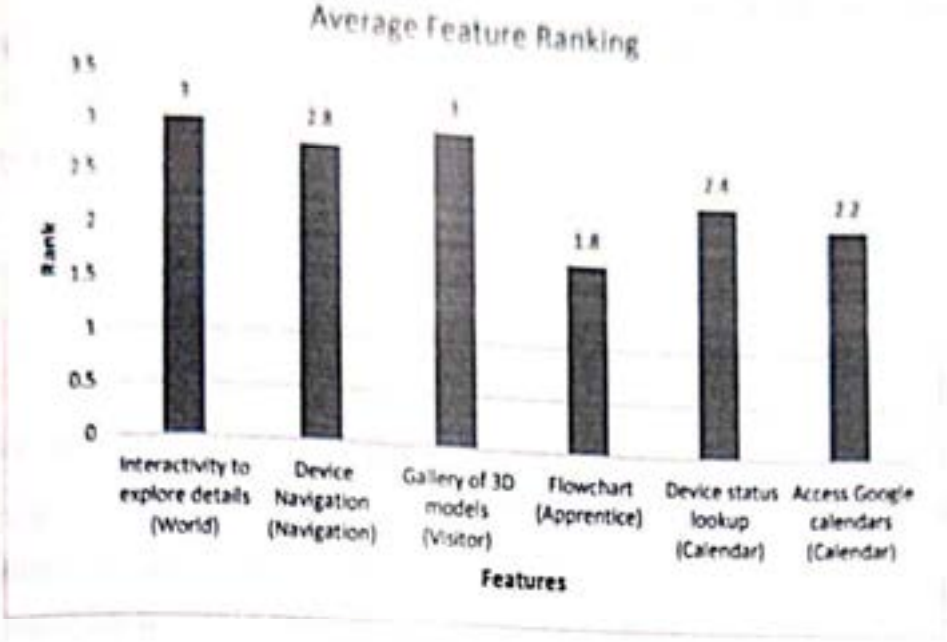
Figure 2.4 Average feature ranking

2.5.4 Result

We conducted another user study, this time for our interactive prototype. Ten users in the CITRIS Invention lab, UC Berkeley were randomly selected. The study was conducted on the affine 3D printer in the lab. The sample set consisted of lab administrators, undergraduate and graduate students who had some experience of working on Affine. They were asked to try out the different functionalities in our application and then answer some questions related to usability. The users were also asked if they would prefer using our application instead of the traditional instructions in the form of documents. As we can see from 80% of the users preferred using our application. The remaining 20% preferred documented instructions since they did not find our 'Apprentice' mode detailed enough. They suggested adding links to videos explaining how to use the tools.

2.5.5 Conclusion

Future work could include replacing our simulated location API with Qualcomm's indoor positioning system (IZat). At this point, localization in our approach is entirely based on the location API and orientation sensor readings. Integrating object detection in the current approach would make the localization extremely robust, giving an inch-level accuracy. As of now, once the device is detected (based on location and orientation) the 'Apprentice' mode



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shows static images that explains how to use that device. If we are able to implement a highly accurate object detection algorithm, then we can get rid of the static images in 'Apprentice' mode and render text and 3D arrows accurately pointing to different parts of the device.

2.5.6 Drawbacks

Finding the right provider and Maintenance is low.

No proper indoor positioning

2.6 Navigation Systems for Fastest Routes

International Journal of Pure and Applied Mathematics Special Issue , Varshit Ratna , Krishna Chythanya August 16, 2018

2.6.1 Introduction

Mobility is very important in our society. People live in one city and work in another. They go to visit friends and family living in different parts of the country. Even leisure time is not always spent in their residence. Despite the Dutch government's efforts to increase the use of public transportation, the car is still the most widely used means of transportation. Every time someone travels from one location to another (by car), he or she first determines the best route to reach the destination. Depending on the time of day and the day of the week, this route may be different. For example, the driver may know that a certain road is always congested at a particular time and day. As a consequence, he chooses to use a different route to avoid this congestion. Car navigation systems are being offered as a special feature of new cars of an increasing number of car-brands. These car navigation systems are capable of taking over some of the tasks that are performed by the driver such as reading the map and determining the best route to the destination. They should also take daily congestion patterns into account. Because a car navigation system uses a built-in computer to determine a route, it can compare many different routes and the user expects the system to determine the best possible, or optimum route fast. This thesis is concerned with route planning algorithms that enable a car navigation system to plan optimum routes on very large real-world road networks in very little time, taking daily congestion patterns into account.

2.6.2 Objective

This paper presents a route navigation system with a new revised shortest path routing algorithm for solving road traffic problems. The system can avoid selecting no left (right) turns, one-way roads, and congested roads when it determines the shortest paths from source to destination. Also, the new revised routing algorithm is compared numerically with existing algorithms such as the Dijkstra algorithm and the algorithm. We choose a road network containing 4000 nodes which have 200 no left turn situations and find in particular that the road traffic problem of a 4000-node traffic network can be solved within only 0.651 seconds on average. The prototype system was built and some extra functions were added so that its benefits not only offer the shortest path but also provide information and security services for drivers.

2.6.3 Technology

Car Navigation Systems Currently, an increasing number of consumers has gained interest in car navigation equipment. Car navigation is no longer a luxury that is only for the rich. A car navigation system is offered as one of the many extras or as an advertising stunt of more and more "middle-class" cars. In the future, car navigation equipment may become as normal as air-conditioning. Of course, also other vehicles can use car navigation, such as trucks, busses and motorcycles. A navigation system offers the driver the possibility to be guided to his destination, by means of spoken and/or visual advices. In order to achieve this, the driver first has to enter his destination into the system. Such a destination may be a city centre, an entire street, or an address including a house number.

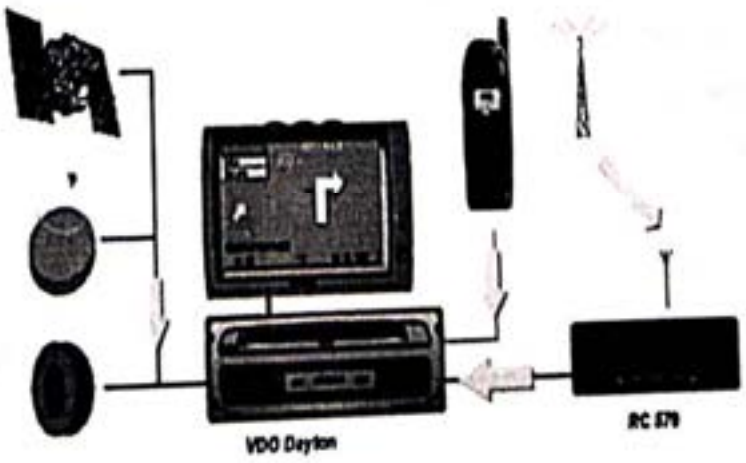


Figure 2.5 Working function of car navigation

The computer, which contains the CD or DVD player, and the screen for displaying the map and visual advice are shown in the middle. On the right, a GSM connection and TMC-RDS broadcasts used for receiving traffic information. . Information on every possible destination is contained in a database that is stored on a CD or DVD that has to be inserted into the car navigation system. Also data from external providers about interesting places such as hotels and restaurants for example is stored on the CD or DVD. The driver can ask for a list of all hotels in a certain area for example.

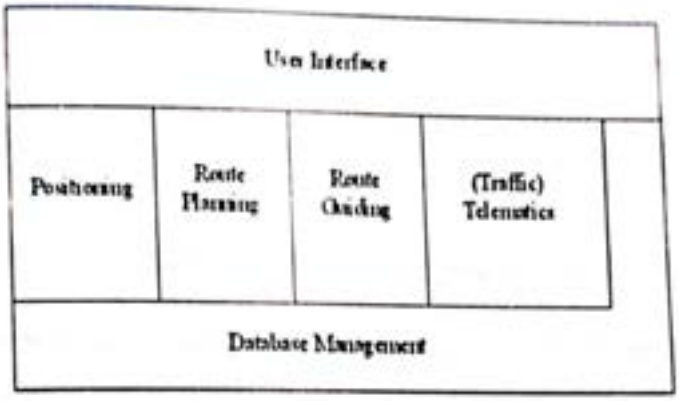


Figure 2.6 Block for navigation

First, we explain positioning. In order to determine the current location of the car on the road network, a car navigation system tries to determine the geographical position of the car. This is done by "dead reckoning" [Zhao, 1997], which is the calculation of the geographical position based on calibrated sensor information. In particular the driven distance from the tacho and the angular rate from the gyro are used to determine the position of the car. This position can be improved by using the GPS position and speed. Subsequently, this geographical position is matched to the available road network. This is done by computing the likelihood that the car is currently at a particular position on a certain road segment. The route presented to the driver is also used in this map matching process. A position on the current route is given a higher preference than other positions. If no position on the road network has a sufficiently high likelihood, the car is not positioned on any of the road segments of the road network, i.e. the car is "off map".

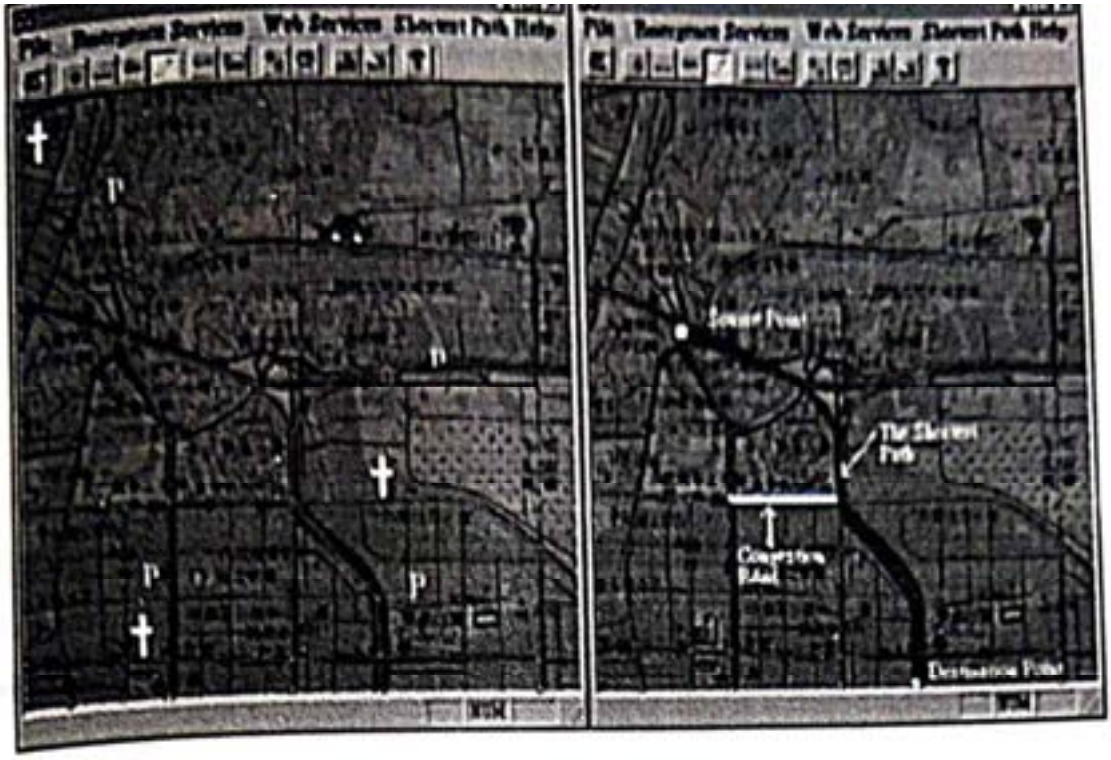
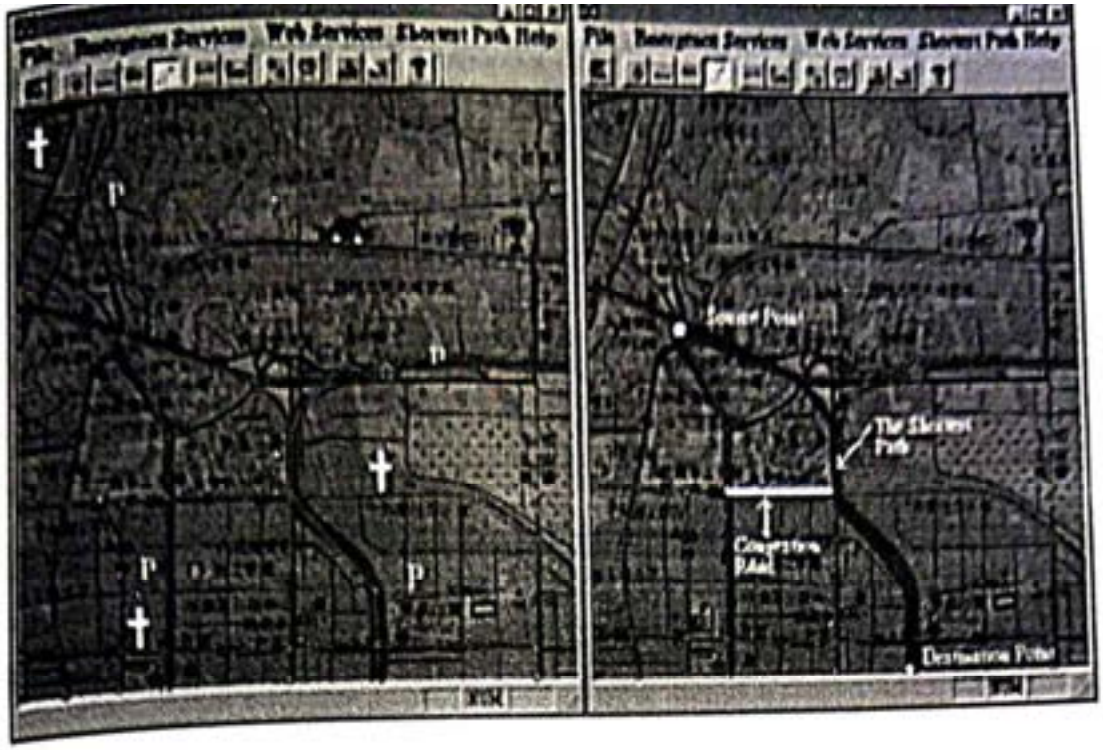


Figure 2.7 Determining fastest routing

Once the position of the car has been determined, a route can be planned from that car position to the destination. This route is planned using the available road network that is stored on a CD or DVD. The algorithm used for planning a route is (generally) based on Dijkstra's single source shortest path algorithm. To be able to determine a route fast, several approximations are used. For example, if the car position and destination are located sufficiently far apart, only important roads are used to determine the major part of the route. Furthermore, estimations of the remaining distance to the destination are used to speed up the planning process.

To calculate the efficiency of the new algorithm, we have implemented a Route Navigation System (RNS). The system was built by using the new revised routing algorithm. The RNS is developed on a PC-based portable computer. The speed of the Centre Process Unit is Pentium 1.7GHz. The size of its main memory is 256M RAM. Through a communication PCMCIA card, the application system is able to connect a server via the Internet and get some vital guidance information, for instance, the number of parking spaces in a parking lot, the number of beds in a hotel, etc. Meanwhile, a wireless Global Positioning System (GPS) receiver is installed on the system. Therefore, the RNS not only can provide the position of the car but also suggest the shortest path from source to destination. The system also can avoid congestion if some roads have heavy traffic because of accidents, rush hour, or road construction. Basically,



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in the experiment of performance evaluation, we adopt 4 kinds of algorithms (i.e., Dijkstra's algorithm, Dijkstra's algorithm, the algorithm, and the revised routing algorithm (i.e., Wen-Hsu's algorithm).

2.6.4 Result

Although this paper designs and analyses the RNS, there are still several aspects where we can further improve its functions. In particular, we can extend its functions to assist the RNS to have an automatic reasoning mechanism using a knowledge-based inference engine. In addition, the method of artificial neural networks for searching the best routes of which we had used in the past can also be added for helping make decisions. So, knowing how to build an efficient searching and learning mechanism for the RNS will be also a major research issue in the future.

2.6.5 Conclusion

This paper proposed a route navigation system with a new modified algorithm for solving the no left (right) turns, one-way roads, and congestion problems on road networks. For evaluating its performance, a prototype system, Route Navigation System (RNS), was built. The system physically proves the efficiency of the system architecture. In terms of the final results of the performance analysis, the system not only provides a good solution for solving road congestion problems but also responses much faster. We strongly believe the system with the new revised routing algorithm will play an important role in traffic navigation systems for users' guidance on road networks.

2.6.6 Drawbacks

Low GUI (graphical user interface)

Could not find very small remote area.

2.7 Navigation in Augmented Reality from Google Maps

IEEE Transactions on Human-Machine Systems PP(99):1-12 · November 2016 with 727 Reads DOI: 10.1109/THMS.2016.2620106

2.7.1 Introduction

Google Maps and Google Earth have had an enormous impact on the way people think, learn, and work with geographic information. With easy access to spatial and cultural

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information, Google Maps/Earth has provided users with the means to understand their world and their communities of interest. Moreover, the customizable map features and dynamic presentation tools found in Google Maps and Google Earth make each one an attractive option for someone wanting to teach geographic information or make customized maps. For academic researchers, Google Mapping applications are also appealing for their powerful ability to share and host projects, create customized KML (Keyhole Mark-up Language) files, and to easily communicate their own research findings in a geographic context. Recognizing their potential for revitalizing map collections and geographic education, the authors felt that many academic libraries were also going to be active in using Google Maps/Earth for a variety of purposes, from promoting their services to developing their own Google KML files for users. With Google Earth's ease of use and visualization capabilities, it was even thought that academic libraries would be using Google Earth heavily in instruction classes bringing geographic information to subject areas traditionally outside of geography.

The authors were interested in discovering how popular the Google mapping products are in the academic library setting. A survey was conducted to establish the mapping products' popularity, and type of use in an academic library setting. Results show that over 90 percent of the respondents use Google Earth and Google Maps either to help answer research questions, to create and access finding aids, for instructional purposes or for promotion and marketing. The authors recommend expanding the mapping products' user base to include all reference and liaison librarians.

2.7.2 Objective

Despite the ubiquity of Google for information searching, there was a surprising paucity of literature that documents the impact of Google Maps/Earth in academic libraries. Nevertheless, there are some articles which indicate just how much Google Maps can help raise the profile of library services. Terry Ballard, a librarian at Quinnipiac University, describes in a few articles how he and colleagues were able to use Google Earth place marks to promote his library's special collections.1 The potential for "Discovering the Library with Google Earth" is also a theme in an article by Brenner and Klein in which the Portland State University Library linked their urban planning documents collection to Google Earth for ease of searching.2 Although the focus is on public libraries, Michael Vandenberg documents how his library system began "using Google Maps as an interface for the library catalogue."

2.7.3 Technology

The first couple questions dealt with the department or area of the library in which the respondent worked in, and what their position encompassed. As expected, a large majority of respondents, 81 percent, worked in "Map/GIS Services" while 28.8 percent also had "General Reference" responsibilities. Other Library Service areas mentioned included "Data Services" and "IT," as well as some that fell outside library boundaries where staff worked in Geography and Environment Science Departments. Not surprisingly, 52 percent of the responses indicated that their position was "librarian," with the majority being "GIS librarian" or "map librarian." Others included "reference & instructional services librarian" and "science librarian." Also received were 17 responses from GIS specialists, library technicians and map assistants. What was especially noteworthy was that 12 responses were from library administrators, directors, or department heads who were finding time to work with Google Earth as part of their responsibilities. This number also included GIS coordinators and map curators responsible for making decisions in their departments.

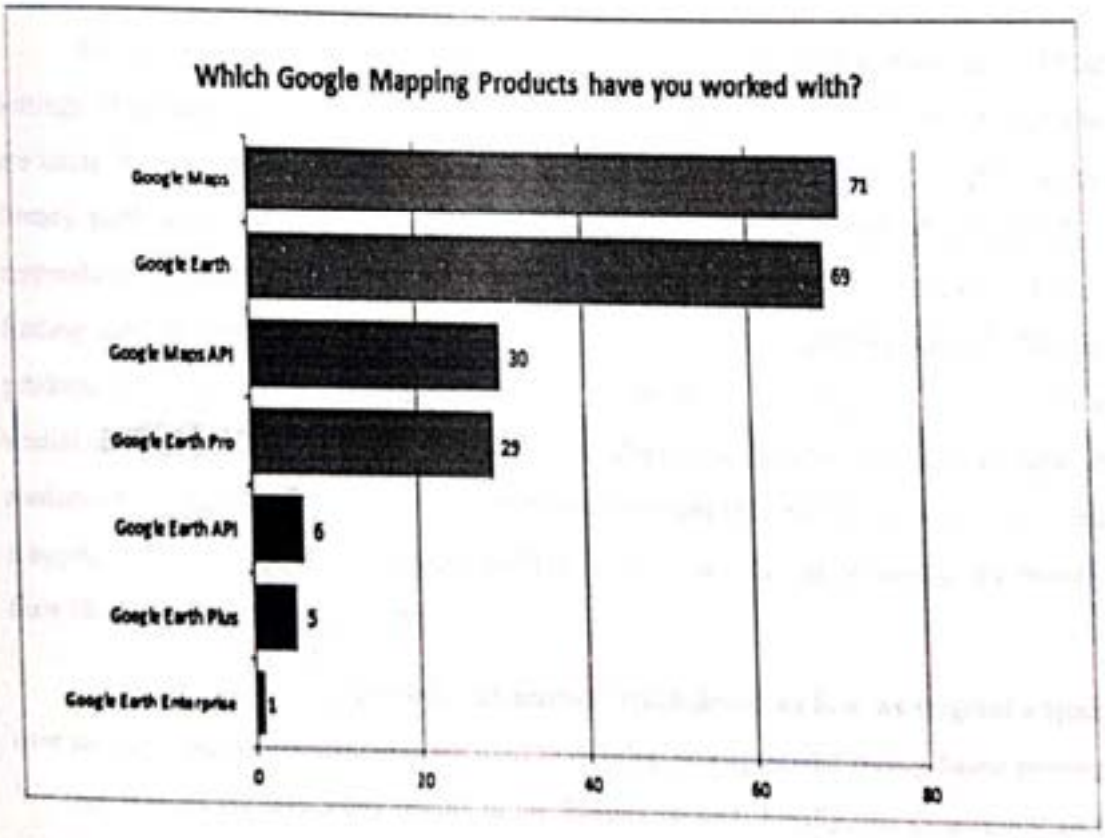

Figure 2.8 Respondents' Use of Google Mapping Products

In the last few years, KML files have become one of the more popular ways to display and distribute geographic information online. With its ease of use, and access, KML files have considerably broadened the user base of geographic information. KML files can be easily created in Google Earth, and they can be easily converted from GIS files in specialized programs. It is this ease of access and usability that has popularized geographic information, hence increasing exposure to library collections and services. This survey was therefore interested in determining how libraries are using and creating KML files.

2.7.4 Result

Although Google Maps and Google Earth are perhaps the most well-known online mapping tools available, the authors were also interested to learn if there were other products that libraries were using as part of their service offerings. As expected many mentioned Esri's ArcGIS online and Esri's Arc Explorer, while other responses included Bing Maps, Open Street Map, and Open Layers.

2.7.5 Conclusion

Google mapping applications are clearly being used for academic purposes in library settings. With such diverse capabilities made available in these programs, library professionals are using them in several different ways. Google Earth and Google Maps are popular among library staff who work with GIS and/or map collections. In fact, over 90 percent of the respondents use both products, either to help answer research questions, to create and access finding aids, for instructional purposes or for promotion and marketing. Google Mapping products have also helped libraries revitalize their collections as well as assist in transferring spatial information literacy skills to academic students and faculty. The authors hope that readers who work in a Map/GIS library setting will be inspired by the many examples of online mapping projects outlined in this paper and they will too use the online tools to the benefit of their library and their library users.

It is followed by the Methodology section, which describes how we targeted a specific user scenario and the technologies we used to develop an augmented reality based prototype. We then discuss the user study results in the Results section. Finally, the Conclusion section summarizes the paper and briefly discusses possible future work in this area. Google mapping products offer libraries an online platform to share information, and resources in an easy, accessible and low-cost way.

2.7.6 Drawbacks

It requires high-powered mobile devices.

Maintenance is low.

2.8 Summary of the Literature Review

The summary of the literature review is given by (**Table 2.1**) contains the of the paper. Techniques and its drawback

S.NO	TITLE	TECHNOLOGY	DRAWBACKS
1.	Location-Based Map Services	Augmented and virtual reality Global positioning system(GPS)	Position of the object decides the output Lack of privacy Expensive to develop and maintain
2.	Review And Analysis of Augmented Reality	Augmented reality technology	Lack of privacy Expensive to download and maintain
3.	Augmented Reality Tracking Techniques	Systematic Literature Review (SLR) for Augmented Reality Techniques (ARTT), is used it is based on a structured protocol, and is therefore, different from other methods SLR	Privacy is lost Dangers of Reality Modification

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		protocol is used in the process of its implementation.	
4.	Navigation In Augmented Reality	The main method was group design and the experiment consisted of three stages, the initial survey study, the prototype testing and the post-experiment questionnaire.	Lack of GPS accuracy and the choice of method and setting. Query is not useable with augmented reality.
5.	Indoor Navigation Using Augmented Reality	Augmented reality with indoor positioning. Smartphone's location and a 2D map of the indoor space	Finding the right provider Maintenance is low No proper indoor positioning

6.	Navigation Systems For Fastest Route	Android studio Cloud storage Navigation tracer GPS	Low GUI(graphical user interface) Could not find very small remote area.
7.	Navigation in augmented reality from google maps	Localization Tracking Relocalization User Experience	It requires high-powered mobile devices.

CHAPTER 3

THEORETICAL BACKGROUND

3.1 Abstract

This project is based on augmented reality, a method which is better than any other maps. When compared to other maps, it gives graphics and contains more information about a particular place. This application requires a mobile camera and when we scan the name board of the particular area, it gives immediate information about that place. This project is done by using "UNITY" application.

3.2 Introduction

Augmented Reality (AR) is a new technology that involves the overlay of computer graphics on the real world. One of the best overviews of the technology is, that defined the field, described many problems, and summarized the developments up to that point. That paper provides a starting point for anyone interested in researching or using Augmented Reality.AR is within a more general context termed Mixed Reality, which refers to a multi-axis spectrum of areas that cover Virtual Reality (VR), AR, telepresence, and other related technologies. Virtual Reality is a term used for computer-generated 3D environments that allow the user to enter and interact with synthetic environments. The users are able to "immerse" themselves to varying degrees in the computers artificial world which may either be a simulation of some form of reality or the simulation of a complex phenomenon .AR example with virtual chairs and a virtual lamp. In telepresence, the fundamental purpose is to extend operator's sensory-motor facilities and problem solving abilities to a remote environment. In this sense, telepresence can be defined as a human/machine system in which the human operator receives sufficient information about the tele operator and the task environment, displayed in a sufficiently natural way, that the operator feels physically present at the remote site. Very similar to virtual reality, in which we aim to achieve the illusion of presence within a computer simulation, telepresence aims to achieve the illusion of presence at a remote location. AR can be considered a technology between VR and telepresence. While in VR the environment is completely synthetic and in telepresence it is completely real, in

AR the use sees the real world augmented with virtual objects. When designing an AR system, three aspects must be in mind: Combination of real and virtual worlds; Interactivity in real time; Registration in 3D.Wearable devices, like Head-Mounted-Displays (HMD), could be used to show the augmented scene, but other technologies are also available .Besides the mentioned three aspects, another one could be incorporated: Portability. In almost all virtual environment systems, the user is not allowed to go around much due to devices limitations. However, some AR applications will need that the user really walks through a large environment. Thus, portability becomes an important issue.

3.3 Materials and Methods

3.3.1 Depth Matching for Targeting

We determined a task for evaluation of BARS that was appropriate for operational use by dismounted warfighters. For BARS-ET, however, we need a slightly different task. The task for BARS was to judge depth of occluded objects through virtual representations. This is a physically unrealistic scenario, which is inappropriate for training. For BARS-ET, we need to modify the task to test perception of depth of virtual representations of objects that would be physically visible if they were real. This is important because an envisioned task for BARS-ET users is that of a forward observer, who call coordinates for indirect fire on a target. The forward observer thus maintains line-of sight contact with the target, and determines the direction and distance from his location to the target. Results from our pilot test that users were reasonably accurate at matching distances, but got poorer with increasing distance to the real object. One training scenario has the forward observer look at a miniature world of about 60 m; our hallway scene measured about 45 m to the most distant referent, with referents roughly equip-spaced along the usable length of the hallway. Four users (normal or corrected-to-normal) manipulated the virtual target's depth in the hallway with a trackball that was restricted to one degree of freedom in software. Linear perspective, provided by the walls and apparent size of the referents and virtual target, was the most powerful depth cue available. The virtual target also became more transparent as the user moved it further away ($\alpha \in [0.7, 0.3]$, near too far). The next step for this particular task is to design a study that can measure the effectiveness of the training with the virtual targets. As noted, virtual targets enable capabilities that are difficult to attain with current targets, such as mobility and variety of scenarios.

But because the nature of the depth perception task is not yet fully understood, we investigate the perceptual effects of this type of training.

3.4 Working model for AR

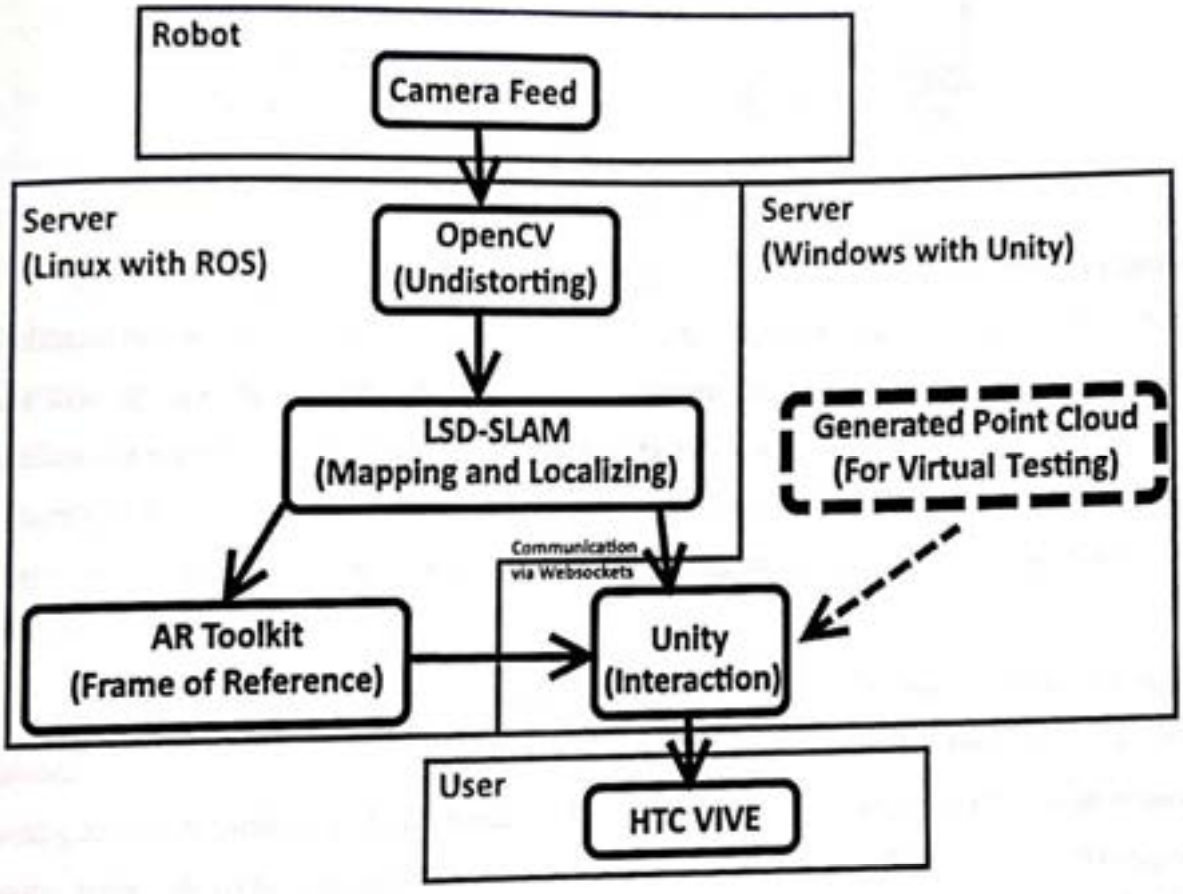

Figure 3.1 Block diagram for AR

3.5 Hardware

3.5.1 Display

Various technologies are used in augmented reality rendering, including optical projection systems, monitors, handheld devices, and display systems, which are worn on the human body.

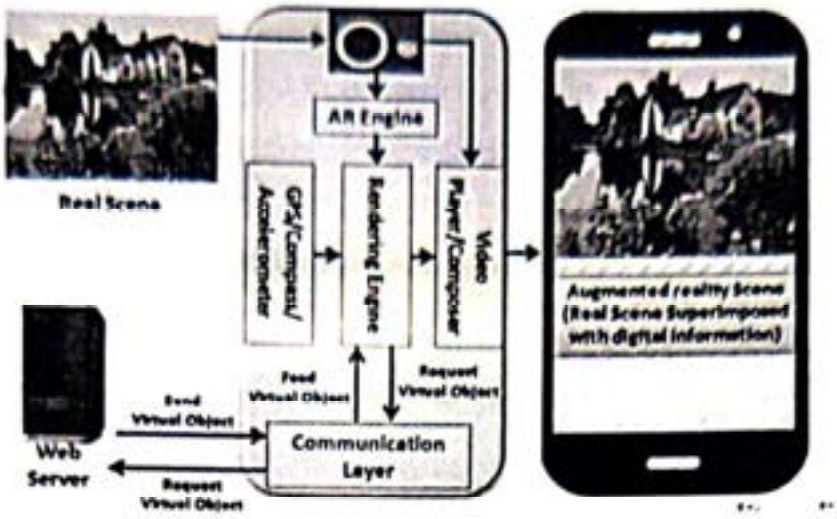

Figure 3.2 Function of AR

A head-mounted display (HMD) is a display device worn on the forehead, such as a harness or helmet-mounted. HMDs place images of both the physical world and virtual objects over the user's field of view. Modern HMDs often employ sensors for six degrees of freedom monitoring that allow the system to align virtual information to the physical world and adjust accordingly with the user's head movements. HMDs can provide VR users with mobile and collaborative experiences. Specific providers, such as uses and Gestigon, include gesture controls for full virtual immersion.

In January 2015, Meta launched a project led by Horizons Ventures, Tim Draper, Alexis Ohanian, BOE Optoelectronics and Garry Tan. On 17 February 2016, Meta announced their second-generation product at TED, Meta 2. The Meta 2 head-mounted display headset uses a sensory array for hand interactions and positional tracking, visual field view of 90 degrees (diagonal), and resolution display of 2560 x 1440 (20 pixels per degree), which is considered the largest field of view (FOV) currently available.

3.5.2 Eye classes

AR displays can be rendered on devices resembling eyeglasses. Versions include eyewear that employs cameras to intercept the real world view and re-display its augmented view through the eyepieces and devices in which the AR imagery is projected through or reflected off the surfaces of the eyewear lens pieces.

3.5.3 Contact lenses

Contact lenses that display AR imaging are in development. These bionic contact lenses might contain the elements for display embedded into the lens including integrated circuitry, LEDs and an antenna for wireless communication. The first contact lens display was reported in 1999, then 11 years later in 2010-2011. Another version of contact lenses, in development for the U.S. military, is designed to function with AR spectacles, allowing soldiers to focus on close-to-the-eye AR images on the spectacles and distant real world objects at the same time.

Many scientists have been working on contact lenses capable of different technological feats. A patent filed by Samsung describes an AR contact lens, that, when finished, will include a built-in camera on the lens itself. The design is intended to control its interface by blinking an eye. It is also intended to be linked with the user's smartphone to review footage, and control it separately. When successful, the lens would feature a camera, or sensor inside of it. It is said that it could be anything from a light sensor, to a temperature sensor.

In Augmented Reality, the distinction is made between two distinct modes of tracking, known as marker and marker less. Markers are visual cues which trigger the display of the virtual information. A piece of paper with some distinct geometries can be used. The camera recognizes the geometries by identifying specific points in the drawing. Marker less tracking, also called instant tracking, does not use markers. Instead, the user positions the object in the camera view preferably in a horizontal plane. It uses sensors in mobile devices to accurately detect the real-world environment, such as the locations of walls and points of intersection.

3.5.4 Virtual retinal display

A virtual retinal display (VRD) is a personal display device under development at the University of Washington's Human Interface Technology Laboratory under Dr.Thomas A. Furness III. With this technology, a display is scanned directly onto the retina of a viewer's eye. This results in bright images with high resolution and high contrast. The viewer sees what appears to be a conventional display floating in space.

Several of tests were done to analyse the safety of the VRD. In one test, patients with partial loss of vision having either macular degeneration (a disease that degenerates the retina)

or keratoconus were selected to view images using the technology. In the macular degeneration group, five out of eight subjects preferred the VRD images to the cathode-ray tube (CRT) or paper images and thought they were better and brighter and were able to see equal or better resolution levels. The Keratoconus patients could all resolve smaller lines in several line tests using the VDR as opposed to their own correction. They also found the VDR images to be easier to view and sharper. As a result of these several tests, virtual retinal display is considered safe technology.

Figure 3.3 Scanning process

Virtual retinal display creates images that can be seen in ambient daylight and ambient room light. The VRD is considered a preferred candidate to use in a surgical display due to its combination of high resolution and high contrast and brightness. Additional tests show high potential for VRD to be used as a display technology for patients that have low vision.

3.5.5 Spatial

Spatial augmented reality (SAR) augments real-world objects and scenes, without the use of special displays such as monitors, head-mounted displays or hand-held devices. SAR makes use of digital projectors to display graphical information onto physical objects. The key difference in SAR is that the display is separated from the users of the system. Since the displays are not associated with each user, SAR scales naturally up to groups of users, allowing for collocated collaboration between users.

Examples include shade lamps, mobile projectors, virtual tables, and smart projectors. Shade lamps mimic and augment reality by projecting imagery onto neutral objects. This provides

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Examples include shade lamps, mobile projectors, virtual tables, and smart projectors. Shade lamps mimic and augment reality by projecting imagery onto neutral objects. This provides

the opportunity to enhance the object's appearance with materials of a simple unit—a projector, camera, and sensor.

Other applications include table and wall projections. One innovation, the Extended Virtual Table, separates the virtual from the real by including beam-splitter mirrors attached to the ceiling at an adjustable angle. Virtual showcases, which employ beam splitter mirrors together with multiple graphics displays, provide an interactive means of simultaneously engaging with the virtual and the real. Many more implementations and configurations make spatial augmented reality display an increasingly attractive interactive alternative.

A SAR system can display on any number of surfaces in an indoor setting at once. SAR supports both a graphical visualization and passive haptic sensation for the end users. Users are able to touch physical objects in a process that provides passive haptic sensation.

3.5.6 Tracking

Modern mobile augmented-reality systems use one or more of the following motion tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, Radio-frequency identification (RFID). These technologies offer varying levels of accuracy and precision. The most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.

3.5.7 Networking

Mobile augmented reality applications are gaining popularity because of the wide adoption of mobile and especially wearable devices. However, they often rely on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is often desired. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there are a plethora of real-time multimedia transport protocols, there is a need for support from network infrastructure as well.

3.5.8 Input devices

Techniques include speech recognition systems that translate a user's spoken words into computer instructions, and gesture recognition systems that interpret a user's body movements by visual detection or from sensors embedded in a peripheral device such as a wand, stylus, pointer, glove or other body wear. Products which are trying to serve as a controller of AR headsets include Wave by See bright Inc. and Nimble by Intugine Technologies.

3.6 Software and algorithms

A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent of camera, and camera images. That process is called image registration, and uses different methods of computer vision, mostly related to video tracking. Many computer vision methods of augmented reality are inherited from visual odometer.

Usually those methods consist of two parts. The first stage is to detect interest points, fiducial markers or optical flow in the camera images. This step can use feature detection methods like corner detection, blob detection, edge detection or thresholding, and other image processing methods. The second stage restores a real world coordinate system from the data obtained in the first stage. Some methods assume objects with known geometry (or fiducial markers) are present in the scene. In some of those cases the scene 3D structure should be calculated beforehand. If part of the scene is unknown simultaneous localization and mapping (SLAM) can map relative positions. If no information about scene geometry is available, structure from motion methods like bundle adjustment are used. Mathematical methods used in the second stage include: projective (epipolar),geometry, geometricalgebra, rotationrepresentation with exponentia lmap, kalman and particle filters, nonlinear optimization, robust statistics.

3.6.1 Development

The implementation of augmented reality in consumer products requires considering the design of the applications and the related constraints of the technology platform. Since AR systems rely heavily on the immersion of the user and the interaction between the user and the system, design can facilitate the adoption of virtuality. For most augmented reality systems, a similar design

guideline can be followed. The following lists some considerations for designing augmented reality applications.

3.6.2 Interaction design

Interaction design in augmented reality technology centres on the user's engagement with the end product to improve the overall user experience and enjoyment. The purpose of interaction design is to avoid alienating or confusing the user by organizing the information presented. Since user interaction relies on the user's input, designers must make system controls easier to understand and accessible. A common technique to improve usability for augmented reality applications is by discovering the frequently accessed areas in the devices touch display and design the application to match those areas of control. It is also important to structure the user journey maps and the flow of information presented which reduce the system's overall cognitive load and greatly improves the learning curve of the application.

In interaction design, it is important for developers to utilize augmented reality technology that complement the system's function or purpose. For instance, the utilization of exciting AR filters and the design of the unique sharing platform in Snapchat enables users to better the user's social interactions. In other applications that require users to understand the focus and intent, designers can employ a reticule or ray cast from the device. Moreover, augmented reality developers may find it appropriate to have digital elements scale or react to the direction of the camera and the context of objects that can are detected.

Augmented reality technology allows to utilize the introduction of 3D space. This means that a user can potentially access multiple copies of 2D interfaces within a single AR application.

3.6.3 Visual design

In general, visual design is the appearance of the developing application that engages the user. To improve the graphic interface elements and user interaction, developers may use visual cues to inform the user what elements of UI are designed to interact with and how to interact with them. Since navigating in an AR application may appear difficult and seem frustrating, visual cue design can make interactions seem more natural.

In some augmented reality applications that use a 2D device as an interactive surface, the 2D control environment does not translate well in 3D space making users hesitant to explore their surroundings. To solve this issue, designers should apply visual cues to assist and encourage users to explore their surroundings.

It is important to note the two main objects in AR when developing VR applications: 3D volumetric objects that are manipulated and realistically interact with light and shadow; and an animated media imagery such as images and videos which are mostly traditional 2D media rendered in a new context for augmented reality. When virtual objects are projected onto a real environment, it is challenging for augmented reality application designers to ensure a perfectly seamless integration relative to the real-world environment, especially with 2D objects. As such, designers can add weight to objects, use depths maps, and choose different material properties that highlight the object's presence in the real world. Another visual design that can be applied is using different lighting techniques or casting shadows to improve overall depth judgment. For instance, a common lighting technique is simply placing a light source overhead at the 12 o'clock position, to create shadows on virtual objects.

3.7 Results and Discussion

The summaries give a brief explanation of the research conducted within each resource. This provides a basic understanding of the reasoning behind the categorization of each resource both for the type of technology used as well as the design process stage(s).

In this thesis an AR prototype was developed for navigational purposes and tested against Google Maps in an experimental study with the focus on the usability requirements learnability. When the prototype was evaluated the results showed that for navigation when walking, Google Maps might be more suitable as the world looks today with the technology at hand but for navigation when driving, an AR application will probably benefit the driver more than using a standardized map application such as Google Maps. When looking at the separate usability requirements the prototype performed as expected on learnability, whilst the usability requirement was negligible for Google Maps since all the test subjects had already used it. There were negligible differences in efficiency, there were some differences in effectivity that favored Google Maps and lastly, Google Maps performed better in user satisfaction. Even though the prototype did not

perform as well as hypothesized based on the literature review, the test gave indication on that there is a lot of future work that can be done in this field and that the concept of augmented reality is highly current in the strive of bringing the virtual into our lives and in the concept of the technology adapting to the user and not the other way around.

3.8 Conclusion

At every new inflection in communication technology, the marketing and advertising community brought their existing models with them in their first efforts to adapt to the new medium. Radio, television, Internet, Web, and Mobile have all seen this progression play out and VR and AR will likely follow that model too Augmented Reality is a technology that has changed the face of smartphone apps and gaming. AR adds digital images and data to amplify views of the real world, giving users more information about their environments. This step is beyond virtual reality, which attempts to simulate reality. AR apps are growing at a tremendous speed as they give businesses a different edge which attracts the customers.

3.8 Applications

From gaming and entertainment to medicine, education and business.

CHAPTER 4

SYSTEM SPECIFICATIONS

4.1 Software Requirements

Unity

Visual Studio

Android Studio

Vitoria Developer Portal

Camera

Photon Engine

AR Core platform

Mobile Phone

4.2 Hardware Requirement

Personal computer

4.3 Introduction of Unity Software

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. As of 2018, the engine had been extended to support more than 25 platforms. The engine can be used to create three-dimensional, two-dimensional, virtual reality, and augmented reality games, as well as simulations and other experiences. Unity is a cross platform game engine developed by unity technologies first announced and released in June 2005 at Apple in worldwide developers .The engine is used to create 3D and 2D virtual reality and augmented reality games as well as simulation and other experiences. The engine has been adopted by industries such as film automotive, architecture, engineering and construction.

4.4 The Android Platform

The android platform allows developers to write managed code using java to manage and to control the android devices. Android studio is a popular IDE developed by goggle for developing applications that are targeted to the android platform.

Visual Studio

Its main purpose is to provide the ecosystem and languages support. It is commercial ion of visual studio. It comes in visual studio in 2010 and later version.

The application is split into two main parts: a tutorial section with an interactive 3D odel of the ventricular system and an educational animation on CSF flow; and a test-your-owledge area with a labelling challenge and multiple choice quiz at different difficulty levels, owing the user to test themselves on what they have learned in the tutorial section. The mmaries give a brief explanation of the research conducted within each resource.

Working Methods

Unity is a cross-platform game engine with a built-in IDE developed by Unity chnologies. It is used to develop video games for web plugins, desktop platforms, consoles nd mobile devices.

(1) A **game engine**, that allows game created to run (hence to be played) in different nvironments,

2) An application where the "visible pieces" of a game can be put together (the ***IDE***) with a raphical preview and using a controlled "play it" function, and

(3) a **code editor** (the one provided is Mono Develop, but developers can use others; yes I know that code writing is usually classified as part of the IDE, but for the sake of clarity of what follows, let's keep it as a separate piece).

So once you have the game design and all the required skills you can put together graphics, sounds, animations in Unity's IDE, write in the editor the code associated to the assets and then generate a playable application that runs in several different environments, as one of the features of Unity is that it is multi-platform, that is more or less the same game can run similarly on an iPad or on Windows.

The process I just outlined is intrinsically quite complicated – videogames are complex structures. Unity provides a complete workflow and a lot of help along the line, and a large set of features come in Unity's free version (see below). But IDE for games have been around for quite a while. This provides a basic understanding of the reasoning behind the categorization of each resource both for the type of technology used as well as the design process stage(s).

Figure 4.1 Overview in unity process

The application is split into two main parts: a tutorial section with an interactive 3D model of the ventricular system and an educational animation on CSF flow; and a test-your-knowledge area with a labelling challenge and multiple choice quiz at different difficulty levels, allowing the user to test themselves on what they have learned in the tutorial section. The summaries give a brief explanation of the research conducted within each resource.

4.7 Conclusion

Unity gives users the ability to create games and experiences in both 2D and 3D, and the engine offers a primary scripting API in C#, for both the Unity editor in the form of plugins, and games themselves, as well as drag and drop functionality. Within 2D games, Unity allows importation of sprites and an advanced 2D world renderer. For 3D games, Unity allows specification of texture compression, mini maps, and resolution settings for each platform that the game engine supports. Unity has been used to create approximately half of the new mobile games on the market and 60 percent of augmented reality and virtual reality content.

CHAPTER 5

WORK TO BE DONE IN PHASE –II

Our project aim is to develop an android development application for navigation map using unity software. In phase I we have learned the basics of Unity software and we have given the procedure, block diagram, how to develop an app using UNITY software. In phase II we will be develop the application for navigation map using software in augmented reality.

REFERENCES

[1] Charles "The Lengthy History of Augmented Reality". Huffington Post. 15 May 2016.

[2] Chen, Brian "If You're Not Seeing Data, You're Not Seeing". Wired. Retrieved 18 June 2019.

[3] Crabben, Jan van der "Why We Need More Tech in History Education". ancient.eu. Retrieved 23 October2018.

[4] Dupzyk, Kevin,"I Saw the Future through Microsoft's Hololens". Popular Mechanics in (6 September 2016).

[5] Geoffrey Milton "How to Transform Your Classroom with Augmented Reality - EdSurge News". 2 November 2015.

[6] Harold Taylor Introducing Virtual Environments Archived at the Way back Machine National Centre for Supercomputing Applications, University of Illinois in 21 April 2016.

[7] Rosenberg, L.B. "The Use of Virtual Fixtures as Perceptual Overlays to Enhance Operator Performance in Remote Environments". Technical Report AL-TR-0089, USAF Armstrong Laboratory, Wright-Patterson AFB OH, 1992.

[8] Rosenberg,L.B,"Virtual Fixtures: Perceptual Overlays for Tele robotic Manipulation". Proceedings of IEEE Virtual Reality Annual International Symposium. pp. 76–82. doi:10.1109/VRAIS.1993.380795. ISBN 978-0-7803-1363-7 in 1993.

[9] Schueffel, Patrick. The Concise Fintech Compendium. Fribourg: School of Management Fribourg/Switzerland in 2017.

[10] Steuer,"Archived copy" (PDF). Archived from the original (PDF) on 24 May 2016. Retrieved 27 November 2018. , Department of Communication, Stanford University. 15 October 1993.

A CYBER PHYSICAL SYSTEM FOR ENVIRONMENTAL MONITORING ON IOT

A PROJECT PHASE-I REPORT

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ABSTRACT

In our project, we introduce the creation of a cyber-physical system that controls environmental circumstances or environmental conditions in distant places in indoor areas. Communication between the parts of the system is carried out using the existing wireless infrastructure based on IEEE standards of 802.11 b / g. The resulting solution provides the opportunity to log measurements from locations around the world and to visualize and analyze the data collected from any device connected to the Internet. This work includes the full solution, a cyber-physical system beginning from the physical stage, composed of sensors and communication protocol, and achieving cyber-level data management and storage. The experimental findings indicate that the suggested scheme for environmental and ambient tracking apps is a feasible and simple solution.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATIONS
ARM	Advanced RISC Machines
API	Application programming interfaces
ADC	Analog-to-digital converter
CoAP	Constrained Application Protocol
CDMA	Code-division multiple access
CPS	Cyber-Physical system
CO_2	Carbon Dioxide
EMS	Environment monitoring system
GPRS	General packet radio service
GSM	Global System for mobile communication
HTTP	Hypertext preprocessor
IOT	Internet Of Things
IP	Internet protocol
IDE	Integrated development environment
LCD	Liquid Crystal Display
LDR	Light Dependent Resistors
MQTT	Message Queue Telemetry Transport
PHP	Hypertext Transfer Protocol
PIR	Passive infrared sensor

UDP	User Datagram Protocol
UAV	Unmanned Aerial Vehicle
WSN	Wireless Sensor Network

CHAPTER 1

INTRODUCTION

1.1 Introduction

A sensor is able to convert physical or chemical readings gathered from the environment into signals that can be calculated by a system. A multi sensor node is able to sense several magnitudes in the same device. In a multi sensor, the input variables might be temperature (it is also able to capture nippy changes of temperature), fire, infrared radiation, humidity, smoke and CO_2.

A wireless sensor network could be a useful architecture for the deployment of the sensors used for fire detection and verification. The most vital factors for the quality and productivity of plant growth are temperature, humidity, light and the level of the carbon dioxide. Constant monitoring of these environmental variables gives information to the farmer to better understand, how each factor affects growth and how to manage maximal crop productiveness.

The optimal greenhouse climate adjustment can facilitate us to advance productivity and to achieve remarkable energy saving, particularly during the winter in northern countries. In the past generation greenhouses it was enough to have one cabled measurement point in the middle to offer the information to the greenhouse automation system.

The system itself was typically simple without opportunities to manage locally heating, lights, ventilation or some other activity, which was affecting the greenhouse interior climate. The typical size of the greenhouse itself is much larger than it was before, and the greenhouse facilities provide several options to make local adjustments to the light, ventilation and other greenhouse support systems. However, additional measurement data is also needed to construct this kind of automation system to work properly. Increased number of measurement points must not dramatically augment the automation system cost. It should also be possible to easily alter the location of the measurement points according to the particular needs, which depend on the specific plant, on the possible changes in the external weather or greenhouse structure and on the

plant placement in the greenhouse. Wireless sensor network can form a useful part of the automation system architecture in modern greenhouses constructively. Wireless communication can be used to collect the measurements and to communicate between the centralized control and the actuators located to the different parts of the greenhouse. In advanced WSN solutions, some parts of the control system itself can also be implemented in a distributed manner to the network such that local control loops can be formed. Compared to the cabled systems, the installation of WSN is fast, cheap and easy. Moreover, it is easy to relocate the measurement points when needed by just moving sensor nodes from one location to another within a communication range of the coordinator device.

If the greenhouse vegetation is high and dense, the small and light weight nodes can even be hanged up to the plants' branches. WSN maintenance is also relatively cheap and easy. The only additional costs occur when the sensor nodes run out of batteries and the batteries need to be charged or replaced, but the lifespan of the battery can be several years if an efficient power saving algorithm is applied. In this work, the very first steps towards the wireless greenhouse automation system by building a wireless measuring system for that purpose is taken and by testing its feasibility and reliability with a simple experimental setup. Clustering may be centralized or distributed, based on the arrangement of CH. In centralized clustering, the CH is preset but in distributed clustering CH has no fixed architecture. Distributed clustering mechanism is used for some private reasons like sensor nodes prone to failure, better collection of data and minimizing redundant information. Hence these distributed clustering mechanisms encompass highly self-organizing capability.

CHAPTER 2

LITERATURE SURVEY

2.1 A Cyber-Physical System for Environmental Monitoring on WSN

National Institute of Standards and Technology Special Publication 1900-202

Nat. Inst. Stand. Technol. Spec. Publ. 1900-202, 61 Pages (March 2006)

2.1.1 Introduction

The vitality from claiming natural screening will be undoubted for our age. This will be the field the piace remote sensor networks (WSNs) need been initial used, their basic role comprising in the perception of the physical reality and the recording of physical amounts characterizing it. The constant attempts of social and economic bodies for the improvement of technologies to develop energy efficiency and to pollution and for the more efficient use of national infrastructure along with the needs of decreasing the reduce cost of computation, networking, and sensing had led to the emergence of a new era of advanced systems, called cyber-physical systems (CPSs), less than a decade ago.

These include embedded systems, sensor networks, actuators, communication and management processes, and services to collect physical information and to work on the physical environment, all integrated under an intelligent decision system. This paper presents a system for environmental and ambient parameter monitoring using low-power wireless sensors connected to the Microcontroller, which send their measurements to a central server using the IEEE 802.11 b/g standards. Finally, data from all over the world, stored on the base station, can be remotely visualized from every device connected to the Internet. This overcomes the problem of system integration and interoperability, providing a well-defined architecture that simplifies the transmission of data from sensors with different measurement capabilities and increases supervisory efficiency.

2.1.2 Techniques

The document includes a development of monitoring solutions that credited from the advantages provided by wireless sensing technology. George Mois presented the development of a cyber-physical system that monitors the environmental conditions or the ambient conditions in indoor spaces at remote locations. The resulted solution provides the possibility of taking measurements from locations all over the world and of visualizing and examining the gathered data from any device connected to the framework. This work encompasses the complete solution, a cyber-physical system, starting from the physical level, consisting of sensors and the communication protocol, and reaching data management and storage at the cyber level . The experimental results show that the proposed system represents a viable and straightforward solution for environmental and ambient monitoring applications. An automated irrigation system based on a distributed wireless framework of soil wetness and temperature sensors that results water savings of 90% compared with classical implementations. It presents a smart monitoring solution for the assessment of possible causes of power inefficiency at the photovoltaic panel level based on WSNs.

The work presented here leads to a ubiquitous network architecture, where the sensors are part of the Internet. The developed monitoring solution, a CPS that incorporates all the developed Wi-Fi sensors and a cloud platform, allows the acquisition of data from every place where a wireless IEEE 802.11 network exists and the visualization of recorded data from every terminal connected to the Internet, without any additional hardware and software application other that an Internet browser.

- A Beagle bone black embedded processor with programmable system on chip (PSOC3).

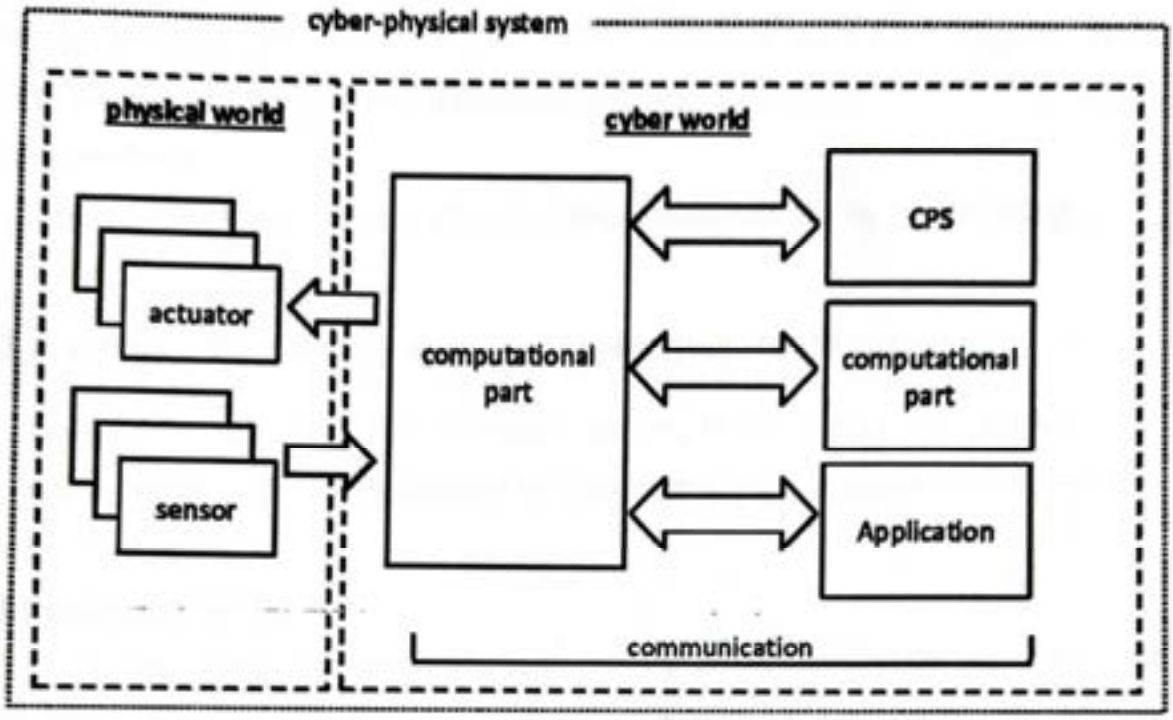

Fig 2.1 Block diagram of CPS system

2.1.3 Result

A number of experiments were performed by George Moise and team to provide reliability and better performance to the data transmission from experimental setup to the host computers. Firstly they tested for server's capabilities to this way and more data can be saved. The second experiment by George Mois and team was with single IOT platform with 4 PCs, which was wirelessly connected. Two time windows were used to transmit one package. The result shows that if period increases, the package loss ratio decreases process large quantity of received messages from nodes in a short time interval (window). The aim behind these tests was to examine the maximum number of packages that can be evaluated in short time interval for a single IOT platform. Figure 6 shows that the losses are reduced.

2.1.4 Conclusion

The improvement of a CPS, it utilizes sensors measuring the encompassing or the environment, which send messages to an IOT stage utilizing UDP. The correspondence protocol and the plan of the hubs help over accomplishing low power consumption, offering battery lifetimes for a long time. The framework dispenses with

cumbersome solutions, gives the likelihood about logging information the place Wi-Fi organize scope exists, furthermore might be utilized within an extensive variety from claiming checking provisions. Future worth of effort means on upgrade those dependability and security of the recommended framework.

2.1.5 Drawback

Expensive hardware, number of sent packages increases, the losses also increase.

2.2 A Cyber - Physical System for Environmental Monitoring

George Mois, Member, IEEE, Teodora Sanislav, Member, IEEE, and Silviu C. Folea, Member, IEEE Transactions on Instrumentation And Measurement, Vol. 65, No. 6, June 2016

2.2.1 Introduction

The importance of environmental monitoring is undoubted in our age. This is the field where wireless sensor networks (WSNs) have been first used, their primary purpose consisting in the observation of the physical world and the recording of physical quantities characterizing it. WSNs are large networks of resource-constrained sensors with processing and wireless communication capabilities, which implement different application objectives within a specific sensing field.

They can also be used for ambient monitoring, a topic of great interest nowadays as well, indoor air quality representing an important factor affecting the comfort, health, and safety of building occupants. Finally, the use of wireless ambient sensors can lead to more energy efficient buildings. The constant attempts of social and economic bodies for the development of technologies for improving energy efficiency and reducing pollution and for the more efficient use of national infrastructure along with the needs of decreasing the cost of computation, networking, and sensing had lead to the emergence of a new generation of digital systems, called cyber-physical systems (CPSs), less than a decade ago.

These include embedded systems, sensor networks, actuators, coordination and management processes, and services to capture physical data and to act on the physical environment, all integrated under an intelligent decision system . In this context, wireless sensors can be used to collect physical information that is further exploited by

CPSs. This will lead to CPSs composed of interconnected clusters of processing elements and large-scale wired and wireless networks of sensors and actuators gathering data about and acting upon the environment. These newly appeared systems have a lot of similarities with the Internet of Things (IoT), anenabler of ubiquitous sensing, that envisions a world in which many billions of Internet-connected objects or things, with sensing, communication, computing, and potentially actuating capabilities, will coexist, allowing an uninterrupted connection between people and things.

This paper presents a system for environmental and ambient parameter monitoring using low-power wireless sensors connected to the Internet, which send their measurements to a central server. Finally, data from all over the world, stored on the base station, can be remotely visualized from every device connected to the Internet. This overcomes the problem of system integration and interoperability, providing well defined architecture that simplifies the transmission of data from sensors with different measurement capabilities and increases supervisory efficiency.

Until recently, Wi-Fi technology has not been considered for implementing wireless sensing solutions because of its inability to meet the challenges in these types of systems, with the major drawback consisting in the unsatisfactory energy consumption. However, this has changed, since new power-efficient Wi-Fi devices have been developed and new solutions can benefit from several advantages offered by this technology, namely, the reduction of infrastructure costs while improving total ownership costs, native IP-network compatibility, and the existence of familiar protocols and management tools. Furthermore, high transmission rates, which are required in industrial applications, are achievable and the access to the network in this case is easy and no special wireless.

2.2.2 Objective

The resulted solution provides the possibility of logging measurements from locations all over the world and of visualizing and analyzing the gathered data from any device connected to the Internet. This work encompasses the complete solution, a cyber-physical system, starting from the physical level, consisting of sensors and the communication protocol, and reaching data management and storage at the cyber level. The experimental results show that the proposed system represents a viable and straightforward solution for environmental and ambient monitoring applications.

2.2.3 Techniques

Micro controller

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (LCD)

LCD is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

Temperature sensor

A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistor are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

Co_2 sensor

They are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, i-butane, propane, methane, alcohol, Hydrogen, smoke. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described: Rs\RL = (V_c-VRL) / VRL.

PROPOSED SCHEME

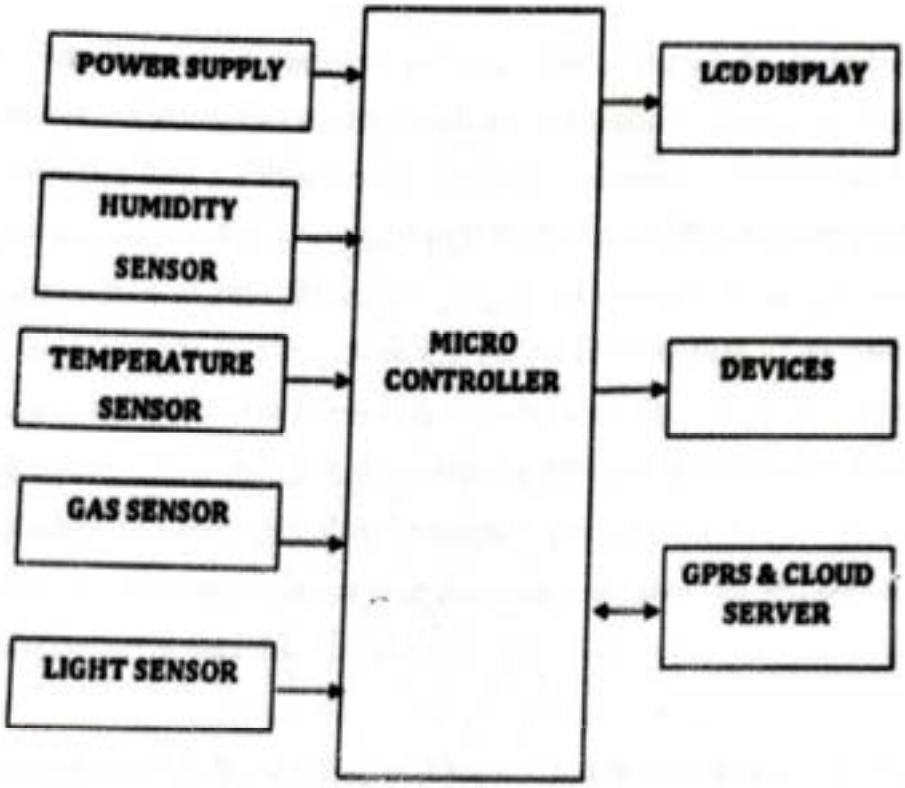

Fig 2.2 Block diagram of proposed scheme using microcontroller

Humidity sensor

Humidity sensor is a device that measures the relative humidity of in a given area. A humidity sensor can be used in both indoors and outdoors. Humidity sensors are available in both analog and digital forms. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. The sensor is made out of a film usually made of either glass or ceramics. The insulator material which absorbs the water is made out of a polymer which takes in and releases water based on the relative humidity of the given area. This changes the level of charge in the capacitor of the on board electrical circuit.

A digital humidity sensor works via two micro sensors that are calibrated to the relative humidity of the given area. These are then converted into the digital format via an analog to digital conversion process which is done by a chip located in the same

circuit. A machine made electrode based system made out of polymer is what makes up the capacitance for the sensor. This protects the sensor from user front panel (interface).

LDR

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. The animation opposite shows that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it. This is an example of a light sensor circuit. When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The LED lights on. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitivity.

GPRS

GPRS (general packet radio service) is a packet based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

2.2.4 Result

It employs sensors measuring the ambient or the environment, which send messages to an IoT platform using UDP. The communication protocol and the design of the nodes help in achieving low power consumption, offering battery lifetimes of several years. The system eliminates bulky solutions, provides the possibility of logging data where Wi-Fi network coverage exists, and can be used in a wide range of

monitoring applications. Future work intends to enhance the reliability and security of the proposed system.

2.2.5 Drawback

Trade - off between the amount of transmitted data and energy consumption.

2.3 A Real-time Cyber-Physical System for Indoor Environment Monitoring

Weihong Mi, Nanshu Zhou and Yaohui Jin International Conference on Manufacturing Science and Information Engineering (ICMSIE 2016) ISBN: 978-1-60595-325-0

2.3.1 Introduction

The last two decades have brought the revolution of internet and embedded system many devices are connected into the Internet. Thus, it makes possible for people to interact with physical world in which we live. The advancement in information technology led the need for a new generation of intelligent solutions on Cyber-Physical Systems. Cyber-physical systems integrate computing, communication and storage capability with monitoring. And it poses a set of advantages with efficient and safe, as well as allowing individual entities to form complex systems with new capacities.

A WSN (Wireless Senor Network) is consists of multiple low-power small embedded system and sensor nodes. It has communication, sensing and data storage, and processing capabilities. Due to the work of Giulio Gam-bardella etc. in micro-electromechanical systems, integrated circuits and radio frequency, WSNs are used in a wide range of applications, with emphasis on environment monitoring. The proposed CPS architecture acquires temperature humidity, noise, PM2.5 via sensors. And it senses the indoor environment well. With the development the technology of sensors, low cost, tiny size sensors are produced, that promotes the area in which environment monitoring, health care, industry automation.

In our system, data sensed by the sensor are sent by the User Datagram Protocol (UDP) to a measurements database, where they are collected. An intelligent cloud-based decision system transforms these sensing data into knowledge, reported to the end-users via restful API. Data or resources from devices or orders specified action to them need to be informed to users if users want to know environment where they are interested in.

Three kinds of protocol that suit for data transmission between devices and cloud are analyzed in, including: Constrained Application Protocol (Co AP), Message Queue Telemetry Transport (MQTT) and Extensible Messaging and Presence Protocol (XMPP). Co AP is running on top of UDP and only support a subset of the HTTP methods and REST full services.

Message Queue Telemetry Transport (MQTT) developed by IBM is another lightweight protocol for data transmission. Different from Co AP, MQTT is running on top of the TCP. UDP based Co AP is responsive than MQTT, but Co AP can cause longer delay at noisy channel because upper-layer retransmission mechanism is not very reactive compared to the TCP. XMPP is scalable and extensible for applications providing near real-time communication and robust delivery using TCP connection, usually used in Internet chatting.

In our system, the data model are built in the data proxy which is the bridge between local server with the cloud to make sure the reliable transmission i for device management and data collection. Thus, we choose MQTT protocol to transmit data from the local server to the cloud. The rest of this paper is structured as follows. In the next section, we make an overview of the existing Cyber-Physical system. In section3 detail architecture will be introduced about sensor hub. While in section 4, the device management and data distribution via restful API are described. The final section gives the conclusion and directions for future work.

2.3.2 Techniques

There are two important features, including management and real-time performance requirement. In, different models are discussed to implement Cyber-Physical system on the basics of 3S design that is, stability, security and systematic. Although the paper emphasized the stability, security and systematics when design a CPS, it ignore the real-time performance requirement and device management. It defines CPS architecture with three tiers and they overcome the difficulties with dynamic composition, dynamic adaptation and high confidence CPS management.

In fact, device management is taken into consideration based on users' requirement. But this is not enough in environment monitoring, in the most case user need to know the environment far away from them to make a better plan with their journey on real time. A cloud-based Cyber-Physical system is designed for

environmental monitoring. The architecture for this system consist of three layer the bottom layer, physical one, collecting data from sensor, the middle layer which is consist of data and knowledge, the top layer, namely application layer, provide users with service. This architecture takes real-time performance requirement into consideration.

The transmitted data represented as hexadecimal values and no time including the data. However, in the poor network condition, such as the network is not so stable, some of data may dismiss. Thus, it has bad influence on providing real-time service. What's worse, some of history data can't be acquired. Another disadvantage for the architecture is that it is lack of device management, it is not feasible to configure device with manual operation. In this paper, we introduce a novel architecture with a better data model and device management in the cloud. The sensor hub transmit data to the data proxy only if it shakes hand with data proxy. In the meantime, the information from the cloud are send to sensor hub to control the device and tag timestamp with sensor data. The proposed CPS architecture is presented in Figure.

2.3.2.1Wireless sensor hub

Sensor hub, who is responsible for sensing, collects and transports sensor data in real-time, is the key component of Wireless Sensor Network (WSN). The sensor hub should be designed for following requirements: Low power consumption, low cost, easy to be extended for new sensor and configurable in runtime, such as sensor enable/disable. A general purpose microprocessor generally has higher power consumption than a microcontroller; therefore it is often not considered a suitable choice for a sensor node. Hence, a battery powered embedded system with microcontroller as core component is a good choice for sensor hub. In our architecture, as Sensor hub is the core part of physical sensing layer and collects sensor data. In case of network being cut off by accident, a SD card is installed on the physical layer.

Proposed architecture

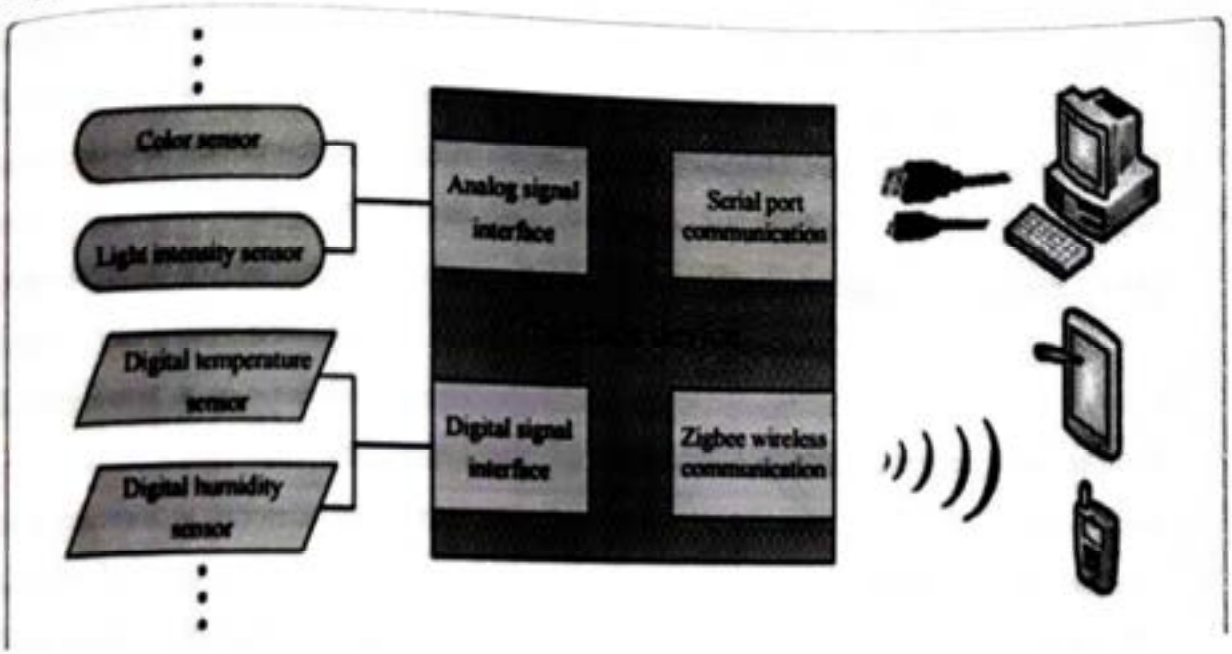

Fig 2.3 proposed CPS architecture

Even there is no network, the sensor hub continues working for a while and stores the data into SD card. When the network resume, the data saved in the SD card would be transmit to the cloud through WIFI. With integrated peripherals provide by sensor hub, many analog and digital sensor can be attached to sensor hub. In our proposed architecture, four sensors including temperature, humidity, noise and PM2.5 sensors compose the sensing part of sensor hub. Communication is performed by an RN-131C Wireless LAN model. We send data to the upper layer via UDP, since UDP is simplicity and less latency. it suitable for situation that has hard demand for real time requirement. However, there is no timestamp tagged with sensor data. Because, there is no timer on the sensor hub for the limit of power consumption.

Instead, the timestamp can be tagged when the data proxy communicating with sensor hub. When the sensor data transmit from sensor hub to data proxy, the processes are described as following and Figure3: Step1: sensor hub notifies the data proxy that data is going transmit from sensor hub to data proxy Step2: data proxy answer the sensor hub with time of local server. Step3: sensor hub checks the data frame from data proxy.

If there is no error, sensor hub will reconfigure the system with revised data including tagging timestamp with sensor data. Then sensor data will be transmitted to

data proxy via UDP. Or the sensor hub dismisses received data and keeps waiting for 3 seconds until it revives the correct data. If time goes out, sensor hub goes to step1. Step4: data proxy receives data and parses the frame ID of the data. Then frame ID is send to sensor hub to make sure that data has been received by data proxy. During the step2, not only timestamp can be sent, but also server IP, server port, SSID and password can be transport to sensor hub And sensor hub reconfigure system according data received from data proxy.

2.3.2.2 Data proxy and decision fusion based on the cloud

Data Proxy When the sensor hubs are in a subset of an organization, the need to be a gateway to forward data to the specific destination or the cloud. Two components consist the Data proxy: data model producer and MQTT client. When the data comes from sensor hub, the data model parses the information that user need and package the data with JSON format. Then, data is forwarded to the MQTT broker in cloud by MQTT broker.

2.3.2.3 Decision fusion the data management later meets the requirements

λ Provides device information and APIs to configure devices λ Data processing based on knowledge λ Provides analyses of environmental monitoring data for upper application According to section3, the data frame from sensor hub contain information about device, such as device mac, server IP, server Port, battery quantity etc. All the information is exposed to end-users. End-uses deduce the working condition of sensor hub to decide which sensor hub need to be replace with new or repaired by looking at the power of sensor hub in the cloud. In the meanwhile, some sensor data with low quality need to be cleared based on knowledge. the data distribution is implement with restful API.REST is an architectural model that can be efficiently implemented as a combination of the Hypertext Transfer Protocol (HTTP) and TCP/IP. Restful API has the advantage of cross-platform and it is friendly to developer.

2.3.4 Result

The paper proposed a real-time Cyber-Physical system for environmental monitoring based on WSNs and cloud computing. The architecture is designed according CPSs paradigm, and restful API are used to distribute sensor data for upper application. In this paper, we propose a method to tag time stamp with sensor data. Even under the poor network condition, the system senses environment without data missing.

2.3.5 Drawback

Expensive method

2.4 A Cyber–Physical System for Environmental Monitoring Through IOT Module

Pratik Padher, Dr. V.M.Rohokale IJEDR 2018 | Volume 6, Issue 3 | ISSN: 2321-9939

2.4.1 Introduction

A cyber physical system is being developed to monitor the environmental conditions or the ambient conditions in indoor spaces at remote locations. The communication between the system's components is performed using the existent wireless infrastructure. Some indoor places like poultry need continuous monitoring of few environmental parameters which cannot be identified by human. So there is a need for electronic equipment. We are using few sensors to detect and intimates to the controller which acts as heart of entire system.

2.4.2 Objective

In this project we are using moisture sensor, CO sensor, light sensor and Temperature sensor. Moisture sensor is arranged to check the moisture content, light/LDR sensor's output varies with the lighting at that place and informs the controller about this. Temperature sensor is given to identify about the abnormal change in temperature. Dangerous gas is sensed using CO sensor. All the parameters are being displayed on LCD and the same values are updated in the web server through IoT module interfaced to the controller. This is to make the information available about these parameters in the remote location also.

2.4.3 Techniques

This project uses sensors such as Humidity, Smoke Sensor, Temperature sensor (LM35).Whenever hazardous gas is detected then buzzer alert is given. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal. The analog signal is converted into digital format by the analog-to-digital converter (ADC). Then the fan will be ON. The status of every sensor will give updates through the IOT. Light gets on whenever LDR senses night mode. Motor will be on in case of dry condition detected by moisture sensor.

2.4.3.1 Wi-Fi module

ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller-based design with simple connectivity (SPI/SDIO or I2C/UART interface).

2.4.3.2 LCD

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons: These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

2.4.3.3 Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

2.4.3.4 Light dependent resistor

LDR or Light Dependent Resistors are very useful especially in light dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. The animation opposite shows that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1,000,000 ohms, but when they are illuminated with light, the resistance drops dramatically.

2.4.4 Result

The greenhouse vegetable production needs less labor, less capital, has faster returns than normal vegetable production. We have arranged few sensors to maintain environment automatically. The status of every sensor will given through the SMS. Here PIR, LDR sensors are also used and their respective relay are also activated accordingly.

2.4.5 Drawback

Low efficiency

2.5 A Real Time Cyber Physical System for Monitoring Environmental Status

International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084

2.5.1 Introduction

The importance of environmental monitoring plays a vital role. This is the field where wireless sensor networks (WSNs) have been first used, their primary purpose consisting in the observation of the physical world and the recording of physical quantities characterizing it. CPSs composed of interconnected clusters of processing elements and large-scale wired and wireless networks.

The paper proposed a real-time Cyber-Physical system for environmental monitoring based on WSNs and cloud computing. The architecture is designed according CPSs paradigm, and restful API are used to distribute sensor data for upper application. In this paper, we propose a method to tag time stamp with sensor data. Even under the poor network condition, the system senses environment without data missing. We implemented and test the system and it works very well. But the control of the sensor hub is relatively centralized. That is not so good for device management when numbers of devices are connected into the system .A distributed strategy will be developed in the future work. The environment monitoring system (EMS) consists of three layers: physical sensing layer, data transport of sensors and actuators gathering data about and acting upon the environment.

These newly appeared systems have a lot of similarities with the Internet of Things (IoT), an enabler of ubiquitous sensing, that envisions a world in which many billions of Internet-connected objects or things, with sensing, communication,

computing, and potentially actuating capabilities, will coexist, allowing an uninterrupted connection between people and things. layer, data management layer. Generally, sensors and sensor hub which collects sensor data and transfer them to the upper layer make up of physical sensing layer. And the main function for data transport layer is to forward sensor data to the specified destination. The last layer is in the cloud, composed of a data processor and a knowledge base.

Data from physical sensing layer can be analyzed due to the strong computation ability of cloud computing. Also, there are abundant restful API (application programming interfaces) are provided by management layer based on users' demand. The proposed architecture provide convenient management with devices since all the information of devices are stored into database in the cloud. Even under the poor condition of network, data produced by sensors can be saved in local storage, making it enough time for user to settle the network problem with no affecting on the environment monitoring.

2.5.2 Objective

CYBER PHYSICAL SYSTEMS (CPS) represents a new generation of digital systems, where cyber entities and physical devices cooperate towards a set of common goals. This paper presents that the CPS monitors the environmental conditions in real time. The communication between the systems components is performed by using IEEE 802.11 b/g standards .It provides a possibility of logging into the system from anywhere in the world with the device connected to the internet.

2.5.3 Techniques

2.5.3.1 UDP port listener and message interpreter:

This component is in charge of listening the UDP port to which the sensors transmit the packets containing the measurement data. The data received are stored into a buffer and processed for being saved in a database. A benchmark program was written to compute the average processing time for each received message. This includes message interpretation and data saving into the database. An average period of 1.5 ms was observed for each data packet that was received and saved on the local memory.

2.5.3.2Database

The SQLite software library was chosen for storing the data received from the Wi-Fi sensors in a data- base.

2.5.3.3Web Server

An open source licensed small memory footprint Web server, namely, light pad was installed on the IoT platform for remote data visualization.

2.5.4 Result

The development of a CPS, which monitors environmental parameters based on the existent infrastructure, was presented. It employs sensors measuring the ambient or the environment, which send messages to an IoT platform using UDP. The system provides the possibility of logging data where Wi-Fi network coverage exists, can be used in a wide range of monitoring applications.

2.5.5 Drawback

Time consumption more

Speed is less

2.6 A Cyber-Physical System for Environmental Monitoring

George Mois, Member, IEEE, Teodora Sanislav, Member, IEEE, and Silviu C.Folea, Member, IEEE

2.6.1 Introduction

The importance of environmental monitoring is undoubted in our age. This is the field where wireless sensor networks (WSNs) have been first used, their primary purpose consisting in the observation of the physical world and the recording of physical quantities characterizing it. WSNs are large networks of resource-constrained sensors with processing and wireless communication capabilities, which implement different application objectives within a specific sensing field.

They can also be used for ambient monitoring, a topic of great interest now a days as well, indoor air quality representing an important factor affecting the comfort, health, and safety of building occupants. Finally, the use of wireless ambient sensors can lead to more energy-efficient buildings. The constant attempts of social and economic bodies for the development of technologies for improving energy efficiency and reducing pollution.

The Associate Editor coordinating the review process was Dr. Antonios Tsourdos. The authors are with the Department of Automation, Faculty of Automation and Computer Science. Color versions of one or more.

National infrastructure along with the needs of decreasing the cost of computation, networking, and sensing had lead to the emergence of a new generation of digital systems, called cyber-physical systems (CPSs), less than a decade ago. These include embedded systems, sensor networks, actuators, coordination and management processes, and services to capture physical data and to act on the physical environment, all integrated under an intelligent decision system. In this context, wireless sensors can be used to collect physical information that is further exploited by CPSs. This will lead to CPSs composed of interconnected clusters of processing elements and large-scale wired and wireless networks of sensors and actuators gathering data about and acting upon the environment.

The rest of this paper is structured as follows. The next section presents the context of the present work, while Section III talks about the current trends and also the motivation of using wireless sensors in the context of CPSs and of the IoT. Section IV gives a description of the developed CPS, with its two main components, the Wi-Fi sensors and the data-center. The general structure of the system and the main characteristics of the two types of devices are presented here. Section V presents the experimental results of the proposed system, highlighting the performances characteristics in terms of reliability influenced by package losses. Finally, Section VI gives the concluding remarks and the directions for future work.

2.6.2 Objective

The resulted solution provides the possibility of logging measurements from locations all over the world and of visualizing and analyzing the gathered data from any device connected to the Internet. This work encompasses the complete solution, a cyber-physical system, starting from the physical level, consisting of sensors and the communication protocol, and reaching data management and storage at the cyber level. The experimental results show that the proposed system represents viable and straightforward solution for environmental and ambient monitoring applications.

2.6.3 Techniques

Scopus is arguably the largest citation database and indexes approximately 15,000 peer-reviewed journals from more than publishers. This study chooses Cyber Physical System", as the keywords to search published papers from January 2012 to March 2017 collected by Scopus databases. Initially, articles are selected. After

removing irrelevant topics, articles in total are chosen and hence used as samples for this study. shows the statistics and trend of publications on CPS applications. shows the type of these publications.

2.6.4 Result

A number of experiments were performed for providing data related to the reliability and performance of the proposed system. The first two sets of experiments consisted in the testing of the server's capabilities of processing large numbers of messages received from sensors in a short period of time (named from here on also as time window). First, a desktop PC was used for sending UDP messages formatted as the ones sent by the two types of sensors to the server platform, and then four notebook PCs using wireless communication were used to send the same messages through UDP.

2.6.5 Conclusion

The development of a CPS, which monitors environmental parameters based on the existent IEEE 802.11 infrastructure, was presented. It employs sensors measuring the ambient or the environment, which send messages to an IoT platform using UDP. The communication protocol and the design of the nodes help in achieving low power consumption, offering battery lifetimes of several years. The system eliminates bulky solutions, provides the possibility of logging data where Wi-Fi network coverage exists, and can be used in a wide range of monitoring applications. Future work intends to enhance the reliability and security of the proposed system.

2.6.6 Drawback

Large size Algorithms

2.7 A Cyber - Physical System for Environmental Monitoring

International Journal of Electronics and Communication Engineering and Technology (IJECET) Volume 8, Issue 2, March - April 2017

2.7.1 Introduction

This is the field where wireless sensor networks (WSNs) have been first used, their primary purpose consisting in the observation of the physical world and the recording of physical quantities characterizing it. WSNs are large networks of resource-constrained sensors with processing and wireless communication capabilities, which implement different application objectives within a specific sensing field.

They can also be used for ambient monitoring, a topic of great interest nowadays as well, indoor air quality representing an important factor affecting the comfort, health, and safety of building occupants. Finally, the use of wireless ambient sensors can lead to more energy efficient buildings. The constant attempts of social and economic bodies for the development of technologies for improving energy efficiency and reducing pollution and for the more efficient use of national infrastructure along with the needs of decreasing the cost of computation, networking, and sensing had lead to the emergence of a new generation of digital systems, called cyber-physical systems (CPSs), less than a decade ago.

These include embedded systems, sensor networks, actuators, coordination and management processes, and services to capture physical data and to act on the physical environment, all integrated under an intelligent decision system . In this context, wireless sensors can be used to collect physical information that is further exploited by CPSs. allowing an uninterrupted connection between people and things. This paper presents a system for environmental and ambient parameter monitoring using low-power wireless sensors connected to the Internet, Finally, data from all over the world, stored on the base station, can be remotely visualized from every device connected to the Internet.

Until recently, Wi-Fi technology has not been considered for implementing wireless sensing solutions because of its inability to meet the challenges in these types of systems, with the major drawback consisting in the unsatisfactory energy consumption. However, this has changed, since new power-efficient Wi-Fi devices have been developed and new solutions can benefit from several advantages offered by this technology, namely, the reduction of infrastructure costs while improving total ownership costs, native IP-network compatibility, and the existence of familiar protocols and management tools., Furthermore, high transmission rates, which are required in industrial applications, are achievable and the access to the network in this case is easy and no special wireless.

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2.7.3.1 Wi-Fi module

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2.7.3.2 LCD

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons: These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

2.7.3.3 Web Server

An open source licensed small memory footprint Web server, namely, light pad was installed on the IoT platform for remote data visualization.

2.7.4 Result

It employs sensors measuring the ambient or the environment, which send messages to an IoT platform using UDP. The system provides the possibility of logging data where Wi-Fi network coverage exists, can be used in a wide range of monitoring applications.

2.7.5 Drawback

Energy consumption is high.

2.8 A Cyber - Physical System for Environmental Monitoring

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2.8.1 Introduction

Cyber-physical system (CPS) is currently of interest in academia, industry, and government due to their potentially signicant impact on society, environment, and economy. Since, the National Science Foundation (NSF) has awarded large amount of funds to research on CPS. Many universities and institutes, such as UC Berkeley, Vanderbilt University, University of Memphis, University of Michigan, University of Notre Dame, University of Maryland, and General Motors Research and Development Center, join this research area the U.S. government has treated CPSs as a new development strategy. At the same time researchers from other countries have started to be aware of signicance for CPS research. In addition, many conferences and workshops on CPS have been organized, such as the CPS Week and the ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), respectively.

2.8.2 Technique

Scopus is arguably the largest citation database and indexes approximately peer-reviewed journals from more than publishers. This study chooses Cyber Physical System "CPS", and Application" as the keywords to search published papers from January to March collected by Scopus databases. Initially, are selected. After removing irrelevant topics, articles in total are chosen and hence used as samples for this study. shows the statistics and trend of publications on CPS applications. shows the type of these publications.

The number of conference papers is more than the number of journal articles. This indicates that there are many novel ideas in CPS research area. Among these publications, the journal papers are from journals during the study period. lists the journals. Three papers come from Proceedings of the IEEE, which has the highest number of publications. Most of these journals are in the fields of IEEE, computer science, and engineering.

2.8.3 Result

This paper conducts an extensive review of publications about CPS applications from collected in Elsevier's Scopus database, aiming to provide scholars and practitioners with a comprehensive overview on CPS applications. These publications are grouped into research categories. The contents of the papers in each research category are summarized. Challenges and trends in each research category are illustrated as well. Scholars can stay up to date with the latest studies on CPS and gain research ideas from this study. Practitioners can also learn new approaches and their effects from this study. As a very active research field, a variety of questions regarding CPS need to be solved, at different layers of the architecture and from different aspects of systems design, to trigger and to ease the integration of the physical and cyber worlds.

2.8.4 Conclusion

The major limitation of this study is that only the Scopus database was selected. Several other important CPS research fields are not covered in this paper, such as critical infrastructure control, distributed robotics, defense systems, and aerospace systems. Future research should review research on CPS based on other databases, such as SCI/SSCI, IEEE explore, and Google Scholar, to validate the findings in this study. In addition, this study only focuses on CPS applications, and research regarding CPS theoretical foundations is not covered. Future research needs to explore the development of CPS theories and technologies.

2.8.5 Drawbacks

There is no remote alert using IOT.

2.7 Summary of Literature Review

The summary of the literature review is given by **Table 2.1** contains title of the paper, techniques and its drawbacks.

Table 2.1 Summary of Literature Review

SNO	Title	Technique	Drawback
1	A Cyber - Physical System For Environmental Monitoring	This project uses sensors such as Humidity, Smoke Sensor, Temperature sensor (LM35). Whenever hazardous gas is detected then buzzer alert is given. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal. The analog signal is converted into digital format by the analog-to-digital converter (ADC).	Here and CO sensor and Air Moisture sensor are not there to identify human and dangerous gas. There is no remote alert using IOT.
2	Digitalized Cyber Physical System for Environmental Monitoring	These proposed solutions are based on ZigBee applications and under relay on gateways when the data has to be sent to the internet.	Time consumption more Speed is less
3	Review On - IoT Based Environment Monitoring System	This system consists of a microcontroller as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller.	As network signals are not available, then locker may not be opened
4	A Cyber-Physical System for Environmental Monitoring	Real time air quality monitoring using WLAN, WSN, Embedded Systems. Wireless Sensors In Cyber-physical Systems	Energy consumption issue Large size Algorithms

5	Review on A cyber physical system for monitoring and controlling of industrial pollution using Raspberry Pi	Wireless Sensors In Cyber Physical System Interfacing	It is time consuming at initial stage
6	A Real-time Cyber-Physical System for Indoor Environment Monitoring	Data Proxy And Decision Fusion Based On The Cloud Data fusion and aggregations based on self organised map (SOM) algorithms.	Trade-off between the amount of transmitted data and energy consumption
7	Cyber-Physical Systems: A Literature Review	Transmission is achieved using local area networks, the Internet or communication technologies such as Wi-Fi, Bluetooth, ZigBee, and infrared. The application layer processes information from transmission layer and issues commands to be executed by the sensors and actuators. The main objective of the layer is to create a smart environment.	Expensive hardware, number of sent packages increases, the losses also increase
8	A Cyber - Physical System For Environmental Monitoring	A Beagle bone black embedded processor with programmable system on chip (PSOC3). Average Slope Multiplication (ASM) to classify odors using dynamic response of sensors.	Low efficiency

CHAPTER 3

THEORETICAL BACKGROUND

3.1 Introduction

A sensor is able to convert physical or chemical readings gathered from the environment into signals that can be calculated by a system. A multi sensor node is able to sense several magnitudes in the same device. In a multi sensor, the input variables might be temperature (it is also able to capture nippy changes of temperature), fire, infrared radiation, humidity, smoke and CO_2. A wireless sensor network could be an useful architecture for the deployment of the sensors used for fire detection and verification. The most vital factors for the quality and productivity of plant growth are temperature, humidity, light and the level of the carbon dioxide. Constant monitoring of these environmental variables gives information to the farmer to better understand, how each factor affects growth and how to manage maximal crop productiveness.

The optimal greenhouse climate adjustment can facilitate us to advance productivity and to achieve remarkable energy saving, particularly during the winter in northern countries. In the past generation greenhouses it was enough to have one cabled measurement point in the middle to offer the information to the greenhouse automation system. The system itself was typically simple without opportunities to manage locally heating, lights, ventilation or some other activity, which was affecting the greenhouse interior climate.

The typical size of the greenhouse itself is much larger than it was before, and the greenhouse facilities provide several options to make local adjustments to the light, ventilation and other greenhouse support systems. However, additional measurement data is also needed to construct this kind of automation system to work properly. Increased number of measurement points must not dramatically augment the automation system cost. It should also be possible to easily alter the location of the measurement points according to the particular needs, which depend on the specific plant, on the possible changes in the external weather or greenhouse structure and on the plant placement in the greenhouse.

Wireless sensor network can form a useful part of the automation system architecture in modern greenhouses constructively. Wireless communication can be used to collect the measurements and to communicate between the centralized control and the actuators located to the different parts of the greenhouse. In advanced WSN solutions, some parts of the control system itself can also be implemented in a distributed manner to the network such that local control loops can be formed. Compared to the cabled systems, the installation of WSN is fast, cheap and easy. Moreover, it is easy to relocate the measurement points when needed by just moving sensor nodes from one location to another within a communication range of the coordinator device. If the greenhouse vegetation is high and dense, the small and light weight nodes can even be hanged up to the plants' branches.

WSN maintenance is also relatively cheap and easy. The only additional costs occur when the sensor nodes run out of batteries and the batteries need to be charged or replaced, but the lifespan of the battery can be several years if an efficient power saving algorithm is applied. In this work, the very first steps towards the wireless greenhouse automation system by building a wireless measuring system for that purpose is taken and by testing its feasibility and reliability with a simple experimental setup. Clustering may be centralized or distributed, based on the arrangement of CH. In centralized clustering, the CH is preset but in distributed clustering CH has no fixed architecture. Distributed clustering mechanism is used for some private reasons like sensor nodes prone to failure, better collection of data and minimizing redundant information. Hence these distributed clustering mechanisms encompass highly self-organizing capability.

3.2 Block diagram

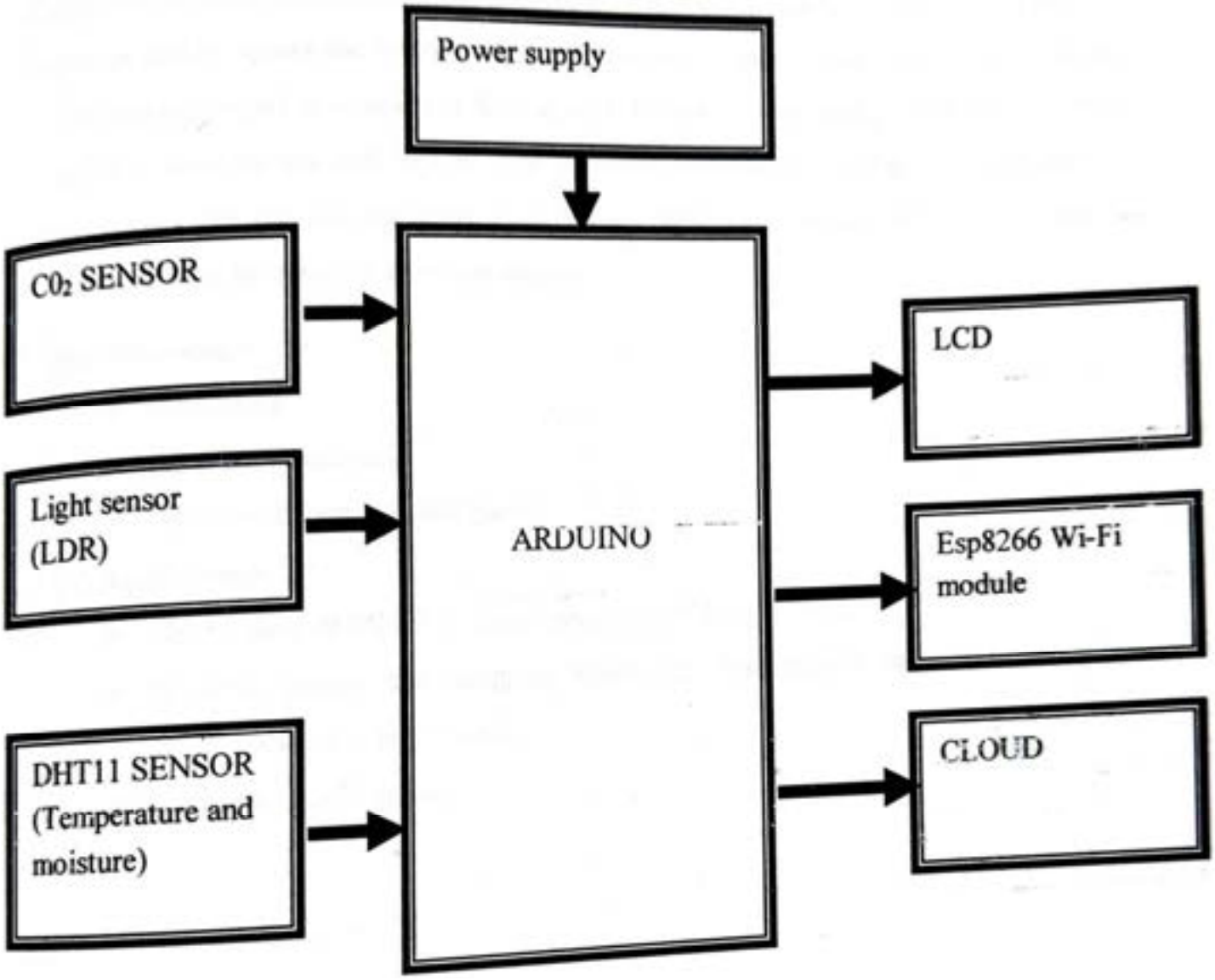

FIG 3.1 PROPOSED BLOCK DIAGRAM

3.3 Methodology

This project uses sensors such as Humidity, Smoke Sensor, Temperature sensor (LM35). Whenever hazardous gas is detected then buzzer alert is given. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal. The analog signal is converted into digital format by the analog-to-digital converter (ADC). Then the fan will be ON. The status of every sensor will give updates through the IOT. Light gets on whenever LDR senses night mode. Motor will be on in case of dry condition detected by moisture sensor.

3.4 Advantages

- Reliability
- Ease of Operation
- Useful to detect harmful gases

3.5 Applications

- Can be used in Mines to detect presence of dreadful gases.
- In public places like shopping malls, etc, this project can be applied where public safety is a major task.
- In Marine Applications.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Software Requirements

Simulator Tool : Arduino IDE

PHP

4.1.1 Hardware Requirements:

- C02 sensor
- DHT11 sensor
- Light sensor (LDR)
- ARDUINO
- LCD
- Esp8266 Wi-Fi module

4.2 Introduction to Arduino IDE

- Arduino IDE is open source software that is mainly used for writing and compiling the code into the Arduino Module.
- It is official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.

- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

4.3 The Arduino IDE system

The IDE environment is mainly distributed into three sections

- Menu Bar
- Text Editor
- Output Pane

4.3.1 Menu Bar

The bar appearing on the top is called **Menu Bar** that comes with five different options as follow

- **File** – You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.

As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

And at the end of compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.

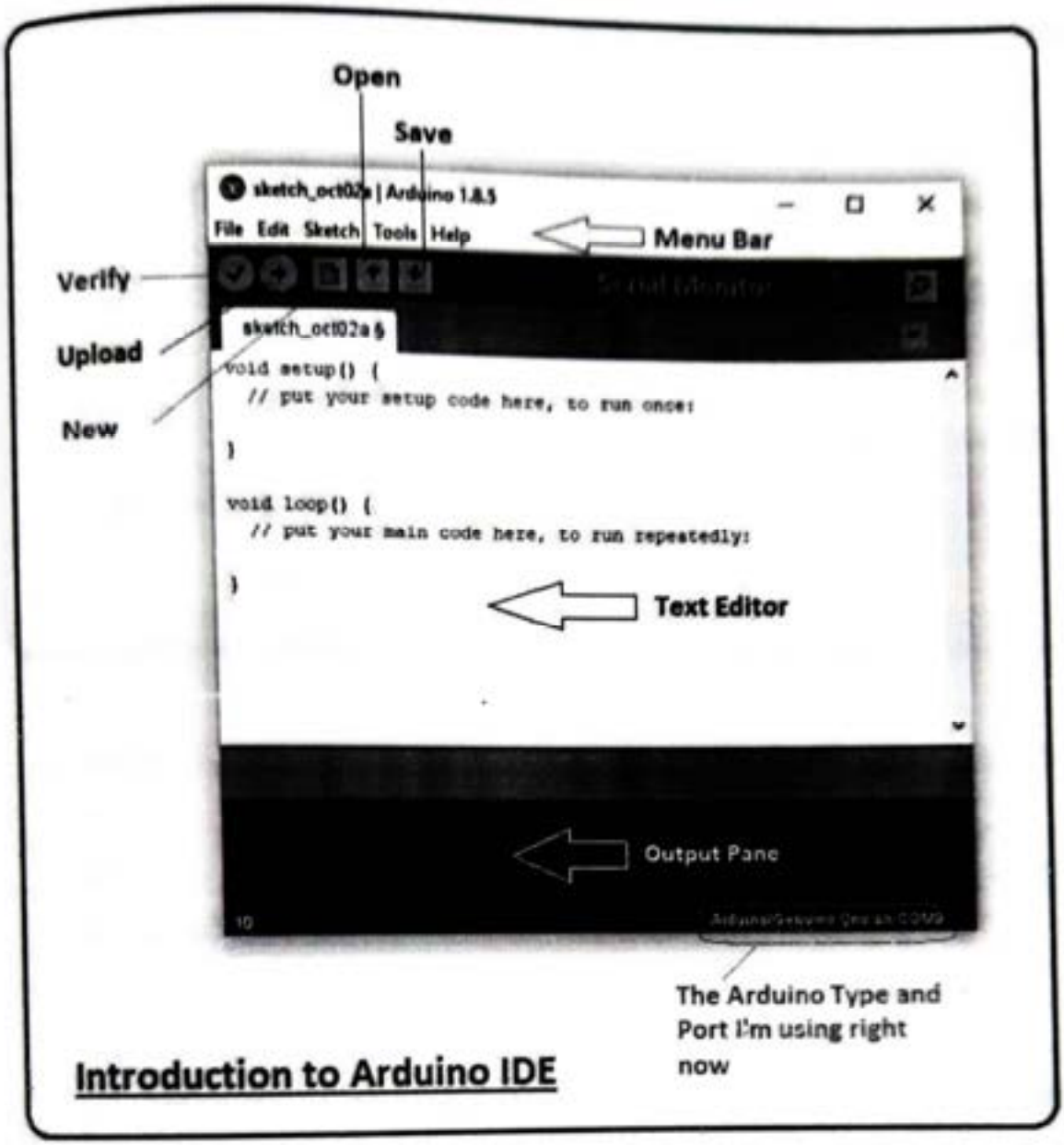

Fig 4.1 Introduction to Ardino IDE

4.3.2 Text Editor

- Edit – Used for copying and pasting the code with further modification for font
- Sketch – For compiling and programming
- Tools – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- Help – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The Six Buttons appearing under the Menu tab are connected with the running program as follow.

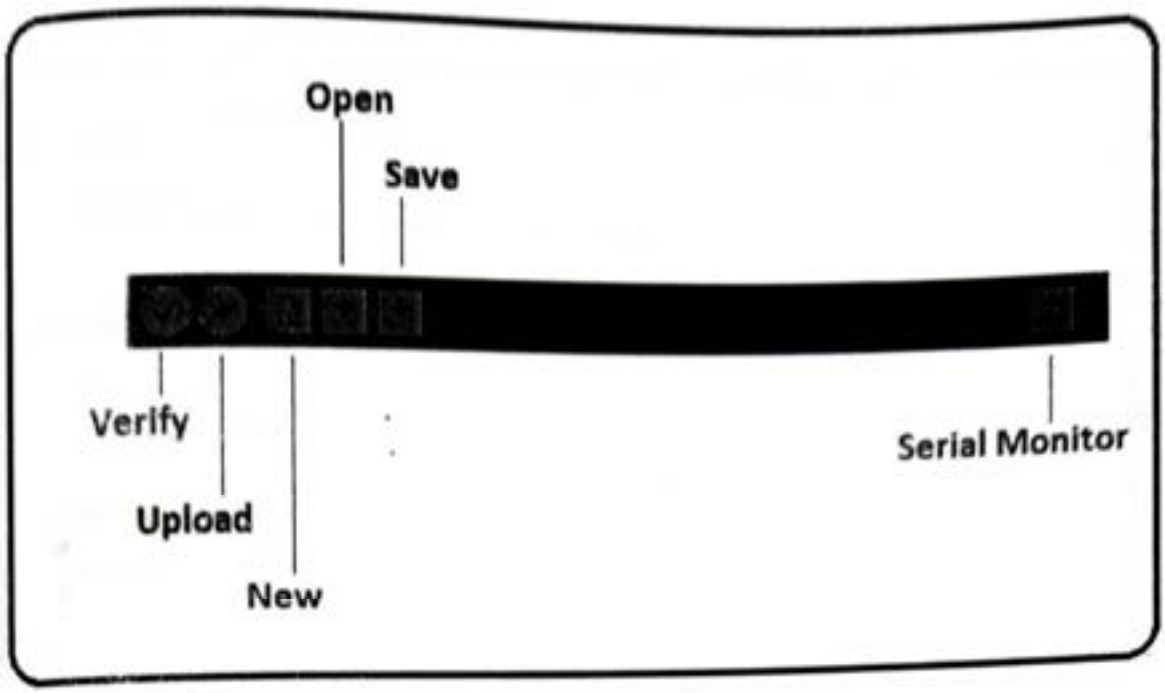

Fig 4.2 Editor Tool

- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a Serial Monitor – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.

The main screen below the Menu bard is known as a simple text editor used for writing the required code.

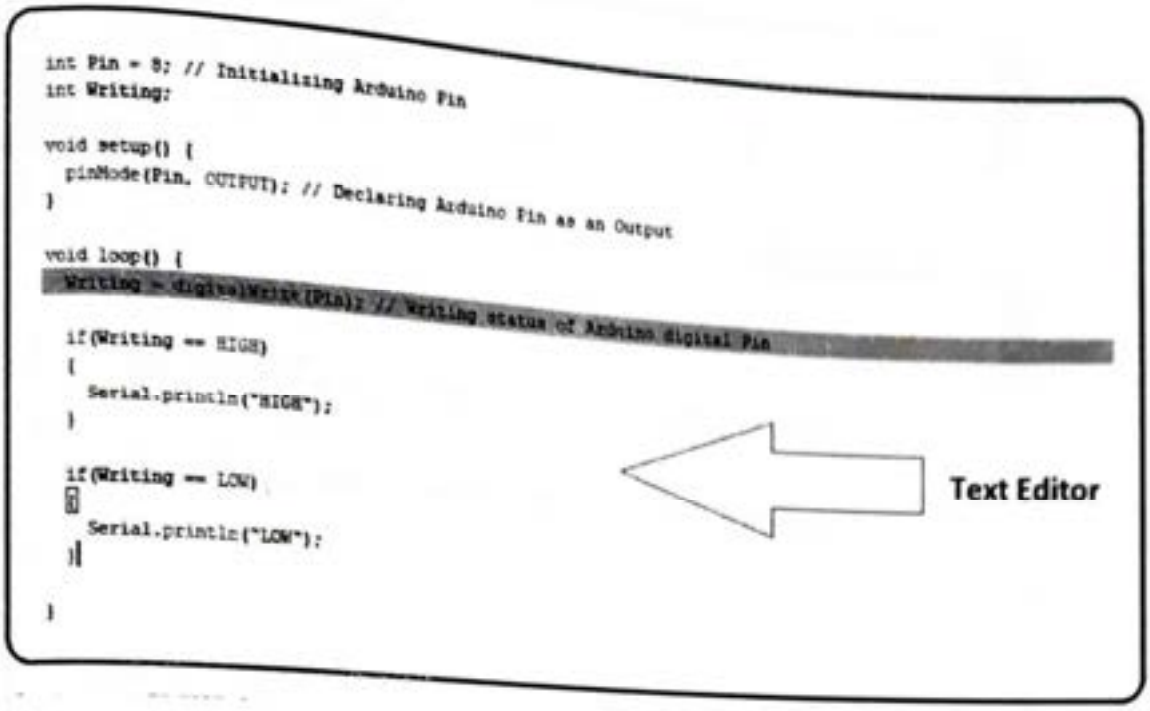

Fig 4.3 Text Editor Window

The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.

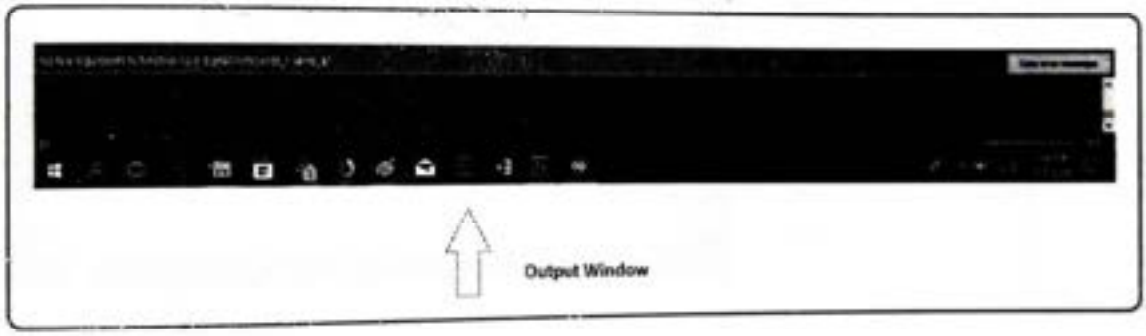

Fig 4.4 Output Window

More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

4.4 Libraries

Libraries are very useful for adding the extra functionality into the Arduino Module. There is a list of libraries you can add by clicking the Sketch button in the menu bar and going to Include Library.

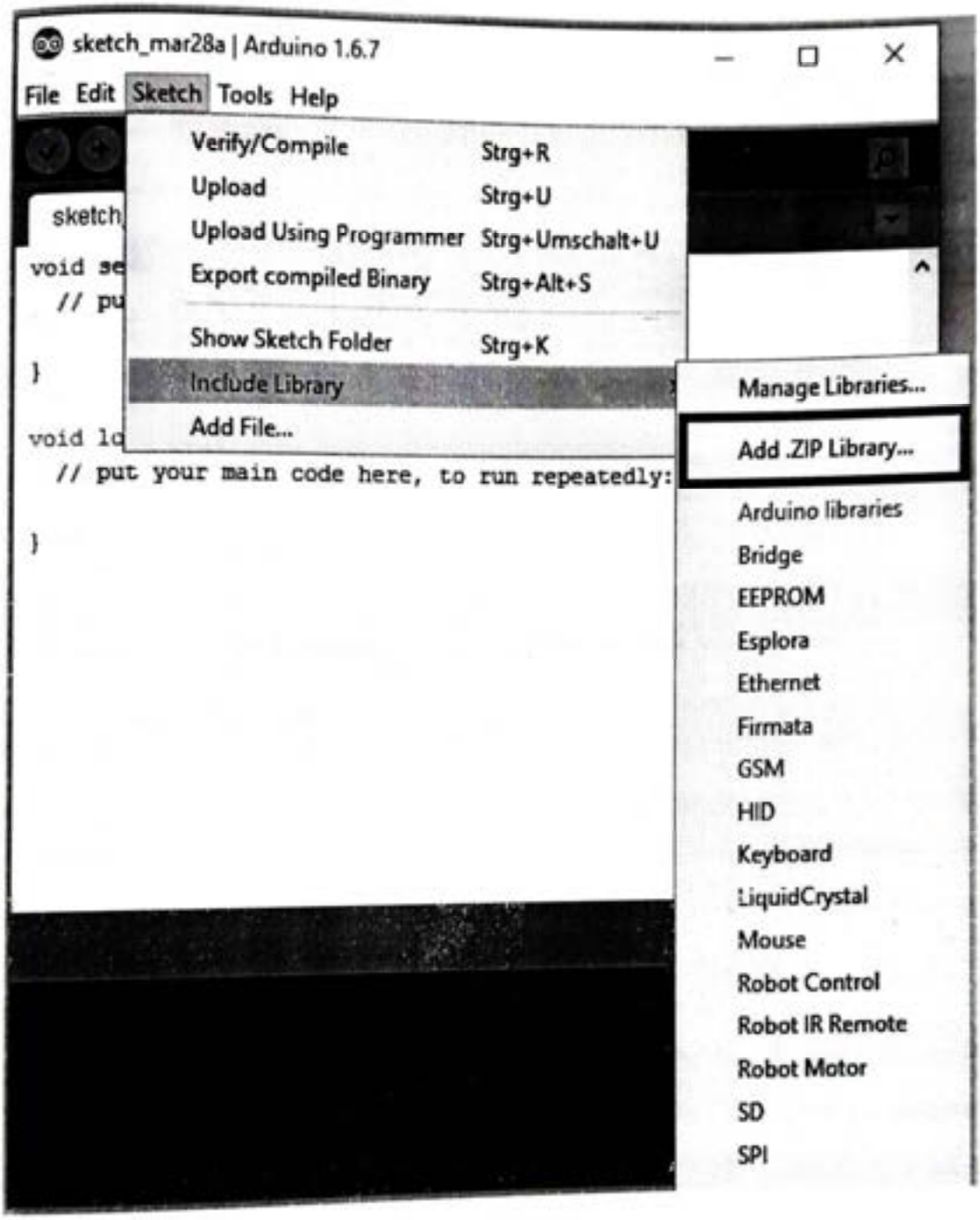

Fig 4.5 Library Window

4.5 Making Pins Input or Output

The digital Read and digital write commands are used for addressing and making the Arduino pins as an input and output respectively.

4.6 Selection of Boards

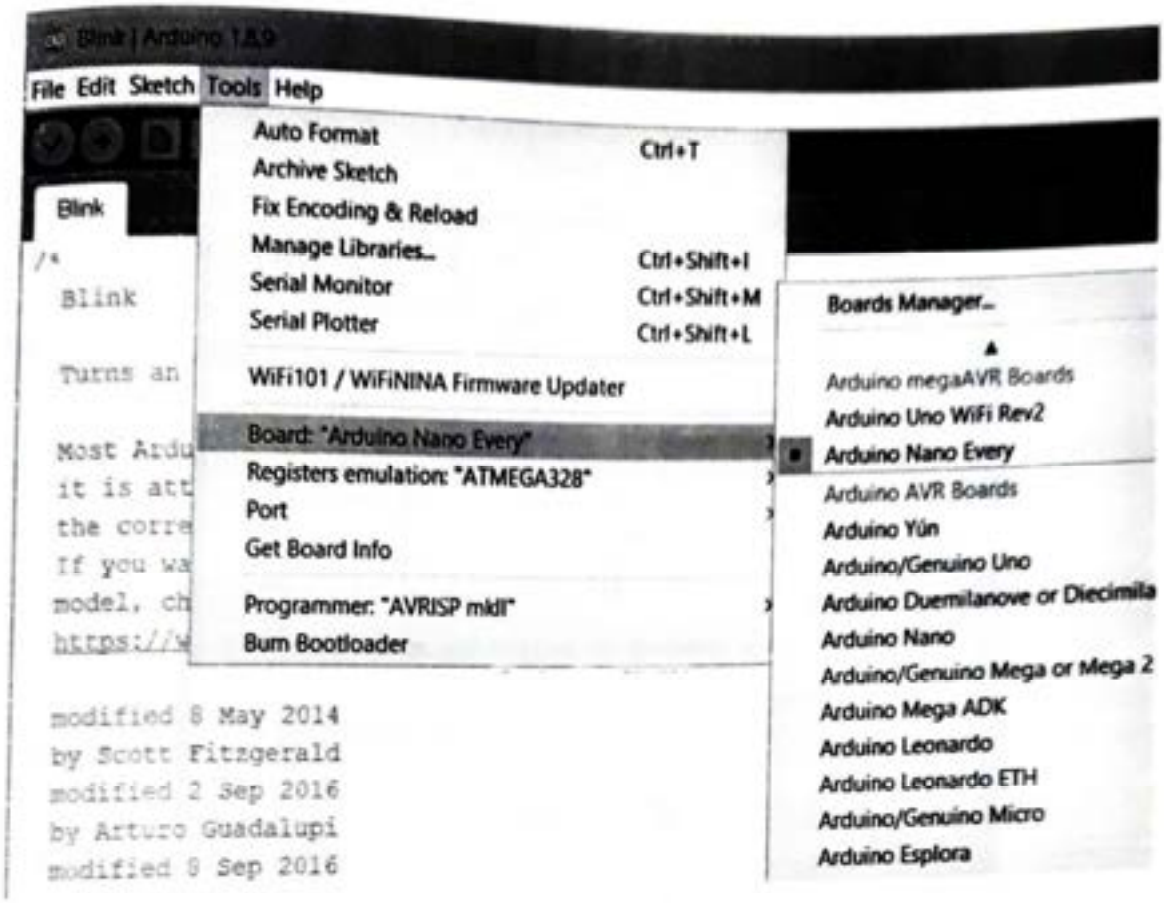

Fig 4.6 Selection of Board Window

- Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.

Following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with COM4 port at the right bottom corner of the screen.

- After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six button section or you can go to the Sketch section and press verify/compile and then upload.
- The sketch is written in the text editor and is then saved with the file extension.ino.

4.7 Bootloader

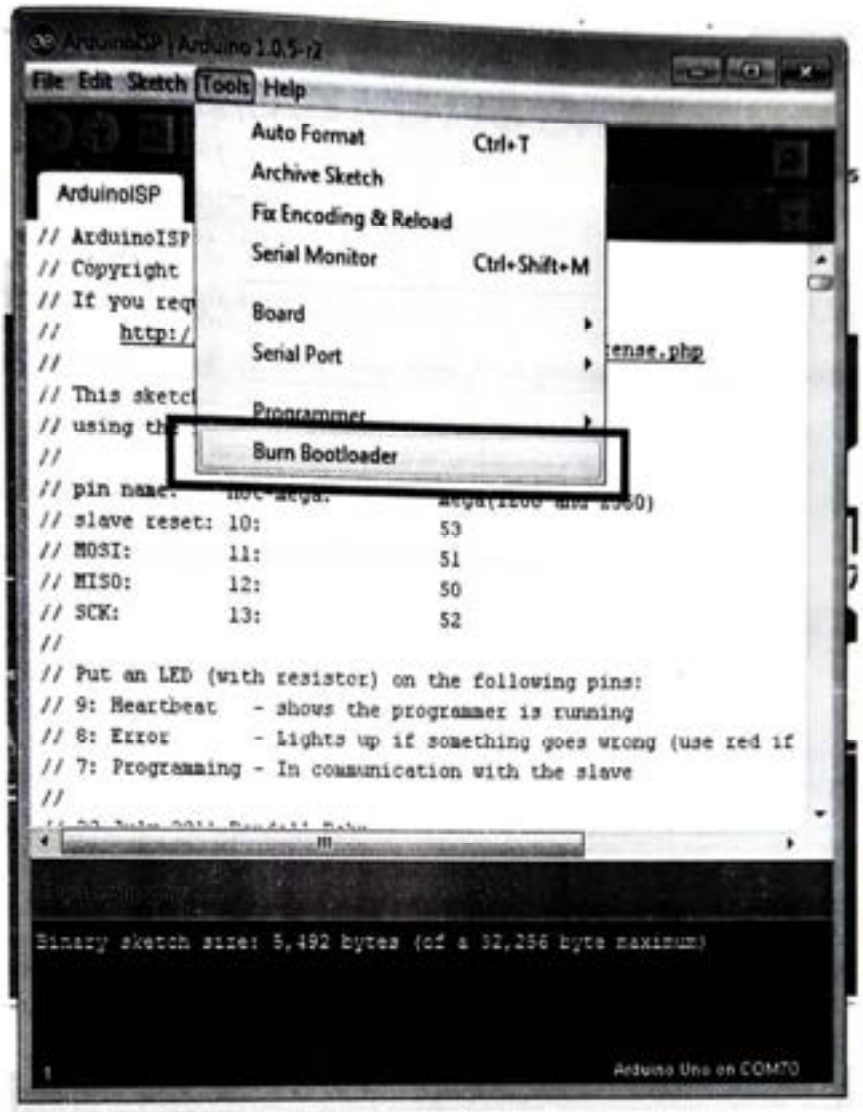

Fig 4.7 Bootloader Window

As you go to the Tools section, you will find a bootloader at the end. It is very helpful to burn the code directly into the controller, setting you free from buying the external burner to burn the required code.

When you buy the new Arduino Module, the bootloader is already installed inside the controller. However, if you intend to buy a controller and put in the Arduino module, you need to burn the bootloader again inside the controller by going to the Tools section and selecting the burn bootloader.

CHAPTER 5

RESULTS AND DISCUSSION

The design and implementation of large-scale and long-term CO2 monitoring sensor network is discussed. A low-cost sensor deployment strategy with guaranteed performance which addresses the sensor deployment problems in the existing models has been proposed. Hardware implementation of this model has been done and the parameters are periodically monitored with few sensors.

CHAPTER 6

WORK HAS TO BE DONE IN PHASE II

For this project in phase II, we are going to implement cyber-physical system that controls environmental circumstances or environmental conditions in distant places in indoor areas. Software tools like Arduino IDE, PHP used for cyber system design. In phase II hardware kit is placed for model.

REFERENCE

1. A.Cerpa, J.Elson, D.Estrin, L.Girod, M. Hamilton, J. Zhao, (2001), "Habitat monitoring: application driver for wireless communications technology, Proceedings of the ACM SIGCOMM Workshop on Data Communications" in Latin America and the Caribbean.
2. D.Dardari, A.Conti, C.Buratti, R.Verdone, (2007), "Mathematical evaluation of environmental monitoring estimation error through energy-efficient wireless sensornetworks", IEEE Transactions on Mobile Computing,Volume 6, Pages 790-803.
3. D.S.Lee, Y.D.Lee, W.Y.Chung, R.Myllyla, (2006), "Vital sign monitoring system with life emergency event detection using wireless sensor network", Proceedings of IEEE Conference on Sensors, Korea.
4. EdoardoBiagioni, Kent Bridges, (2002),"The application of remote sensor technology to assist the recovery of rare and endangered species, Special Issue on Distributed Sensor Networks" for the International Journal of High Performance Computing Applications, Volume 16, Number 3.
5. J.Hao, J.Brady, B.Guenther, J.Burchett, M.Shankar,S.Feller, (2006), "Human tracking with wireless distributed pyroelectric sensors", IEEE Sensors Journal.
6. Jong-Won Kwon, Yong-Man Park, Sang-Jun Koo, Hiesik Kim, (2007), "Design of air pollution monitoring system using zigbee networks for ubiquitous-city", Proceedings of the International Conference on Convergence Information Technology, Pages 1024-1031.
7. M.de Boer, (1998), "Facing the air pollution agenda for the 21st century". Int. J. Advanced Networking and Applications Volume: 5 Issue: 5 Pages: 2060-2065 (2014) ISSN: 0975-0290 2065 Issues & Policy, Elsevier Science B.V, Netherland, Pages 3- 8.
8. N.D. Van Edmond, (1998), "Historical perspective and future outlook in air pollution in the 21st century", Priority Issues and Policy, Elsevier Science B.V, Netherland, Pages 35-46.
9. V.Rajaravivarma, Y.Yang, T.Yang, (2003), "An overview of wireless sensor network and applications", Proceedings of 35th South Eastern Symposium on System Theory.
10. Zhang Qian, Yang Xiang-Long, Zhou Yi-Ming, Wang Li-Ren, Guo Xi-Shan, (2007), "A wireless solution for greenhouse monitoring and control system based on Zigbee technology", J Zhejiang UnivSci A, Pages 1584-1587. [4] Jong-Won Kwon, Yong-M

ARDUINO BASED LIQUOR DETECTION AND AUTOMATIC VEHICLE ENGINE LOCKING WITH LOCATION TRACKING SYSTEM

A PROJECT PHASE-I REPORT

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(AUTONOMOUS)

OCTOBER 2019

ABSTRACT

In our project Arduino based automatic vehicle engine locking with location tracking system. We hear lot of accidents due to drunken driving. Drunken drivers will not be in stable condition and so rash driving causes inconvenience for other road users. In this project we are developing an Automatic engine lock system.We are introducing a system that will detect drunken driver through alcoholic sensor through fitted on the steering .The controller keeps looking for the output from these sensors. If there are any traces of alcohol above the set limit, then the system will lock the engine. GPS and GSM are used to track the location and the system sends an alert to the owner on his mobile phone or mail as a short message (SMS). By implementing this system in vehicle, a safe journey is possible which would decrease the injuries during accident also reduce the accident rate. Additional features such as mobile call detector and vibration sensor are also included. Mobile call detector is used to detect the incoming and outgoing calls, SMS and video, etc.., and vibration sensor is used for the indication of accident to the police/ambulance.

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LIST OF ABBREVIATIONS

ACRONYMS	ABBREVIATIONS
ADC	Analog to Digital Converter
AVR	Automatic Voltage Regulation
CPU	Central Processing Unit
EEPROM	Electrically Erasable Programmable Read Only Memory
FPGA	Field Programmable Gate Array
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
ICSP	Internet and Computer Service Provider
IDE	Integrated Device Electronics
IoT	Internet of Things
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Multipoint Control Unit
MEMS	Micro Electro Mechanical System
PIC	Programmable Interface Controller
PROM	Programmable Read Only Memory
PWM	Pulse Width Modulation
RTOS	Real Time Operating System
ROM	Read Only Memory
SMS	Short Message Service
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

Now-a-days, many accidents are happening because of the alcohol consumption of the driver or the person who is driving the vehicle. Thus drunk driving is a major reason of accidents in almost all countries all over the world. In this system consists of hardware components are Arduino Uno board, MQ6 Alcohol sensor, Vibrating sensor, Mobile phone detector. GSM and GPS module. The MQ-6alcoholsensor is used to sense the liquor detection and the system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle. At the same time an SMS along with the location of the vehicle is send to the owner of the four wheelers. Additional features such as mobile call detector and vibration sensor are also included. Mobile call detector is used to detect the incoming and outgoing calls, SMS and video, etc.., and vibration sensor is used for the indication of accident to the police/ambulance. Government must enforce laws to install such circuit in every four wheelers and must regulate all four wheelers companies to pre install such mechanisms while manufacturing the four wheelers itself. If this is achieved the deaths due to drunken drivers can be brought to minimum level.

CHAPTER 2

LITERATURE SURVEY

.1 Alcohol Detection and Motor Locking System

International journal of advanced research in electrical, electronics and nstrumentation engineering- vol. 6, issue 2, February 2017

:.1.1 Introduction

Every hour, 40 people which beneath the age of 25 die in highway accidents. And as according to the world fitness organization, road traffic accidents caused an about 1.24 million deaths international within the yr. 2010, slightly down from 1.26 million in 2000. That is one person is died for every 25 seconds. Only 28 international locations, representing 449 million people (7% of the world's population), have well enough legal guidelines that cope with all five danger elements (pace, drink–using, helmets, seat-belts and toddler restraints). Over a third part of street site visitors dying are in low- and middle-earnings countries are among pedestrians and cyclists. However, less than 35% of low and center earnings nations have regulations in area to guard those road users .The important aim of this device is to keep away from the fee accidents which can be usually occurred due to drunkenness of driving force. This device stumble on the drunkenness of driving force and save you them from riding, so this attempt to provide one form of security or protection mechanism to driving force and save stay. There also are lot of coincidence purpose together with excessive pace of automobile, drunken, drowsiness of driver, seat belt adjustment, and keep away from the use helmet that's all cause twist of fate.

2.1.2 Microcontroller AT89C51

Now let us talk about this popular 8051 chip. It has on chip ROM in the form of flash memory. This is ideal for fast development since flash memory can be erased in seconds compared to the twenty minutes or more needed for the 8751. For this reason the AT89C51 is

used in place of the 8751 to eliminate the waiting time needed to erase the chip and thereby speed up the development time. To use the AT89C51 to develop a microcontroller-based system requires a ROM burner that supports flash memory; however, a ROM eraser is not needed. Notice that in flash memory you must erase the entire contents of ROM in order to program it again. This erasing of flash is done by the PROM burner itself.

2.1.3 Result

Our system efficiently checks the accidents occurs or not and drunken driving. By implementing this system in vehicle, a safe journey is possible which would decrease the injuries during accidents and also reduce the accident rate due to drunken driving.

2.1.4 Drawback

The drawback is that it cannot detect the location of vehicle.

2.2 Automatic Engine Locking System through Alcohol Detection in Arduino Using IOT

International Research Journal of Engineering and Technology (IRJET)
www.irjet.net p-ISSN: 2395-0072

2.2.1 Introduction

We hear lot of accidents due to drunk driving and it will not be in stable condition. So it rash driving is the in convenience for other road death for the drunk driver and not for others. In this system uses a compact Arduino Uno board. Programs are developed in embedded C. The main purpose for this project is "Automatic Engine Locking System through Alcohol Detection using Arduino". Most of these days many accidents are happening became of the alcohol detection of the driver or the person who is in the vehicle. Almost all the countries in the world are facing major accidents because of Drunk & Drive. In this project is designed for safety of the people seating the vehicle.

2.2.2 MQ-3 Alcohol sensor

This alcohol sensor is appropriate for distinguishing liquor fixation on your breath, much the same as your normal Breathalyzer. It has a high affectability and quick reaction time. Sensor gives a simple resistive yield in view of liquor fixation. The drive circuit is extremely straight forward; all it needs is one resistor. A basic interface could be a 0-3.3V ADC.

2.2.3 Result

An effective solution is provided to develop the intelligent system for vehicles which will monitor various parameters of vehicle in between constant time period and will sent data to the concerned persons. This is done by using platforms like Arduino, Sensor, DC motor, LCD display.

2.2.4 Drawback

The location of the vehicle cannot be found.

2.3Arduino Based Automatic Engine Locking System for Drunken Drivers.

International journal of innovative research in science, engineering and technology, www.irjet.net p-ISSN: 2395-0072

2.3.1 Introduction

Now-a-days, many accidents are happening because of the alcohol consumption of the driver or the person who is driving the vehicle. Drunk driving is a major reason of accidents in almost all countries all over the world. Alcohol Detector in Car project is designed for the safety of the people seating inside the car. This project should be fitted / installed inside the vehicle. By implementing this design a safe car journey is possible and also drunken drivers can be controlled. Government must enforce laws to install such circuit in every car and must regulate all car companies to preinstall such mechanisms while manufacturing the car itself. If this is achieved the deaths due to drunken drivers can be brought to minimum level. In this

type of system, future scope can be safely landing of car aside without disturbing other vehicles. India had earned the dubious distinction of having more number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India. Drinking and driving is already a serious public health problem, which is likely to emerge as one of the most significant problems in the near future. The system implemented by us aims at reducing the road accidents in the near future due to drunken driving. The system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle. At the same time an SMS along with the location of the vehicle is send to three pre-selected contacts. Future scope of this system is to control the accidents and providing useful details about the accidental vehicle, thereby reducing the rate of accidents taking place due to drunken driving.

2.3.2 Arduino Uno Board

Arduino UNO R3 is a open source micro controller board based on the ATmega 328 chip. This board has 14 digital input/output pins,6analog input pins, Onboard 16 MHZ ceramic resonator, Port for USB connection, Onboard DC power jack, An ICSP header and a micro controller reset button.

2.3.3 Result

In this project we have developed a real time model that can automatically lock the engine when a drunken driver tries to drive a car. By fitting this alcohol sensor into the car, we can save guard the life of the driver and also the remaining passengers.

2.3.4 Drawback

The drawback is, it cannot track the position clearly.

2.4 Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Modem

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering-Vol. 3, Issue 7, July 2014.

2.4.1 Introduction

The high demand of automobiles has also increased the traffic hazards and the road accidents. Life of the people is under high risk. This is because of the lack of best emergency facilities available in our country. An automatic alarm device for vehicle accidents is introduced in this paper. This design is a system which can detect accidents in significantly less time and sends the basic information to first aid centerwithin a few seconds covering geographical coordinates, the time and angle in which a vehicle accident had occurred. This alert message is sent to the rescue team in a short time, which will help in saving the valuable lives. A Switch is also provided in order to terminate the sending of a message in rare case where there is no casualty, this can save the precious time of the medical rescue team. When the accident occurs the alert message is sent automatically to the rescue team and to the police station. The message is sent through the GSM module and the location of the accident is detected with the help of the GPS module. The accident can be detected precisely with the help of both Micro electro mechanical system (MEMS) sensor and vibration sensor. The Angle of the rolls over of the car can also be known by the message through the MEMS sensor. This application provides the optimum solution to poor emergency facilities provided to the roads accidents in the most feasible way.

2.4.2 GSM & GPS Module

GSM is used as a media which is used to control and monitor the transformer load from anywhere by sending a message. It has its own deterministic character. It is also highly economic and less expensive; hence GSM is preferred most for this mode of controlling.GPS is used in vehicles for both tracking and navigation. Tracking systems enable a base station to keep track of the vehicles without the intervention of the driver where, as navigation system

helps the driver to reach the destination. When an accident occurred in any place then GPS system tracks the position of the vehicle.

2.4.3 Result

The proposed Vehicle accident detection system can track geographical information automatically and sends an alert SMS regarding accident. Experimental work has been carried out carefully. The result shows that higher sensitivity and accuracy is indeed achieved using this project.

2.4.4 Drawback

It does not work without network.

2.5 Alcohol Sensing Alert - Engine Locking System by Using Internet of Things (IOT) Technology

International Journal of Technical Innovation in Modern Engineering& Science (IJTIMES)

2.5.1Introduction

Now a day's every system is automated in order to face new challenges. In the present days Automated systems have less manual operations, flexibility, reliability and accurate. Due to this demand every field prefers automated control systems. Especially in the field of electronics automated systems are giving good performance. We usually come across drink and driving cases where drunk drivers crash their cars under the influence of alcohol causing damage to property and life. So here we propose an innovative system to eliminate such cases. Our proposed system would be constantly monitoring the driver breath by placing it on the driver wheel or somewhere the driver's breath can be constantly monitored by it. So if a driver is drunk and tries to drive the system detects alcohol presence in his/her breathe and locks the

engine so that the vehicle fails to start. In another case if the driver is not drunk while he starts the vehicle and engine is started but he/she drinks while driving the sensor still detects alcohol in his breath and stops the engine so that the car would not accelerate any further and driver can steer it to roadside. In this system we use an AVR family microcontroller interfaced with an alcohol sensor along with an LCD screen and a dc motor to demonstrate the concept. So here the alcohol sensor is used to monitor uses breath and constantly sends signals to the microcontroller.

2.5.2 IoT

Internet of Things (IoT) is an eco-community of associated physical items that are available through the web. The 'thing' in IoT could be a man with a heart screen or a vehicle with worked in-sensors, i.e. objects that have been appointed an IP address and can gather and exchange information over a system without manual help or mediation.

2.5.3 Result

The "Ignition Interlock by Alcohol Breath Analyzer using IOT Technology" was designed such that the driver alcohol content is transmitted to the owner on his mobile phone as a short message (SMS) at his request. The microcontroller gets the information regarding the alcohol through the alcohol sensor.

2.5.4 Drawback

The main drawback is that the exact location cannot be detected and they may not work properly at sometimes.

2.6 Automatic Accident Detection and Alerting System Based on IOT

(International Journal of Innovative Research in Computer and Communication Engineering- An ISO 3297: 2007 Certified Organization)

2.6.1 Introduction

Transportation has great importance in our daily life and its development has made many of our chores much easy. But it can cause disaster to us and even can kill us through accidents. During 2008, Road Traffic Injuries ranked fourth among the leading causes of death in the world. Nearly 1.3 million people die every year on the world's roads and 20 to 50 million people suffer non-fatal injuries, with many sustaining a disability as a result of their injury. Road traffic injuries are the leading cause of death among young people aged 15-29 years and cost countries 1-3% of the gross domestic product (GDP). If no action is taken, road traffic crashes are predicted to result in the deaths of around 1.9 million People annually by 2020.The purpose of project is to find the vehicle where it is and locate the vehicle by means of sending location using a system which is placed inside of vehicle system. Most of the times we may not be able to find accident location because we don't know where accident will happen. In order to give treatment for injured people, first we need to know where the accident happened through location tracking and sending a message to your related one or to the emergency services.

2.6.2 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

2.6.3 Result

The system provides the design which has the advantages of low cost, portability and small size. The platform of the system is IDE along with accelerometer sensor, GPS and GSM,

interfacing which reduces the alarm time to a large extent and locates the site of accident accurately.

2.6.4 Drawback

The great maintenance is requires at the track location.

2.7 Programmed Engine Locking System by Automatically Detecting Drunken Drivers.

International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 11, November 2011

2.7.1 Introduction

The employments of installed frameworks are basically boundless, in light of the fact that consistently new items are acquainted with the business sector that uses inserted PCs in novel ways. As of late, equipment, for example, microprocessors, micro controllers, and FPGA chips have turned out to be much less expensive. So while actualizing another type of control, it's savvier to simply purchase the nonexclusive chip and compose your own custom programming for it. Creating a uniquely crafted chip to handle a specific errand or set of assignments expenses much additional time and cash. Numerous inserted PCs even accompany broad libraries, so that "written work your own particular programming" turns into an exceptionally insignificant undertaking to be sure. From a usage perspective, there is a noteworthy contrast between a PC and an inserted framework. Implanted frameworks are frequently required to give Real-Time reaction. The primary components that make implanted frameworks exceptional are its unwavering quality and straightforwardness in troubleshooting.

2.7.2 AT89S52 Microcontroller

The Intel 8052 is Harvard architecture, single chip microcontroller (µC) which was developed by Intel in 1987 for use in embedded systems. 8052 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bits has to be broken

into 8-bit pieces to be processed by the CPU. 8052 is available in different memory types such as UV-EPROM, Flash and NV-RAM.

2.7.3 Result

Coordinating elements of all the equipment parts utilized have been created as a part of it. Vicinity of each module has been contemplated out and set deliberately, in this manner adding to the best working of the unit.

2.7.4 Drawback

The drawback is that, it cannot detect the location of the vehicle.

2.8 Liquor Detection through Automatic Motor Locking System

2.8.1 Introduction

Now-a-days we hear about lot of accidents due to drunken driving. Drunken drivers will not be in stable condition and so the rash driving is the inconvenience for other road users and also question of life and death for the drunken drivers, also for others. In this project, we are developing an Auto Lock System. The input for the system is from Detection Sensors either from Alcohol Breath or any other mechanism. The controller keeps looking for the output from these sensors. If there are any traces of Alcohol above the set limit, then the system will lock the Engine. Here a simulating process is activated using a DC motor through the relay and the complete process is under the supervision of an intelligent AT89c51 microcontroller. Even though efficient set up of requirements have been adopted for the traditional methods it may not be sufficient and that much protective for such a complex method, whereas here in this process this could be a better idea of inserting the complete state of art design into the system.

2.8.2 MQ3 Alcohol Sensor

The alcohol sensor (MQ3) is efficient among all the other sensors with fast response, high sensitivity, stable life and also a simple drive circuit. In brief the sensitivity is always improved by the variable load resistor i.e the sensitivity is proportional to the resistor load.

2.8.3 Result

Finally after the design of system the input is identified by the sensor through the breathe of a human. In the next scenario the levels of alcohol is measured by the sensor and compared with the set-in limits. If the set limit of consumption in alcohol is less than the alcohol consumed by the person the system of activating relay is initiated which in turn activities the automatic lock on the vehicle i.e., stops the motor if it is in running state or it is unable to start.

2.8.4 Drawback

The location tracking is not possible.

2.9 Alcohol Detection System in Vehicle Using Arduino

International Research Journal of Engineering and Technology (IRJET)

Volume: 04 Issue: 06 | June -2017

2.9.1 Introduction

Drinking and driving is already a serious public health problem ,which is likely to merge as one of the most significant problems in near future .the system implemented by us ims at reducing the road accident in the near future due to drunken and drive . This paper resent the progress in using the alcohol detector ,a device that senses a change in the coholic gas content of the surrounding air these device is more commonly referred to as a

breath analysis, as it analysis the alcohol content from person's breath. The system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle.

2.9.2 Arduino Board

The Arduino board is the central unit of the system. The Arduino Uno is the microcontroller board based on the ATmega 328. It is a programmable microcontroller for prototyping electromechanical devices. It has 14 digital inputs/output pins (of which 6 can be used as PWM output), 6 analog inputs, a 16 MHz ceramic resonators the arduino differs from all preceding board is that it does not use the FTDI USB to serial driver chip.

2.9.3 Result

We have provided a very effective solution to develop an intelligent system for vehicles for alcohol detection whose core is Arduino. Future scope of this system is to control the accidents causes due to alcohol consumption. This system improves the safety of human being. And hence providing the effective development in the automobile industry regarding to reduce the accidents.

2.9.4 Drawback

This system is not suitable for location tracking and it's only used for engine locking system.

2.10 Alcohol Detection and Vehicle Controlling

International Journal of Engineering Trends and Applications (IJETA)

– Volume 2 Issue 2, Mar-Apr 2015

2.10.1 Introduction

India had earned the dubious distinction of having more number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India. Drinking and driving is already a serious public health problem, which is likely to emerge as one of the most significant problems in the near future. The system implemented by us aims at reducing the road accidents in the near future due to drunken driving. The system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle. At the same time an SMS along with the location of the vehicle is send to three pre-selected contacts. Hence the system reduces the quantum of road accidents and fatalities due to drunk driving in future.

2.10.2 Arduino Microcontroller Board

The Arduino board is the central unit of the system. The Arduino Uno is a microcontroller board based on the ATmega328. It is a programmable micro controller for prototyping electromechanical devices.

2.10.3 Result

An effective solution is provided to develop the intelligent system for vehicles which will monitor various parameters of vehicle in-between constant time period .The designed system would finish the function of communicating GPS, GSM and control of various parameters. Future scope of this system is to control the accidents and providing useful details about the accidental vehicle, thereby reducing the rate of accidents taking place due to drunken driving.

2.10.4 Drawback

It need more cost and more maintenances.

2.11 Summary of Literature Review

Table 2.1 Summary of literature review

S.NO.	Technique	Principle	Drawbacks
1	**Alcohol Detection and Motor Locking System**	They had use PIC 16876A controller, Alcohol sensor, LCD Display And Alarm system to notify driver only, Ignition system was immediately off when detected alcohol.	It does not work without network.
2	**Automatic Engine locking System Through Alcohol Detection in Arduino using IOT**	This system uses MQ3 alcohol sensor with arduino along with GSM module to send message notification for users numbers and LCD Display to identify the alcohol is detected or not and DC motor to sense by the alcohol and it automatically stop the motor.	The drawback is that it cannot detect the location of vehicle.
3	**Arduino Based Automatic Engine Locking System for Drunken Drivers**	The input for the system is from Detection Sensors either from Alcohol Breath or any other mechanism. The controller keeps looking for the output from these sensors. If there are any traces of Alcohol above the set limit, then the system will lock the Engine	The location of the vehicle cannot be found.

4	**Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Modem**	The vehicle accident detection system can track geographical information automatically and sends an alert SMS regarding accident	The drawback is, it cannot track the position clearly.
5	**Alcohol sensing alert-engine locking system by using internet of things (IOT) technology.**	The microcontroller on encountering high alcohol signal from the alcohol sensor displays alcohol detection note on LCD screen and also stops the dc motor to demonstrate as engine locking.	The main drawback is that the exact location cannot be detected and they may not work properly at sometimes.
6	**Automatic Accident Detection and Alerting System Based on IOT**	The purpose of the project is to find the vehicle where it is and locate the vehicle by means of sending a message using a system which is placed inside of vehicle system	The great maintenance is requires at the track location.

7	**Programmed Engine Locking System by Automatically Detecting Drunken Drivers**	The purpose of the project is to find the vehicle where it is and locate the vehicle by means of sending a message using a system which is placed inside of vehicle system using AT89S52 microcontroller programming.	The drawback is that, it cannot detect the location of the vehicle.
8	**Liquor Detection through Automatic Motor Locking System**	The microcontroller keeps looking for the output from these sensors. If there are any traces of Alcohol above the set limit, then the system will lock the Engine. Here a simulating process is activated using a DC motor through the relay and the complete process is under the supervision of an intelligent AT89c51 microcontroller.	The location tracking is not possible
9	**Alcohol Detection System in Vehicle Using Arduino**	This project using the alcohol detector ,a device that senses a change in the alcoholic gas content of the surrounding air these device is more commonly referred to as a breath analysis, as it analysis the alcohol content from person's breath. The system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle.	This system is not suitable for location tracking and it's only used for engine locking.
10	**Alcohol Detection and Vehicle Controlling**	We propose the detection of alcohol using alcohol detector connected to Arduino such that when the level of alcohol crosses a permissible limit, the vehicle ignition system will turn off the present location.	It need more cost and more maintenances.

CHAPTER 3

THEORETICAL BACKGROUND

3.1 Introduction

These years, the cases of traffic accident caused by drunk driving have increased rapidly. More and more people have realized that the drunk driving does great harm to public security. It's time to develop a kind of system which can stop the drunk driving effectively. We try to develop this system which is available on every car.

This project should be fitted / installed inside the vehicle. By implementing this design a safe car journey is possible and also drunken drivers can be controlled. Government must enforce laws to install such circuit in every car and must regulate all car companies to preinstall such mechanisms while manufacturing the car itself. If this is achieved the deaths due to drunken drivers can be brought to minimum level. In this type of system, future scope can be safely landing of car aside without disturbing other vehicles. India had earned the dubious distinction of having more number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India.

Drinking and driving is already a serious public health problem, which is likely to emerge as one of the most significant problems in the near future. The system implemented by us aims at reducing the road accidents in the near future due to drunken driving. The system detects the presence of alcohol in the vehicle and immediately locks the engine of the vehicle. At the same time an SMS along with the location of the vehicle is send to three pre-selected contact.

3.2 Proposed System

Alcohol detection in vehicle system is continuously growing over years which could resolve drunken driving accidents worldwide. The Project Consists Arduino UNO board, MQ3-Alcohol Sensor, Buzzer, Rectifier Regulator, LCD Display, DC Motors, GSM Module &GPS Module. This project is used to sense the liquor detection using MQ3 Sensor and stop the running of dc motor using arduino programmer. Vehicle location will be traced using GPS and GSM module and send the location & message to the end user.

In this proposed system uses MQ3 alcohol sensor with arduino along with GSM module to send message notification for users numbers and LCD Display to identify the alcohol is detected or not and DC motor to sense by the alcohol and it automatically stop the motor. And the system check the permissible limit then the sensor will be triggered the processor about the respective voltage. Thus the system will automatically stop the motor and it send message to the users. Additional features such as mobile call detector and vibration sensor are also included. Mobile call detector is used to detect the incoming and outgoing calls, SMS and video, etc.., and vibration sensor is used for the indication of accident to the police/ambulance.

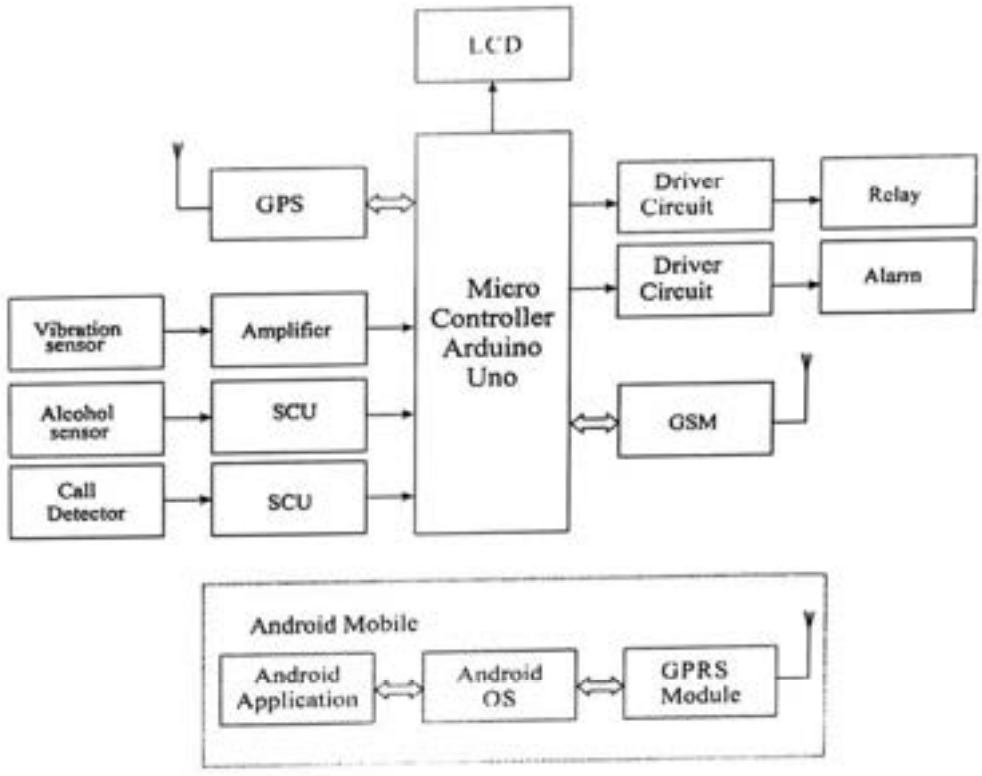


Figure 3.1 Block diagram of Liquor detection& Automatic Engine locking System

3.2.1 Arduino UNO board

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

3.2.2 MQ-6 Alcohol Sensor

Sensitive material of MQ-6gas sensor is SnO2, which with lower conductivity in clean air. When the target flammable gas exist, the sensor's conductivity gets higher along with the gas concentration rising. MQ-6gas sensor can detect kinds of flammable gases, especially has high sensitivity to LPG (propane). It is a kind of low-cost sensor for many applications.

3.2.3 GSM Module

Global System for Mobile Communication is used as a media which is used to control and monitor the transformer load from anywhere by sending a message. It has its own deterministic character. Thereby, here GSM is used to monitor and control the DC motor, Vibrating sensor, Alcohol sensor and Mobile call detector by sending a message through GSM modem.

3.2.4 GPS Module

Global Positioning System is used in vehicles for both tracking and navigation. When an accident occurred in any place then GPS system tracks the position of the vehicle and sends the information to the particular person through GSM by alerting the person through SMS or by a call.

3.2.5 DC Motors

A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a uniform magnetic field, it experiences a mechanical force ".

3.2.6 Motor Driver

A driver is an electrical circuit or other electronic component used to control another circuit or other component, such as a high-power transistor.

3.2.7 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such line.

3.2.8 Regulator

A voltage regulator is used to produce a constant linear output voltage. It's generally used with AC to DC power supply. And also it can be used as well as a DC to DC voltage convertor.

3.2.9 Rectifier

Rectifier is converted into Ac into pulsating Dc. A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

3.2.10 Buzzer

A Buzzer or beeper is an audio signaling device. It may be A mechanical, electro mechanical, magnetic, electromagnetic, electro–acoustic or piezoelectric audio signaling device. A click, beep or ring can indicate that a button has been pressed.

3.2.11 Power supply

Rechargeable battery, storage battery, secondary cell or accumulator is a type of electrical battery which can be charged, discharged into load and recharged many times.

3.2.12 Vibration Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal.

3.2.13 Mobile Call Detector

It is also useful for detecting the use of mobile phone for spying and un-authorized video transmission. This must detect the incoming and outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode.

3.2.14 Water Valve

A solenoid valve is an electro mechanical valve for use with liquid or gas controlled by running or stopping an electrical current through a solenoid, which is a coil of wire, thus changing the state of the valve.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware Requirements

- Arduino UNO board
- MQ6-Alcohol Sensor
- Buzzer
- Rectifier
- Regulator
- LCD Display
- DC Motors
- GSM Module
- GPS Module
- Water valve
- Driver circuit
- Vibrating Sensor
- Mobile call detector
- Power Supply

4.1 Hardware Requirements

4.1.1 Arduino UNO board

The Arduino board is the central unit of the system.

Introduction:

The Arduino Uno is a microcontroller board based on the ATmega328. It is a programmable micro controller for prototyping electromechanical devices. You can connect Digital and Analog electronic signals:

- Sensors (Gyroscopes, GPS Locators, accelerometers)
- Actuators (LEDS or electrical motors)

It has 14 digital Input / output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic Resonator, a USB connection, a power jack, an ICSP header and a reset button as shown in figure 2. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed.

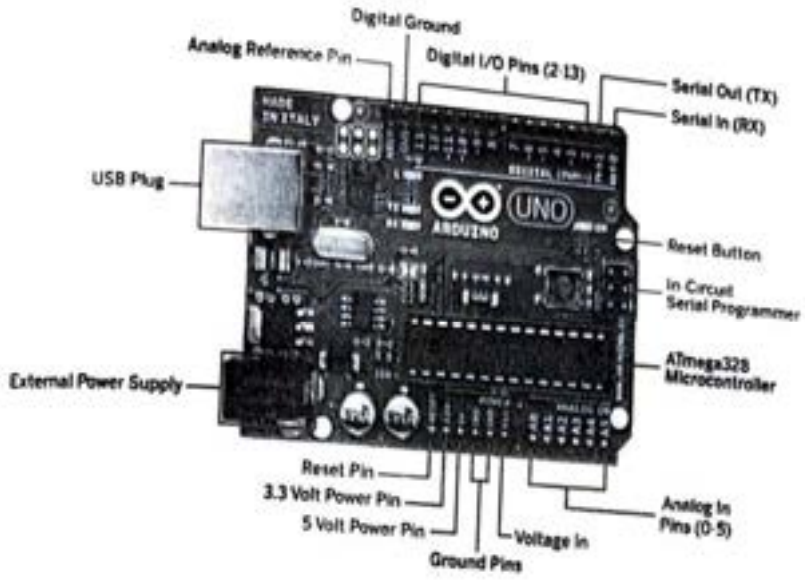


Figure4.1 Arduino Board Description

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Figure4.2 Arduino Board

Getting Started

You can find in the Getting Started section all the information you need to configure your board, use the Arduino Software (IDE), and start tinker with coding and electronics.

Technical specs

TABLE 4.1 Arduino Board Features

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P)

SRAM	of which 0.5 KB used by bootloader
EEPROM	2 KB (ATmega328P)
Clock Speed	1 KB (ATmega328P)
Length	16 MHz
Width	68.6 mm
Weight	53.4 mm
	25 g

4.1.2 Alcohol Sensor MQ-6

Sensitive material of MQ-6gas sensor is SnO2, which with lower conductivity in clean air. When the target flammable gas exist, the sensor's conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivityto correspond output signal of gas concentrationthrough a simple circuit.MQ-6gas sensor can detect kinds of flammable gases, especially has high sensitivitytoLPG (propane). It is a kind of low-cost sensor for many applications.

Features

- High sensitivity to LPG, iso-butane, propane
- Small sensitivity to alcohol, smoke.
- Fast response.
- Stable and long life
- Simple drive circuit

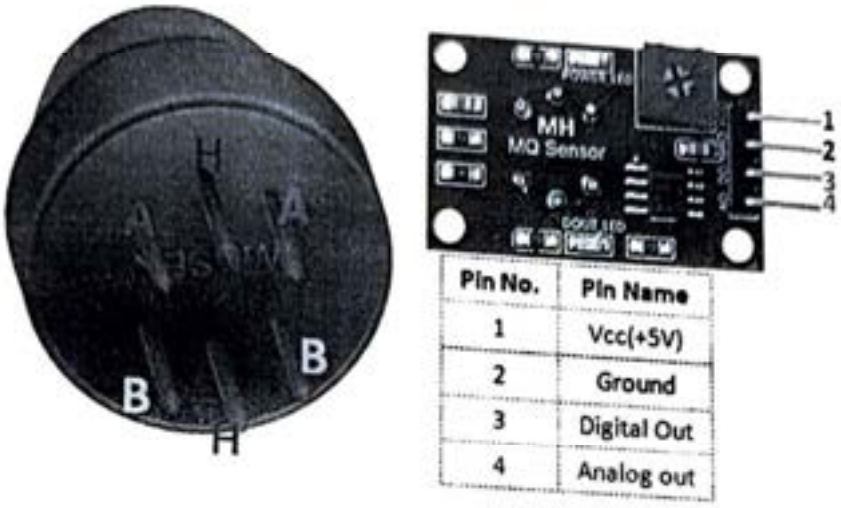
Sensitivity Adjustment

Resistance value of MQ-6 is difference to various kinds and various concentration gases. So, when using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for1000ppm of LPG concentration in air and use value of Load resistance (RL) about 20KΩ(10KΩ to 47KΩ).When accurately measuring. the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

TABLE 4.2 Alcohol Sensor MQ-6 Features

Model No.		MQ-6
Sensor Type		Semiconductor
Standard Encapsulation		Bakelite, Metal cap
Detection Gas		LPG
Concentration		300-10000ppm (propane)
circuit	Loop voltage	≤ 24V DC
	Heater voltage	5.0V ±0.1V AC or DC
	Load resistance	Adjustable
character	Heater resistance	26 Ω± 3Ω (Room Temp)
	Heater consumption	≤ 950 Mw
	Sensitivity	RS (in air)/RS (in 2000ppm C3H8) ≥5
	Output Voltage	2.5V-4.0V(in 2000ppm C3H8)
	Slope	≤ 0.6 (R3000ppm/R1000ppm C3H8)
condition	Temp. humidity	20°C±2°C; 55%± 5%RH
	Standard test circuit	VC:5.0V ±0.1V; VH:5.0V ±0.1V
	Pre heat time	over 48hours
	Fast response Time	<10s

Figure 4.3 MQ-6 Sensor



Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

Figure 4.4 MQ6-Gas Sensor Pin out

Application

They are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, iso-butane, propane, LPG, avoid the noise of alcohol and cooking fumes and cigarette smoke.

4.1.3 GSM Module

The GSM net used by cell phones provides a low cost, long range, wireless communication channel for applications that need connectivity rather than high data rates.

chinery such as industrial refrigerators and freezers, HVAC, vending machines, vehicle vice etc. could benefit from being connected to a GSM system.

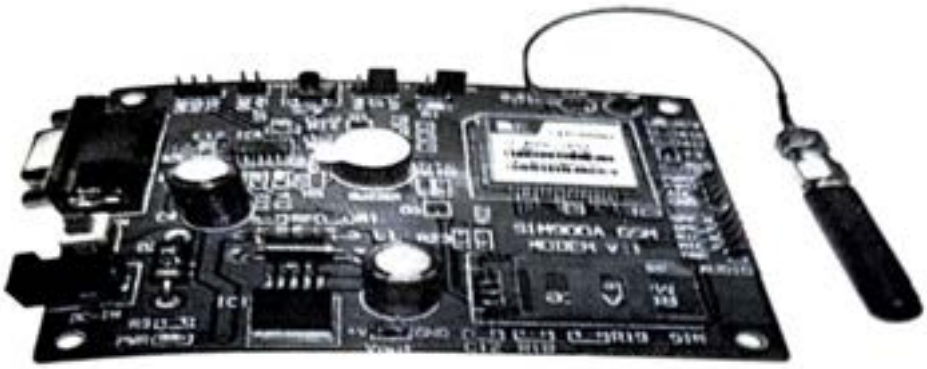


Figure 4.5 GSM Module

Take a given example. A garage offers a very special package to their customers. ased on the mechanics knowledge and the given vehicle, tailored service intervals can be ecified. A part of the service agreement is installation of a GSM modem in the vehicle. n on board service application can then notify the garage when the vehicle approaches s service interval. The garage will schedule an appointment and inform the customer.

The customer will benefit from a reliable and well-serviced vehicle at a minimum ost. The garage on the other hand can provide excellent customer support, vehicle atistics, efficient work scheduling, and minimum stocks.

This application note describes how to use an AVR to control a GSM modem in a ellular phone. The interface between modem and host is a textual protocol called Hayes T-Commands. These commands enable phone setup, dialing, text messaging and many uch features.

4.1.4 GPS Module

The Global Positioning System (GPS) is a space based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

Figure 4.6 GPS Module

TABLE 4.4 GPS module features

Chipset	SiRF Star III
Frequency	L1, 1575.42 MHz
C/A code	1.023 MHz chip rate
Channels	20 channel
Sensitivity	-159 dBm
Position	10 meters
Velocity	0.1 m/s

Time	1μs synchronized to GPS time
Default	WGS-84
Electrical level	0V ~ 2.85V RS-232
Baud rate	4,800 bps
Dimension	30mm*30mm*10.5mm ± 0.2mm
Operating temperature	-40°C to +85°C
Acceleration	Less than 4g
Main power input	4.5V ~ 6.5V DC
Power consumption	44mA
Reacquisition average	0.1 sec.,
Hot start average	1 sec.,

GPS devices may have capabilities such as:

- Maps, including streets maps, displayed in human readable format via text or in a graphical format turn-by turn navigation directions to a human in charge of a vehicle or vessel via text or speech.
- Directions fed directly to an autonomous vehicle such as a robotic probe.
- Traffic congestion maps (depicting either historical or real time data) and suggested alternative directions.
- Information on nearby amenities such as restaurants, fueling stations, and tourist attractions.

Figure 4.7 GPS Location tracking system

Other GPS devices need to be connected to a computer in order to work. This computer can be a home computer, laptop, PDA, digital camera, or smart phones. Depending on the type of computer and available connectors, connections can be made through a serial or USB cable, as well as Bluetooth, Compact Flash, SD, PCMCIA and the newer Express Card. Some PCMCIA/Express Card GPS units also include a wireless modem.

4.1.5 Liquid Crystal Display

Introduction

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Figure4.8 LCD Display

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

Features

- 5 x 8 dots with cursor
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

4.1.6 DC Motor

This DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of dc motor established. The direction of rotation of a this motor is given by Fleming's left hand rule,

which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which force is experienced by the shaft of the dc motor.

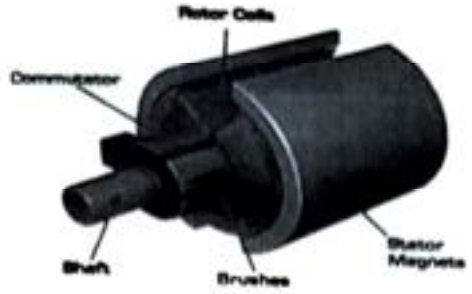


Figure 4.9 DC motor principle and construction

Structurally and construction wise a direct current motor is exactly similar to a DC generator, but electrically it is just the opposite. Here we unlike a generator we supply electrical energy to the input port and derive mechanical energy from the output port. We can represent it by the block diagram shown below.

Here in a DC motor, the supply voltage E and current I is given to the electrical port or the input port and we derive the mechanical output i.e. torque T and speed ω from the mechanical port or output port. The input and output port variables of the direct current motor are related by the parameter K.

$$T=KI \text{ and } E=Kw \quad \ldots\ldots\ldots 4.1$$

Figure4.10 Dc moto

4.1.7 Dc Motor Driver

In electronics, a driver is an electrical circuit or other electronic component used to control another circuit or other component, such as a high-power transistor. The term is used, for example, for a specialized computer chip that controls the high-power transistors in AC-to-DC voltage converters. An amplifier can also be considered the driver for loudspeakers, or a constant voltage circuit that keeps an attached component operating within a broad range of input voltages.

The following circuit will allow you to drive a 12V relay using logic voltage (an input of 4V or greater will trip the relay). The circuit has its own 12V power supply making itself contained but the power supply portion can be left out if an external supply will be used. The circuit shows an output from the power supply that can be used to power other devices but it should be noted that the supply is unregulated and not particularly powerful with the parts stated. The 12V DC output is suitable for powering a few LEDs or low voltage lights but should not be used to power other electronic boards or motors.

Using Transistor

Single direction control

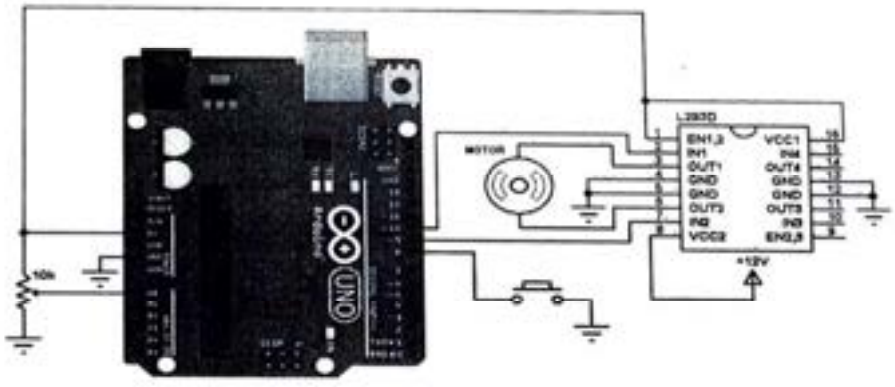


Figure 4.11 Arduino DC Motor control

Using L293D/L298

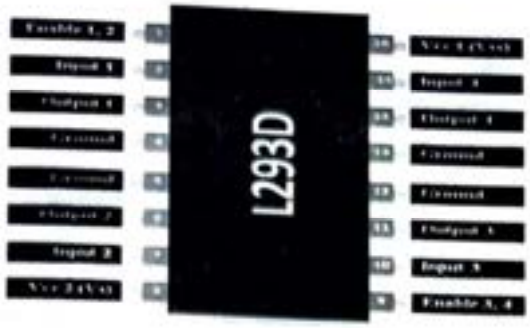


Figure 4.12L293D pin configuration

4.2.8 Power supply

Power supply unit (or PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use switched-mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage

Rechargeable battery, storage battery, secondary cell or accumulator is a type of electrical battery which can be char Rechargeable battery, storage battery, secondary cell or accumulator is a type of electrical battery which can be charged, discharged into load and recharged many times.

Block diagram

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

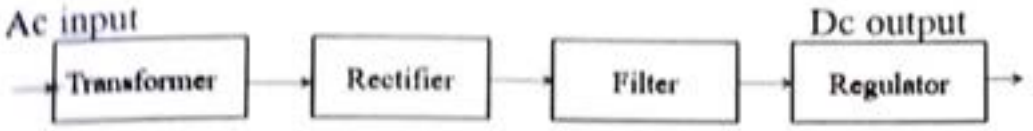


Figure4.13 Block diagram (Power supply)

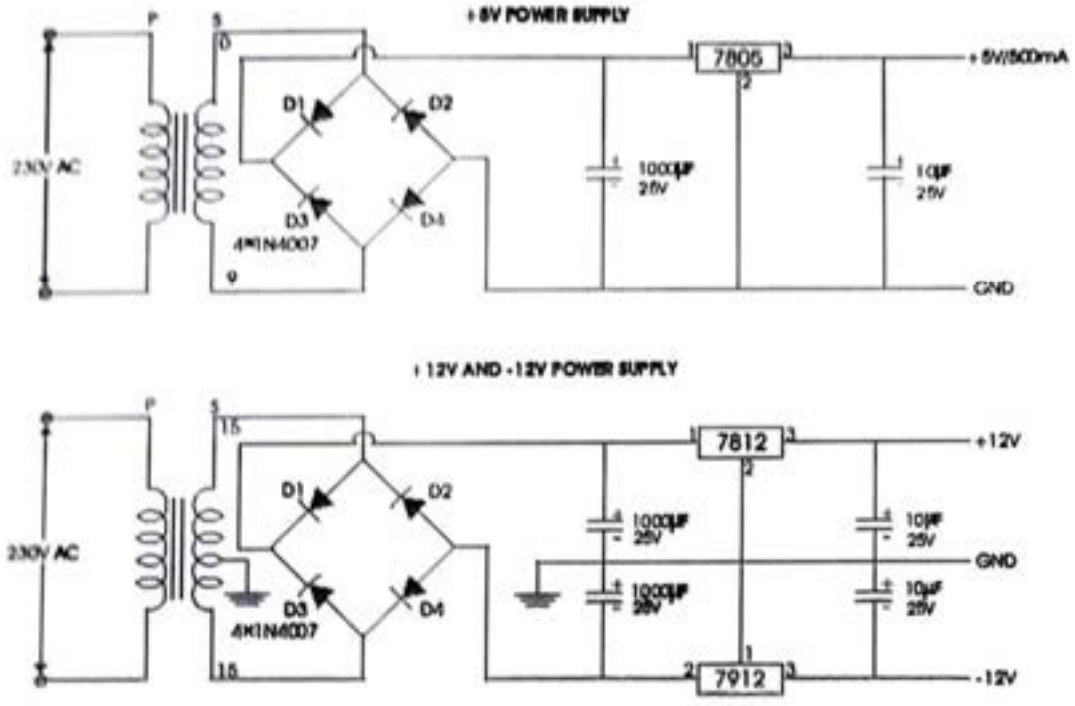


Figure 4.14 Circuit diagram (Power supply)

4.1.9 Regulator

A voltage regulator is used to produce a constant linear output voltage. It's generally used with AC to DC power supply. And also it can be used as well as a DC to DC voltage convertor.

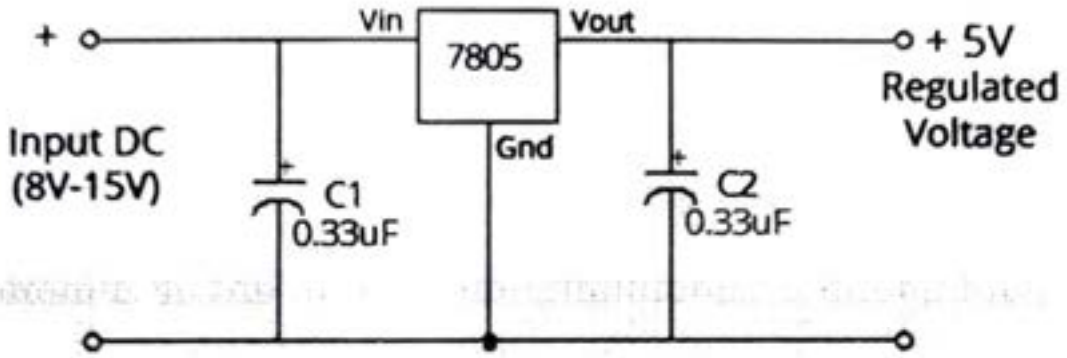


Figure4.16 voltage regulator circuit

To regulating low voltage, most used device is one single IC. 7805, 7812, 7905 etc. 78xx series are design for positive and 79xx series are for Negative voltage regulator. 7805 is a three terminal +5v voltage regulator IC from 78XX chips family. See 7805 pin out below. LM78XX series are from National Semiconductor. They are linear positive voltage regulator IC; used to produce a fixed linear stable output voltage.

4.1.10 Rectifier

Rectifier is converted into Ac into pulsating DC. A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

Before the development of silicon semiconductor rectifiers, vacuum tube thermionic diodes and copper oxide or selenium-based metal rectifier stacks were used. With the introduction of semiconductor electronics, vacuum tube rectifiers became obsolete, except for some enthusiasts of vacuum tube audio equipment. For power rectification from very low to very high current, semiconductor diodes of various types (junction diodes, Schottky diodes, etc.) are widely used. Other devices that have control electrodes as well as acting as unidirectional current valves are used where more than simple rectification is required e.g., where variable output voltage is needed. High-power rectifiers, such as those used in high-voltage direct current power transmission, employ silicon semiconductor devices of various types. These are thyristors or other controlled switching solid-state switches, which effectively function as diodes to pass current in only one direction.

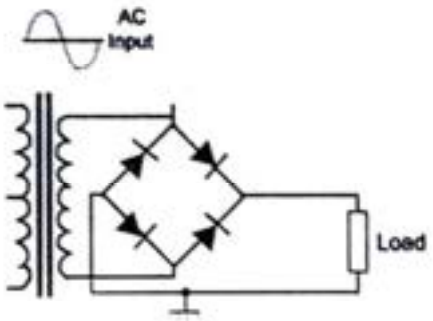


Figure4.17 Rectifier

4.1.11 Buzzer

Buzzer is the convenient sound generator utilized as a part of electronic circuits to give sound sign. It is broadly utilized as caution generator in electronic gadgets. It is accessible in different sorts and size to suit the prerequisites. A Piezo bell has a Piezo circle and an oscillator inside. At the point when the ringer is controlled, the oscillator

creates a recurrence around 2-4 kHz and the Piezo component vibrates as needs be to deliver the sound. A conventional Piezo bell works between 3 – 12 volts DC.

Features

- The PS series are high performance buzzers that employ uni-morph piezoelectric elements and are designed for easy incorporation into various circuits.
- They feature extremely low power consumption in comparison to electromagnetic units.
- Because these buzzers are designed for external excitation, the same part can serve as both a musical tone oscillator and a buzzer.
- They can be used with automated inserters, moistureresistant models are also available.

Figure 4.18 Buzzer

4.1.12 VIBRATION SENSOR

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal.

Vibration sensor is used originally as vibration switch because of its high sensitivity; it is sensitive to environment vibration, and generally used to detect the ambient vibration strength.

Figure 4.19 vibration sensor

Table 4.5 Vibration sensor features

Model name	SW -18010P
Type	Vibration sensor switch
Material	Metal ,PVC
Supply voltage	3.3V to 5V
Current	< 50 mA
PCB board size	3.2 cm× 1.4 cm
Closed resistance	< 30 ohm
open resistance	> 10M ohm
Output form	Digital switch output(0&1)
Temperature range	Storage:-40˚C-85˚CC, Operating:-25˚CC to 85˚C
Conductive time	2ms
Humidity	95%RH,40˚C for 96 hours

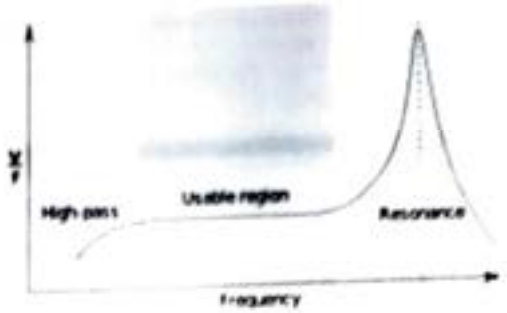


Figure 4.20 Frequency response of a piezoelectric sensor: Output voltage vsapplied force.

Sensing materials

Two main groups of materials are used for piezoelectric sensors: piezoelectric ceramics and single crystal materials. The ceramic materials (such as PZT ceramic) have a piezoelectric constant / sensitivity that is roughly two orders of magnitude higher than those of single crystal materials and can be produced by inexpensive sintering processes. The less sensitive crystal materials (gallium phosphate, quartz, and tourmaline) have a much higher – when carefully handled, almost infinite – long term stability.

4.1.13 MOBILE CALL DETECTOR

A digital telecommunication, pulse shaping is the process of changing the waveform of transmitted pulses. Its purpose is to make the transmitted signal better suited to the communication channel by limiting the effective bandwidth of the transmission. By filtering the transmitted pulses this way, the intersymbol interference caused by the channel can be kept in control. In optics, femtosecond pulse shaping is a technique that modifies the temporal profile of an ultra-short pulse from a laser. Pulse shaping can be used to shorten/elongate the duration of optical pulse, or to generate more complex pulses.

Use of Cell Phone Detector

It is also useful for detecting the use of mobile phone for spying and un-authorized video transmission. Certain places where use of mobile phones are not allowed like exam hall, temple, offices and theaters. in those places to detect and restrict the use of mobile phones this proposed system is very helpful. This must detect the incoming and outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode. The illegal use of cell phones is a growing and dangerous problem in correctional institutions worldwide. These devices are a significant threat to prison security and circumvent the monitoring processes in prisons, while helping inmates commit new crimes both inside and outside the facility.

TABLE 4.6 Mobile Call Detector Features

Technology Used	RF Technology
Frequency range	0.9 to 3 GHz
Wavelength	3.3 to 10 cm
Transmitter power	20 -100 watts
Transistors output	10mV
Bandwidth Resolution	2MHz
Bandwidth	824 - 894 MHz band
Sensitivity	-60 dBm
Coverage	40 to 50 foot radius

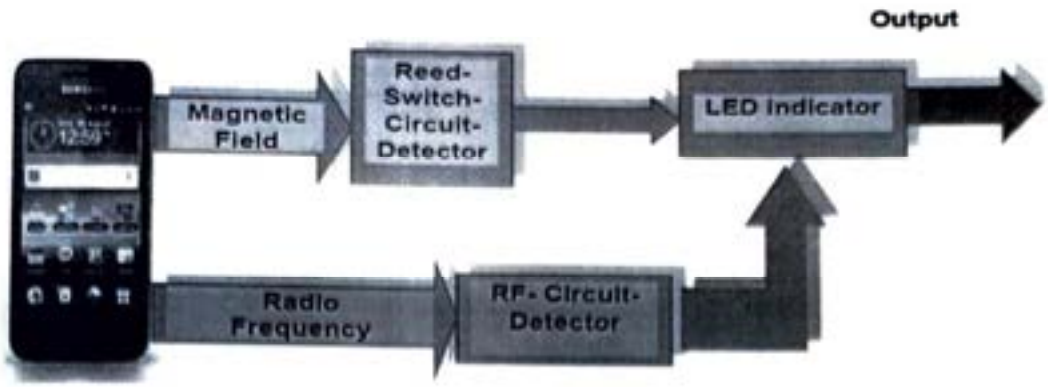


Figure 4.21 Block Diagram for RF Technology

4.1.14 WATER VALVE

A Water valve is an electro mechanical valve for use with liquid or gas controlled by running or stopping an electrical current through a solenoid, which is a coil of wire, thus changing the state of the valve. The operation of a solenoid valve is similar to that of a light switch, but typically controls the flow of air or water, whereas a light switch typically controls the flow of electricity. Solenoid valves may have two or more ports: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened or closed while the valve is not activated.

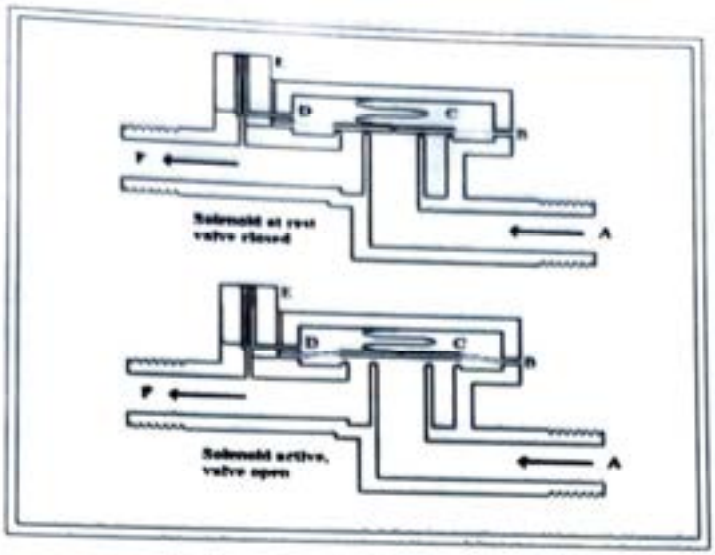


Figure 4.22 Solenoid Water Valve Structure

A- Input side

B- Diaphragm

C- Pressure chamber

D- Pressure relief conduit

E- Solenoid

F- Output side

Figure 4.23water valve

Table 4.7 Water Valve Features

Product name	Water Valve
Voltage	DC 12V-DC 24V
Power	6.5 W
Product material	PP (Polypylene)
Sealing material	EPDM
Working Temperature	1°C -75°C
Starting pressure	0-8 Bar
Coil resistance	37.5 ohms
Response Time(open)	≤ 0.15 sec
Response Time(close)	≤ 0.3 sec
Actuating time	≥ 50 million cycles
Dimensions	3 "× 2.25"× 2"
Weight	4.3 oz

4.2 Software Component

- Arduino IDE

CHAPTER 5

RESULT AND DISCUSSIONS

In this project we have developed a real time model in embedded system. By fitting the alcohol sensor in the steering of the four wheeler that can automatically lock the engine when a drunken driver tries to drive a car. With the help of GPS and GSM, we can track the location and send the message to the user. We can save the life of driver and also the passengers. The proposed method is verified to be a highly beneficial for the automotive industry. The kit shown in figure.5.1

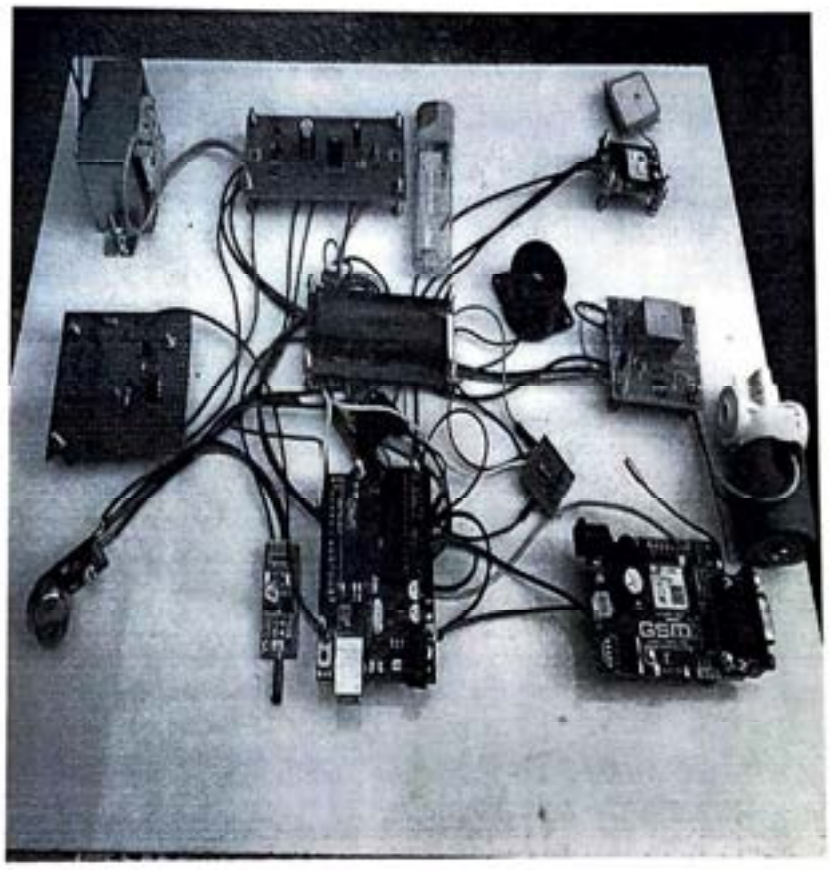


Figure 5.1 Hardware Kit

CHAPTER 6

WORK TO BE DONE IN PHASE II

CONCLUSION

By implementing this system in vehicle, a safe journey is possible which would reduce the accident rate due to drunken driving. This system has the accident prevention technology which would sense the alcohol breath. If there any trace of alcohol set limit, then the system will stop the engine and track the location with sent the message to the pre-defined number. Additional features such as mobile call detector and vibration sensor are also included. Whenever accident occurs, Vibration sensor is used for the indication of accident to the user and Mobile call detector is used to detect the incoming and outgoing calls, and SMS etc.,

APPENDIX

Arduino Software Code

```
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
#include <EEPROM.h>
LiquidCrystal lcd(13,12,11,10,9,8);
#define pul 5
#define mob 6
#define rlyy 7
#define alm 4
char a[60],lat[25],lon[25],b[10],sec6=0,beat;
char j=0,jj=0;
unsigned char rly[4],speed1,spe,speed2;
int ii;
unsigned char mobile1[12],g=0,mov_val,val,aq=0;
unsigned char xax,yax,zax;
unsigned char a1,a2,inte;
unsigned char a3,a4,a5,a6,bb;
unsigned int i,qq,alc;
unsigned char var11,var12,var10;
void monitoring();
void sending_sms();
void keypad1();
void gsm_init();
void serialEvent();
//void decimal2(char a,char b,unsigned char val);
void decimal3(unsigned int);
SoftwareSerial mySerial(2, 3);
```

```
void setup()
{
 pinMode(alm, OUTPUT);
 pinMode(rlyy, OUTPUT);
pinMode(pul, INPUT_PULLUP);
pinMode(mob, INPUT_PULLUP);
//pinMode(pul, INPUT_PULLUP);
 lcd.begin(16, 2);
 Serial.begin(9600);
 mySerial.begin(9600);
 lcd.setCursor(0,0);
 lcd.print("----------------");
 lcd.setCursor(0,1);
 lcd.print("----------------");
 // pinMode(speed1,INPUT);
// digitalWrite(set,HIGH);
 digitalWrite(mov,HIGH);
 digitalWrite(inc,HIGH);
 digitalWrite(dec,HIGH);
 digitalWrite(ent,HIGH);
digitalWrite(alm,LOW);
 digitalWrite(rlyy,HIGH);
delay(500);
 lcd.clear();
 for(i=0;i<10;i++)
 {
  mobile1[i]=EEPROM.read(i);
  delay(20);
}
```

```
 delay(1000);
 gsm_init();
 delay(500);
  lcd.setCursor(0,0);
 lcd.print("POL:          ");
 lcd.setCursor(0,1);
 lcd.print("                ");
}
void loop()
{
alc=analogRead(A0)/4;
lcd.setCursor(4, 0);
decimal3(alc);
//if(digitalRead(inc)==LOW){while(digitalRead(inc)==LOW);keypad1();}
if((digitalRead(mob)==LOW)&&!var12)
 {
  a5=1;
  lcd.setCursor(0,0);digitalWrite(alm,HIGH);digitalWrite(rlyy,LOW);
  lcd.print("  MOBILE CALL   "); aq=2;
  lcd.setCursor(0,1);
  lcd.print("   IDENTIFIED   ");
  delay(2000);
  sending_sms();
   bb=0;
  var12=1; //delay(2000);
  //inte=0; digitalWrite(alm,HIGH);
 }
if((digitalRead(pul)==LOW)&&!var11)
 {
```

```
a5=1;
lcd.setCursor(0,0);digitalWrite(alm,HIGH);digitalWrite(rlyy,LOW);
lcd.print("  ACCIDENT  ");
lcd.setCursor(0,1);
lcd.print("  IDENTIFIED  ");aq=1;
delay(2000);
sending_sms();
 bb=0;
 var11=1; //delay(2000);
 //inte=0; digitalWrite(alm,HIGH);
}
 if((alc>100)&&!var10)
 {
  a5=1;
  lcd.setCursor(0,0);digitalWrite(alm,HIGH);digitalWrite(rlyy,LOW);
  lcd.print("  ALCOHOL  "); aq=3;
  lcd.setCursor(0,1);
  lcd.print("  IDENTIFIED  ");
  delay(2000);
  sending_sms();
   bb=0;
  var10=1; //delay(2000);
  //inte=0; digitalWrite(alm,HIGH);
 }
 if(alc<100 && (digitalRead(pul)==HIGH) && (digitalRead(mob)==HIGH))
 {
  a5=0;
 var12=0;var11=0;var10=0;
 digitalWrite(alm,LOW);digitalWrite(rlyy,HIGH);
```

```
  }
  if(jj==1)
  {
   jj=0;j=0
  }
 }
 void serialEvent()
 {
  while (Serial.available())
  {
   a[j] = Serial.read();
   if(a[0]!='$'){j=0;}
   else if((a[0]=='$') && (a[1]!='G')){j=1;}
   else if((a[0]=='$') && (a[1]=='G') && (a[2]!='P')){j=2;}
   else if((a[0]=='$') && (a[1]=='G') && (a[2]=='P') && (a[3]!='R')) {j=3;}
   else if((a[0]=='$') && (a[1]=='G') && (a[2]=='P') && (a[3]=='R') && (a[4]!='M')){j=4;}
   else if((a[0]=='$') && (a[1]=='G') && (a[2]=='P') && (a[3]=='R') && (a[4]=='M')
&&(a[5]!='C')) {j=5;}
   else if((a[0]=='$') && (a[1]=='G') && (a[2]=='P') && (a[3]=='R') && (a[4]=='M')
&&(a[5]=='C')){j++;if(j>49){jj=1;}}
  }
}
void gsm_init()
{
 Serial.println("AT");
 delay(1500);
 Serial.println("AT+CMGF=1");
 delay(1500);
 Serial.println("AT+CNMI=2,2,2,0,0");
 delay(1500);
```

```
}
void sending_sms()
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("SENDING MESSAGE ");
 Serial.print("AT+CMGS=\"");
 Serial.print("9597646506");
 /*for(i=0;i<10;i++)
 {
  Serial.write(mobile1[i]);
  delay(10);
 }*/
 Serial.println("\"");
 delay(1000);delay(1000);
 //Serial.print("SPEED:");
// serial_Decimal3(speed2);
 //Serial.write(0x0d);Serial.write(0x0a);
 if(aq==1)Serial.println(" ACCIDENT OCCUR ");
 if(aq==2)Serial.println(" MOBILE CALL DETECT ");
 if(aq==3)Serial.println(" ALCOHOL DETECT ");
 Serial.println("LOCATION:");
 for(i=19;i<=20;i++)
 {
  Serial.write(a[i]);
  delay(10);
 }
Serial.print(" ");
for(i=21;i<=29;i++)
```

```
  {
   Serial.write(a[i]);
   delay(10);
  }
  Serial.println(" ");
  //Serial.write(0x0d);Serial.write(0x0a);
  for(i=33;i<=34;i++)
  {
   Serial.write(a[i]);
   delay(10);
  }
 Serial.print(" ");
  //mySerial.write(0xC2);
   //mySerial.write(0xB0);
   // mySerial.print("°");
  for(i=35;i<=41;i++)
  {
   Serial.write(a[i]);
   delay(10);
  }
Serial.write(0x0d);Serial.write(0x0a);   delay(1000);delay(1000);delay(1000);delay(1000);
Serial.write(0x1A);
 delay(1000);delay(1000);delay(1000);delay(1000);delay(1000);delay(1000);
 lcd.setCursor(0, 0);
 lcd.print("  MESSAGE SENT2 ");
 delay(1000);
 lcd.clear();
 lcd.clear();
 lcd.setCursor(0,0);
```

```
lcd.print("SENDING MESSAGE ");
Serial.print("AT+CMGS=\"");
Serial.print("9489559299");
/*for(i=0;i<10;i++)
 {
  Serial.write(mobile1[i]);
  delay(10);
 }*/
  Serial.println("\"");
  delay(1000);delay(1000);
  //Serial.print("SPEED:");
 // serial_Decimal3(speed2);
  //Serial.write(0x0d);Serial.write(0x0a);
 if(aq==1)Serial.println(" ACCIDENT OCCUR ");
 if(aq==2)Serial.println(" MOBILE CALL DETECT ");
 if(aq==3)Serial.println(" ALCOHOL DETECT ");
 Serial.println("LOCATION:");
 for(i=19;i<=20;i++)
 {
  Serial.write(a[i]);
  delay(10);
 }
Serial.print(" ");
 for(i=21;i<=29;i++)
 {
 Serial.write(a[i]);
 delay(10);
}
Serial.println(" ");
```

```
  //Serial.write(0x0d);Serial.write(0x0a);
  for(i=33;i<=34;i++)
  {
   Serial.write(a[i]);
   delay(10);
  }
 Serial.print(" ");
  //mySerial.write(0xC2);
   //mySerial.write(0xB0);
   // mySerial.print("°");
 for(i=35;i<=41;i++)
 {
  Serial.write(a[i]);
  delay(10);
 }
  Serial.write(0x0d);Serial.write(0x0a);
delay(1000);delay(1000);delay(1000);delay(1000);
Serial.write(0x1A);
delay(1000);delay(1000);delay(1000);delay(1000);
lcd.setCursor(0, 0);
lcd.print("  MESSAGE SENT2 ");
delay(1000);
lcd.clear();
lcd.clear();
lcd.setCursor(0,0);
lcd.print("POL:          ");
lcd.setCursor(0,1);
lcd.print("                ");
}
```

```
void decimal3(unsigned int val)
 {
   unsigned int h,hr,t,o;
 h=val/100;
 hr=val%100;
 t=hr/10;
 o=hr%10;
      lcd.write(h+0x30);
      lcd.write(t+0x30);
      lcd.write(o+0x30);
```

REFERENCES

1) Altaf, Suggala S. V. Abhinay, Ebran Ansari, Md. Kaunain ,Rashid Anwer "Alcohol Detection and Motor Locking System", International journal of advanced research in electrical, electronics and instrumentation engineering- vol. 6, issue 2, february 2017.

2) Jammula Hima Bindu , Gujjula Asreeth Reddy , Pilli Anoosha , Karavadi Anny Vijaya Vinoli "Programmed Engine Locking System by Automatically Detecting Drunken Drivers" (International Journal of Innovative Research in Science, and Technology) Vol. 4, Issue 11, November 2015.

3) Jeelan BashaK.M , Dr. K. Prahlada Rao "Alcohol Sensing Alert - Engine Locking System by Using Internet of Things (IOT) Technology" -International Journal of Technical Innovation inModern Engineering& Science(IJTIMES).

4) Monisha V, Priyanga M, Yamini C, Sobiyaa P "Automatic Engine Locking System through Alcohol Detection in Arduino using IOT" International Research Journal of Engineering and Technology (IRJET)www.irjet.net p-ISSN: 2395-0072.

5) Prabha.C, R.Sunitha , R.Anitha "Automatic Vehicle Accident Detection and Messaging System using GSM and GPS Modem" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering- Vol. 3, Issue 7, July 2014 .

6) Phani Sridhar.A, Samuel Susan.V, G. Kalyan Chakravathi, Ravi Teja.G "Liquor Detection Through Automatic Motor Locking System".

7) Prathiksha bhuta ,Karan desai , Archita keni "Alcohol Detection and Vehicle Controlling" International Journal of Engineering Trends and Applications (IJETA) – Volume 2 Issue 2, Mar-Apr 2015.

8) Pranjali Ingalepatil, Priyanka Barhate, Bhagyashri Nemade, Vijay D. Chaudhari "Alcohol Detection System in Vehicle using Arduino" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 06 | June -2017

9) Subhalakshmi.N, R.Aswathi, D.Gobigadharani, S.Hemalatha, F.Joezeet Flora "Arduino Based Automatic Engine Locking System for Drunken Drivers" International journal of innovative research in science, engineering & technology, www.irjet.net p-ISSN: 2395-0072.

10) Surekha Pinnapati, Manjunath Kamath K , Carmal Joseph , Dayana Thomas, Jibin P Babu , Jithin P Babu "Automatic Accident Detection and Alerting System Based on IOT" (International Journal of Innovative Research in Computer and communication Engineering-An ISO 3297: 2007 Certified Organization.

IOT BASED MODERN GREENHOUSE WITH GSM MODULE USING ARDUINO PLATFORM

A PROJECT PHASE-I REPORT

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ABSTRACT

Several parameters contribute to the growth of plants in a commercial greenhouse, namely soil moisture, soil temperature, atmospheric temperature and humidity, carbon dioxide (CO_2) and light intensity. Maintaining optimal levels of these environmental parameters is essential for healthy growth of the plants and to maximise yields in terms of fruits and flowers. Monitoring only a few parameters, such as temperature and humidity, while neglecting others, leads to inaccurate observations and sub-optimal yields. At the same time, increases in greenhouse sizes have forced the growers to increase measurement points (sensor stations) to accurately track changes in the environment. However, increases in measurement points mean increases in installation and maintenance cost of the sensor stations. In this paper, an automated wireless greenhouse climate monitoring system has been detailed with special emphasis on the programming aspects and testing of a temperature and humidity sensor. The proposed system consists of three units- Sensor Station (SS), Coordinator Station (CS) and Central Control Station (CCS). The backbone of the wireless network is based on ZigBee modules for communication between the SS and CS whereas the communication between the CS and CCS uses a XStream proprietary RF modem. Field trials conducted have established the functionality and reliability of the designed wireless sensor network. The overall system architecture shows advantages in cost, size, power, flexibility and distributed sensing.

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LIST OF ABBREVIATIONS

ACRONOYM	ABBREVIATION
CO2	Carbon dioxide
C	Celsius
IOT	Internet of Things
NGN	Next Generation Network
HTML	Hypertext Markup Language
RF	Radio Frequency
LDR	Light Dependent Resistor
MCU	Micro Controller Unit
WCN	Wireless Communication Network
GSM	Global System for Mobile Communication
CDMA	Code Division Multiple Access
dB	Decibels
ICSP	In Circuit Serial Programming
DFM	Device Firmware Update
NTC	Negative Temperature Coefficient
EEPROM	Electrically Erasable Programmable Read Only Memory

CHAPTER 1

INTRODUCTION

1.1 Introduction

We live in the world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. One such field is agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable .Greenhouses form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climate conditions for optimum produce. Automating a greenhouse envisages monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Automation is process control of industrial machinery and processes, thereby replacing human operations.

We live in a world where each and everything can be controlled and operated automatically, but still there are still a few important sectors in our country where even now automation has not been adopted some cases has not been put to a full-fledged use, perhaps because of certain reasons. Among all one such reason is cost. And the one such field is agriculture. Agriculture is one of the primary occupations of man since early civilizations. Manual interventions in farming even today are inevitable. The greenhouse industry is one of the fastest growing sectors across the globe. The work of the greenhouse is to separate the crop from the environment and to provide shelter from the direct influence of the weather conditions prevailing externally. This in turn enables the production of crops which otherwise can't be produced at that specific location. Greenhouses are those that form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum production. The greenhouse environment enables the manipulation of the crop environment. This asset allows the farmer in several ways mainly is to improve the cultivation in a way that the plants need. This leads certain advantages like higher crop yield, prolonged production period, better quality, and lesser use of protective chemicals.

The added value per unit area in greenhouse crops is very much higher than that is prevailing in the open-field cultivation. In moderate climatic zones, some energy is needed, whereas in arid zones, the cooling and availability of water is a major concern. The usage of materials, energy, crop yield and quality can be influenced by operation of greenhouse by adjusting its components, such as heating and cooling inputs, window opening, drip irrigation, screening and CO2 dosage. Thus, hopefully we can expect that, by the way these controls are operated; it influences the final economic result. In order to fully exploit the enhanced possibilities for crop and resource management in the greenhouse, it is indispensable to know the control variables with a remote sensing system installed to it. Finally, automation in a greenhouse helps in monitoring and controlling of the climatic parameters which directly or sometimes indirectly governs the plant growth hence that results in a profitable production. Greenhouses in India are being employees in the high-altitude regions where the sub- zero temperature up to -40° C makes any kind of plantation which is almost impossible and in arid regions where in the conditions for plant growth are hostile. In the present people are moving around the world, hence there is an increased demand for connectivity with our properties wherever in we are on the planet. So here comes the role of connecting every device to the internet so that it is accessible wherever we have an internet access across the globe. This interesting fact has thrown upon us the need for the implementation like a solution of integrating our present resources. This is how internet of things comes into the picture. This project extensively focuses on implementation of a smart greenhouse that can monitor using IOT technology.

The increase in living standards and higher consumer demands have increased pollution of the air with CO2 and other greenhouse gases; particulate matter of water along with a variety of chemicals, nutrients, and oil spills; and of the soil owing to the disposal of hazardous wastes, application of herbicides and pesticides, and disposal of non-biodegradable materials, etc. Man-made chemicals like pesticides, cosmetics, personal and household care products, and pharmaceuticals, which are in use worldwide and are indispensable for modern society, are adding pollutants to the atmosphere . Furthermore, human activities have resulted in contamination of water resources with biological micropollutants, such as viruses and bacteria. Such agents have generated renewed awareness due to their potential pathogenicity and are referred to as emerging or reemerging pathogens. Biological micropollutants, such as enteric

bacteria, mycoplasmas, viruses, and protozoa, are the source of many waterborne diseases and remain a major cause of death worldwide . For the overall safety and security of living systems, there should be a comprehensive analysis of toxicants, as well as their detection and continuous monitoring in environmental samples of soil, water, and air. Two different approaches have been considered for monitoring pollutants in environmental samples. The traditional approach provides accurate analysis of chemical or physical properties of environmental samples but requires costly analytical instruments with specialized laboratories for analysis of pollutants present in the samples.

However, these systems of analysis fail to provide information on the bioavailability of pollutants and related effects on biological systems. To overcome shortcomings of the traditional approach, a complementary approach is being evaluated where living systems are used for environmental sample bioassays. Unicellular microorganisms, particularly bacterial systems, are used for such purposes. It is because of their rapid growth rate, large population size, and minimum requirement for growth and maintenance (low cost). The Korean Society for Microbiology and Biotechnology Environmental security is one of the major concerns for the safety of living organisms from a number of harmful pollutants in the atmosphere. Different initiatives, legislative actions, as well as scientific and social concerns have been discussed and adopted to control and regulate the threats of environmental pollution, but it still remains a worldwide challenge. Therefore, there is a need for developing certain sensitive, rapid, and selective techniques that can detect and screen the pollutants for effective bioremediation processes. In this perspective, isolated enzymes or biological systems producing enzymes, as whole cells or in immobilized state, can be used as a source for detection, quantification, and degradation or transformation of pollutants to non-polluting compounds to restore the ecological balance. Biosensors are ideal for the detection and measurement of environmental pollution in a reliable, specific, and sensitive way. In this review, the current status of different types of microbial biosensors and mechanisms of detection of various environmental toxicants are discussed systems can be genetically engineered to analyze the pollutants in their environmental conditions. Furthermore, proteins that are present in cells can also be applied for the detection of a specific analyse.

CHAPTER 2

LITERATURE SURVEY

2.1. Iot Based Intelligent Greenhouse Monitoring and Control System

International Journal,value 7 Issue No.2.May 2014.

2.1.1 Introduction

IoT Technology has been used to reduce the distance between the staff in the article "Things" and its digital impersonation in data frameworks. It's seen as the next generation network (NGN) of the internet . The IoT is driven by an extension of the Internet through the incorporation of physical articles joined with a capacity to provide more quick-witted administrations to the earth as more information ends up noticeably accessible. Several application areas going from Green-IT and vitality effectiveness to coordination's are now beginning to profit by Internet of Things ideas . A Greenhouse provides basic methods for employment to its proprietor and must be financially pragmatic for the specific atmosphere in which it stands. Also, Greenhouse could be defined as advanced Innovation for Protected Horticulture addresses the major natural elements of light, temperature, and irrigation . This paper investigates the usefulness of using the IoT based on the greenhouse to utilize low-cost tools and decrease the effort of the Pleasants. This could be implemented by including the automation in irrigation process, conserving temperature, and the degree of brightness inside the greenhouse structure. More recent attention has been focused on the provision of improvement on the Internet of things (IoT) and how to utilize it with the various applications. The IoT is interesting subject that recently whiteness very large number of papers that aimed to develop this technology.

2.1.2 Proposed Technique

2.1.2.1 IoT Structure

The function of IoT in this work gives the pleasant the ability to monitor and control their greenhouses remotely. To make the work of IoT easy to understand, provide an imagination about how the IoT work in upload and download data and deliver it to the control systems.

2.1.2.2 Design a web application

The First step was designing a web page to display the information for the user. The web page should be easy to use, attractive, and has a simple HTML code in order to speed up the execution of functions of the web page. The designed web application is important to be secured with Username and password for each user. Also, the permissions of each member are different, a part of members are authorized to access, monitor, and control the systems.

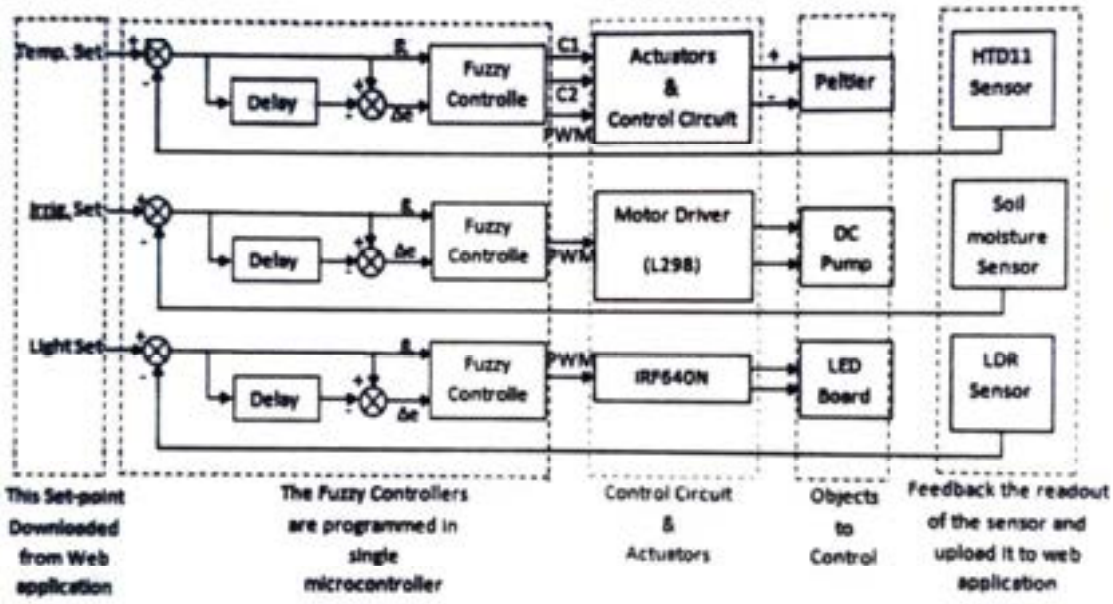


Figure 2.1 Block diagram of the greenhouse system

Table 1.1 The IOT time calculation

No.	Time of Action	Time to Downloading Set-points	Time To Uploading the System Status
1	10:32 PM	220 msec.	1178 msec.
2	12:06 AM	357 msec.	1572 msec.
3	08:31 PM	188 msec.	1152 msec.

Figure 2.2 The web application control and monitor

2.1.2.3 Local communications of nodes

In order to make several nodes capable to connect to internet and download the set-points and upload their system status, the master-slave technique could be used. The master would be defined as node that has the ability to connect to the public internet by the Ethernet to download/upload the nodes data. Also, the master node communicate locally with others node by using the RF Transmitter. While, the slave node is only communicate with slave node to send their status and receive the set-point that specified for its control system.

2.1.2.4 Remotely Management and Monitor the system's status:

In this article, attempt to construct a prototype IoT, using simple, cheap, and available tools. To apply the IoT in a practical application, there are many tools should be employed like Ethernet Arduino Shield and Arduino microcontroller. The Ethernet plays as the main tool which makes a connection between the greenhouse and the router that acts as a gateway.

2.1.3 Conclusion

The intelligent greenhouse, the resulting prototype has numerous advantages like employing three intelligent control systems (Cooling/Heating System, Irrigation Control System, Light Control System). These control systems are managed by Fuzzy controllers which designed and programmed inside the microcontroller (standalone) without requiring any external

processing, this provides the ability to describe the system as practical system. Also, the IoT provide features that may make the works of the peasant much easier by enable them to monitor their plants and make a suitable decision by adjusting the set-points to accommodate any changes may effect on growing the plants.

2.1.4 Result

The operation of the cooling/heating system, the irrigation system, and the lighting system depending on the set-points. Finally, upload the readout of the sensor to the web application. In order to calculate the system sampling time, each system should be determined individually. The temperature control system, irrigation control system, and light intensity control system are take 308, 259, and 115 milli sec respectively.

2.1.5 Draw Back

The IoT depend on the public internet to deliver its data, so that it could be effected directly by the internet problems such congestion. Also, the LDR has been used as light intensity sensor. This tool may produce unprecise result and that may effect on the overall system performance such as the overshot that appear.

2.2 Remote Control System for Greenhouse Environment using Mobile Devices

International Journal Research & Technology ISSN:2278-0181.

2.2.1 Introduction

Production of competitive crop and greater income, farmers need efficient cultivation and management techniques. Remote control of the environment for protected production facilities using wireless sensing and control technologies may increase crop yield and quality, and also reduce labor requirement. A greenhouse control system consisted of 4 sub-levels: 1st level to manage and operate sensors and equipment, 2nd level to integrate the 1st level units, 3rd level for communication, and 4th level to operate the entire system by users. A modular measuring equipment using Micro Controller Unit (MCU) for cultivated land. It used eight-channel multiplexing card to measured temperature and humidity, and solar radiation and rainfall sensors were connected directly to the MCU, and then transferred to a server computer through RS-232 communication port. The amount of used water in sensor-based and timer-based irrigation systems, and reported that 11% of the water could be saved in the sensor-based system. A sensor network using MCU, Zigbee protocol to measure temperature and humidity for greenhouse, and applied the sensor network for heater operation.

2.2.2 Proposed Technique

WCN part installed at multiple locations in a greenhouse, user part to monitor the environment and send control commands, and central management part to receive and process commands, and connect WCN and users. Each WCN node included MCU-based relay node and Zigbee communication module. User part utilizes mobile devices to send control commands using CDMA, 3G, or Wi-Fi communication. Central management program was coded in Visual Basic ver. 6.0 to process control commands and activate the WCN relay nodes.

Wireless communication, a Zigbee-base module was used. The communication module featured low power consumption, micro sized and low cost module. It could transfer data in a 250-kbps speed among up to 65,000 nodels within 10~20 with the IEEE802.15.4 communication protocol.

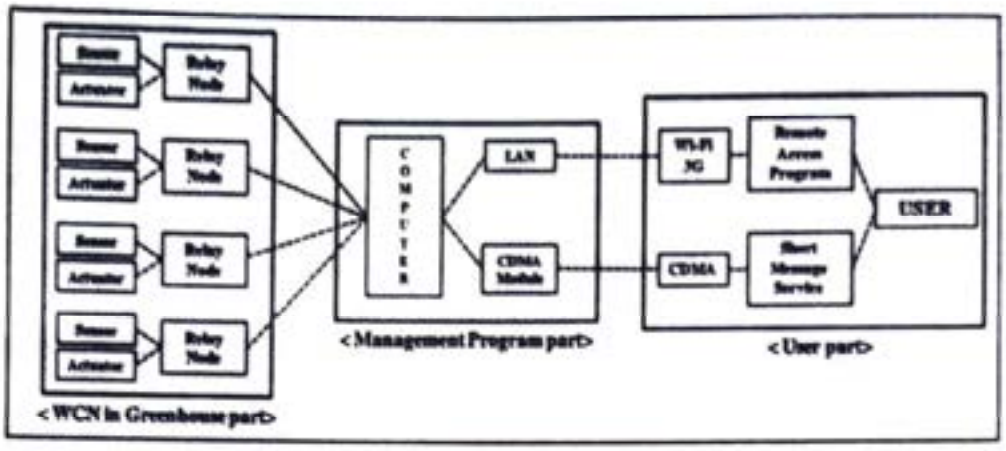


Figure 2.3 Concept of remote control system using WCN and mobile device

Performance of the remote control system was evaluated in terms of communication success ratio, response time, power consumption. Time required to activate relay node was measured by number of node. Response time to control environment was also measured. Irrigated water was monitored for 15 minutes on 1-minute intervals. Response time of the window motor was evaluated for different partial opening and closing levels. For heating and ventilation, temperature and humidity sensors were installed at 1-m distance from the heater and fan. Illumination intensity was measured under the light source. For each WCN component, power consumption was also evaluated.

2.2.3 Result

Temperature values were both 16°C and humidity values were 60 and 66%, respectively. With heater operation, inside temperature increased logarithmically and was maintained at 24±0.5°C after 2 hours. Air relative humidity was decreased to 50% after 20 minutes, and maintained at 43±0.5% after 2 hours.

Irrigation and window operation showed linear patterns, irrigated rate was 2.76 mL/min, and required time to control window opening by 10% of the full range was about 11.14 s.

Communication and remote control was successful for all cases. Depending on location, response times were less than 14 seconds for Wi-Fi communication conditions. For 3G

communication, response times were 10.55 and 15.71 seconds for stationary (0 km/h) and high speed (100 km/h) conditions, respectively. They were less than 12.35 seconds for sending remote control command using CDMA SMS service.

2.2.4 Conclusion

Performance of remote access under Wi-Fi condition High Signal Intensity Low Signal Intensity Home Office Hotspot Home Office Hotspot No. of success 30 30 30 30 30 30 Response time (s) 4.82 7.26 12.86 14.22 14.29 14.82 .

Performance of remote access under 3G condition 0 km/h 100 km/h No. of success 30 30 Response time (s) 10.55 15.71 .

Performance of remote access under CDMA condition -95 ~ -80 (dBm) -79 ~ -60 (dBm) No. of success 30 30 Response time (s) 12.35 9.84 .

Generally, actual power consumption levels were lower than the rated levels. For solenoid value, power level was about 2.11 W, which was greater than the rated level, but decreased and stably maintained at about 1.61 W. Initial operation of the irrigation pump required about 193.25 W, and the level increased up to 236.97 W with full amount of water flow, but they were lower than the rated power consumption level. The heater-cooler consumed the greatest power with average of 1753.43 W and the maximum of 2957 W at the initial operation period. Ventilation fan and lighting bulb required about 26.23 W and 18.93 W, respectively. Window more required 54.86 W, while a relay node required about 0.41 W. Estimation of power consumption during crop production should consider duration and interval of operation.

2.2.5 Draw Back

Due to the use of Wi-Fi for the remote control it can cover very minimum distance. so that the Wi-Fi technique is not possible for large area of greenhouse.

2.3 ARDUINO Based Automatic Plant Watering System

International Journal Of Computer Science And Mobile Computing, Vol.5 Issue.8, Auguest-2016.

2.3.1 Introduction

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. When a zone comes on, the water flows through the lateral lines and ultimately ends up at the irrigation emitter (drip) or sprinkler heads. Many sprinklers have pipe thread inlets on the bottom of them which allows a fitting and the pipe to be attached to them. The sprinklers are usually installed with the top of the head flush with the ground surface. When the water is pressurized, the head will pop up out of the ground and water the desired area until the valve closes and shuts off that zone. Once there is no more water pressure in the lateral line, the sprinkler head will retract back into the ground. Emitters are generally laid on the soil surface or buried a few inches to reduce evaporation losses. Healthy plants can transpire a lot of water, resulting in an increase in the humidity of the greenhouse air. A high relative humidity (above 80-85%) should be avoided because it can increase the incidence of disease and reduce plant transpiration. Sufficient venting or successive heating and venting can prevent condensation on plants surfaces and the greenhouse structure. The use of cooling systems during the warmer summer months increases the greenhouse air humidity. During periods with warm and humid outdoor conditions, humidity control inside the greenhouse can be a challenge. Greenhouses located in dry, dessert environments benefit greatly from evaporative cooling systems because large amounts of water can be evaporated into the incoming air, resulting in significant temperature drops. Since the relative humidity alone does not tell us anything about the absolute water holding capacity of air, a different measurement is sometime used to describe the absolute moisture status of the soil.

The vapor pressure deficit is a measure of the difference between the amount of moisture the air contains at a given moment and the amount of moisture it can hold at that temperature when the air would be saturated. Pressure deficit measurement can tell us how easy it is for

plants to transpire: higher values stimulate transpiration (but too high can cause wilting), and lower values inhibit transpiration and can lead to condensation on leaf and greenhouse surfaces. In the mid 20th century, the advent of diesel and electric motors led to systems that could pump groundwater out of major aquifers faster than drainage basins could refill them. This can lead to permanent loss of aquifer capacity, decreased water quality, ground subsidence, and other problems. Apart from all these problems and failures, there has been a considerable evolution in the methods to perform irrigation with the help of technology. The application of technology in the areas of irrigation has proven to be of great help as they deliver efficiency and accuracy.

2.3.2 Proposed Technique

The ATmega328 on the Arduino Uno comes preburned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).We can also bypass the boot loader and programs the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

Figure 2.4 Automatic plant watering block diagram

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by: On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

Table 2.1 Arduino specifications

FEATURE	SPECIFICATION
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2.3.3 Result

The water pump is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it to a microcontroller. It can be triggered ON/OFF by

sending signals as required. The process of artificially supplying water is known as pumping. There are many varieties of water pumps used. This project employs the use of a small water pump which is connected to a H-Bridge.

2.3.4 Conclusion

It has been developed by integrated features of all the hardware components used. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Thus, the Arduino Based Automatic Plant Watering System has been designed and tested successfully. The system has been tested to function automatically. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level , the moisture sensor sends the signal to the Arduino board which triggers the Water Pump to turn ON and supply the water to respective plant using the Rotating Platform/Sprinkler. When the desired moisture level is reached , the system halts on its own and the Water Pump is turned OFF.

2.3.5 Draw Back

Expensive technique. It requires probe to be inserted in the soil it requires labor to collect the data and maintain the measurement processes. The watermark sensors provide less accuracy in sandy soils due to large particles

2.4 Greenhouse Monitoring and Automation using GSM Module

Journal Of Information, Knowledge And Research In Electronics And Communication Engineering ,September-2000.

2.4.1 Introduction

The concern with a lot of consumer needs and demand for the agriculture products has stimulated awareness among the farmer that increases their products in the market by implementing advance technologies in this industry. The products that are important that may come to the farmers' interest that controls the use of natural sources and natural environment which controls agriculture with various aspects. Therefore, this problem makes farmers interest to implement agro-conditions sending alert notification messages to farmers using GSM and SMS technology. The proposed system is aimed to be a reliable and cost environment with remote monitoring method in their agriculture field.

For some crucial plants such as vegetarian and flowers plants, which need 24 hours attention from human so that the plant quantities and qualities are controlled with proper management by the collected data and information from the fields. This will provide enormous foundation for future growth and future development of their plants in the green house. However, with the increasing size in farming areas, this type of manual practice is increases time consuming and cost of the labour. However, with the growth of management in agriculture techniques and with modern telecommunication technologies which provides great assistance with the implementation in the agriculture industry. With the rapid development in telecommunication and wireless technologies, it is proved that wireless communication has good practice for remote sensing in the agriculture industries. In this paper uses wireless sensor network, Global System for Mobile Communication (GSM) and short message service (SMS) to carry out data from the green house with sensors directly alert the farmers to their mobile phone. This type of practice can eliminate the use in the farming areas. This technology has seen to be suitable for these modern days. Moreover, this paper focuses on the monitoring and automation system in greenhouse which has capability of controlling.

2.4.2 Proposed Technique

2.4.2.1 GSM Module

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

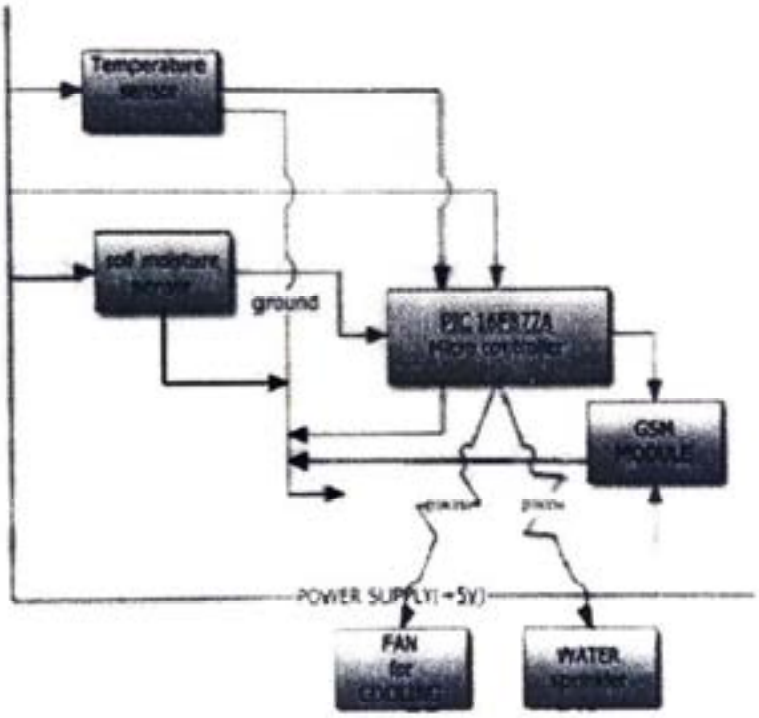


Figure 2.5 Block diagram of the system

2.4.3 Result

The system consist of two subsystems temperature monitor and soil moisture and control system. The system operates according to the flow chart show. The temperature monitor and control system consist of a LM35 temperature sensor a user mode switch the fan for cooling. The user mode switch is connected to RB7 pin in the microcontroller and tested whether the switch

is ON, if it is ON (RB7read as high) the microcontroller saves the value to the EEPROM set by the user by means of the potentiometer connected to the RA1 pin. The analogue input value is converted to a digital value inside the microcontroller and the value is saved in the variable. Then it will be written to an address location of the EEPROM which in this case is 0x10. The program then checks again whether the user mode switch is pressed and if it is ON once again the program convert the analogue input value to digital and saves it in the value set by the user. In this mode the temperature sensor detects the current temperature value and inputs it to RA0 pin of the microcontroller. The input is an analogue input and it is converted to a digital input and calibrated as follows. The resulting value after A/D conversion is reduced by a constant 1 and divided by 2. Then it is displayed and checked with the user defined temperature value saved in the EEPROM. If the result is negative it means that the current temperature value is greater than the user defined temperature value so the microcontroller makes the RB7 pin high to ON the cooler fan to bring down the temperature to the user defined value and sends SMS alerts to the user. If both the values are equal the result is zero then both RB7 pin is set to low hence fan is switched off and sends SMS alert to user mobile.

2.4.4 Conclusion

With the wide improvement of wireless and GSM technology. The system may be cost with wireless sensors may little cost but it works with more effectively. The system may be implemented with the help of many technologies but these technologies more reliable, easy to implement, works effectively and easy to operate.

2.4.5 Draw Back

This paper uses a GSM module technology. This can be improved by the new technology of wireless communication. Because the GSM module cover short distance.

2.5 Greenhouse Monitoring and Conclusion using ARM

Basrah Journal For Engineering Sciences, Vol. 17, No. 1, 2017.

2.5.1 Introduction

The greenhouse industry is the fastest growing sector worldwide. The greenhouse separates the crop from the environment, This enables the production of crops that otherwise could not be produced at that specific location. The greenhouse enclosure permits the manipulation of the crop environment. This asset allows the farmer to steer the cultivation in a desirable direction. It leads to higher crop yield, prolonged production period, better quality, and less use of protective chemicals. The crop yield and quality can be influenced by operating the adjustable components of greenhouse. To fully exploit the enhanced possibilities For crop and resource management in greenhouse, it is indispensable to adjust and control variables with a remote controlling system via SMS by using the GSM - SMS. This is because it is almost difficult for human being to manipulate and be present every day near the system.

2.5.2 Proposed Technique

2.5.2.1 GSM Modem

A GSM modem is a specialized type of modem, which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem can be a dedicated modem device with a serial, or it may be a mobile phone that provides GSM modem capabilities. Here SIM 300 Modem is used.

2.5.2.2 Hardware Implementation and Description

Various Parameters are taken such as Temperature, Humidity, Light will sense gives a voltage output corresponding to values. This signal is taken into LPC2148 processor through the analog input channel for comparison. This signal is digitized using the inbuilt 10-bit ADC of the LPC2148 processor and compare the data with Predefined data for any status changes or value crossing the limit. Then System will send the message to concerned authority(s) by sending an

SMS through GSM MODEM to his/her Mobile phone and Then authorized person sends message to the system then microcontroller switches the ON/OFF.

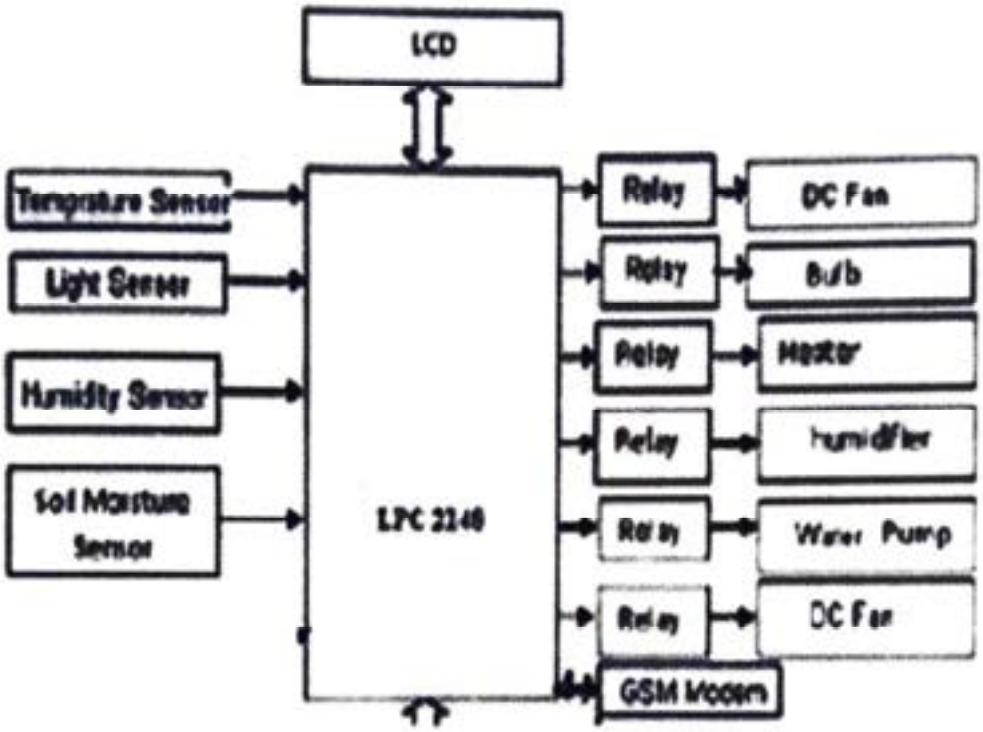


Figure 2.6 Functional block diagram

2.5.2.3 Software Development

The software for the system is developed in Embedded C and Visual Basic.

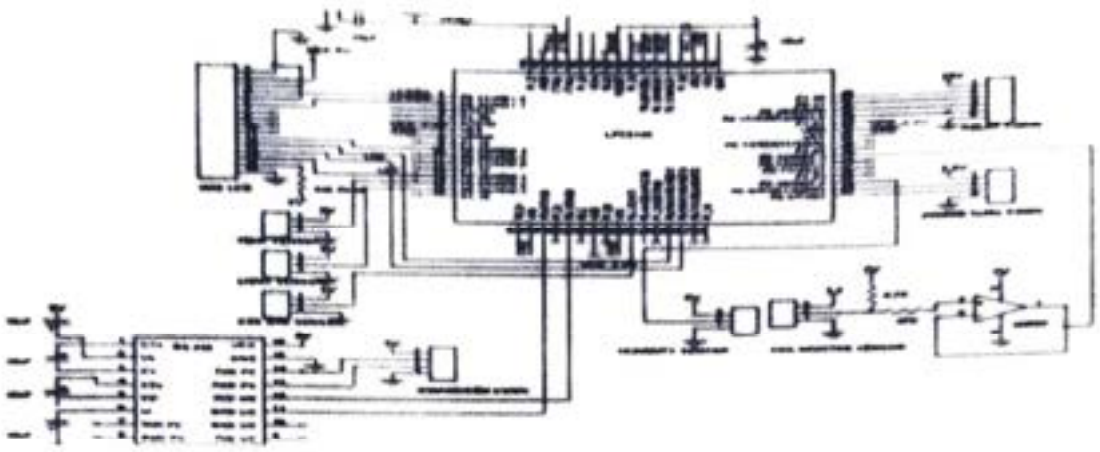


Figure 2.7 The circuit diagram of the entire system

2.5.3 Result

2.5.3.1 Temperature Sensor

The LM35 thus has an advantage over linear temperature sensors , as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling. Features are as follows 1. Calibrated directly in ° Celsius (Centigrade) 2. Linear + 10.0 mV/°C scale factor 3. 0.5°C accuracy guaranteable (at +25°C) 4. Rated for full −55° to +150°C range 5. Suitable for remote applications 6. Low cost due to wafer-level trimming 7. Operates from 4 to 30 volts .

2.5.3.2 Humidity Sensor

These modules convert relative humidity to the output voltage. Humidity Sensor is designed to operate on DC 5 V, 0-60° c, 30-90° c RH , output voltage is DC 1.980 mv ± at 25 °c 60% RH.

2.5.4 Conclusion

The system has provided a low cost, remotely monitored and controlled solution for Greenhouse introduced. The use of a ARM Processor, GSM module, Sensors and different Controlling devices provide exciting possibilities. However as far as the Greenhouse applications are concerned this can be viewed as a low cost, customized Remote Measurement and Control system .The approach discussed in the paper is novel and has achieved the target to control Greenhouse remotely using the GSM SMS-based system satisfying user needs and requirements. GSM technology capable solution has proved to be controlled remotely. Hence we can conclude that the required goals and objectives of the system have been achieved.

2.5.5 Draw Back

Some arm processor clock frequencies and their speeds and memory are limited in such cases. The approach discussed in the paper is novel and has achieved the target to control Greenhouse remotely using the GSM SMS-based system satisfying user needs and requirements. GSM technology capable solution has proved to be controlled remotely. Hence we can conclude that the required goals and objectives of the system have been achieved.

2.6 Smart Greenhouse Monitoring using Internet of Things

Basrah Journal For Engineering Sciences, Vol. 17, No. 1, 2017.

2.6.1 Introduction

Before coming to the main topic let us discuss a little bit about green house and greenhouse effect. Green house is something related to a building or a place where small plants and vegetables are grown. And the area under green house is covered with glass or translucent plastic roofs. And this plays an important role for the vegetation in colder regions, because it is still very cold to take them to an outside environment. And now moving forward to discuss about the greenhouse effect. Greenhouse effect is simply a process in which various greenhouse gases entraps the infrared rays from the sunlight thus leading to increase of level of carbon dioxide which further helps in increasing the amount of chlorophyll and thus leading to impressive plant growth and yield. As we know that the green house contains the environmental parameters such as humidity, temperature, moisture, light etc. And sometimes what happen, due to the lack of knowledge among farmers, they are not able to perform their activities with accuracy.

They usually perform such activities on the basis of their own observation from the past and with their gut feeling which may lead to unexpected results most of the times. So in an order to cover it up and get more proper and accurate results for what activities a farmer should perform in different environmental condition this system is used. And the green house system helps in boosting the efficiency. And thus our system are based to perform such activities that are to monitor and control the sytem from a particular place which would take care of weather inside the green house It contains Aurdino UNO microcontroller, various sensors such as temperature sensors, humidity sensors, LDR sensors, smoke sensors etc and windows application for controlling green house and its parameters. When sensors reaches a certain threshold or critical value it will send the signal to microcontroller and required action will be taken automatically e.g fan will automatically start working when temperature inside the green house crosses the critical value.

2.6.2 Proposed Technique

2.6.2.1 Internet of Things

Internet of things is one of the most important technologies of the 21st century. It is trending everywhere. It is basically an environment in which simple physical objects are made capable enough to get accessed through internet. Internet of things could also be considered as collection of physical objects, controller, sensors, actuators and internet in appropriate and required manner. The Internet of Things permits articles to be detected and controlled remotely crosswise over existing system framework, making open doors for a more straight forward combination between the physical world and PC based frameworks and bringing about enhanced effectiveness, exactness and monetary advantage. It contributes to improved customer engagement, enhancing data collection, technology optimization and reducing waste.

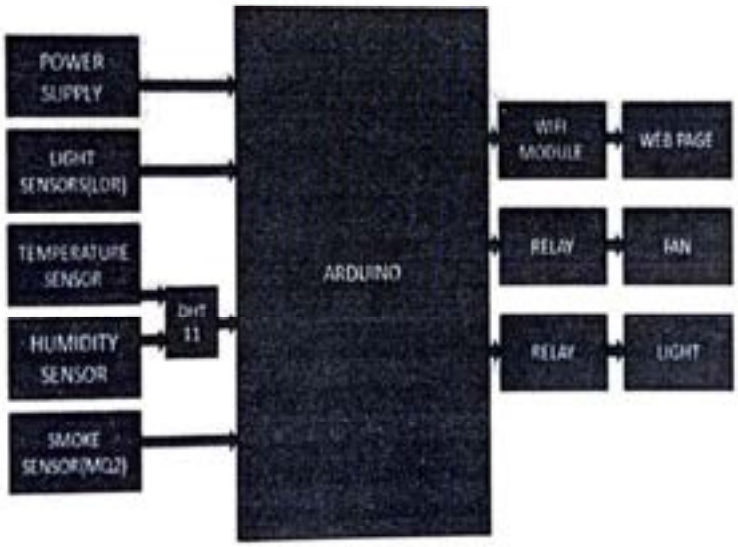


Figure 2.8 Block diagram

And we are making use of this technology in our proposed project. "Most physical parameters which are required in a nursery could be measured via programmed sensors. This includes temperature, light, soil dampness, and relative mugginess. Precipitation can likewise be distinguished, in spite of the fact that it is to some degree less normal. All the said physical

factors are inspected and put away electronically at general interims when something is evolving. In general, the estimations give a significant decent information yield photo of the physical part of the nursery edit framework. This proposed a commitment to the advancement of nursery observation.

2.6.3 Result

2.6.3.1 Light Sensors

LDR(Light Dependent Resistor) is the light sensor which is usually used for the purpose. Its main function is to monitor the intensity of light. It turns off the light when it need to save the power and turns on the light when light is required in the greenhouse.

2.6.3.2 Temperature Sensors

As the name suggests, these are used for monitoring the temperature and used to check whether the temperature is high or low inside the green house. And a critical value of temperature is fixed. And when sometimes the temperature inside the greenhouse reaches above the critical temperature level, the coolant is provided to cool down the temperature and bring it down to the favourable required temperature inside the green house.

2.6.3.3 Humidity Sensors

Humidity Sensors are basically used for measuring the relative humidity, which is the measure of vapour air to the total amount of vapour that could be held in the air for a given temperature.

2.6.3.4 DHT11 Sensors

We have used DHT11 sensors in our project. It is basically a humidity and temperature sensors which helps in getting digital output. It is quite reliable and has good stability and at the same time is cost effective. It comprises of three main elements- a resistive type humidity sensor, an NTC thermistor (for temperature measurement) and an eight-bit microcontroller which helps in converting analog signals from both sensors and helps in sending out digital signal.

2.6.3.5 Smoke Sensors

MQ2 smoke sensor has been used in this project which helps in detecting if there is some sort of leakage of any gases in the crop field or may be fire. It works on inverted logic. MQ2 smoke sensors has great sensitivity and has quick response time and at the same time is stable and has long life time.

2.6.4 Conclusion

Farming activities, even in urban zones are on an ascent as of late, in remarkable structures. Innovative advance makes the agrarian area develop high, which here is made by the IoT. The IoT will be playing a great role in changing the day to day life experience. And right now we are using limited number of parameters in our project but with the further advancement more number of parameters could be added for boosting the production. In future by building up a versatile application for IoT framework makes more adaptable to the people groups.

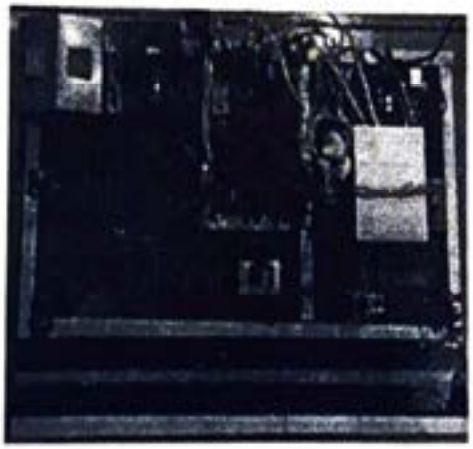


Figure 2.9 Greenhouse model

2.6.5 Draw Back

In this proposal they are used less number of parameters for the cultivation. This will be reducing the crop production.

2.7 Greenhouse Automation System using PSOC 3

International Journal Of Advanced Research In Electronics And Communication Engineering May-2011.

2.7.1 Introduction

Greenhouse Automation System is the technical approach in which the farmers in the rural areas will be benefitted by automatic monitoring and control of greenhouse environment. It replaces the direct supervision of the human. In this paper the different papers have been reviewsed and developed the proposed system based on the limitation in the present monitoring system. It also focuses on the Generic Architecture which can be applied for many other Automation Application.

Greenhouse is a building where plants are grown in a controlled manner. Nowadays due to urbanization and lack of land availability there is a great need to construct the Greenhouses which will be reserved mainly for growing crops.

Table 2.3 Components Specifications

References	Technology	Processor	Monitoring Station
1.	Wird	AT89C52	LCD Display
2.	Zigbee,WSN	PIC	LCD Display
3.	GSM Modem	_	PC
4.	GSM Modem,Bluetooth	PICI6F877A	Mobile
5.	GSM Modem	PICI6F877A	Mobile LCD
6./	Wird	AT89C51	LCD Display
7.	GSM	AT89C51	Mobile,LCD
8.	GSM	ATmega644P	Mobile PC
9	Wird	PICI6F877A	LCD Display

2.7.2 Proposed Technique

The proposed architecture consists of the sensors, Psoc 3, relay circuit and the actuators which is as shown in fig. 1. The system consists of hardware and software requirements. The sensors used in this system are Temperature Lm 35DZ and for humidity SY- HS-220 sensor which is suitable for the greenhouse Environment.

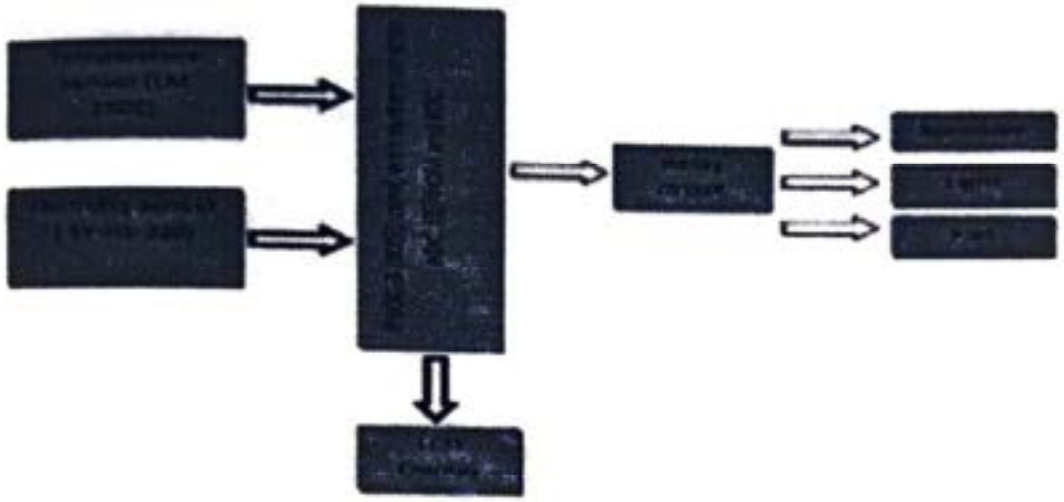


Figure 2.10 Block diagram of proposed architecture

2.7.2.1 Hardware Requiremnt

The hardware required for the Greenhouse control are:

Transducers: The transducer are the sensors which converts the physical quantity into electrical quantity. Two sensors used in the system are:

Temperature sensor(LM 35DZ) - It calibrates directly in degree celcius.

2.7.2.2 Software Requirement

The software required to implement the code is Psoc Creator. It has updated versions. For this system Psoc Creator 2.2 is used to code, Debug and program the device. The Communication between the PC and the device is done through the USB.

The Psoc Creator has 3 windows:

1) Schematic Window: The window where the components are dragged and dropped and connected through the wires.

2) Ports/Pin Assignment Window: The window where the pin number are assigned to the components and the system configuration can be changed.

2.7.3 Result

Psoc 3 Kit: It is the programmable system on chip which integrates analog and digital peripherals, memory and microcontroller(8051 core).

Relays: A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts.

Actuators: It is a device which is used to control the parameter to the desired level. The actuators used in the system are: Fan Light Sprinkler.

Table 2.4 Crop details

Greenhouse Crop	Temperature Required(in Celcius)	Humidity Required(in RH%)
Rose	24 to 28	65-70
Capsicum	21 to 24	50-65

2.7.4 Conclusion

This paper shows the existing technology and processor used for the Greenhouse Applications. The Psoc 3 coding is done to set the limits of the parameters of the two crops. If the parameters are within the range then the value is displayed in the LCD. If it is not within the range the controller will turn on/off the actuators as per the requirements. Thus controlling the Greenhouse automatically without human intervention. Further the details can be updated to the user's mobile through GSM Modem interfaced with Psoc 3.

2.7.5 Draw Back

The main drawback of this paper is to control the two greenhouse at the same time. So that the parameters are not work for a set point level.

2.8 Plant Health Monitoring and Controlling of Environment in a Conservetris

Journal Of Information, Knowledge And Research In Electronics And Communication Engineering ,September-2000.

2.8.1 Introduction

Protection of plants in general and protection of crops against diseases in particular are important for better yield. Crop losses due to pathogens, pests, animals, and weeds are about 20 to 40% of global agricultural productivity . These losses can be reduced by monitoring health of the plant using technology and rising alerts upon detection of disease or when the disease crosses certain thresh hold. Image capturing and processing is one such technique to detect the health of the plant.

All plants and vegetation require certain conditions for their healthy growth. It is necessary to control the environmental conditions to make them optimum for the best growth of plants. Parameters, such as humidity, temperature, light intensity, soil moisture etc. are monitored and controlled to create the optimal environment. An automated management reduces manual intervention, labor cost, implements necessary action with least time delay.

2.8.2 Proposed Technique

Need to effectively grow a plant is of increasing demand in agricultural industry for improving the yield. In order to do so, it is important to monitor the plant during its growth period, as well as, at the time of harvest. Plants can suffer from viral, fungal and bacterial diseases. Here, bacterial and fungal affected leaf diseases are considered for experimentation as viruses produce no telltale signs that can be readily observed and often easily confused with nutrient deficiencies and herbicide injury. One method to detect these bacterial and fungal diseases is manual inspection and detection with the help of botanic experts; but manual detection of leaf diseases is much laborious and time consuming task. So, there is a need for machine based method to detect the plant diseases with better efficiency as compared to manual detection. Image Processing involves the steps of image acquisition, pre-processing (Image Contrast Enhancement), image segmentation, feature extraction, leaf disease detection &

classification. In the present work, image acquisition is performed by considering RGB color disease affected leaf image. Image pre-processing is performed to enhance the image quality using histogram equalization. Image segmentation is performed using kmeans clustering. Image feature extraction is performed to extract the features of leaf disease symptoms.

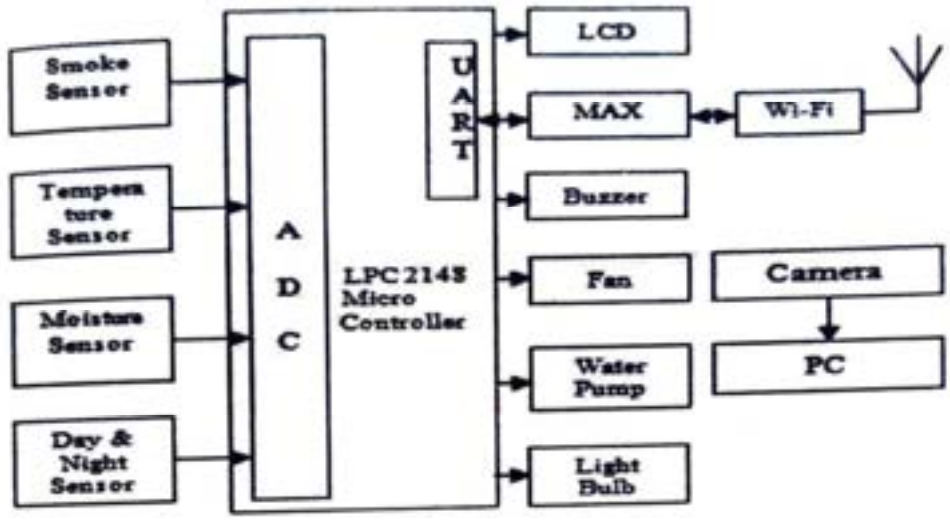


Figure 2.11 Block schematic of the experimental setup

2.8.3 Result

Percentage of disease in the selected image (=39%) The Smoke sensor (MQ2) is used to sense smoke or hazardous gases such as carbon monoxide, methane, propane, i-butane and carbon dioxide. Upon detection of any of the above mentioned gases, conductivity of the sensor increases, which is recorded by measuring the analog voltage. Change in measured voltage is a measure of concentration of the gas. If the measured value crosses the prefixed thresh-hold value then microcontroller activates a buzzer to alert the farmer.

LM35 temperature sensor is used to monitor the temperature of the conservatorium. This sensor measures temperature and produces output voltage which is linearly proportional to temperature in centigrade. Preferable temperature range for most of the plants is between 200C to 350C.

The test set up was installed in a conservatorium with tomato plants. A glimpse of the Conservatorium at GKVK and cultivation of Tomato plants inside the conservatorium. A prototype model developed in the present work used in the lab environment mimicking the GKVK conservatorium and small plants being grown inside it.

Figure 2.12 Diseased leaves

2.8.4 Conclusion

Developed system is very useful to monitor health of plant, take corrective action when the parameters of interest cross the specified ranges required. Integration of disease detection system and ambient control are unique feature of this work. ARM microcontroller can be explored to do the image processing part to eliminate the need for PC. Developed system can be installed with slight modifications anywhere to cultivate any type of crop. Automated controlling of devices eliminates the middleman and help farmers to produce high quality, high yield crops.

2.8.5 Draw Back

This proposal is for the identification of the diseases in the plant. But the pest is provided to the plants due to that the plant will get affected and influence to more diseases.

2.9 Different Technique of Greenhouse Remote Monitoring System

International Journal Of Advanced Research In Electronics And Communication Engineering.May-2018.

2.9.1 Introduction

Climatological condition monitoring is one of the most important aspects in agricultural production that has a direct impact on the productivity and maintenance of crop. A huge loss occurs every year due to damage of crops by various diseases caused by improper climatic conditions. Greenhouse is the advanced facility available in which we can control the climate to increase plant growth and avoid the effect of season changes on the plants. Greenhouse is playing a significant role in the production of out-of-season fruits, flowers and vegetables as well as high value and sensitive plants like capsicum. The purpose of greenhouse environmental monitor is to get the best climatic conditions (controlled temperature, humidity, light and level of carbon dioxide) for crop growth, increased crop yields, improved quality of crops, and regulated growth cycle of crops . Greenhouses are often used for growing flowers, vegetables, fruits, and tobacco plants. Most Greenhouse systems still use the manual system in monitoring the temperature and humidity. A lot of problems can occur not for worker but also affected production rate because the temperature and humidity of the greenhouse must be constantly monitored to ensure optimal conditions.

Table 2.5 Comparison of Zigbee Wi-Fi

Technology	Zigbee	Wi-Fi	GSM
Range	1-100+	1-100	wide
Source metrics	Reliability, Cost, power	Speed, Flexible	Cost
Application	Monitor & control	web, email	Data X^er

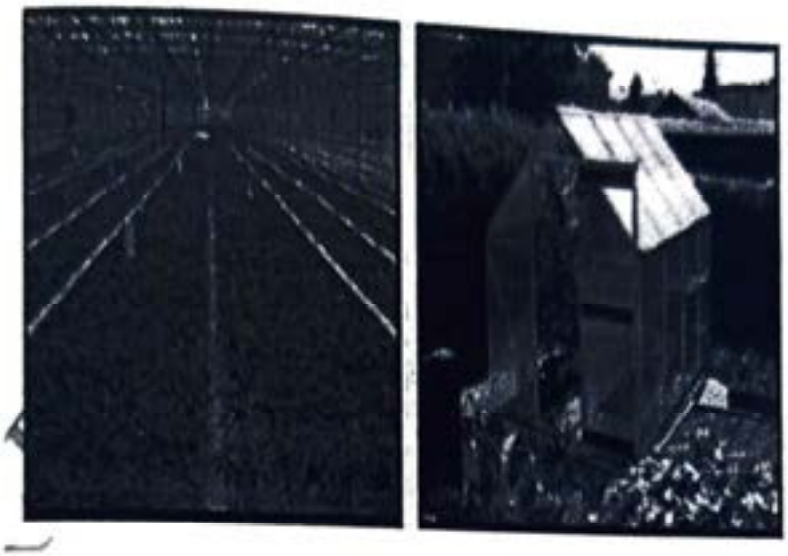
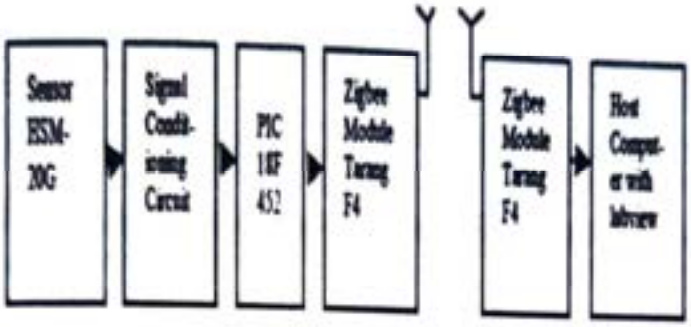


Figure 2.13 Greenhouse concept

2.9.2 Proposed Technique

However, compared with wired data communication, ZigBee communication mode is more suitable for short distance communication inside greenhouse because its advantages, such as, no complicated wire, flexible networking, easy to upgrade. In recent years, Ethernet has been introduced in the remote information transmission technology for greenhouse because of its fast speed, general protocol, good expansibility and easy Internet integration, etc . Another wireless sensor GSM which has developed rapidly in recent years. Short Message Service of GSM is a value-added service based on data packet switching. Because the GSM network can be interconnected and roamed all over the country, it has strong network ability, the users has no need to organize another network. The coverage of the network is improved and expensive network building and maintenance cost can be saved for users. At the same time, the number of its users is not limited. GSM network provides a strong platform for remote data transmission and monitoring the communication of equipment, it is an important method of wireless remote monitoring system. A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physically or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location . WSN can be used in some special situation for signal collection,

processing and transmitting. Wireless communication can be used to collect the measurement and to communicate between the centralized control and the actuators located in the different parts of the greenhouse. Moreover, it is easy to relocate the measurement points when needed by just moving sensor nodes from one location to another within a communication range of the coordinator device. WSN maintenance is also relatively cheap and easy .



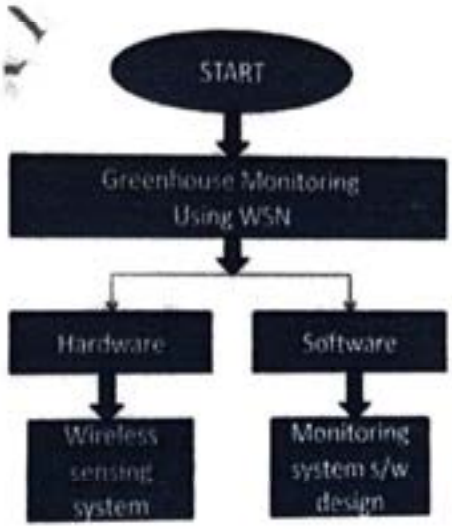


Figure 2.14 Block diagram of wireless sensing system

2.9.3 Result

The network of field data acquisition and transmission is built on the wireless sensor network and RS232 bus. The sensor nodes arranged in the greenhouse sample temperature, soil moisture, humidity and other information. Monitoring software of system server is the most critical part in the greenhouse environment information monitoring system, which is used for

dealing with the users and obtaining information of wireless sensor. The main function of monitoring software consists of parameter setting, display, query, analysis, report processing and alarm for real-time data, online real-time monitoring, real-time curve display, and remote real-time communication.

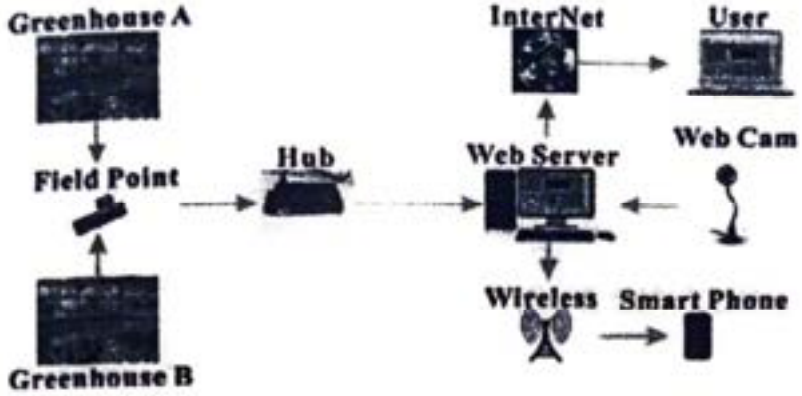


Figure 2.15 Greenhouse environment and control architecture

2.9.4 Conclusion

A review of the literature on environmental monitoring systems elucidates that the existing systems suffer from several drawbacks and thus modifications are being continuously suggested. The available environmental monitoring systems have limitations as unstable system; all parameters cannot be measured simultaneously. So there is a need for a system which can measure environmental parameters simultaneously; in addition, it should be energy efficient, economical, robust, and easy to operate.

2.9.5 Draw Back

The aim of research work is to design, develop and implement a sensor-based wireless communication system to monitor and control the greenhouse parameters using virtual instrumentation. Data analysis, control solutions and more complex network setups will be left to be the main directions of future work.

2.10 Automated Greenhouse Monitoring System

Basrah Journal For Engineering Sciences, Vol. 17, No. 1, 2017.

2.10.1 Introduction

In a world where everything can be controlled and operated automatically, but there are still few important sector in our country where automation has not be adopted not be put to a fully fledge use. perhaps because of several reasons. One such a reason is cost and one such field is agriculture. Agriculture has been one of the primary occupation of man since early civilization part and horticulture sectors. In our country, as they can be used to grow plant under controlled climatic parameters which directly or indirectly governed the plant growth and hence they produced. Automatic is process control of industrial machinery and a process they by replacing human operators. This system consist of various sensors namely soil moisture, temperature and light. This sensor sense various parameter temperature, soil moisture, and the light intensity and are then send to PIC microcontroller AT89S52. The microcontroller constantly monitors the digitalized parameter of various sensor and verify them with the predefined threshold values under check if any corrective action to be taken for contain at that instant time in case such situation arises it activate the actuator to perform a controlled operation.

2.10.2 Proposed Technique

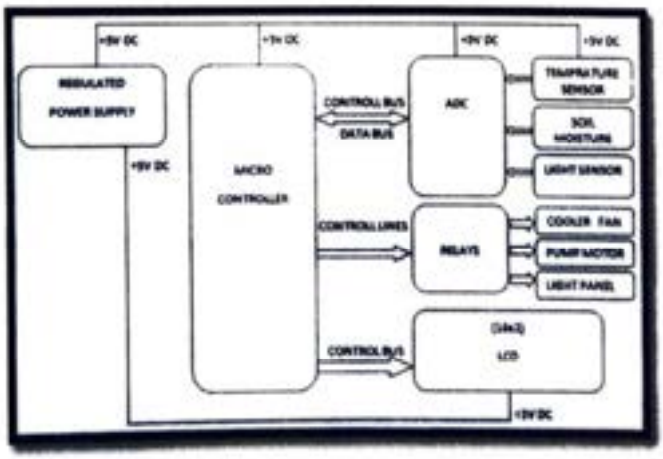


Figure 2.16 Block diagram of the system

2.10.2.1 LCD (Liquid Crystal Display)

LCD screen is an electronic display module and find a wide range of applications. A 16X2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segments and other multi-segment LEDs. The reason being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16X2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5X7 pixel matrix. These LCD has two registers, namely, command and data.

2.10.2.2 Relay

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows throught it). You can think of a relay as a kind of electric lever: switch it ON with tiny current and it switches on (leverages) another appliance using a much bigger current. Why is that useful? As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small elctric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small current to activate larger ones.

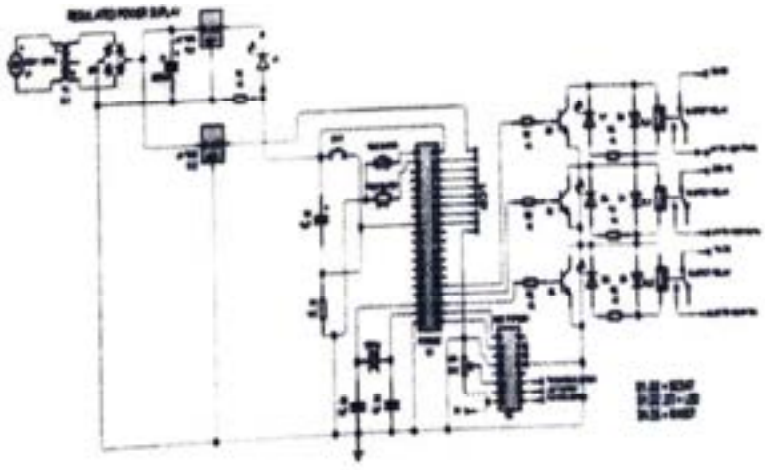


Figure 2.17 Circuit diagram of automatic greenhouse monitoring system

2.10.3 Result

This section consists of various devices like cooler fan to reduce the atmospheric temperature, water pump to insrease water content in the soil, light pannel to compensate for lack of sunlight inside the green house. These are actuated by relays controlled by the microcontroller 89S52.

2.10.4 Conclusion

Automated greenhouse monitoring system consists of various sensor namely soil moisture sensor, temperature sensor, and light sensor. These sensors sense various parmeters soil moisture, temperature, and light intensity and are then sent to the microcontroller 89S52 and control action taken by the microcontroller to compare with preset values. Automated greenhouse monitoring system eliminates risk of green house not bieng maintained at specific environmental conditions due to human error and labour cost can be reduced and it is eco friendly. Pests are eliminated by this system and also the quantity of yield can be increased.

2.10.5 Draw Back

In this proposal they were used conventional energy resource. The components in a greenhouse consume more power. So the components are get easily heated. In future we need to overcome these problems

2.11 Summary of Literature Review

S.NO	TITLE	TECHNIQUE	DRAWBACKS
1	Remote control system for greenhouse environment using mobile devices	Wireless sensing and control technology	While we use WIFI it covers only a short distance
2	Plant health monitoring and controlling of environment in a conservation	Image processing	automated controlling of devices eliminates the middleman and help farmers to produce high quality , high yield of crops.
3	IoT based intelligent greenhouse monitoring and scontrol system	FUZZY Controller	Due to LDR ,the overall system performance is overshot . Because it produces un precise result.
4	Smart Greenhouse monitoring using IOT	IOT	less number of physical objects are assigned with IP address.
5	Greenhouse monitoring and automation using GSM module	GSM	System may occur at high cost.

6	Different techniques of greenhouse remote monitoring system	WSN.ZIGBEE.GSM	The system become unstable due to more components and all the parameters are not possible to measure.
7	Automated greenhouse monitoring and control system	Microcontroller	Power consumption is very large because all the sensors uses the conventional energy resources.
8	Greenhouse monitoring and controlling using ARM	GSM	Some arm processor clock frequencies and their speeds and memory are limited in such cases.
9	Arduino based automatic plant watering system	Automatic watering plants	Expensive technique.
10	Greenhouse automation system using PSOC3	PSOC3 KIT	Due to monitor and control of different greenhouse system the power consumption is required more than normal greenhouse.

CHAPTER 3

THEORETICAL BACKGROUND

3.1 Introduction

We live in the world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. We live in a world where each and everything can be controlled and operated automatically, but still there are still a few important sectors in our country where even now automation has not been adopted some cases has not been put to a full-fledged use, perhaps because of certain reasons. The increase in living standards and higher consumer demands have increased pollution of the air with CO2 and other greenhouse gases; particulate matter of water along with a variety of chemicals, nutrients, and oil spills; and of the soil owing to the disposal of hazardous wastes, application of herbicides and pesticides, and disposal of non-biodegradable materials, etc.

3.2 Proposed Block Daigram

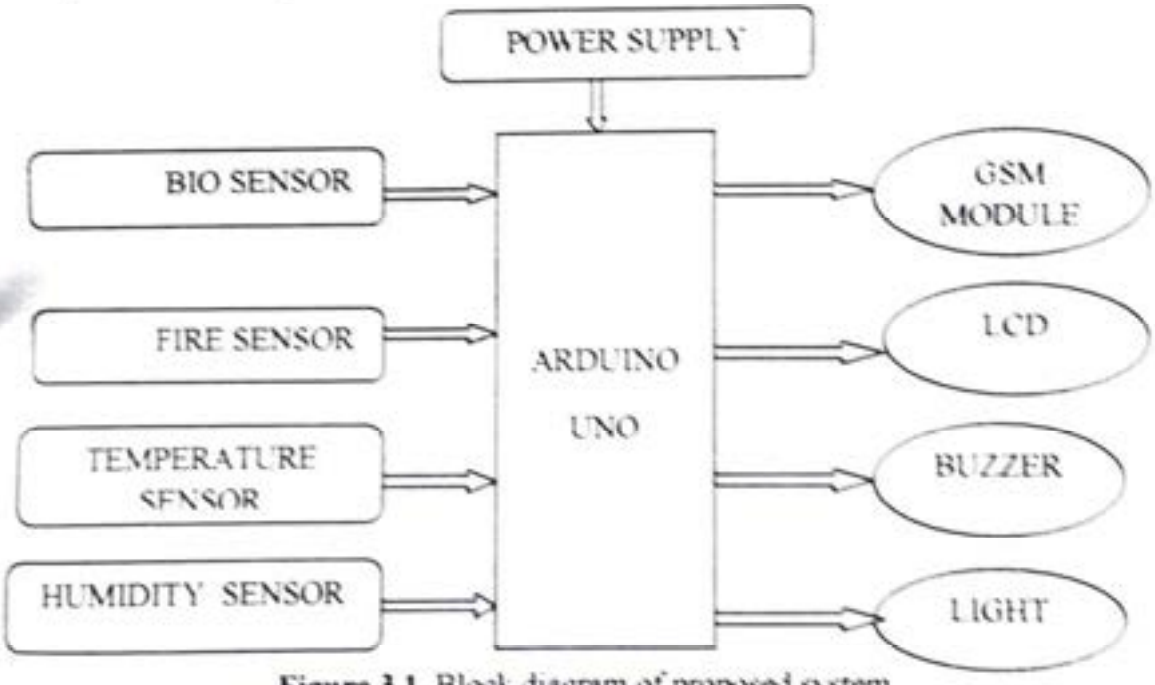


Figure 3.1 Block diagram of proposed system

3.3 Hradware Requirement

3.3.1 Arduino UNO

The arduino Uno is a microcontroller board based on the ATmega328, It has 14 digital input/output pins, 6 analog input, a 16 MHZ crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Uno differ from all preceding boards in that it does not use the FTDI USB to serial driver chip."UNO" means one in Italian and is named to mark the upcoming release of arduino 1.0. The Uno is the latest in a series of USB Arduino boards and reference model for Arduino platform. The Arduino Uno can power via the USB connection or with external power supply. External power can come either from an AC to DC adapter or battery.The board can operate on an external supply of 6 to 20 volts. If supply with less than 7v, however, the 5v pin may supply less than five volts and the board may be unstable. The Ttmega328 has 32 KB of flash memory for storing code .It has also 2KB of SRAM and 1KB of EEPROM. The Arduino software includes a serial monitor which allows simple textual data to be send to and from the Arduino board, The RX and TX LEDs on the board will flash when data is being transmitted via the USB to serial chip and USB connection to the computer. A Software Serial library allows for serial communication on any of the UNO's digital pins, the arduino software includes a wire library to simplify use of the I2C bus. Arduino is open source hardware and software, which are license under the GNU lesser General public license, which is permitting the manufacture of Arduino board and software distribution by anyone.

Figure 3.2 arduino uno

3.3.2 Soil Moisture Sensor:

The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil that forms a conductive path between two sensor probes leading to a close path to allow current flowing through.

Figure 3.3 Soil Moisture Sensor

3.3.3 LDR Sensor

The light sensor is extremely sensitive in visible light range. With the light sensor attached to the system when the surrounding natural lights are low, it displays the digital values.

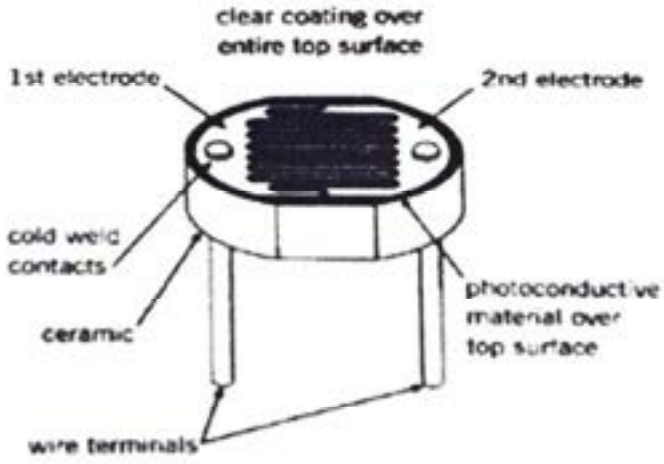


Figure 3.3 LDR Sensor

Figure 3.3 LDR Sensor

3.3.4 Humidity Sensor

Humidity sensor is used for sensing the vapours in the air. The change in RH (Relative Humidity) of the surroundings would result in display of values.

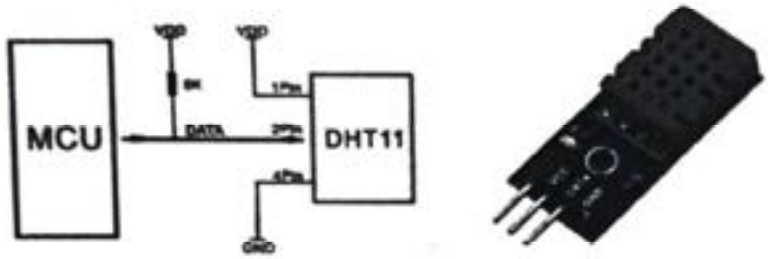
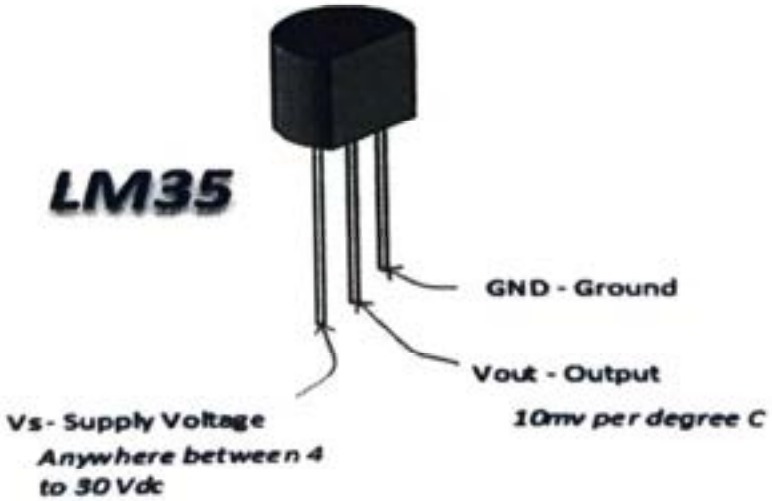


Figure 3.4 DHT11 Sensor

3.3.5 Temperature Sensor

If the temp exceeds beyond the limit set then a fan will be automatically switched ON as a coolant to reduce the temp. When it reaches the desired temp the fan will be switched OFF automatically with the help of a relay. But if the temp decreases bellow the optimum temp a bulb as a heater will be switched ON to set the temp within the desired range.



CHAPTER 4

SYSTEM SPECIFICATIONS

4.1 Software Implementation

The software part programming through Arduino Uno software (IDE). It is easy to write code and upload it to the board. C ,C++ language are used for programming.

4.2 Arduino Uno

The **Arduino `Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "uno" means "one" in Italian and was chosen to mark the initial release of the Arduino Software. The Uno board is the first in a series of USB-based Arduino boards, and it and version 1.0 of the Arduino IDE were the reference versions of Arduino, now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

4.3 Background

The Arduino project started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. At that time, the students used a BASIC Stamp microcontroller at a cost of $100, a considerable expense for many students. In 2003 Hernando Barragán created the development platform Wiring as a Master's thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas, who are known for work on the Processing language. The project goal was to create simple, low-cost tools for creating digital projects by non-engineers. The Wiring platform consisted of a printed circuit board (PCB) with an ATmega168 microcontroller, an IDE based on Processing and library functions to easily program the microcontroller. In 2003, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, added support for the cheaper ATmega8 microcontroller to Wiring. But instead of continuing the work on Wiring, they forked the project and renamed it Arduino. Early arduino boards used the FTDI USB-to-serial driver chip and an ATmega168.

CHAPTER 5

RESULT AND DISCUSSION

5.1 Result

In this project we are using IOT technology and GSM module technology .The sensors are deployed in the greenhouse which senses the current climatic conditions ,moisture of the soil in the greenhouse. The sense data is in analog form so that is converted in ADC circuit .ADC converter using to convert analog to digital form and transmit to a microcontroller computes the values and senses and send to the computer. sensor will sense the environment of the greenhouse and give all the information to the computer and according to the information computer will notify the about all the climatic condition to the mobile application .when it exceeds the above the threshold level it give alert through GSM module to mobile devices.

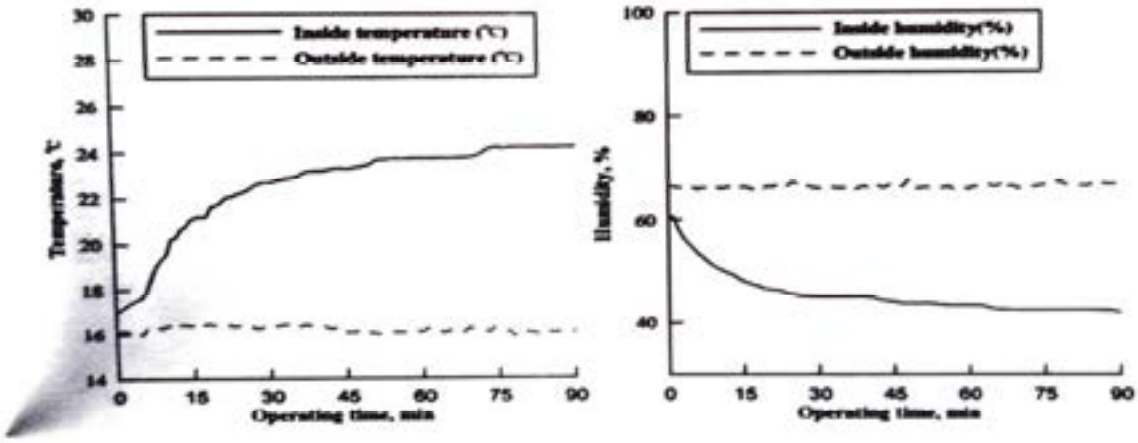


Figure 5.1 Temperature and Humidity by operating time

5.2 Discussion

The report is consist of the work done for the proposed technique of this project. In this, the proposed block diagram components are explained in detail. Then the software part of the project is Arduino IDE. With the help of this software we can load the program in the arduino board. This will identify the set level and done all the work of the greenhouse in automatic manner.

CHAPTER 6

WORK TO BE DONE IN PHASE II

For this project in phase II we are going to growth a plant in a controlled manner in a greenhouse. The temperature, moisture, humidity, light sensor's are placed in the greenhouse. The coding for the greenhouse system is loaded in the arduino board. Then the a level is set for the each sensor when the process reaches that level the parameters are ON automatically. In phase II hardware kit is placed for model.

REFERENCES

1. Nutan Kumar Sahu," Automated Greenhouse Monitoring System", International Journal,value 7 Issue No.2.

2. Trupti N. ," Different Techniques Of Greenhouse Remote Monitoring System". International Journal Research & Technology ISSN:2278-0181.

3. Kadarla Ramyateja "Greenhouse Monitoring And Controlling Using Arm " International Journal Of Computer Science And Mobile Computing, Vol.5 Issue.8, August- 2016.

4. Akshayyatnalkar" Green House Monitoring And Automation Using Gsm Module " An Iso 3297: 2007 Certified Organization.

5. Sengunthar Gayatri R," Greenhouse Automation System Using Psoc 3", Journal Of Information, Knowledge And Research In Electronics And Communication Engineering Issn.

6. Zaidon Faisal Shenan" Iot Based Intelligent Greenhouse Monitoring And Control System" Basrah Journal For Engineering Sciences, Vol. 17, No. 1, 2017.

7. Harshitha K," Plant Health Monitoring And Controlling Of Environment In A Conservatorium", International Research Journal Of Engineering And Technology (Irjet) Volume: 05 Issue: 07 | July 2018 .

8. Sin-Woo Kang, Sun-Ok Chung, Ki-Dae Kim" Remote Control System For Greenhouse Environment Using Mobile Devices "Chungnam National University, Daejeon, Republic Of Korea .

9. Aadil Imam ," Smart Greenhouse Monitoring Using Internet Of Things" International Journal Of Advanced Research In Electronics And Communication Engineering (Ijarece) Volume 7, Issue 5, May 2018.

CLOUD BASED FOREST FIRE ALERT SYSTEM USING IOT

A PROJECT PHASE - II REPORT

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(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

The proposed system is cloud based forest fire alert system using IOT technology. The most common hazard in forest fire Accident are themselves destroy the forest and great threat for wildlife and peoples. The number of trees has reduced drastically so the forest are creates an unhealthy environment for animals to survive in the forest. Forest covers 31% of the world and 21% of the India. It has found in a survey that 80% of losses are caused due to fire. This project of a system fire was detected early stages. It was tracking and alarming for protection of trees against forest fire. Now IOT (Internet of things) devices and cloud based to forest fire alerting system. If cloud can used to storing the information of data to monitoring the different environmental variables such as temperature, smoke, moisture of the forest. So finally to prevent the fire to spread over a huge area and precaution the forest. In the advancing world, it is very crucial to protect our environment. The fire cause serious change and disturbance to wildlife and human life. In wild animals are most affected and die also known for forest fire. If forest trees also burned to affect atmosphere, environment. This fire made naturally and man-made. So this project need to prevent and pre-cautions from forest fire. In order to achieve the best fire detection result with faster time to detect the temperature variation. When temperature sensor used to measure the temperature variation. Smoke sensor is a device that dense smoke, typically as an indicator of fire. Arduino at mega 328p used to control and monitor the activities. Cloud is a storage purpose to use him. Because each and every second to monitoring the environment condition data can be stored. IOT Device to interface with Arduino and cloud.so finally fix the monitoring system done in nearby forest office station. The detail about the system is connected with a computer system monitored by the officer.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATION
AC	Alternating Current
CO2	Carbon Di Oxide
DC	Direct Current
EDA	Electronic Design Automation
FFDS	Forest Fire Detection System
GND	Ground
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HTML	Hyper Text Mark-up Languages
I/O	Input And Output
IDE	Integrated Development Environment
IOT	Internet Of Things
IT	Information Technology
LCD	Liquid Crystalline Display
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
PIC	Predesignated Interexchange Carrier
RF	Radio Frequency
RISC	Reduced Instruction Set Computer
RST	RESET
SIM	Subscriber Identity Module
SMS	Short message service
TDMA	Time Division Multiple Access
TSPC	True Single Phase Clock
USART	Universal Synchronous /Asynchronous Receiver/ Transmitter
USB	Universal Serial Bus
VCC	Voltage Collector To Collector
WPF	Windows Presentation Foundation

CHAPTER 1

INTRODUCTION

1.1 Introduction

Fire is very deadly and it leads to loss of human life and property. Fire detection systems are necessary to reduce the destruction of personal belongings and caused by fire both man made and induced. Fire accidents claim roughly 65 victims every day. A total of 1.21 lakh fire accidents occurred between the years 2010 and 2014. Forests generate water supplies, biodiversity, pharmaceuticals, recycled nutrients for agriculture and flood prevention, and are central to the transition towards a Green Economy in the context of sustainable development and poverty eradication. The over utilization of ground water has drastically reduced the ground water level in the last 15 years. Also we should develop some new methods that use the renewable sources of energy. The development of these new techniques are going to reach our goal of sustainable development as well as to cut off the emission of greenhouse gases to a minimum level. The Internet of Things is a collection of sensor, actuators, software, electronics embedded with home appliances, physical devices and vehicles which connect with each other to connect and exchange date which helps in increasing the efficiency of everyday appliances using computer based systems. IoT is just another way to make everyday life easier for humans by developing smart devices. IoT devices have increased 31% per and was at 8.4 billion in the year 2017. IoT involves connecting objects beyond the range of standard devices which are used for everyday purposes. In Arduino Uno Atmega328p used to interface the LCD Display and the information .In this paper we have developed a cloud based forest fire alert system using IoT. The wireless mobile device to connect the cloud, then monitoring and exact location find it. Gas sensor, it detects the presence of any flammable gas like CO2. Temperature sensor, detects of there is any unusual change in the temperature. The connectivity and compilation.

CHAPTER 2

LITERATURE SURVEY

2.1 Forest Fire Detection and Alerting System

Michel Owayjan, George Freiha, Roger Achkar," Forest Fire Detection and Alerting System" 17th IEEE Mediterranean Electro technical conference, Beirut, Lebanon 13-16 April 2014.

2.1.1 Introduction

As the human technology moved further, the risk of natural and man induced catastrophes increase exponentially. One of the most dangerous disasters is fires. In addition to its direct danger on human's lives, fire consumes forests where trees that provide humans with oxygen are destroyed. The risk of fire has increased due to the problem of global warming which appeared in the 1980s. Forest fires represent a constant threat to ecological systems, infrastructure and environmental aspects of a community. This gives rise to the urgent need to detect forest fires as fast as possible. This paper highlights the powerful feature of wireless sensor networks as a potential solution to the challenge of early detection of forest fires. The device presented makes use of various sensors attached, solar recharging mechanism, and wireless data transmission, to fulfill the task in question. These collected data are transmitted to a near central unit where they are analyzed and then uploaded to an online website which contacts the Civil Defense unit if necessary. This website is accessible by the specific authorities in order to take early actions in case of any alert. It is worth mentioning that this system is efficient and green; thus, enforcing the need for its creation.

2.1.2 Technique

The box contains different types of sensors. These units communicate wirelessly and send the data collected from all the sensors to a base station that contains a central computer and an Internet Connection. The data collected will be uploaded in a database from the base station computer to an online website; this database compiles the history of the data that has been gathered from all the installed systems across the forest. The main part of this design is how to process the sensor outputs, send the data to the central unit to check if there is a fire. Thus, the Easy Bee module must include a microcontroller to collect the data and put them in a string, and a communication medium to send them. The microcontroller used in the system is the PIC16F877A, which is the main component responsible for acquiring, sending, and receiving data. The main part of this design is how to process the received string and send the data to the computer where custom software will analyze it to check if there is fire. Thus, the circuit must include a microcontroller to collect the data coming from the Zig Bee and redirect them to the computer. The microcontroller used in the system is the same as the one used in the transmitter part, PIC16F877A. Since Zig Bee is a mesh network that can communicate with other modules having the same protocol, the same module was used in the receiver unit.

2.1.3 Drawbacks

- Short range
- Low data speed
- High maintenance cost

2.2 Forest Fire Detection using Wireless Sensor

Harjinder Singh," Forest Fire Detection using Wireless Sensor", International Journal of Scientific & Engineering Research, Volume 7, Issue 7, July-2016.

2.2.1 Introduction

The advancement in human technology the risk of natural and man induced catastrophes increased exponentially. One of most dangerous disaster is forest fire. The forest fire represents continuous threat to species of flora as well as fauna. This paper highlights the powerful feature of wireless sensors for forest fire detection. The sensor data is collected using Arduino development board and transmitted to base station wirelessly.

2.2.2 Technique

At a particular time interval if the temperature 'T' which is output of temperature sensor is below the threshold value will indicate that there is no forest fire. These temperature values along with the value of humidity and smoke will be transmitted in real time to base station so as monitor the forest environment condition continuously. Now if the temperature becomes greater than the normal at the particular time an alert is send to base station through call and SMS.

2.2.3 GSM Module

GSM (Global System for Mobile Communication) is a digital mobile telephony that is widely used across the world. GSM uses a variation in time division multiple access (TDMA) which allows different users to share same frequency channel by dividing signal into different time slots. The GSM used in this project is SIM-300 GSM module. It is a tri band based engine that works on frequencies 900 MHz, 1800 MHz and 1900 MHz. In India at a frequency of 900 MHz. SIM-300 is used to make a call and send SMS to base station when temperature exceeds threshold value, humidity, smoke value.

2.2.4 Draw backs

- It is not fully secure.
- Short battery life.

2.3 Forest-Fires Surveillance System Based On Wireless Sensor Network

Mr.Lalit Patil, Miss.Divya Chopda, Miss.Prachi Jadhav," Forest-Fires Surveillance System Based On Wireless Sensor Network", Mr.Lalit Patil.et al. Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 6, Issue 4, (Part - 2) April 2016.

2.3.1 Introduction

Forest fires cause billions of Rupees in damage to property and the environment every year. To combat forest fires effectively their early detection and continuous tracking is vital. With the help of advanced Wireless sensor network techniques many methods have been developed to detect a forest fire in remote regions. Fire fighters need frequent and high-quality information updates of a fires development in order to conduct an effective and safe firefighting mission. Because forest fire monitoring is a difficult task. Forest cover is an important input variable for assessing changes to carbon stocks, climate and hydrological systems, biodiversity richness and other sustainability science disciplines. Despite incremental improvements in our ability to quantify rates of forest clearing, there is still no definitive understanding on global trends. Without timely and accurate forest monitoring methods, policy responses will be uninformed concerning the most basic facts of forest cover change. Results of a feasible and cost effective monitoring strategy are presented that enable timely, precise, and internally consistent estimates of forest. Taking in to consideration all this reasons we are designing a system that will help nature savior by help of advance technology.

2.3.2 Technique

Catching of fire in many of the forest is being detected lately. And which basically causes wide amount of disaster to nature. In prior system weather condition (e.g. clouds) seriously decrease the accuracy of satellite-based forest fire detection as the limitations led by the long scanning period and low resolution of satellites. So our idea behind this problem is to get the early detection of fire in the forest before it spreads to the entire forest. We will be

using different types of sensors i.e. smoke sensor, humidity sensor, and temperature sensor. Which will immediately recognize the amount of fire and will send the required data to the forest officer in this way we are trying to help the nature from destroying it. There are two main unites of hardware. In which one is Forest section which will be placed in the forest having Microcontroller unit to which different units are connected. Sensors are used to sense i.e smoke sensor is used to sense the smoke generated by the forest fire. As there occurs change in temperature when fire in been generated so for that purpose temperature sensor is used. Humidity sensor is used to since the humidity in the environment after changing the temperature. For data transmission purpose RF module/zigbee is used that sends the data to the receiver side but to send the data from microcontroller unit to the RF module/Zigbee we require standard RS232 cable. Entire circuit will work on 5v power supply. From the receiver side decoding is done of the data and the signal transmitted through serial communication cable.

2.3.3 Drawbacks

- Short range communication
- Low data speed
- Blur or accuracy is less.

2.4 Design and Development of Automatic Fire Detection Using SMS and Voice Alert System

Sathishkumar.R, Vinothkumar.M, Devaraj Varatharaj," Design and Development of Automatic Fire Detection Using SMS and Voice Alert System", International Journal of Scientific & Engineering Research, Volume 7, Issue 5, May-2016.

2.4.1 Introduction

In this work a review of existing fire-detector types has been carried out along with the development of a low cost, portable, and reliable PIC microcontroller based automated

fire voice alerting system for remotely alerting any fire incidents in industrial premises. During fire emergency response operations, establishment and utilization of situational awareness are of essential importance, enabling first responders, especially incident commanders, to better assess changing on-scene situations and make informed decisions. To keep in mind of the above mentioned situations, our proposed system is designed to alert the distant property-owner efficiently and quickly by sending short message (SMS) via GSM network and voice alerting system. This system guides the usage of Fire extinguisher during the fire accidents. A Linear integrated LM35 sensor detects Fire beyond preset value. The sensor units are connected via common data line to PIC microcontroller. A GSM kit based network module, capable of operating in standard GSM bands, has been used to send alert messages. Therefore the system is called eco-friendly system since the system automated in such a way to replace the conventional practices during fire accidents. The proposed system describes the nature of occurrence of fire and the system used to control them in the source**.**

2.4.2 Technique

In this system the fire is detected with the help of LM35 FIRE DETECTION sensor. Sensor sends a signal to microcontroller. In the next step microcontroller sends an active signal to other externally connected devices. The efficiency and memory of the microcontroller can be increased if microcontroller is used in place of 16f877a. Multiple SMS can be send by changing programming GSM module and VOICE alert. To change the SIM card we have to make changes in program. GSM module sends the information to the mobile phone in the form of sms to the customer and mean while alerts the entire industry through voice recorder. Voice recorders guide the employees in the correct direction and give instructions for the operation of fire extinguisher. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, Arduino software to developing the code for sending an SMS to safety officer or concerned authority person. SMS based Fire Alarm system are very useful in remote locations where human interaction is limited. Voice Alert system combines fire alert system. In this system digital voice technology is used today. Transmitters and a remote Receiver/Speaker Base Unit. When a zone is breached, a signal is sent up to 50 feet to the remote Base Unit.

2.4.3 Drawbacks

- Cannot interface high power directly.
- More complex.
- It is generally used in micro equipment.

2.5 Forest Fire Detection System

Dr.S.Praveenchakkaravarthy, J.Nancy, V.S.NaveenKumar." Forest Fire Detection System", International Journal of Recent Trends in Engineering & Research (IJRTER) Conference on Electronics, Information and Communication Systems (CELICS'17) Special Issue; March – 2017.

2.5.1 Introduction

Forest fire also known as bush fire or hill fire is an uncontrolled fire occurring wild or forest areas. It is very important to detect these kinds of fires as early as possible so as to prevent the damage from it to ecological system. The land were forest is burnt it becomes impossible to grow vegetation over there. This is because soil becomes water repellent and accepts no more water, leading to reduction in ground water level. Fire causes huge loss of lives and properties every year. Some of the main causes are erratic climatic change, prolonged dry season, low winter rainfall etc. but the argument is these conventional fire extinguishing systems are not enough to take prompt action during fire and save life. Traditional manual system does not ensure 24/7 monitoring from fire protection. Moreover, existing fire protection system could spread panic inside the whole building since it does not announce the location of fire or intensity. It only raises alarm whenever fire is detected at any place. Frightened people could starts to run away haphazardly. As a result buildings full of workers in the factories women, children could be smashed by the outgoing pressure of the frightened crowd and injured severely. It could lead a devastating result. In this paper FFDS system is presented that can minimize the hazard. Along with fire alarm this system announces locations of fire and able to detect severity.

2.5.2 Technique

The forest fire detection system can be divide in three different parts: the fire detector with sensors for temperature and smoke levels, the GSM transmitter which converts the information obtained by sensors into digital data and transmits them through GSM network, and the electrical supply, which should take into account the stand-alone use of this front-end. Although a GSM front-end can be made with discrete components, its integration has many advantages, such as higher microelectronics. The Global Warming Report 2008 mentions forest fire as one of the major cause behind increase in global warming. In recent year 2016 more than 4000 hectares of forest were burnt in the performance at lower cost, size reduction and less power consumption. It is well known, there will be large variations/increase in temperature from the normal temperature whenever forest fire occurs. This can be detected/ monitored continuously by using temperature sensors and in accordance with the simple arrangement of transmitters. This concept is quite reliable and cost-effective in detecting of forest fire's since simple equipment's are arranged in a simple configuration and also GPS is used in this project to get the location of the forest fire. The goal behind the development of this technology was the early detection of forest fires accurately in order to curtail the loss of forests as well as wild life and people as well. The sink then sends the data to a control station, usually far away, via the Internet, Satellite communication, GSM etc.

2.5.3 Drawbacks

- Data frame is limited by size.
- Data transfer speed is low.

2.6 Fire Monitoring System for Fire Detection Using ZigBee and GPRS System

Kiran Kumar.D, Kishore, T.V.Suresh Kumar," Fire Monitoring System for Fire Detection Using ZigBee and GPRS System", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) Volume 12, Issue 1, Ver. III (Jan.-Feb. 2017).

2.6.1 Introduction

Forest ecosystems are dynamic and complicated. Disturbance to any part of the network affects the balance of relationships and equally on the complete schemes either absolutely or negatively. When global climate change, drought and different conditions have caused occurrences of intense wildfire to extend, which may harm forest badly so once wildfire occurs it takes years to naturally recover. Sometimes wildfire becomes important for forests, however it additionally becomes a threat to them, thus sturdy policies and management are important to prevent wildfire. The best way to prevent such wildfire is to detect fire as early as possible. To detect the fire main three environmental conditions one has to monitor are relative humidity, temperature and wind direction. Two factors which have direct influence on fire are relative humidity and temperature. Temperature is very essential factor in detecting the wildfire as it is a measure requirement in ignition and continuing the combustion process. Humidity is nothing but moisture in the form of water vapour present in the atmosphere. Relative humidity is the percentage ratio of actual water vapour contain to the amount of water vapour that would saturate the atmosphere at the same temperature. Normally fire closure occurs when relative humidity is less than 10%, temperature is in between 89-90F and RH is 15 percent or less, temperature is in between 90-99F and RH is 20 percent or less, temperature is higher than 100F and RH is 25 percent or less Currently for wildfire detection different methods has been deployed such as patrols, satellite monitoring and observations from watch towers. As watch tower method is low cost and easy but it has many drawbacks such as need of trained labors, personal abound as carelessness of labours, absence from the post, limited coverage area. In other hand satellite monitoring is highly costly and comes with drawbacks as it is not effective as the images from satellite sometimes becomes useless due to pixel covered by clouds and also it needs long scanning cycle and resolution of saturated pixel dots of images is low. WSN is solution in between cost and effectiveness. zigbee based sensor nodes in WSN monitors real time temperature and humidity data which effects in wildfire and sends the data to gateway nodes where the collected data is analyzed and change in data is monitor.

2.6.2 Technique

The state machine is made up of three basic state. The transition in state occurs when sudden rise in temperature or relative humidity occurs. The zero state indicates the normal state, in this state the temperature is monitored continuously. This state is in self loop, when sudden rise in temperature occurs machine changes its state from state 0 normal states to the second state. To avoid ambiguity between rise in temperature due to fire and rise in temperature due to other reasons like sunrise or combustion of gases on sun's surface, the machine stays in state. In each state 0, the average of the previous five values of temperature (Tavg) is calculated and which is checked against the new measured value which is t (temperature), if the new measured value is exceeds 3degree Celsius in case of temperature then the change from state0 to state1 occurs. The sensor end point nodes are light in weight and can be mounted on trees, the end points are made with Arduino board interfaced with temperature sensor LM35 and HTM2500 the values are transferred to the gateway nodes via serial communication. For serial communication the ZigBee modules are used which are interfaced with ATmega328 in Arduino board. ZigBee transition is used for 3 meter range with low power of 3.3 v supply. Number of sensor nodes are arranged to cover the entire coverage, these ZigBee will work as routers in the zigbee network. The gateway node is also has Arduino interfaced with zigbee module. Continuous monitoring of these two parameter helps us to detect the occurrence of wildfire. The method has included wireless sensor network to transfer the information. This network has included short range communication via zigbee and long range communication via GPRS. Short range communication has included for data exchange between different area of the forest and to process this data, whereas long term communication has used to send the alert messages. The unique SIM ID in GPRS helps to detect the exact location of the wildfire. This method is less complex and needs low maintenance, and useful in low power application.

2.6.3 Drawbacks

- It is fully not secure.
- Short battery life.
- Speed is very poor.

2.7 Forest Fire Detection Using Optimized Solar Powered Wireless Sensor Networks

Pallavi C. Jamdhade, Ashwini D. Kawate, ShitalS.Lachake," Forest Fire Detection Using Optimized Solar Powered Wireless Sensor Networks", International journal of Advance search in science and engineering, Volume NO.07, Issue NO.02, February 2017.

2.7.1 Introduction

Forests are part of the important and indispensable resources for human survival and social development that protect the balance of the earth ecology. However, because of some uncontrolled anthropogenic activities and abnormal natural conditions, Forest Fires occur frequently. These fires are among the most serious disasters to forest resources and the human environment. In recent years, the frequency of forest fires has increased considerably due to climate changes, human activities and other factors. The prevention and monitoring of Forest Fires has become a global concern in Forest Fire prevention organizations. Currently, Forest Fire prevention methods largely consist of Patrols, Observation from watch towers, Satellite Monitoring and lately Wireless Sensor Networks. Although observation from watch towers is easy and feasible, it has several defects. In the first place, this method requires many financial and material resources and a trained labor force. Second, many problems with fire protection personnel abound, such as carelessness, absence from the post, inability for real-time monitoring and the limited area coverage.

2.7.2 Technique

Microcontrollers have only been with us for a few decades but their impact (direct or indirect) on our lives is profound. Usually these are supposed to be just data processors performing exhaustive numeric operations. Microcontroller is a single chip micro-computer that has everything inbuilt i.e. circuitry of microcontroller has built in RAM, ROM, input output devices, timer, counter, interrupts The 89c series is a low-power, high-performance CMOS 8-bit microcomputer with Flash programmable and erasable read only memory (PEROM). Here We are using ATMELS AT89c/s52 microcontroller. The controller executes instructions as per the clock cycles; this clock is generated using a crystal which is connected to the XTAL1 &

XTAL2 pin of the microcontroller, the two capacitors C1 &C2 are connected between the two XTAL pins &the ground. They are required for the crystal to oscillate. A Power ON reset circuit is connected to the RESET pin of the microcontroller, the controller must be reseted properly whenever is power is turned on, which is done by applying a Vcc to the reset pin & for normal operation of the controller the pin should be pulled low. So an RC (R1, C3) circuit is connected to the RST (9) pin of the microcontroller. Whenever the power is turned ON the Capacitor is fully charged & the RST pin gets 5 v. Then the capacitor slowly discharges through the resistor & is then pulled to ground. Microcontrollers Port 0 does not have an Internal Pull Up resistor so we need external Pull Up resistors on port 0. For which we use 9-Pin SIP resistor which are basically eight resistors with one end common. Mechanical modeling for accessible and inaccessible areas helps in the easy implementation of the Forest Area modules. The system can also be upgraded with low-power elements. In generally, the wireless systems designer has two overriding constraints: it must operate over a certain distance and transfer a certain amount of information within a data rate. The RF modules are very small in dimension and have a wide operating voltage i.e. 3V to 12V.

2.7.3 Drawbacks

- More complex architecture.
- Cost is increases.
- It can't interface high power devices.

2.8 Implementation of Wireless Sensor Network and IOT for Real Time Forest Fire Warning System

S.Varunkumar, P.V Yokeshraj, V.Vignesh," Implementation of Wireless Sensor Network and IOT for Real Time Forest Fire Warning System", International Journal of Engineering and Techniques - Volume 4 Issue 1, Jan – Feb 2018.

2.8.1 Introduction

As we all know, the forest is considered as one of the most important and indispensable resources, the prevention and detection of the forest fire, have been researched

hotly in worldwide Forest Fire Prevention Departments. Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO2) in the atmosphere comes from forest fires), in addition to irreparable damage to the ecology (huge amounts of smoke and carbon dioxide (CO2) in the atmosphere). Among other terrible consequences of forest fires are long-term disastrous effects such as impacts on local weather patterns, global warming, and extinction of rare species of the flora and fauna. Based on the deficiencies of conventional forest fire detection on real time and monitoring accuracy, the wireless sensor network technique for forest fire detection is being implemented here. The problem with forest fires is that the forests are usually remote, abandoned/unmanaged areas filled with trees, dry and parching wood, leaves, and so forth that act as a fuel source. The fire ignition may be caused through human actions like smoking or barbeque parties or by natural reasons such as high temperature in a hot summer day or a broken glass working as a collective lens focusing the sun light on a small spot for a length of time thus leading to fire ignition. Once ignition starts, combustible material may easily fuel to feed the fires central spot which then becomes bigger and wider. The initial stage of ignition is normally referred to as "surface fire" stage. This may then lead to feeding on adjoining trees and the fire flame becomes higher and higher, thus becoming "crown fire." Mostly, at this stage, the fire becomes uncontrollable and damage to the landscape may become excessive and could last for a very long time depending on prevailing weather conditions and the terrain.

2.8.2 Technique

The real time transmission and reception of parameters such as humidity, temperature, air quality, and location are obtained. The Raspberry Pi is more efficient than its other counterparts in multiprocessing of data with minimum expenditure of power. The Wireless sensor node network ensures long distance transmission of data from inside dense forest to the receiver even if it has poor network coverage. The forest is scattered with multiple zig bee node points and they transmit it to a central zig bee system and each central zig bee transmits its data individually to the receiver end which receives all sensor data from each node point in of the

forest The live monitoring and condition based picture capturing method ensures an additional warning system that forest fire occurred. And is programmed to be in sleep mode when not triggered to save power. SMTP protocol and SMS are an efficient method to send an early warning whenever a forest fire is detected. Through this way an early warning intimation when a forest fire occurs reaches the monitoring station and immediate actions on extinguishing the fire are taken.

2.8.3 Drawbacks

- Low short range.
- High maintenance.
- Low network stability**.**

2.9 Iot Enabled Forest Fire Detection and Altering the Authorities

T. Sai Kumar, P. Sriramya," Iot Enabled Forest Fire Detection and Altering the Authorities", International Journal of Recent Technology and Engineering (IJRTE) Volume-7, Issue-6S4, April 2019.

2.9.1 Introduction

In the present arena, wildlife and forest departments are facing the problem of movement of animals from forest area to residential area. The number of trees has reduced drastically from the forest that creates an unhealthy environment for animals to survive in the forest. It has been found in a survey that 80% losses are caused due to fire. This could have been avoided if the fire was detected in the early stages. This project proposes a system for tracking and alarming for the protection of trees against forest fires. Nowadays IOT (Internet of Things) devices and sensors allow the monitoring of different environmental variables, such as temperature, humidity, moisture etc. Arduino platform based IOT enabled fire detector and monitoring system is the solution to this problem. In this project we have built fire detector using Arduino UNO which is interfaced with a temperature sensor, a smoke sensor and a buzzer. In order to implement this project, we will be using GSM which is used to provide the final

SMS to the user through the given number in the simulation program, Temperature sensor which is used to denote the temperature High and Low that will be displayed in the LCD Display, Flame sensor which is used to denote the flame ranges and if it is high the forest fire will be detected in the LCD display and if it is low forest fire won't be detected. Whenever a fire occurs, the system automatically senses and alerts the user by sending an alert to an app installed on user's android mobile or webpage accessible through the internet.

2.9.2 Technique

Arduino/Genuino Uno is a microcontroller board subject to the UNO, which we are using. It has 14 induced data/yield pins in which 6 can be used as PWM yields, 6 fundamental data sources, a 16 MegaHz quartz gainful stone, a USB affiliation, a power jack, an ICSP header and a reset catch which used for resetting input data. You can gauge temperature frequently than a utilizing an indoor regulator. This is a remote modem that works with an its remote framework. It continues like a dial-up GSM modem. The main difference between the dial-up modem sends and gets the data through a fixed telephone line but, which a remote modem sends and gets the data through radio waves. Appealing transducers contain an alluring circuit involving an iron focus with damage twist and a weight plate, an unending magnet and a vibrating stomach with a portable iron piece. Ringers like the TMB-course of action are alluring fit for being heard banner devices with natural faltering circuits. Transistors, resistors, diodes and other little devices go about as circuit contraptions for driving sound generators. IOT based forest fire detection was implemented using the Arduino. So when the temperature is increased it will display on the LCD and also gives message to authorities by using the registered mobile number. Same process is implemented for the fire detection, when the flame gets increased the buzzer will get activated and intimation will be conveyed to the authorities.

2.9.3 Drawbacks

- It don't get to the know about micro controller inside the Arduino deeply.
- Arduino IDE get limited library.
- Important factor is cost.

2.10 Fire Alarm System Using IOT

Angeline.R, Aditya.S, Abhishek Narayanan," Fire Alarm System Using IOT", International Journal of Innovative Technology and Exploring Engineering (IJITEE) Volume-8, Issue-6S3, April 2019.

2.10.1 Introduction

Forests generate water supplies, biodiversity, pharmaceuticals, recycled nutrients for agriculture and flood prevention, and are central to the transition towards a Green Economy in the context of sustainable development and poverty eradication. Recent studies into the extent of illegal logging estimate that illegal logging accounts for 50-90 per cent of the volume of all forestry in key producer tropical countries and 15-30 per cent globally. At home and abroad there are forest fire preventions such as artificial way of looking, forest aircraft, Fire-Watch forest fire automatic warning systems and satellite circuit monitoring system,. Not only does it help in improving the efficiency of a device\ but also has economic benefits. Iot is just another way to make everyday life easier for humans by developing smart devices. The market value for IoT devices is also set to increase to $7.1 million by the year 2020. Iot involves connecting objects beyond the range of standard devices which are used for everyday purposes. In this paper we have developed an IoT based fire alarm with additional safety and verification methods. The devices uses a wide variety of sensors- PIR sensor, to detect the exact location of the origin of fire. Gas sensor, it detects the presence of any flammable gas like CO2. Temperature sensor, detects of there is any unusual change in the room temperature. The connectivity and compilation of data is done by using a Raspberry Pi 3. As soon as the sensors detect some unusual activity, the web camera attached to the device takes a picture of the surrounding and sends it to the watchman and the nearby fire stations. The watchman has a grace period of 120 seconds to confirm the fire and its validity. Upon his verification the fire Marshalls arrive at the scene to put out the fire. If the message is unanswered by the watchman for 120 seconds the device sends out a red alert to the fire station requesting their immediate arrival.

2.10.2 Technique

Fires cause serious damage and disrupts daily life in a devastating manner. Hence preventing them or reducing their effects is a top priority. Though there are many systems that have been created to tackle this problem, false alarms is a challenge that is yet to be avoided. In our model, the place to be monitored is under constant surveillance by a closed circuit television. At tactical points, a number of sensors are placed. The sensor include pir sensor, temperature sensor, heat sensor and gas sensor. Each sensor plays a vital role in detecting a fire if it occurs. On top of these sensors, the footage from the camera is also used to detect the fire through image processing. The main advantage of this system is that it has a very high accuracy. If the fire has been detected a mail is sent to the security and the nearest fire department with an attachment of the photo. The architecture diagram is almost self-explanatory. The sensors and the camera act as input devices that gives input data to the raspberry pi which then processes the information and deduces through the unique algorithm whether there is a fire or not. The buzzer and spikler are close vicinity warning and countermeasure system while the wifi is used to send a message to the security guard and the nearest fire department.

2.10.3 Drawbacks

- It does not replace your computer.
- Processor is not so fast.
- Time consuming to download and the software.

Table 2.1 Summary of literature survey

Paper Title	Technique used	drawbacks
Forest Fire Detection and Alerting System	The powerful feature of wireless sensor networks as a potential solution to the challenge of early detection of forest fires.	➢ Short range ➢ Low data speed
Forest Fire Detection using Wireless Sensor	➢ Wireless sensors for forest fire detection. ➢ Alert is send using GSM module.	➢ It is not fully secure. ➢ Short battery life.
Design And Development Of Automatic Fire Detection Using Sms And Voice Alert System	➢ Sending short message (SMS) via GSM network and voice alerting system. ➢ Fire extinguisher during the fire accidents.	➢ GPS location not in proper because of low signal strength. ➢ Cannot interface high power directly.
Forest Fire Detection System	The fire hazard FFDS notifies the control room and others by text messages.	➢ Data frame is limited by size. ➢ Data transfer speed is low.
Forest Fire Detection Using Optimized Solar Powered Wireless Sensor Networks	The technologies of MODIS and Basic Wireless Sensor Network - based Forest Fire Detection Systems.	➢ Cost is increases. ➢ It can't interface high power devices.

Fire Monitoring System for Fire Detection Using ZigBee and GPRS System	The present methodology based on ZigBee and GPRS wireless sensor network.	➢ Using ZigBee data transfer not possible in long distance
Implementation of Wireless Sensor Network and IOT for Real Time Forest Fire Warning System	➢ The real time monitoring system. ZigBee module and Gps location	➢ High maintenance. Low network stability
Forest-Fires Surveillance System Based On Wireless Sensor Network	➢ Current surveillance systems utilize a camera, an infrared sensor system and a satellite system	➢ Camera resolution or blur may occur so accuracy is not good. ➢ Low data speed.
IOT Enabled Forest Fire Detection and Altering the Authorities	➢ Arduino platform based IOT technology. ➢ Alerts the user by sending an app installed on user's android mobile.	➢ It don't get to the know about micro controller inside the Arduino deeply
Fire Alarm System Using IOT	➢ The Raspberry Pi and real time sensor with IOT technology.	➢ More expensive components. ➢ Processor is not so fast.

CHAPTER-3

THEORETICAL BACKGROUND

3.1 Exciting Method

The paper depicts the necessity and an efficient solution for fire safety. Internet of Things was the main concept used and the project mainly builds on the techniques which are already presents and also it has overcome many obstacles present in the previous systems. But still there are few tweaks and remodeling required to get a more efficient and working model. The time taken for process is to be reduced for practical use.

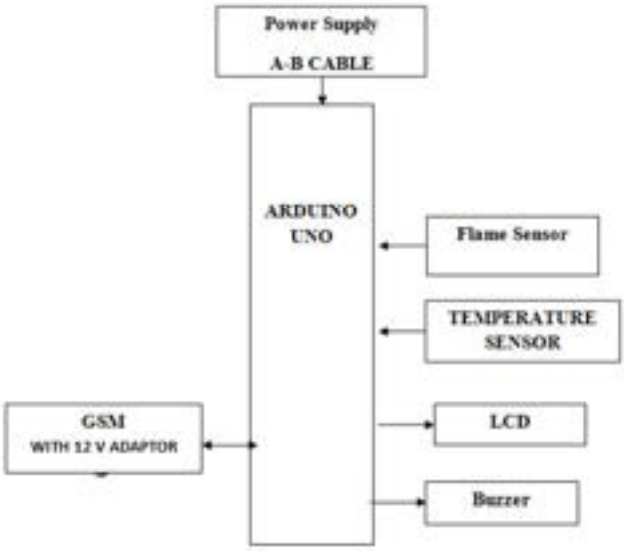

Fig 3.1 Exciting Block Diagram

Fires cause serious damage and disrupts daily life in a devastating manner. Hence preventing them or reducing their effects is a top priority. Though there are many systems that have been created to tackle this problem, false alarms is a challenge that is yet to be avoided.

In our model, the place to be monitored is under constant surveillance by a closed circuit television. At tactical points, a number of sensors are placed. The sensor include flame sensor, temperature sensor. Each sensor plays a vital role in detecting a fire if it occurs. On top of these sensors, the footage from the camera is also used to detect the fire through image processing. The main advantage of this system is that it has a very high accuracy.

3.2 Proposed System

The proposed system is cloud based forest fire alert system using IOT technology. The most common hazard in forest fire Accident are themselves destroy the forest and great threat for wildlife and peoples. The number of trees has reduced drastically so the forest are creates an unhealthy environment for animals to survive in the forest. Forest covers 31% of the world and 21% of the India. It has found in a survey that 80% of losses are caused due to fire. This project of a system fire was detected early stages. It was tracking and alarming for protection of trees against forest fire. Now IOT (Internet of things) devices and cloud based to forest fire alerting system. If cloud can used to storing the information of data to monitoring the different environmental variables such as temperature, smoke, moisture of the forest. So finally to prevent the fire to spread over a huge area and precaution the forest. In the advancing world, it is very crucial to protect our environment. In wild animals are most affected and die also known for forest fire. If forest trees also burned to affect atmosphere, environment. This fire made naturally and man-made. So this project need to prevent and pre-cautions from forest fire. In order to achieve the best fire detection result with faster time to detect the temperature variation. When temperature sensor used to measure the temperature variation. Smoke sensor is a device that dense smoke, typically as an indicator of fire. Arduino at mega 328p used to control and monitor the activities. Cloud is a storage purpose to use him. Because each and every second to monitoring the environment condition data can be stored. IOT Device to interface with Arduino and cloud.so finally fix the monitoring system done in nearby forest office station. The detail about the system is connected with a computer system monitored by the officer.

- Cloud computing.

3.2.1 Cloud computing

Cloud computing is the on-demand availability pf computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the internet. Cloud computing services provide information technology (IT) as a service over the internet or dedicated network, and payment based in usage. Cloud computing services range from full applications and development platforms, to servers, storage, data base, networking, software, analytics, intelligence, and virtual desktops over the internet to offer faster innovation, flexible resource, and economics of scale.

3.3 Block Diagram

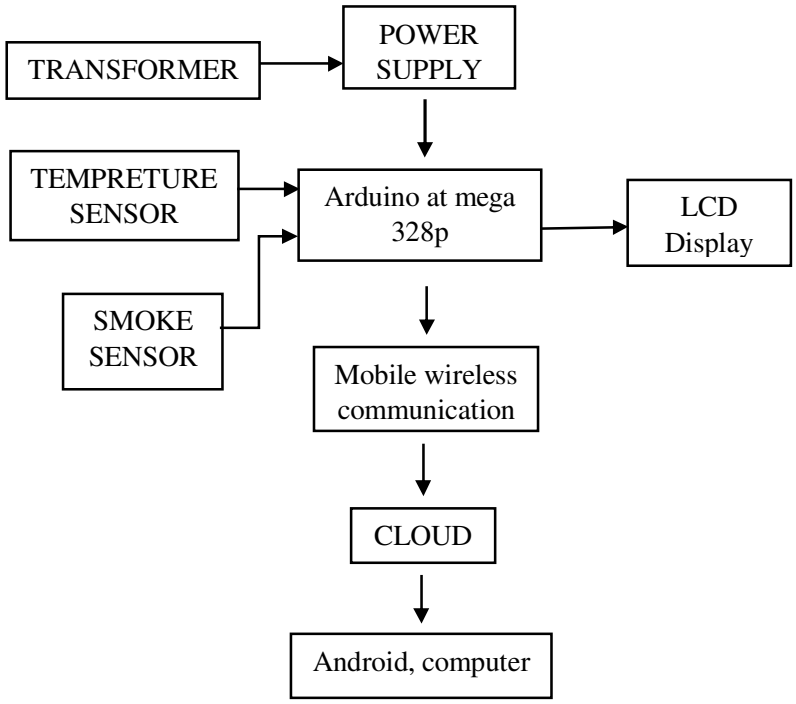

Fig 3.2 Block Diagram of Proposed System

3.3.1 Arduino atmega 328p

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards. ATMEGA328 is used similar to any other controller. All there to do is programming. Controller simply executes the program provided by us at any instant. Without programming controller simply stays put without doing anything. As said, first we need to program the controller and that is done by writing the appropriate program file in the ATMEGA328P FLASH memory. After dumping this program code, the controller executes this code and provides appropriate response.

Fig 3.3 Atmega 328p Microcontroller

3.3.2 Temperature Sensor

LM35 is a temperature sensor that outputs an analog signal which proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of LM35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating. Low cost and greater accuracy. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino. Power the IC by applying a regulated voltage like +5V (VS) to the input pin and connected the ground pin to the ground of the circuit.

Fig 3.4 Temperature Sensor of LM35

3.3.3 Smoke Sensor MQ-2

The MQ-2 is a flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage.The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm.The MQ-2 gas sensor is sensitive to LPG, i-butane, propane, methane, alcohol, Hydrogen and smoke. They are used in gas leakage detecting equipment's in family and industry and in portable gas detector.

Fig 3.5 smoke sensor MQ-2

3.3.4 Bluetooth

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by

AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices.

Fig 3.6 Bluetooth HC-05

The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

3.3.5 LCD Display

16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16*2 LCD, hence we are using it here. These black circles consist of an interface IC and its associated components to help us use this LCD with the MCU. Because our LCD is a 16*2 Dot matrix LCD and so it will have (16*2=32) 32 characters in total and each character will be made of 5*8 Pixel Dots.

Fig 3.7 LCD Display

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware Requirements

- Arduino atmega 328p
- Temperature sensor
- Smoke sensor
- Bluetooth
- LCD Display
- Transformer
- Cloud

4.2 Software Requirements

- Windows 7
- Visual studio
- Embedded C

4.1 Hardware Explanation

4.1.1 Arduino atmega 328p

Arduino is an open source computer hardware and software company, project and user community that designs and manufactures single- board micro controller micro controller kits for building digital devices and interactive objects that can sense and control object in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or bread boards.

Arduino Uno is a microcontroller board based on the Atmega328p.

Fig 4.1 Arduino At mega 328p

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and reset button. It contains everything needed to support the micro controller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing somethings wrong, worst case scenario you can replace the chip for a few dollars and starts over again. The Uno board and version 1.0 of Arduino software (IDE) were the reference versions of Arduino, now evolved to newer release the uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.

4.1.1.1 Pin diagram

Arduino atmega 328p is a 28 pin chip as shown in above. Many pins of the chip here have more than one function. We will describe functions of each pin in below.

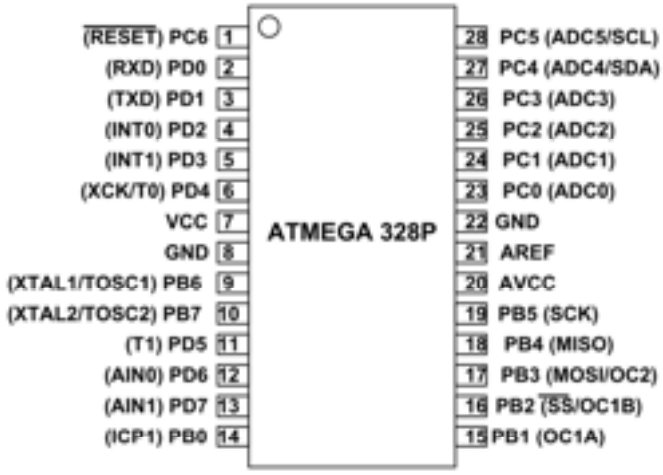

Fig 4.2 Pin diagram of ATMEGA 328p

In pin no.1 name is PC6 (RESET) pin by default is used as RESET pin. PC6 can only be used as I/O pin when RSTDISBL Fuse is Programmed. Pin No.2 is PD0 (RXD) is (Data input pin for USART) is used serial communication interface. Pin no.3 PD1 (TXD) is (Data output pin for USART) is used serial communication interface with INT2 (External interrupt 2 input).Pin no.4 is PD2 (INTO) used external interrupt source 0. Pin no.5 is PD3 (INT1/OC2B) External interrupt source1wiith OC2B (PWM – Timer? Counter2 output compare Match B output).pin no.6 PD4 (XCK/T0) T0 (Timer0 External counter input) and XCK (USART external clock I/O). Pin no.7 is Denotes VCC is connected to positive Voltage. Pin no.8 GND is connected to Ground.

Pin no.9 is PB6 (XTAL1/TOSC1) is XTAL1 (chip clock oscillator pin 1 or external clock input) and TOSC1 (timer oscillator pin 1).pin no.10 is P7 (XTAL2/TOSC2) XTAL2 (chip clock oscillator pin 2) and TOSC2 (timer oscillator 2). Pin no.11 is PD5 (T1/OC0B) is T1 (timer1 external counter input) and OC0B (PWM- timer/counter0 output compare match B output). Pin no.12 PD6 (AIN0/OC0A) is AIN0 (Analog comparator positive I/P) and OC0A (PWM-timer/counter0 output compare Match A output). Pin no.13 is PD7 (ALN1) is ALN1 (analog comparator negative I/P). Pin no.14 PB0 (ICP1/CLK0) is denotes ICP1 (timer/counter 1 input capture pin) and CLK0 (divided system clock. The divided system

clock can be output on the PB0 pin). Pin no.15 is PB1 (OC1A) is OC1A (timer/counter1 output compare match A output). Pin no.16 PB2 (SS/OC1B) is SS (SPL slave select input). This pin is low when controller acts as slave. And OC1B (timer/counter1 output compare match B output).

Pin no.17 PC4 (ADC4/SDA) is ADC4 (ADC input channel 4) and SDA (two-wire serial bud data input/output line). Pin no.18 PB4 (MISO) is MISO (master input slave output). When controller acts as slave, the data is sent to master by this controller through this pin. Pin no.19 is PB5 (SCK) is SCK (SPI bus serial clock). This is the clock shared between this controller and other system for accurate data transfer. Pin no.20 is AVCC is power for internal ADC converter. Pin no.21 is AREF is analog reference pin for ADC. Pin no 22 is GND is denoted as ground. Pin no.23 is PC0 (ADCO) ADC0 (ADC input channel 0). Pin no.24 is PC1 (ADC1) is ADC1 (ADC input channel 1) to Pin no.28 PC5 (ADC5/SCL) is denotes ADC5 (ADC input channel 5) and SCL (two-wire serial bus clock line).

4.1.1.2 Architecture of Atmega 328p

Here architecture is of Arduino or precisely the IC of Arduino (atmega 328p). The atmega 328p is a low power CMOS 8-bit micro controller based on the AVR enhanced RISC (reduced instruction set computer) architecture.

In order to maximize performance and parallelism, the AVR uses Harvard architecture- with separate memories and buses for program and data. Instruction in the program memory are executed with a single level of pipelining. The clock is controlled by an external 16 MHZ crystal oscillator.

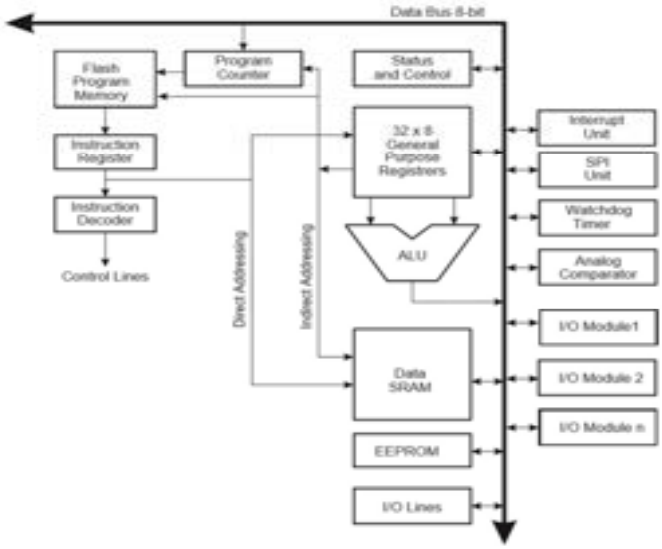

Fig 4.3 Architecture of ATMEGA 328p

The basic working of CPU of Atmega 328p

1. The data is uploaded in serial via the port (being upload from the computer's Arduino IDE). The data is decoded and then the instructions are sent to instruction register and it. Decodes the instructions on the same clock pulse.
2. On the next clock pulse the next pulse the next set of instructions are loaded in instruction register.
3. In general purpose register the registers are of 8-bit but there are 3 16- bit register also.
   a. **8-bit** registers are used to store data for normal calculations and results.
   b. **16-bit** registers are used to store data of timer counter in 2 different register. Eg. X-low & X-high. They are fast, and are used to store specific hardware functions.
4. **EEPROM** stores data permanently even if the power is cut out. Programming inside a EEPROM is slow.
5. **Interrupt unit** check whether there is an interrupt for the execution of instruction to be executed in ISR (interrupt service Routine).
6. **Serial peripheral interface (SPI)** is an interface bus commonly used to send data between micro controllers and small peripherals such as camera, Display, SD cards, etc. it uses

separate clock and data lines, along with a select line to choose the device you wish to talk to.

7. **Watchdog** timer is used to detect and recover from MCU malfunctioning.
8. **Analog comparator** compares the input values on the positive and negative pin, when the value of positive pin is higher the output is set.
9. **Status and control** is used to control the flow of execution of commands by checking other blocks inside the CPU at regular intervals.
10. **ALU (Arithmetic and logic unit)** the high performance AVR ALU operates in direct connection with all the 32 general purpose working registers. Within a single clock cycle, arithmetic operations b/w general purpose register are executed. The ALU operations are divided into 3 main categories- arithmetic, logical, and bit- function.
11. **I/O Pins** the digital inputs and outputs (digital I/O) on the Arduino are what allow you to connect the Arduino sensors, actuators, and other ICs. Learning how to use them will allow you to use the Arduino to do some really useful things, lightings indicators, and controlling relay outputs.
12. **Automatic (software) Reset** rather than requiring a physical press of the reset button before an upload, the Arduino is designed in a way that allows it to be reset by software running on a connected computer. The Arduino software (IDE) uses this capability to allow you to upload button in the Arduino environment.

4.1.1.3 Specification of At mega 328p

Operating voltage	5V
Recommended input voltage	7-12V
Input voltage limits	6-20V
CPU	8-bit
Number of pins	28

Analog input pins	14(of which 6 provide PWM output)
Digital I/O pins	6
DC current per I/O pin	40mA
Flash Memory	32KB(atmega328) of which 0.5 KB used by boot loader
Clock speed	16 MHZ
EEPROM	1 Kbytes EEPROM
RAM	2kbytes for 1MHz
Operating temperature	-40^0c to $+105^0$c(+105 being absolute maximum, -40 being absolute minimum)

4.1.2 Temperature sensor of LM35

The temperature sensor of LM35 is used to this project. LM35 is a temperature sensor that outputs an analog signal which proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of LM35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating. Low cost and greater accuracy make it popular among hobbyists, DIY circuit makers, and students. Many low- end products take advantage of low, greater accuracy and used LM35 in their products. It's approximately 15+ years to its first release but the sensor is still surviving and is used in any products.

Fig 4.4 Temperature sensor of LM35

LM35 can measure from -55 degrees centigrade to 150-degree centigrade. The accuracy level is very high if operated at optimal temperature and humidity levels. The conversion of the output voltage to centigrade is also easy and straight forward. The input to LM35 can be from +4 volts to 30 volts. It consumes about 60 microamperes of current. LM35 has many family members a few names areLM35C, LM35CA, LM35D, LM135, LM235, and LM355. All LM35 family members work on the same principles but temperature measuring capacity varies and also they are available in many package (SOIC, TO-220, TO-92, TO).

- Linear +10-mv/^{0}c scale factor

In order to understand the working principle of LM35 temperature sensor we have to understand the linear scale factor. In the features of LM35 it is given to be +10 mills volt per degree centigrade. It means that with increase in output of 10 mills volt by the sensor vout pin the temperature value increases by one. For example, if the sensor is outputting 100 mills volt at vout pin the temperature in centigrade will be 10-degree centigrade. The same goes for the negative temperature reading. If the sensor is outputting -100mills volt the temperature will be -10 degrees Celsius.

4.1.2.1 Circuit Diagram of LM35

LM35 can be used in two circuit configuration. Both yield different results. In the first co0nfiguration, you can only measure the positive temperature from 2 degrees Celsius to 150 degrees Celsius. In this first configuration, we simply power lm35 and connect the output directly to analog to digital converters. In the second configuration, we can utilize all the sensor

resources and can measure the full range temperature from -55 degree centigrade to 150 degree centigrade. This configuration is a little complex but yield high results. We have to connect an external resister, in this case, to switch the level of negative voltage upwards. The external resister value can be calculated from the formula given below the configuration circuit. The second configuration circuit can be made in various ways. To see about the second configuration circuits visit the LM35 datasheet by Texas instruments enlists the circuit with clear component value.

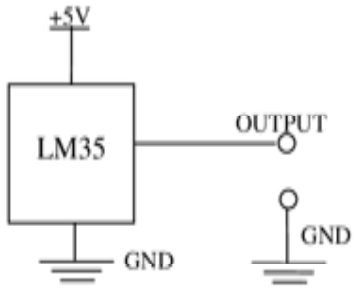

Fig 4.5 Circuit diagram for LM35

Although the first configuration did not need a resister at the output side, I recommended connecting an 80k to 100k resister between vout and ground pin. When I performed several experiments I noticed that the readings some time fluctuate and the vout pin floats. So a resister between ground tights the vout pin low and prevents them from floating.

PARAMETER	VALUE
Accuracy at 25^0c	+/- 0.5 ^{0}c
Accuracy from -55^0c to 150^0c	+/- 1^0c
Temperature slope	10 mv/^{0}c

The accuracy parameters for both configurations are different. The average accuracy level is +-1 degree Celsius for both configurations. But the accuracy level decreases for temperature between 2-degree to 25 degree centigrade. Now that we have discussed the LM35 temperature pin out, structure, linear scale factor and accuracy level it's time to list down the steps on how to measure temperature using LM35 temperature sensor.

4.1.2.2 Working principle of LM35

In principle, the sensor will perform sensing when the temperature changes every 1 ºC temperature will show a voltage of 10 mV. In placing the LM35 can be affixed with adhesive or can be cemented on the surface but the temperature will be slightly reduced by about 0.01 ºC being absorbed in the surface temperature. In this way the expected difference between the air temperature and the surface temperature can be detected by a sensor LM35 same temperature as the surrounding, if the surrounding air temperature is much higher or much lower than the surface temperature, the LM35 is the surface temperature and the temperature of the surrounding air.

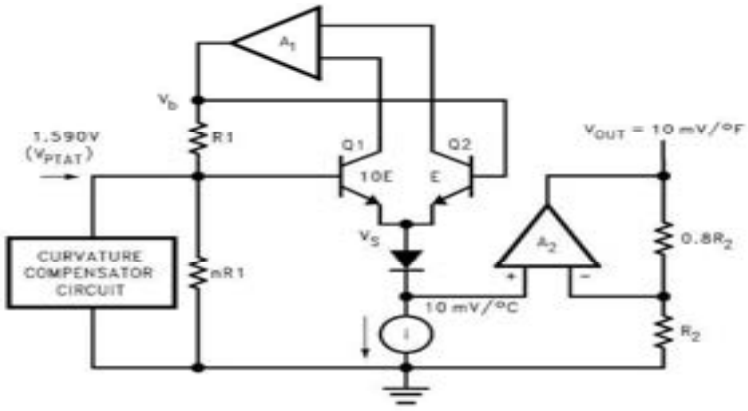

Fig 4.6 Working principle of LM35

The long distance necessary liaison which is not affected by interference from the outside, so use the cable sheath is earthed so that it can act as an antenna receiver and deviation therein, can also act as a rectifier which corrects in such cases, using the method of

bypass capacitors from Vin to be earthed. So we can conclude LM35 sensor working principle as follows.

- The ambient temperature in the detection using the IC part temperature sensitive.
- The ambient temperature is converted into electrical voltage by a circuit in the IC, where the Temperature change is proportional to the output voltage changes.
- In the series LM35

Vout=10 mV/^{0}c

Every change of 1 $^{\circ}$ C would produce a change in output voltage of 10mV s ebesar. Vout is a scalable sensor output voltage linearly with the measured temperature, which is 10 millivolts per 1 degree Celsius. So if Vout = 530mV, then the measured temperature is 53 degrees Celsius. If Vout = 320mV, then the measured temperature is 32 degrees Celsius. The output voltage can be directly fed as input to the signal conditioning circuit such as the operational amplifier circuit and filter circuits, or other circuits such as voltage comparator circuit.

The basic circuit enough to merely experiment or for applications that do not require a perfect measurement accuracy. But not for a real application. Evident from the experiments that I have done, sensor output voltage is not yet stable. At the temperature conditions are relatively similar, if my supply voltage fluctuates (I raise or lower), then Vout also changes. Indeed, the logic of this seems true, but for the instrumentation it is not allowed. Compared with the level of precision, the degree of accuracy of measuring instruments more prominent since the measuring instrument should be used as a benchmark for its users. If the value is changeable relative to the condition that there is no change, then the measuring tool so it cannot be used.

4.1.2.3 Steps to calculate temperature

- Build circuit.
- Power LM35 Vcc to +5-20 volts and Ground.

- Connect Vout to analog to digital converter input.
- Sample the readings, Vout voltage.
- Convert the voltage to temperature.

Centigrade temperature = voltage read by ADC/ 10 mV (mills volt)

I divided by 10 mV because linear scale factor is for is 10 mV. Following the above steps and tutorial, you can easily interface LM35 temperature sensor with any microcontroller that has a built in analog to digital converter pins. Almost all the micro controllers today have built in ADC.

4.1.2.4 LM35 temperature of features

- Calibrated directly in Celsius (centigrade).
- Linear +10 mV/^{0}c scale factor.
- 0.5^{0}c ensured accuracy (at 25^{0}c).
- Rated for full -55^{0}c to 150^{0}c range.
- Suitable for remote applications.
- Operates from 4V to 30V.
- Less than 60- micro A current drain.
- Low self- heating, 0.08^{0}c in still Air.
- Non-linearity only +/- 1/4^{0}c typical.
- Low- impedance output, 0.1 ohm for 1-mA load.

4.1.2.5 Specification of LM35

Communication protocol	Analog Output
Power supply	-2 to 35V
Temperature Range	-55 to 150^{0}c

Accuracy	+/-0.5^{0}c (at 25^{0}c)
Output voltage	-1 to 6V
Output current	10mA

4.1.3 Smoke Sensor of MQ-2

The MQ-2 Smoke LPG Butane Hydrogen Gas Sensor Detector Module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by the potentiometer. MQ-2 gas sensor using gas sensitive material is to be clean air in the lower conductivity of Tin oxide (SnO2).

Fig 4.7 Smoke Sensor MQ-2

When the sensor when flammable gases are present in the environment in which the conductivity of the sensor with an increasing concentration of combustible gas in the air increases. Use a simple circuit to convert the changes in conductivity and output signal that corresponds to the concentration of the gas. Using an MQ sensor it detects a gas is very easy. You can either use the digital pin or the analog pin to accomplish this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features

above) before you can actually work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V).

MQ2 gas sensor can be used to detect the presence of LPG, Propane and Hydrogen, also could be used to detect Methane and other combustible steam, it is with low cost and suitable for different application. Sensor is sensitive to flammable gas and smoke. Smoke sensor is given 5 volt to power it. Smoke sensor indicate smoke by the voltage that it outputs .More smoke more output. A potentiometer is provided to adjust the sensitivity. Sn02 is the sensor used which is of low conductivity when the air is clean. But when smoke exist, an analog output is produced based on the concentration of smoke. The circuit has a heater. Power is given to heater by VCC and GND from power supply.

MQ-2 gas sensor higher sensitivity to liquefied petroleum gas, propane, hydrogen, detection of gas and other combustible vapors are ideal. This sensor can detect a variety of flammable gas, is a low-cost sensor for many applications.

4.1.3.1 Pin diagram of gas sensor MQ-2

In pin number 1 is represents Vcc is pin powers the module, typically the operating voltage is +5V. Pin number 2 is Ground is Used to connect the module to system ground. If pin number 3 is Digital Out is you can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer. And the pin number 4 is consists, Analog out is pin outputs 0-5V analog voltage based on the intensity of the gas.

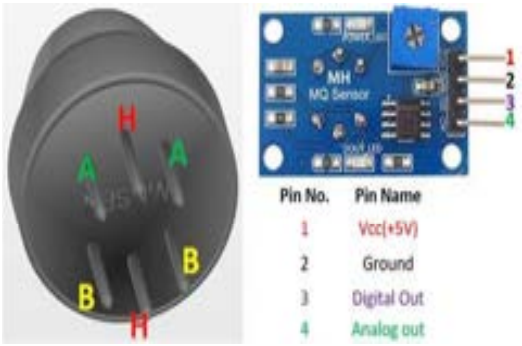

Fig 4.8 Pin diagram of MQ-2

In A-Pins is the A pins and B pins are interchangeable. These pins will be tied to the Supply voltage, B-pin is the A pins and B pins are interchangeable. One pin will act as output while the other will be pulled to ground. H- Pin is Out of the two H pins, one pin is connected to supply and the other to ground.

4.1.3.2 Working principle of smoke sensor MQ-2

This sensor contains a sensing element, mainly aluminum-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals.

Sensors are the electronic devices used for interaction with the outer environment. There are various types of sensor available that can detect light, noise, smoke, proximity etc. With the advent in technology, these are available as both analog and digital forms. Besides forming a communication with the outer environment, sensors are also a crucial part of safety systems. Fire sensors are used to detect the fire and take appropriate precautions on time. For smooth functioning of control systems and sensitive electronics, humidity sensors are used for maintaining humidity in the unit. One of such sensor used in safety systems to detect harmful gases is MQ2 Gas sensor.

Fig 4.9 Working of MQ-2 sensor

Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow. Now current can flow through the sensor, which generated analog voltage values.

These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is. Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This sensor is also used for Air quality monitoring, Gas leak alarm and for maintaining environmental standards in hospitals. In industries, these are used to detect the leakage of harmful gases. These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high

4.1.3.3 Features of smoke sensor MQ-2

1. Good sensitivity to Combustible gas in a wide range
2. High sensitivity to LPG, Propane, and Hydrogen
3. Long life and low cost

4. Simple drive circuit
5. Can be used as a Digital or analog sensor
6. The Sensitivity of Digital pin can be varied using the potentiometer
7. Can be used to Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane.

4.1.3.4 Specification of Smoke Sensor MQ-2

Operating Voltage	+5V
Analog Output Voltage	0V to 5V
Digital output Voltage	0V to 5V (TTL Logic)
Heating consumption	0.5 to 800mW
Equivalent sensors	MQ-6,AQ-2,MQ-306A
Concentration	200 to 1000ppm

4.1.4 Bluetooth HC-05

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

The **HC-05** has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two

modes by using the key pin as explained in the pin description. It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the TX of MCU and TX pin of module to Rx of MCU as shown in the figure below

Fig 4.10 Bluetooth HC-05

HC - 05 module is an easy to use **Bluetooth SPP (Serial Port Protocol) module**, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified **Bluetooth V2.0+EDR (Enhanced Data Rate)** 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses **CSR Blue core 04** - External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.

4.1.4.1 Pin diagram of Bluetooth HC-05

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth. It has 6 pins,

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

1. **Data mode:** Exchange of data between devices.

2. **Command mode:** It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. **VCC:** Connect 5 V or 3.3 V to this Pin.

Fig 4.11 Pin diagram of HC-05

3. **GND:** Ground Pin of module.
4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth Module).
6. **State:** It tells whether module is connected or not.

HC-05 module

- HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously

in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.

- This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.
- As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.

4.1.4.2 Working principle of HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project.

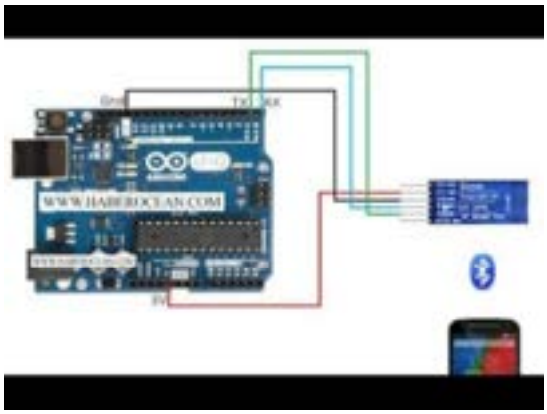

Fig 4.12 Working of Bluetooth

The **HC-05** is a very cool module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like

a Phone or Laptop. There are many android applications that are already available which makes this process a lot easier. The module communicates with the help of USART at 9600 baud rate hence it is easy to interface with any microcontroller that supports USART. We can also configure the default values of the module by using the command mode. So if you looking for a Wireless module that could transfer data from your computer or mobile phone to microcontroller or vice versa then this module might be the right choice for you. However do not expect this module to transfer multimedia like photos or songs; you might have to look into the CSR8645 module for that.

4.1.4.3 Program for HC-05 Bluetooth Module

The program given below is the HC-05 Bluetooth module program. This process is quite different from others since we are going to use android mobile to control and communicate with Arduino. Here the Bluetooth module acts as an interface between our mobile and Arduino board. Before getting into the execution process, follow the given procedure:

- First of all, the user should install an application called **Bluetooth SPP PRO** from the play store which is a free application.
- After installation, pair the Bluetooth module to your mobile as like connecting one device to other using Bluetooth. The default pairing code is **1234**.
- Upload the given program to the Arduino Uno board. After uploading the code, unplug the USB from the Arduino.
- Now use external power adapter to power the Uno board.
- The Bluetooth SPP PRO has three types of communication mode. Here Byte stream mode is used to communicate. So select that mode and give the input as **1**, as soon as the input has given the led will turn on and for **0** led will turn off.

Command Mode

- When we want to change settings of HC-05 Bluetooth module like change password for connection, baud rate, Bluetooth device's name etc.
- To do this, HC-05 has AT commands.
- To use HC-05 Bluetooth module in AT command mode, connect "Key" pin to High (VCC).
- Default Baud rate of HC-05 in command mode is 38400bps.
- Following are some AT command generally used to change setting of Bluetooth module.
- To send these commands, we have to connect HC-05 Bluetooth module to the PC via serial to USB converter and transmit these command through serial terminal of PC.

4.1.4.4 Features of HC-05

Hardware Features

- Typical - 80dBm sensitivity.
- Up to +4dBm RF transmit power.
- 3.3 to 5V I/O.
- PIO (Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

Software Features

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.
- Auto - connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto - pairing PINCODE:" 1234" as default.

4.1.4.5 Specification of HC-05

Modulation	GFSK(Gaussian Frequency Shift Keying)
Operating Voltage	3.3V
Operating Frequency band	2.4 GHZ ISM band
Flash memory Size	8-bit
Emission Power	≤4dBm
Sensitivity	≤-84dBm at 0.1% BER
Speed Asynchronous	2.1Mbps(Max)/160 Kbps
Speed Synchronous	1Mbps/1Mbps

4.1.5 LCD Display

16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16*2

LCD, hence we are using it here. All the above mentioned LCD display will have 16 Pins and the programming approach is also the same and hence the choice is left to you. We come across LCD displays everywhere around us. Computers, calculators, television sets, mobile phones, digital watches use some kind of display to display the time. An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates of a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix.

Fig 4.13 LCD Display

If you can see starting addresses for each character with their printing commands. The first character is generated at address 0x40 to 0x47 and is printed on LCD by just sending simple command 0 to the LCD. The second character is generated at address 0x48 to 0x55 and is printed Generating custom characters on LCD is not very hard. It requires the knowledge about custom generated random access memory (CG-RAM) of LCD and the LCD chip controller. Most LCDs contain Hitachi HD4478 controller. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size. CG-RAM address starts from 0x40 (Hexadecimal) or 64 in decimal. We can generate custom characters at these addresses.

4.1.5.1 Pin diagram of LCD display

In pin no 1 is consists of Ground is Ground (0V). If pin no 2 is represents Supply voltage for LCD display 5V (4.7V – 5.3V) Vcc. In pin no 3 is VO / VEE Contrast adjustment; the best way is to use a variable resistor such as a potentiometer. The output of the potentiometer is connected to this pin. Rotate the potentiometer knob forward and backwards to adjust the

LCD contrast. Pin no 4 is RS (Register Select) Selects command register when low, and data register when high**.** Pin no 5 is consists of Read/write Low to write to the register; High to read from the register.

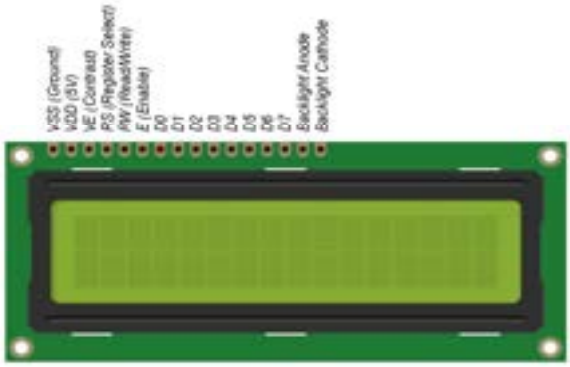

Fig 4.14 Pin diagram of LCD

In pin no 6 is Enable Sends data to data pins when a high to low pulse is given; Extra voltage push is required to execute the instruction and EN (enable) signal is used for this purpose. Usually, we make it en=0 and when we want to execute the instruction we make it high en=1 for some milliseconds. After this we again make it ground that is, en=0.In pin no 7 to 14 is namely as, DB0 to DB7 is 8-bit data pins. Pin no 15 is Led+ Backlight VCC (5V). Pin no 16 is Led- consists Backlight Ground (0V).

RS (Register select)

A 16X2 LCD has two registers, namely, command and data. The register select is used to switch from one register to other. RS=0 for command register, whereas RS=1 for data register.

Command Register

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. Processing for commands happens in the command register.

Data Register

The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. When we send data to LCD it goes to the data register and is processed there. When RS=1, data register is selected.

4.1.5.2 features of LCD Display

- Operating voltage is 4.7 to 5.3 v.
- Current consumption is 1mA without backlight.
- Alphanumeric LCD Display module, meaning can display alphabets and numbers.
- Can work on both 8-bit and 4- bit.

4.1.5.3 Specification of LCD Display

- The 16*2 LCD Display is a very basic module commonly used in DIYs and circuit.
- The 16*2 translates 0 a display 16 character per line in 2 such lines.
- In this LCD each character is displayed in 5*7 pixel matrix.

4.1.6 Transformer

Step down the voltage level 230V AC is converted into 12V AC using a step down transformer. 12V output of step down transformer is an RMS value and its peak value is given by the product of square root of two with RMS value, which is approximately 17V.

To identify which side primary follow either any one steps. Step down transformer are used in interconnection of transmission system with different voltage level. They decrease voltage level from high to lower level value. These transformer are huge and have very high nominal power (even 1000 MVA).The transformers are designed for either single-phase supply or three-phase supply. It may be either step up or step down transformer. However, the **working principle of**

step down transformer and all these transformers are the same and that is electromagnetic induction.

A transformer consists of two highly inductive coils (windings) wound on a steel or iron core. The winding connected to the AC supply is known as primary winding whereas the winding connected to the load is known as secondary winding. The primary and secondary windings are isolated from each other as well as from the iron core electrically. The electrical power is transferred from primary circuit to secondary circuit by magnetic flux

Fig 4.15 Step down transformer

If you have multi meter check the resistance, primary side will have higher resistance and secondary will have lower resistance (Sometimes you may not notice the difference as you might be using transformer for smaller size) Or else if possible supply lower AC voltage on either side or check the output on other side. By that you can identify which side is stepping down.

4.1.6.1 Working principle of step down transformer

When the primary winding is connected to the AC supply an AC current starts flowing through it. The AC current of primary winding produces an alternating flux φ in the core. Most of this alternating flux links with secondary winding through the core. This alternating flux induces a voltage into the secondary winding according to the Faraday's law of electromagnetic induction.

The EMF is induced in the secondary winding is due to mutual induction hence it is known as mutually induced EMF. The induced EMF in the secondary and primary depends

upon the rate of change of flux linkages (Ndφ/dt). The rate of change of flux in secondary and primary circuit is the same. Therefore, induced EMF in secondary is proportional to number of turns of the secondary winding (E2 α N2) and in primary is proportional to number of turns of primary (E1 α N1).

A transformer changes only current and voltage levels of AC supply. It does not have any effect on the frequency of AC supply. It can be operated only on AC supply. If a transformer is connected to the DC supply, a large amount of current will flow through the primary winding and it can damage the transformer winding.

4.1.6.2 Convert of 230V to 12V

1. **Transformer:** Connect 230V AC to a 230 to 30V step down transformer. After this you will get a 30V pullulating AC voltage.

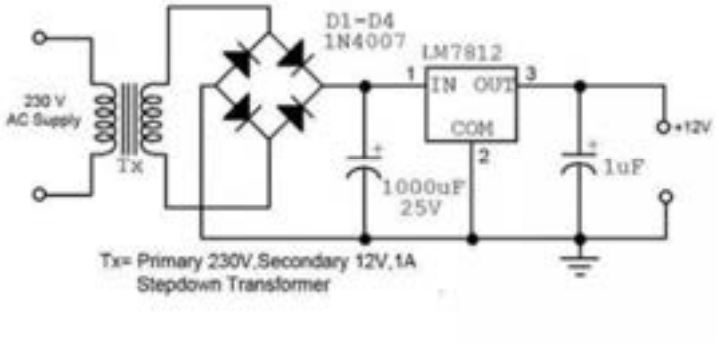

Fig 4.16 Conversion of 230V to 12V

2. **Rectify:** Connect a bridge made up of four Diodes. The output will be 2*VP/pi, which is 19.10V.

3. **Filter:** Connect a filter, which filters out ripples from the signal. Usually a capacitor or Inductor is used. The output will be around 19V with little ripples.
4. **Regulate:** Connect a LM317, and regulate the output to 12V. You will get a smooth 12V regulated DC output.

4.1.6.3 Specification of Transformer

voltage level	230V to 12V
Output Voltage	12V
Maximum of current level	1mA
RMS Value	17V

4.1.7.1 Cloud Computing

Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet. Large clouds, predominant today, often have functions distributed over multiple locations from central servers. If the connection to the user is relatively close, it may be designated an edge server.

Clouds may be limited to a single organization (enterprise clouds), or be available to many organizations (public cloud). Cloud computing relies on sharing of resources to achieve coherence and economies of scale.

Fig 4.17 Cloud Computing

Advocates of public and hybrid clouds note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and that it enables IT teams to more rapidly adjust resources to meet fluctuating and unpredictable demand, providing the burst computing capability: high computing power at certain periods of peak demand Cloud providers typically use a "pay-as-you-go" model, which can lead to unexpected operating expenses if administrators are not familiarized with cloud-pricing models.

The availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture and autonomic and utility computing has led to growth in cloud computing. By 2019, Linux was the most widely used operating system, including in Microsoft's offerings and is thus described as dominant.

4.1.7.2 Public cloud

For a comparison of cloud-computing software and providers, see Cloud-computing comparison A cloud is called a "public cloud" when the services are rendered over a network that is open for public use. Public cloud services may be free.[89] Technically there

may be little or no difference between public and private cloud architecture, however, security consideration may be substantially different for services (applications, storage, and other resources) that are made available by a service provider for a public audience and when communication is effected over a non-trusted network. AWS, Oracle, Microsoft, and Google also offer direct connect services called "AWS Direct Connect", "Oracle Fast Connect", "Azure ExpressRoute", and "Cloud Interconnect" respectively, such connections require customers to purchase or lease a private connection to a peering point offered by the cloud provider.

4.2 Software Explanation

4.2.1 Windows 7

Windows 7 is a personal computer operating system that was produced by Microsoft as part of the Windows NT family of operating systems. It was released to manufacturing on July 22, 2009, and became generally available on October 22, that year less than three years after the release of its predecessor, Windows Vista. Windows 7's server counterpart, Windows Server 2008 R2, was released at the same time. Microsoft ended mainstream support for Windows 7 on January 13, 2015 and extended support ended on January 14, 2020.

Fig 4.18 Windows 7

Windows 7 was primarily intended to be an incremental upgrade to Microsoft Windows, addressing Windows Vista's poor critical reception while maintaining hardware and software compatibility. Windows 7 continued improvements on Windows Aero (the user interface introduced in Windows Vista) with the addition of a redesigned taskbar that allows applications to be "pinned" to it, and new window management features. Other new features were added to the operating system, including libraries, the new file sharing system Home Group, and support for multitouch input. A new "Action Center" interface was also added to provide an overview of system security and maintenance information, and tweaks were made to the User Account Control system to make it less intrusive.

Windows 7 was a major success for Microsoft; even prior to its official release, pre-order sales for the operating system on the online retailer Amazon.com had surpassed previous records. In just six months, over 100 million copies had been sold worldwide, increasing to over 630 million licenses by July 2012. As of January 2020, 26.79% of traditional PCs running Windows are running Windows 7 (and thus 21% of all traditional PCs) which still has over 60% market share in some countries.

Windows 7 includes 13 additional sound schemes, titled Afternoon, Calligraphy, Characters, Cityscape, Delta, Festival, Garden, Heritage, Landscape, Quirky, Raga, Savanna, and Sonata. Internet Spades, Internet Backgammon and Internet Checkers, which were removed from Windows Vista, were restored in Windows 7. Users are able to disable or customize many more Windows components than was possible in Windows Vista. New additions to this list of components include Internet Explorer 8, Windows Media Player 12, Windows Media Center, Windows Search, and Windows Gadget Platform67 A new version of Microsoft Virtual PC, newly renamed as Windows Virtual PC was made available for Windows 7 Professional, Enterprise, and Ultimate editions. It allows multiple Windows environments, including Windows XP Mode, to run on the same machine. Windows XP Mode runs Windows XP in a virtual machine, and displays applications within separate windows on the Windows 7 desktop. Furthermore, Windows 7 supports the mounting of a virtual hard disk (VHD) as a normal data storage, and the bootloader delivered with Windows 7 can boot the Windows system from a VHD; however, this ability is only available in the Enterprise and Ultimate editions70 The Remote Desktop Protocol (RDP) of Windows 7 is also enhanced to support real-time

multimedia application including video playback and 3D games, thus allowing use of DirectX 10 in remote desktop environments.

4.2.1.1 Service Pack 1

Windows 7 Service Pack 1 (SP1) was announced on March 18, 2010. A beta was released on July 12, 2010. The final version was released to the public on February 22, 2011.[133] At the time of release, it was not made mandatory. It was available via Windows Update, direct download, or by ordering the Windows 7 SP1 DVD. The service pack is on a much smaller scale than those released for previous versions of Windows, particularly Windows Vista.

Windows 7 Service Pack 1 adds support for Advanced Vector Extensions (AVX), a 256-bit instruction set extension for processors, and improves IKEv2 by adding additional identification fields such as E-mail ID to it. In addition, it adds support for Advanced Format 512e as well as additional Identity Federation Services. Windows 7 Service Pack 1 also resolves a bug related to HDMI audio and another related to printing XPS documents.

In Europe, the automatic nature of the BrowserChoice.eu feature was dropped in Windows 7 Service Pack 1 in February 2011 and remained absent for 14 months despite Microsoft reporting that it was still present, subsequently described by Microsoft as a "technical error". As a result, in March 2013 the European Commission fined Microsoft €561 million to deter companies from reneging on settlement promises.

4.2.1.2 Platform Update

The Platform Update for Windows 7 SP1 and Windows Server 2008 R2 SP1 was released on February 26, 2013 after a pre-release version had been released on November 5, 2012. It is also included with Internet Explorer 10 for Windows 7.

It includes enhancements to Direct2D, Direct Write, Direct3D, Windows Imaging Component (WIC), Windows Advanced Rasterization Platform (WARP), Windows Animation Manager (WAM), XPS Document API, H.264 Video Decoder and JPEG XR

decoder. However support for Direct3D 11.1 is limited as the update does not include DXGI/WDDM 1.2 from Windows 8, making unavailable many related APIs and significant features such as stereoscopic frame buffer, feature level 11_1 and optional features for levels 10_0, 10_1 and 11_0.

4.2.1.3 Disk Cleanup update

In October 2013, a Disk Cleanup Wizard addon was released that lets users delete outdated Windows updates on Windows 7 SP1, thus reducing the size of the WinSxS directory. This update backports some features found in Windows 8.

4.2.1.4 Windows Management Framework 5.0

Windows Management Framework 5.0 includes updates to Windows PowerShell 5.0, Windows PowerShell Desired State Configuration (DSC), Windows Remote Management (WinRM), Windows Management Instrumentation (WMI).

4.2.1.5 Convenience rollup

In May 2016, Microsoft released a "Convenience rollup update for Windows 7 SP1 and Windows Server 2008 R2 SP1", which contains all patches released between the release of SP1 and April 2016. The rollup is not available via Windows Update, and must be downloaded manually. This package can also be integrated into a Windows 7 installation image.

Since October 2016, all security and reliability updates are cumulative. Downloading and installing updates that address individual problems is no longer possible, but the number of updates that must be downloaded to fully update the OS is significantly reduced.

4.2.1.3 System Requirements

Component	Operating system architecture	
	32-bit	**64-bit**
Processor	1 GHz IA-32 processor	1 GHz x86-64 processor
Memory (RAM)	1 GB	2 GB
Graphics card	DirectX 9 graphics processor with WDDM driver model 1.0	
Storage space	16 GB	20 GB
Installation media	DVD drive or USB drive	

4.2.2 Visual studio

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

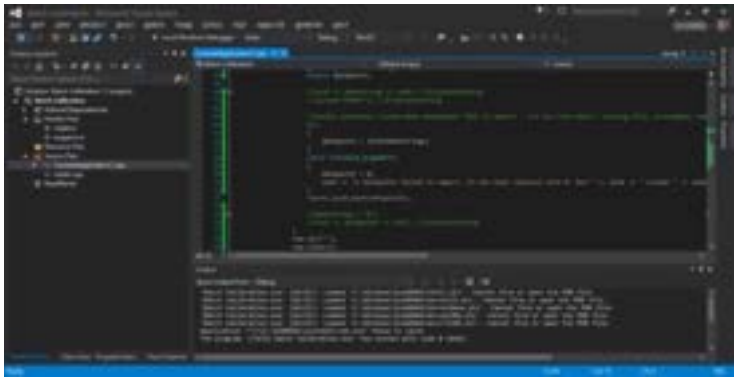

Fig 4.19 Visual studio

Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. It accepts plug-ins that enhance the functionality at almost every level including adding support for source control systems (like Subversion and Git) and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle.

Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#, JavaScript, Typescript, XML, XSLT, HTML, and CSS. The most basic edition of Visual Studio, the Community edition, is available free of charge. The slogan for Visual Studio Community edition is "Free, fully-featured IDE for students, open-source and individual developers". The currently supported Visual Studio version is 2019.

4.2.2.1 Architecture

Visual Studio does not support any programming language, solution or tool intrinsically; instead, it allows the plugging of functionality coded as a VSPackage. When installed, the functionality is available as a Service. SVsUIShell, which provides windowing and UI functionality (including tabs, toolbars, and tool windows); and SVsShell, which deals with registration of VSPackages. In addition, the IDE is also responsible for coordinating and enabling communication between services. All editors, designers, project types and other tools are implemented as VSPackages. Visual Studio uses COM to access the VSPackages. The Visual Studio SDK also includes the Managed Package Framework (MPF). The services can then be consumed for creation of other packages, which add functionality to the Visual Studio IDE.

4.2.2.2 Code editor

The Visual Studio code editor also supports setting bookmarks in code for quick navigation. Other navigational aids include collapsing code blocks and incremental search, in

addition to normal text search and regex search. The code editor also includes a multi-item clipboard and a task list. The code editor supports code snippets, which are saved templates for repetitive code and can be inserted into code and customized for the project being worked on. A management tool for code snippets is built in as well. These tools are surfaced as floating windows which can be set to automatically hide when unused or docked to the side of the screen. The Visual Studio code editor also supports code refactoring including parameter reordering, variable and method renaming, interface extraction, and encapsulation of class members inside properties, among others.

4.2.2.3Designer

Visual Studio includes a host of visual designers to aid in the development of applications. These tools include

4.2.2.4 Windows Forms Designer

The Windows Forms designer is used to build GUI applications using Windows Forms. Layout can be controlled by housing the controls inside other containers or locking them to the side of the form. Controls that display data (like textbox, list box and grid view) can be bound to data sources like databases or queries. Data-bound controls can be created by dragging items from the Data Sources window onto a design surface.. The designer generates either C# or VB.NET code for the application.

4.2.2.5 WPF Designer

The WPF designer, codenamed Cider, was introduced with Visual Studio 2008. Like the Windows Forms designer it supports the drag and drop metaphor. It is used to author user interfaces targeting Windows Presentation Foundation. It supports all WPF functionality including data binding and automatic layout management. It generates XAML code for the UI. The generated XAML file is compatible with Microsoft Expression Design, the designer-oriented product. The XAML code is linked with code using a code-behind model.

4.2.2.6 Web designer/development

Visual Studio also includes a web-site editor and designer that allows web pages to be authored by dragging and dropping widgets. It is used for developing ASP.NET applications and supports HTML, CSS and JavaScript. It uses a code-behind model to link with ASP.NET code. From Visual Studio 2008 onwards, the layout engine used by the web designer is shared with Microsoft Expression Web. There is also ASP.NET MVC support for MVC technology as a separate download and ASP.NET Dynamic Data project available from Microsoft.

4.2.2.7 Class designer

The Class Designer is used to author and edit the classes (including its members and their access) using UML modeling. The Class Designer can generate C# and VB.NET code outlines for the classes and methods. It can also generate class diagrams from hand-written classes.

4.2.2.8 Data designer

The data designer can be used to graphically edit database schemas, including typed tables, primary and foreign keys and constraints. It can also be used to design queries from the graphical view.

4.2.2.9 Mapping designer

From Visual Studio 2008 onwards, the mapping designer is used by LINQ to SQL to design the mapping between database schemas and the classes that encapsulate the data. The new solution from ORM approach, ADO.NET Entity Framework, replaces and improves the old technology.

4.2.3 Embedded C

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.Embedded C programming typically requires nonstandard extensions to the C language in order to support enhanced microprocessor features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

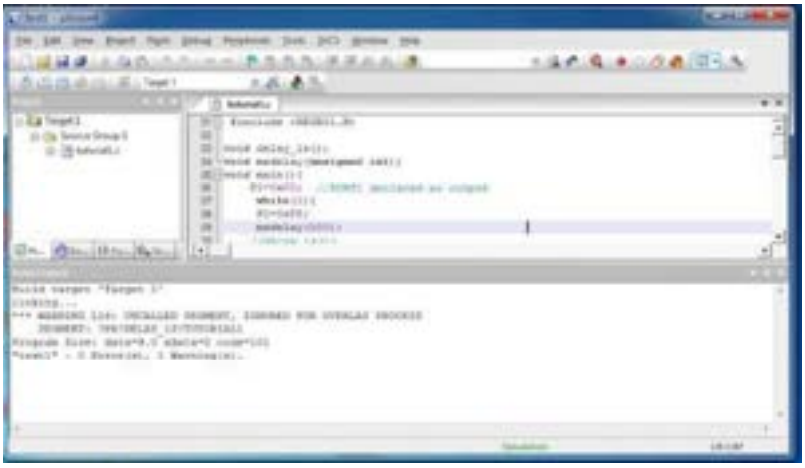

Fig 4.20 Embedded C

In 2008, the C Standards Committee extended the C language to address such capabilities by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., main () function, variable definition, datatype declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures, structures and union, bit operations, macros, etc. A Technical Report was published in 2004 and a second revision in 2006.

CHAPTER 5

RESULT AND DISCUSSION

5.1 Result and Discussion

Science and technology is panacea for all our growing problems. Predicting the natural processes are highly complex and our system needs to be tested against real time conditions.. The system needs to be robust to withstand all the climate changes which may affect its functioning. However, our system will play a crucial role in curbing the forest fires which would prevent loss of huge resources and financial losses. We have tested in forest like conditions, but real hardship which we may face is during implementation in large area in real it. Forest is a very important and grow in many places in around world. In a forest is piece of land with many trees. Many animals to live and survive the forest. Forest also used to prevent soil erosion, climate changes. This paper, a cloud based forest fire alert system using IOT technology. Temperature is increased or smoke typically fire indicate to LCD display. The real time sense a data will send and stored cloud. Finally information of the different parameter to be monitor forest officer and nearby forest survival peoples.

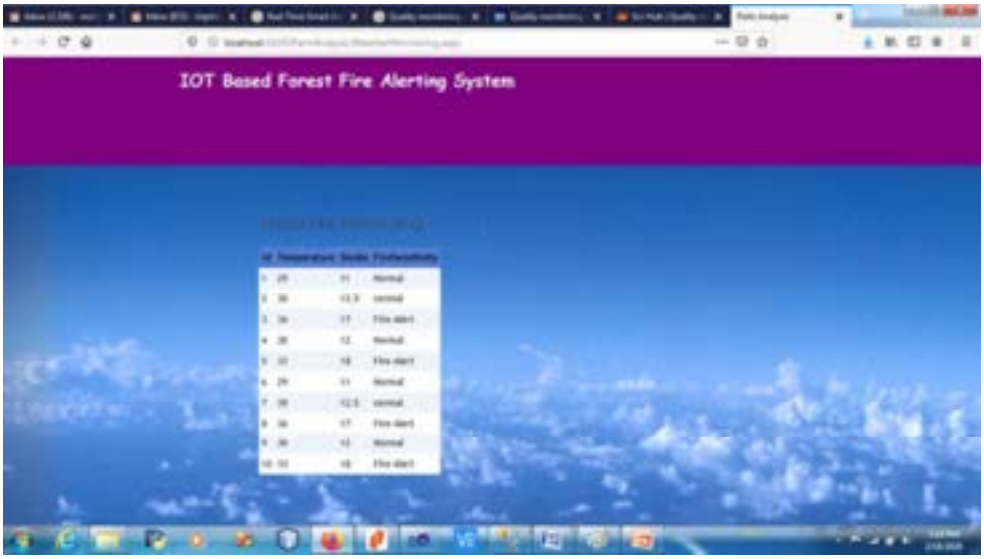

Fig 5.1 output of the system

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 Conclusion

Forest and land fires in direct and indirect well recognized as one of the main contributor to deforestation and land conversion which responsible for mostly of greenhouse gas produced which finally related with the global climate change. Forest fire is a multi-sector issues. To solve the problem, reduction of forest and land fire occurs and land conversion hopefully is one of the reasonable action and prevention efforts is the best solution through community involvement. The national forest commission, has recommended creating an enabling environment to facilitate assessment, monitoring and reporting on national level criteria and indicators for sustainable forest management. A large data base can be achieved over the entire fire season for further evaluations and research activities.so this project developed in cloud based forest fire alert system using IOT. To managing the storing a data and communicating the information.

6.2 Future Enhancement

1. Fire accidents can be controlled to a great extent in a places such as forests, homes, Colleges, Industries, trains and some other public places.
2. Fire accidents leads to death of excess of People, by using this technique we can save Those Life's easily.

CHAPTER 7

APPENDICES

PROGRAM

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Data.SqlClient;
using System.Data;
public partial class FireMonitoring : System.Web.UI.Page
{
protected void Page_Load(object sender, EventArgs e)
{
gridview();
}
SqlConnection con = new SqlConnection("Data Source = (local)\\MSSQL2008; Initial
Catalog=Fire;Integrated Security=true;");
```

```
    private void gridview()
{
     // con.Open();
    con.Open();
    SqlCommand cmd = new SqlCommand("select * from tbl_ForestFireAlert", con);
    SqlDataAdapter ada = new SqlDataAdapter(cmd);
     DataSet ds = new DataSet();
     ada.Fill(ds, "FireAlert");
     GridView1.DataSource = ds.Tables["FireAlert"];
     GridView1.DataBind();
     con.Close();
      }
  }
     <%@Page Title="" Language="C#" MasterPageFile="~/MasterPage5.master"
     AutoEventWireup="true"CodeFile="FireAlert.aspx.cs" Inherits="FireAlert " %>
    <asp:Content ID="Content1" ContentPlaceHolderID="ContentPlaceHolder1"
     Runat="Server">
    <h1>Forest Fire Monitoring</h1>
    <asp:GridView ID="GridView1" runat="server" CellPadding="4"
     EnableModelValidation="True" ForeColor="#333333" GridLines="None">
```

```
<AlternatingRowStyle BackColor="White" />
<EditRowStyle BackColor="#2461BF" />
<FooterStyle BackColor="#507CD1" Font-Bold="True" ForeColor="White" />
<HeaderStyle BackColor="#507CD1" Font-Bold="True" ForeColor="White" />
<PagerStyle BackColor="#2461BF" ForeColor="White" HorizontalAlign="Center" />
<RowStyle BackColor="#EFF3FB" />
<SelectedRowStyle BackColor="#D1DDF1" Font-Bold="True" ForeColor="#333333" />
</asp:GridView>
</asp:Content>
```

Bluetooth Code :

```
package com.example.sairamkrishna.myapplication;
import android.app.Activity;
import android.bluetooth.BluetoothAdapter;
import android.bluetooth.BluetoothDevice;
import android.content.Intent;
import android.os.Bundle;
import android.view.View;
import android.widget.ArrayAdapter;
import android.widget.Button;
import android.widget.ListView;
```

```
import android.widget.Toast;

import java.util.ArrayList;

import java.util.Set;

public class MainActivity extends Activity  {

Button b1,b2,b3,b4;

private BluetoothAdapter BA;

private Set<BluetoothDevice>pairedDevices;

ListView lv;

 @Override

    protected void onCreate(Bundle savedInstanceState)

{

    super.onCreate(savedInstanceState);

    setContentView(R.layout.activity_main);

    b1 = (Button) findViewById(R.id.button);

    b2=(Button)findViewById(R.id.button2);

    b3=(Button)findViewById(R.id.button3);

    b4=(Button)findViewById(R.id.button4);

    BA = BluetoothAdapter.getDefaultAdapter();

    lv = (ListView)findViewById(R.id.listView);

}
```

```
      public void on(View v)
{
   if (!BA.isEnabled())
{
 Intent turnOn = new Intent(BluetoothAdapter.ACTION_REQUEST_ENABLE);
 startActivityForResult(turnOn, 0);
 Toast.makeText(getApplicationContext(), "Turned on",Toast.LENGTH_LONG).show();
}
  else
{
 Toast.makeText(getApplicationContext(), "Already on"Toast.LENGTH_LONG).
  show();
     }
}
 public void off(View v){
 BA.disable();
 Toast.makeText(getApplicationContext(), "Turned off" ,Toast.LENGTH_LONG).
  show();
}
 public  void visible(View v){
```

```
 Intent getVisible = new
 Intent(BluetoothAdapter.ACTION_REQUEST_DISCOVERABLE);
 startActivityForResult(getVisible, 0);
}
 public void list(View v){
 pairedDevices = BA.getBondedDevices();
 ArrayList list = new ArrayList();
 for(BluetoothDevice bt : pairedDevices) list.add(bt.getName());
Toast.makeText(getApplicationContext(), "Showing Paired
 Devices",Toast.LENGTH_SHORT).show();
 final ArrayAdapter adapter = new Array Adapter(this,android.R.layout.
                                    simple_list_item_1, list);
  lv.setAdapter(adapter);
    }
 }
```

REFERENCES

[1]. Angelline.R, Adithya.S, Abishek narayanan, "Fire Alarm System Using IOT", international journal of innovative Technology and exploring engineering (IJITEE) volume-8, issue-653, April 2019.

[2]. Dr.S.praveenchakravarthy, J.Nancy, V.S.Naveen Kumar, "Forest Fire Detection System", international journal of Recent trends in engineering & research (IJRTER) conference on electronics, information and communication System (CELCIS'17) special issue, March-2107.

[3]. Harjinder Singh," Forest Fire Detection Using Wireless Sensor", international journal of scientific & engineering Research, volume 7, issue 7, July-2016.

[4]. Kiran kumar.D, Kishore.T, Suresh kumar.V, "Fire Monitoring System for Fire Detection Using ZigBee and Gprs System", IOSR journal of electronics and communication engineering (IOSR-JECE) volume 12, issue 1, ver.III (Jan-feb.2017).

[5]. Michel owayjan, George freiha, roger achkar, "Forest Fire Detection and Alerting System" 17th IEEE Mediterranean Electro technical conference, Beirut, Lebanon 13-16 April 2014.

[6]. MR. Lalti patil, Miss. Divya chopra, Miss. Prachi jadhav, "Forest- Fire Surveillance System Based on Wireless Sensor Network", international. Journal of engineering research and applications ISSN: 2248-9622, vol. 6, issue 4, (part-2) April 2016.

[7]. Pallavi.C, jamdhade, Ashwini.D. Kawate, shitals.lachake," Forest fire detection using optimized solar powered Wireless sensor networks", international journal of advance search in science and engineering, volume No.07, Issue NO.02, February 2017.

[8]. Sathish kumar.R, vinoth kumar.M, devaraj varatharaj,"Design and Development of Automatic Fire Detection Using Sms and Voice Alert System", international journal of scientific & engineering Research, volume 7, issue 5, May-2016.

[9]. Sai kumar.P, Sriramya," IOT Enabled Forest Fire Detection and Alerting the Authorities ", international journal Of Recent technology and engineering (IJRTE) Volume-7, issue-654, April -2019.

[10].Varun kumar. S, P.V yokesh raj, V. Vignesh, "Implementation Of Wireless Sensor Network And IOT For Real Time Forest Fire Warning System", international journal of engineering and technology-Volume 4 issue 1, Jan-Feb 2018.

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Cloud Based Forest Fire Alert System Using Iot

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ABSTRACT

The most common hazard in forest fire Accident are themselves destroy the forest and great threat for wildlife and peoples. The number of trees has reduced drastically so the forest are creates an unhealthy environment for animals to survive in the forest. Forest covers 31% of the world and 21% of the India. It has found in a survey that 80% of losses are caused due to fire. This project of a system fire was detected early stages. It was tracking and alarming for protection of trees against forest fire. Now IOT (Internet of things) devices and cloud based to forest fire alerting system. If cloud can used to storing the information of data to monitoring the different environmental variables such as temperature, smoke, moisture of the forest. So finally to prevent the fire to spread over a huge area and precaution the forest**.**

KEYWORD: *Arduino UNO atmega328p, temperature sensor, smoke sensor, LCD Display, mobile Wireless communication.*

I. INTRODUCTION

Forest fire detection become one such issue. Due to forest fire has caused serious environmental Problems and devastation of flora fauna. The current turbulent global economic, demographic, social and ecologic context, government, local administrative authorities and commercial companies or individuals have the importance resources contained in forest environment. Forest ecosystems are dynamic and complicated. Disturbance to any part of network affect the balance of relationship and equally complete scheme either absolutely or negativity.so global climate change, drought and different conditions have caused occurrence of wildfire to extend, once wildfire occur it takes years to naturally recover. Forest fire is an uncontrolled fire occurring in nature and man-made. Once fire starts ignited it rapidly spreads all over area in the forest. The land were forest is burnt it became impossible to grow vegetation over there. This is because soil becomes water repelled and accepts no more water. Leading to reduction of ground water level. Fire causes huge loss of lives and properties every year. The national crime records Bureau indicates that there have been of 113972 fatalities due to fire accidents of the year 2010 to 2014.one of the most destructive properties of fire is that it spreads exponentially and with the right medium can spread uncontrollably. This is why timely detection of fire of fire is necessary for avoiding a fire hazard. The internet of things is a collection of sensor, actuators, software, embedded with electronics, connect each other with cloud. It is an also economic benefits. IOT make everyday life easier for humans by developing smart devices. If increased IOT devices 31% at 8.4 billion in the year 2017. IOT involves connecting objects beyond the range of standard device which are used for every day purpose. The Arduino UNO at mega 328p for open platform for IOT to program easily and IOT devices also used to interface the embedded system and application of users. Temperature sensor used to measure the temperature level, smoke sensor is used find smoke type of quantities. If cloud to communication the devices.

II. PROPOSED SYSTEM

The proposed system is cloud based forest fire alert system using IOT technology. In the advancing world, it is very crucial to protect our environment. The fire cause serious change and disturbance to wildlife and human life. In wild animals are most affected and die also known for forest fire. If forest trees also burned to affect atmosphere, environment. This fire made naturally and man-made. So this project need to prevent and pre-cautions from forest fire. In order to achieve the best fire detection result with faster time to detect the temperature variation. When temperature sensor used to measure the temperature variation. Smoke sensor is a device that dense smoke, typically as an indicator of fire. Arduino at mega 328p used to control and monitor

the activities. Cloud is a storage purpose to use him. Because each and every second to monitoring the environment condition data can be stored. IOT Device to interface with Arduino and cloud.so finally fix the monitoring system done in nearby forest office station. The detail about the system is connected with a computer system monitored by the officer.

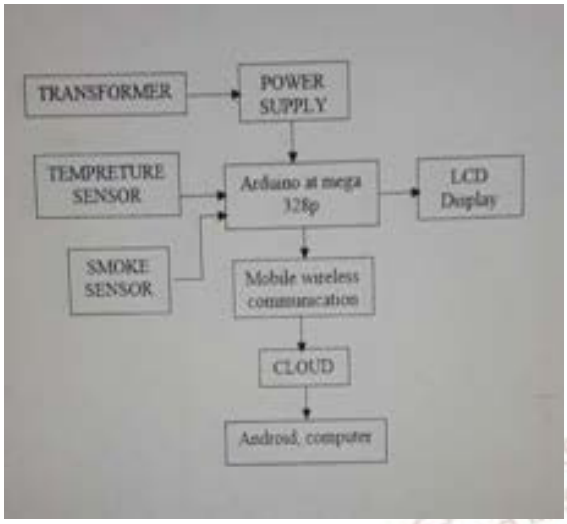

Fig 1. Block Diagram

III. HARDWARE IMPLEMENTATION

A. TEMPRATURE SENSOR

Temperature sensor normally used to measure variation of the temperature in particular area in range. In LM35 is basic temperature sensor that can be used for experimental purpose.

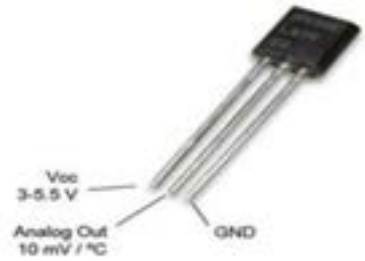

Fig 2. Temperature sensor

In this sensor output voltage value directly linear propositional to the Degree Celsius (centigrade). The advantage of this sensor more memory processing and communication capabilities. Power supply is -2 to 35v and temperature Range -55^0 to 150^0c.

B. SMOKE SENSOR

Smoke sensor mq-2 is used to detect smoke and flammable combustible gasses in atmosphere. Good sensitivity to alcohol in wide range, long life line, low cost. Output is a reading in analog voltage. The sensor measure of flammable gas range is 200 to 1000 ppm. Operating voltage 5v.

Fig 3. Smoke sensor

C. BLUETOOTH

The Bluetooth HC-05 is a very cool module which add two way wirelessly functionally the project. It connect a small devices like TV, mobile phones. It is easy to use serial port protocol. Operating frequency band is 2.4 GHZ. Flash memory size is 8-bit. And operating voltage is 3.3v.

Fig 4. Bluetooth

D. ARDUINO ATMEGA 328P

Arduino at mega 328p is an open source electronics platform. The main advantage is easy to use hardware and software. It has 14 digital input/output. At mega 328p is an 8-bit micro controller based on AVR RISC. So preparing this microcontroller for flashing the Arduino bootloader. Operating voltage is 5v and the clock speed is 16MHZ.

Fig 5. Arduino At mega 328p

E. LCD DISPLAY

An LCD is an electronic display. Which uses liquid crystalline display produces a visible image. The 16*2 LCD Display is very basic module commonly used for DIYs and circuit. Which translates the 16 character per 2 such a line. In advantage is sharpness, brightness, high peak intensity produces. Operating voltage is 4.7v to 5.3v.

Fig 6. LCD Display

F. CLOUD

Cloud is a very important big level storage place and interconnect the computer, mobile phones with internet. Cloud is mainly used to storage the data and information will be shared.

Fig 7. Cloud computing

If embedded system sends the monitoring data to server access and maintained. In public cloud use the project to server to provide the information via internet.

IV. CONCLUTION

Forest is a very important and grow in many places in around world. In a forest is piece of land with many trees. Many animals to live and survive the forest. Forest also used to prevent soil erosion, climate changes. This paper, a cloud based forest fire alert system using IOT technology. Temperature is increased or smoke typically fire indicate to LCD display. The real time sense a data will send and stored cloud. Finally information of the different parameter to be monitor forest officer and nearby forest survival peoples.

REFERENCES

[1].Angelline.R. Adithya.S. Abishek narayanan. "Fire Alarm System Using IOT". international journal of innovative Technology and exploring engineering (IJITEE) volume-8, issue-653, April 2019.

[2].Dr.S.praveenchakravarthy, J.Nancy, V.S.Naveen Kumar. "Forest Fire Detection System". international journal of Recent trends in engineering & research (IJRTER) conference on electronics, information and communication System (CELCIS'17) special issue, March-2107.

[3].Harjinder Singh." Forest Fire Detection Using Wireless Sensor". international journal of scientific & engineering Research, volume 7, issue 7, July-2016.

[4]. Kiran kumar.D, Kishore.T, Suresh kumar.V. "Fire Monitoring System for Fire Detection Using ZigBee and Gprs System". IOSR journal of electronics and communication engineering (IOSR-JECE) volume 12, issue 1, ver.III (Jan-feb.2017).

[5].Michel owayjan, George freiha, roger achkar. "Forest Fire Detection and Alerting System" 17th IEEE Mediterranean Electro technical conference, Beirut, Lebanon 13-16 April 2014.

[6]. MR. Lalti patil, Miss. Divya chopra, Miss. Prachi jadhav. "Forest- Fire Surveillance System Based on Wireless Sensor Network", international. Journal of engineering research and applications ISSN: 2248-9622, vol. 6, issue 4, (part-2) April 2016.

[7].Pallavi.C, jamdhade, Ashwini.D. Kawate, shitals .lachake." Forest fire detection using optimized solar powered Wireless sensor networks", international journal of advance search in science and engineering, volume No.07, Issue NO.02, and February 2017.

[8].Sathish kumar.R, vinoth kumar.M, devaraj varatharaj, "Design and Development of Automatic Fire Detection Using Sms and Voice Alert System". international journal of scientific & engineering Research, volume 7, issue 5, May-2016.

[9]. Sai kumar.P. Sriramya." IOT Enabled Forest Fire Detection and Alerting the Authorities ". international journal Of Recent technology and engineering (IJRTE) Volume-7, issue-654, April -2019.

[10].Varun kumar. S, P.V yokesh raj, V. Vignesh, "Implementation Of Wireless Sensor Network And IOT For Real Time Forest Fire Warning System". international journal of engineering and technology-Volume 4 issue 1, Jan- Feb 2018.

SECURED INTRUSION PROTECTION SYSTEM THROUGH EAACK IN MANETS

A PROJECT PHASE-II REPORT

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IN

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PAAVAI ENGINEERING COLLEGE, NAMAKKAL

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ABSTRACT

Achieving reliable routing has always been a major issue in the design of communication networks, among which mobile ad hoc networks (MANETs) possess the most adversarial networking environment due to the absence of fixed infrastructure, the nature of open transmission media and the dynamic network topology. These characteristics also make the design of routing protocols in MANETs become even more challenging. Determining feasible routing paths for distributing messages in a decentralized network where network topology varies is a difficult job. Factors such as the open medium and vast distribution of nodes, topological changes, variable wireless link quality, and propagation path loss become pertinent issues and make MANET unprotected to instructions. Thus, it becomes pivotal to develop a systematic intrusion detection scheme to secure Mobile Ad Hoc networks from intruders. In this project, we put forward and applied an efficient IDS mechanism based on Enhanced Adaptive Acknowledgment (EAACK) especially made for MANETs which performs better than the previous techniques such as Watchdog, TWOACK and AACK.

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LIST OF ABBREVIATIONS

ACRONOYM	ABBREVIATION
ACK	Acknowledgment
ARP	Address resolution protocol model
AODV	Ad Hoc On Demand Distance Vector routing
CBR	Constant Bit Rate
DoS	Denial of Service
DSDV	Destination Sequenced Distance Vector routing
DSR	Dynamic Source Routing
EAACK	Enhanced Adaptive Acknowledgment
HTTP	Hyper Text Transfer Protocol
IDS	Intrusion Detection System
IP	Internet Protocol
LAN	Local Area Network
MANNET	Mobile Ad hoc Network
MRA	Misbehaviour Report Analysis
NAM	Network Animator
NS	Network Simulator
OSPF	Open Short Path First
OTCL	Object oriented variant of Tcl
RIP	Routing Information Protocol
RREP	Route Reply
RREQ	Route Request
S-ACK	Source Acknowledgment
TCP	Transmission Control Protocol
TORA	Temporally Ordered Routing Algorithm
UDP	User Datagram Protocol
ZRP	Zone Routing Protocol

CHAPTER 1

INTRODUCTION

Introduction

Wireless networking is the need of hour for many applications because of its easier network expansion, increased mobility improved responsiveness, better access to information, and enhanced guest access. In addition, with the increasing standard of industry and use of lightweight network hardware devices that are even smaller and largely mobile. The wireless communication is enhanced by Mobile ad hoc networks (MANETs) having high degree of node mobility.

1.1 Mobile Adhoc Network (MANETS)

Wireless cellular systems have been in use since 1980s. We have seen their evolutions to first, second and third generation's wireless systems. Wireless systems operate with the aid of a centralized supporting structure such as an access point. These access points assist the wireless users to keep connected with the wireless system, when they roam from one place to the other. The presence of a fixed supporting structure limits the adaptability of wireless systems. In other words, the technology cannot work effectively in places where there is no fixed infrastructure. Future generation wireless systems will re quire easy and quick deployment of wireless networks. This quick network deployment is not possible with the existing structure of current wireless systems. The next generation of wireless communication systems, there will be a need for the rapid deployment of independent mobile users. Significant examples include establishing survivable, efficient, dynamic communication for emergency/rescue operations, disaster relief efforts, and military networks. Such network scenarios cannot rely on centralized and organized connectivity, and can be conceived as applications of Mobile Ad Hoc Networks. Mobile ad-hoc networks or "short live" networks operate in the absence of fixed infrastructure. They offer quick and easy network deployment in situations where it is not possible otherwise. Ad-hoc is a Latin word, which means "for this or for this only."

Mobile ad-hoc network is an autonomous system of mobile nodes connected by wireless links; each node operates as an end system and a router for all other nodes in the network.

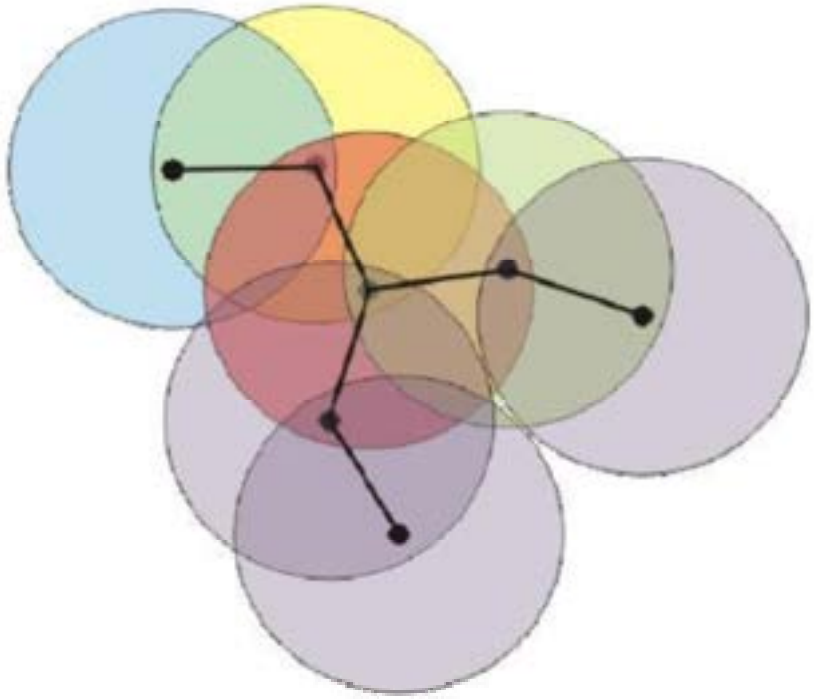


Figure1.1 Manet Structure

MANET is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the nodes themselves must execute the topology and delivering messages, i.e., routing functionality will be incorporated into mobile nodes. The set of applications for MANETS is diverse, ranging from small, static networks that are constrained by power sources, to large-scale, mobile, highly dynamic networks. The design of network protocols for these networks is a complex issue. Regardless of the application, MANETS need efficient distributed algorithms to determine network organization, link scheduling, and routing. However, determining viable routing paths and delivering messages in a decentralized environment where network topology fluctuates is not a well-defined problem. While the shortest path (based

on a given cost function) from a source to a destination in a static network is usually the optimal route, this idea is not easily extended to MANETS. Factors such as variable wireless link quality, propagation path loss, fading, multi-user interference, power expended, and topological changes, become relevant issues. The network should be able to adaptively alter the routing paths to alleviate any of these effects. Moreover, in a military environment, preservation of security, latency, reliability, intentional jamming, and recovery from failure are significant concerns. Military networks are designed to maintain a low probability of intercept and/or a low probability of detection. Hence, nodes prefer to radiate as little power as necessary and transmit as infrequently as possible, thus decreasing the probability of detection or interception. A lapse in any of these requirements may degrade the performance and dependability of the network.

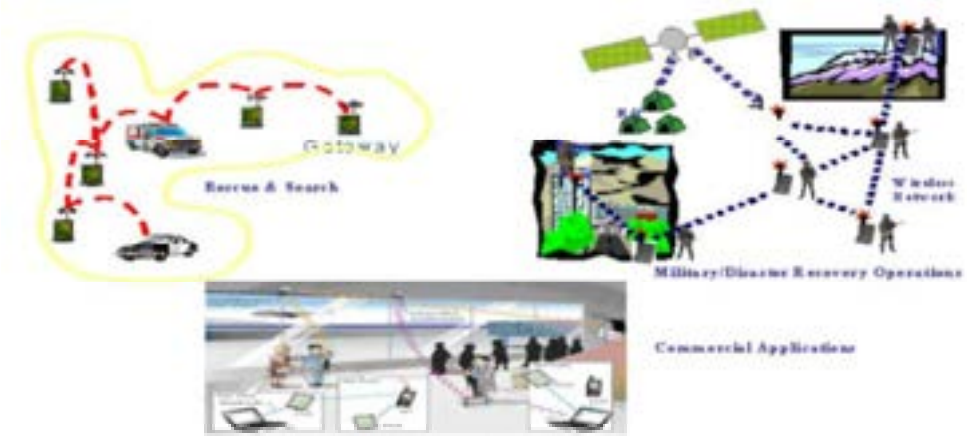


Figure 1.2 Mobile Ad Hoc Network Applications

Mobile ad-hoc network (MANET) is ideally to be used in emergency situations like natural disasters, military conflicts, emergency medical situations etc as shown in Fig1.2

1.2 Routing in Ad-Hoc Networks

Mobile Ad-Hoc networks (MANETS) are by definition peer-to-peer, multi-hop networks, without any existing infrastructure. If a network host wishes to communicate with another network host that is outside its radio range, it must use intermediate hosts to route the communications. Therefore routing functionality needs to

be incorporated into the mobile hosts. Note: - Because of the common distinction between hosts and routers in networking documentation, the term mobile node shall be used from here on. In wired networks routing algorithms are categorized as link state based protocols (e.g. OSPF Open Short Path First) or distance vector based (e.g. RIP Routing Information Protocol). The link state protocols use the Dijkstra algorithm. Link state advertisements are sent to all network routers. The routers accumulate link-state information and the Dijkstra algorithm is used to calculate the shortest path to each node. The distance vector based protocols use the Bellman-Ford algorithm. These call for routers to distribute their routing table, but only to their neighbors. The Bellman-Ford algorithm can be used to maintain and update routing information in a wireless network, where there is not a high degree of mobility. However, when a high degree of mobility is introduced, Bellman-Ford protocols are not able to catch up with the frequent link changes and resulting in poor network convergence and low communication throughput. In the design of routing protocols for mobile ad-hoc networks, the following are desirable factors: -

(1) Distributed operation With no central hierarchy of routers, routing must be distributed amongst the participant nodes.

(2) Loop-freedom Aim to avoid route discovery or maintenance processes from spinning from node to node indefinitely.

(3) Demand-based operation versus Proactive operation Are routes to be determined as a source requires it or should a pre-defined current table of routes be distributed amongst nodes? Both approaches are taken in adhoc networks and protocols fall into either of these two categories.

(4) "Sleep" period operation To conserve energy, it is desirable that when a node is not actively participating on a network, should be able to enter a 'sleep' state. The routing protocol should be able to accommodate such periods without major impact on operation.

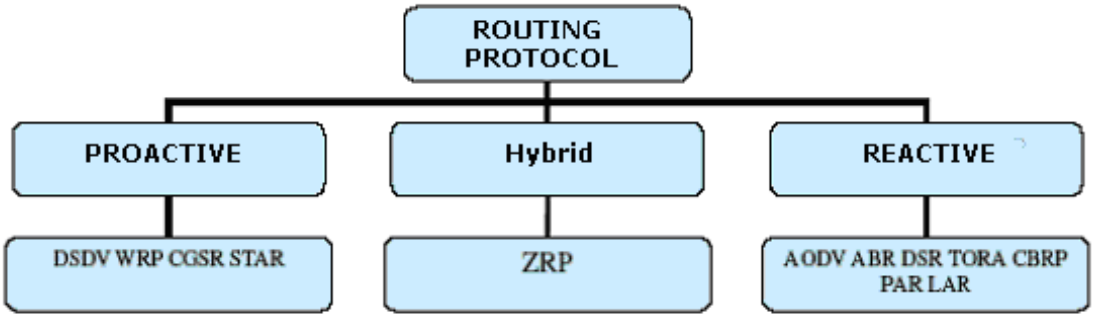


Figure 1.3 Categorization of adhoc routing protocols

(5) Unidirectional link supports Due to variances in wireless radio range between devices, routes may not be bi-directional. This needs to be factored into protocol design so that an alternative route can be used for the return path.As mentioned, ad-hoc network routing protocols fall into two categories: - Demand driven (reactive) protocols or Table-driven (proactive) protocols. Proactive protocols seek to reduce node discovery latency. These protocols require each node to maintain up-to-date routing tables containing routing information from each node to every other node in the network. They respond to changes in network topology by propagating route updates throughout the network to maintain a consistent network view. The areas in which the various protocols differ are the number of necessary routing-related tables and the methods by which changes in the network structure are broadcast. In 2.1 the operation of the proactive protocol, DSDV (Destination Sequenced Distance Vector routing), is outlined. Demand-based (Reactive) protocols seek to reduce control overhead and link usage by constructing routing information only when the source node requires a route. These savings are gained at a cost of increased route discovery relay. A source node looking for a route to a destination initiates a route discovery within the network. This process is completed once a route is found or all possible route permutations have been examined. Once a route has been discovered and established, some form of route maintenance procedure maintains it until either the destination becomes inaccessible along every path from the source or the route is no longer desired. In 2.2 the operation of the reactive protocol AODV (Ad Hoc On Demand Distance Vector routing) is outlined.

1.3 DSDV Protocol Outlined

Destination Sequenced Distance Vector routing is a table-driven routing protocol based on the Bellman-Ford algorithm. The modification for ad-hoc networks is that routing loops are avoided. Each network node maintains its own routing table in which all destination nodes in the network and the numbers of routing hops are recorded. Routing information is always available, whether a route is required or not by a source node. Routes are given a sequence number to distinguish stale routes from new ones. Routing table updates are sent periodically throughout the network to maintain consistency. To reduce the amount of network traffic that this produces, table updates are sent as smaller incremental updates during periods of low mobility. During periods of high mobility, full table updates are distributed. As new routes are added to the tables, they include the destination node address and the number of hops. The route with the most recent sequence number (indicating freshness) is always used. If two routes have the same sequence number then the one with the smaller hop count is used.

1.4 AODV Protocol Outlined

The Ad Hoc On-Demand Distance Vector (AODV) builds on the DSDV protocol by minimizing the required number of broadcasts by creating routes on a source initiated, on-demand basis. There is no requirement to maintain a complete list of routes. When a source node wants to communicate with a destination node, it broadcasts (multicasts, if IPv6 is being used) a route request (RREQ) packet to its neighbors. They will forward it on to their neighbors and so on, until it reaches a node with a fresh route to the destination or the destination itself.

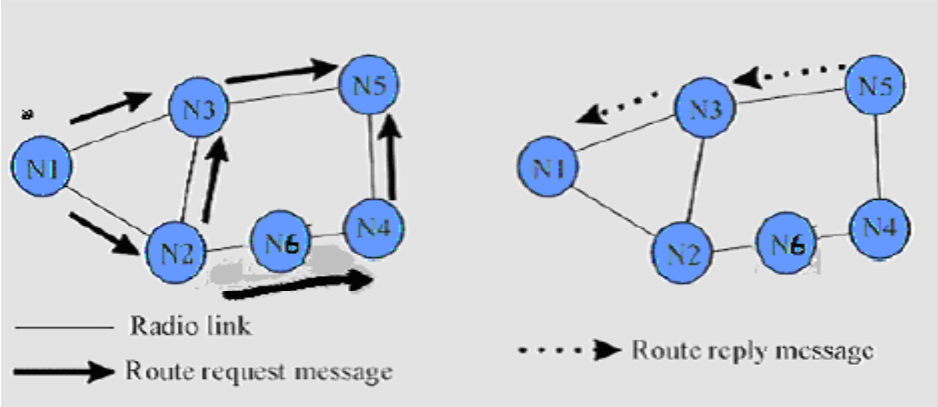


Figure 1.4 AODV/DSR route discovery, route request message is broadcast,route reply message is unicast

AODV uses sequence numbers to indicate route freshness and to avoid route loops. During the forwarding of RREQ packets the intermediate nodes record in their cached route tables the address of the neighbor from whom they received the RREQ, thereby establishing a reverse path. The destination node or intermediate node with a fresh route to the destination, responds by unicasting a route reply (RREP) package to the source along the reverse path. (Note: Because of this AODV has the limitation of only supporting routes over bi-directional links, routes over uni-directional links will fail). Mobility of nodes may break a previously established route. An upstream node detects this and a link failure notification is sent to each of its active upstream neighbors until the source is reached which may initiate a new route request if require.

1.5 Securities in Mobile Ad-Hoc Networks

When discussing network security in general, two aspects need to be considered; the services required and the potential attacks. The security services aspect includes the functionality that is required to provide a secure networking environment while the security attacks cover the methods that could be employed to break these security services.

1.5.1 Network Security Goals

In providing a secure networking environment some or all of the following services may be required:

Confidentiality Ensures that the intended receivers can only access transmitted data. This is generally provided by encryption. Two types of encryption are commonly used (a detailed description of these is outside the scope of this report).Symmetric Encryption, where 2 nodes share a key (e.g. - DES, AES). Any data transmitted between the nodes is encrypted using this key. This key must be provided to the nodes over a secure channel. Symmetric encryption generally requires less computational resources than public key encryption. Public Key Encryption, where all nodes participating generate a public\private key pair pubKn/privKn. The node makes its public key pubKn available to all nodes. If other nodes wish to send data to node *n*, they encrypt their data using pubKn, safe In the knowledge that it can only be decrypted by *n*'s private key privKn, which only node n knows.

Integrity Ensures that the data has not been altered during transmission. The integrity service can be provided using cryptographic hash functions along with some form of encryption. When dealing with network security the integrity service is often provided implicitly by the authentication service.

Authentication Both sender and receiver of data need to be sure of each other's identity. Authentication can be provided using encryption along with cryptographic hash functions, digital signatures and certificates. Details of the construction and operation of digital signatures can be found in RFC2560.

Non-repudiation Ensures that parties can prove the transmission or reception of information by another party, i.e. a party cannot falsely deny having received or sent certain data. Non-repudiation requires the use of public key cryptography to provide digital signatures. A trusted third party is required to provide a digital signature.

Availability Ensures that the intended network security services listed above are available to the intended parties when required. The availability is typically ensured by redundancy, physical protection and other non-cryptographic means, e.g. use of robust protocols.

This is a vague metric and is provided in varying degrees by all security protocols. There are various types of threats or attacks networks can be vulnerable to, some of which are listed below:

1.5.2 Attacks

Eavesdropping This attack is used to gain knowledge of the transmitted data. This is a passive attack, which is easily performed, in many networking environments. However using an encryption scheme to protect the transmitted data can prevent this attack.

Impersonation Here the attacker uses the identity of another node to gain unauthorized access to a resource or data. This attack is often used as a prere qui site to eavesdropping. By impersonating a legitimate node the attacker can try to gain access to the encryption key used to protect the transmitted data. Once the attacker knows this key, she can successfully perform the eavesdropping attack.

Modification This attack modifies data during the transmission between the communicating nodes, implying that the communicating nodes do not share the same view of the transmitted data. An example could be when the transmitted data represents a financial transaction where the attacker has modified the transactions value.

Replay The attacker retransmits data previously transmitted by a legitimate node.

Denial of Service (DoS) This active attack aims at obstructing or limiting access to a certain resource.

This resource could be a specific node or service or the whole network. This will affect the availability security service mentioned above. The nature of ad-hoc networks where several routes exist between nodes and routes are very dynamic gives ad-hoc a built-in resistance to DoS attacks, compared to fixed networks. Security mechanisms

for wireless ad-hoc networks should aim to provide all the security services listed above and prevent any of the attacks mentioned. However, due to the lack of infrastructure in an ad-hoc wireless network, typical wired-network implementations of the methods mentioned above may not be possible. Along with the general issues listed above, there are also other specific key issues and challenges for providing security in ad-hoc.

Link Level Security In wireless environment the links are susceptible to attacks where eavesdropper can intercept data packets. Physical barriers such as walls\rooms\&c. provide no barrier to wireless radio packets.

Routing\Network layer Security The routing within ad hoc networks is more vulnerable to attack as each device itself acts as a router. An attacker can pose as a member node and incorrectly route packets to achieve an attack. Denials of service attacks are particularly easy doing this. Thus implementation of secure routing protocol is one of the challenges within ad hoc network. The use of IPSec to provide authentication, confidentiality and integrity is discussed in this report. By securing all IP traffic (or whatever network layer protocol is used), you are also securing outing.

Key Management General network security implementation of keys involves a trusted authority.

Given the lack of infrastructure in ad-hoc, it is generally not possible to have a fixed trusted authority. An alternative to this is required. Security mechanisms will now be outlined for the 802.11 protocols and the Bluetooth protocol.

CHAPTER 2

LITERATURE REVIEW

2.1 Detection And Prevention Of Attacks On Manets Using Advanced Eaack And Hybrid Key Cryptography

Sharad Awatade, Pankaj Chandre, International Journal of Advanced Computational Engineering and Networking, ISSN: 2320-2106, Volume-4, Issue-1, Jan.-2016

2.1.1 Introduction

MANET having decentralized architecture in which all the node communicating in wireless manner. Thus, to increase the scalability of network there is need all node properly work together. MANETs are self-forming, self –maintained and Self-configuring allowing extreme network Scalability, & flexibility, which is often used in military conflict and medical emergency recovery. it oprets on single hop network and multihope network. Mantes is useful in emergency requirements where network range not possible and difficult to install network. Because it supports easy deployment, low cost, faster speed. MANETS having distributed architecture therefore providing security to MANETS is very difficult**.** In this paper, we aim to develop such an efficient and reliable intrusion detection system (IDS). Elliptic Curve Cryptography (ECC) algorithm is used to provide security to the data that is sent between the nodes. to reduce network overhead caused by digital signature Hybrid key cryptography technique is used.

2.1.2 Result

In this paper we study different attacks on Mantes Such as Gray hole Attack Man in Middle attack, wormhole Attack, HTTP GET Food Attack. For preventing these attacks we use RSA, DSA, RC6, Blowfish algorithm, Twoflish algorithm. First watchdog use for IDS for MANETs. But There are lots of disadvantages or drawbacks for removing these drawbacks we use EAACK algorithm .For preventing attack first we use

RSA and DSA algorithm. for reducing network overhead which is caused by digital signature we use hybrid cryptosystem.

2.1.3 **Drawbacks**

- Ambiguous collision
- Receiver collision
- Not able to implement clustering

2.2 A Survey on Secure Intrusion Detection System for MANET

Ms Priyanka P Kulkarni, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 1, January 2015 ISSN: 2277 128X

2.2.1 Introduction

MANET (Mobile Ad hoc network) is an IEEE 802.11 framework which is a collection of mobile nodes equipped with both a wireless transmitter and receiver communicating via each other using bidirectional wireless links. This type of peer to peer system infers that each node or user in the network can act as a data endpoint or intermediate repeater. Thus, all users work together to improve the reliability of network communications. MANETs are self-forming, self maintained and self-healing allowing for extreme network flexibility, which is often used in critical mission applications like military conflict or emergency recovery. Minimal configuration and quick deployment make MANET ready to be used in emergency circumstances.. Due to MANET's distributed architecture and changing topology, a traditional centralized monitoring technique is no longer feasible in MANETs. Hence, it is crucial to develop an intrusion detection system in MANETs. In this paper, we aim to develop such an efficient and reliable intrusion detection system (IDS).

2.2.2 Result

In this research paper, we have study a novel INTRUSION-DETECTION SYSTEM named EAACK protocol specially designed for MOBILE AD-HOC NETWORKs and compared it against other popular mechanisms in different scenarios through simulations. The demonstrated positive performances against Watchdog, TWOACK, and AACK.We also surveyed some intrusion detection systems that deals with various attacks. Attacker may find some new way to attack the system. Therefore system need to much robust so that it prevents new vulnerabilities and themselves. It is important to develop network security policies and deploy into MANET, this can be good research area. There should be system that learns from the knowledge of previous attacks and able to infer and detect new attacks; this can be potential research area.

2.2.3 Drawback

- Limited transmission power

2.3 Design of EAACK Protocol for Partial Dropping in Watchdog Security Scheme

S.Sri Gowthem, K.P. Kaliyamurthie, International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 9, September 2015

2.3.1 Introduction

Mobile Ad hoc NETwork (MANET) is a collection of mobile nodes equipped with both a wireless transmitter and a receiver that communicate with each other via bidirectional wireless links either directly or indirectly. Industrial remote access and control via wireless networks are becoming more and more popular these days. One of the major advantages of wireless networks is its ability to allow data communication between different parties and still maintain their mobility. MANET solves this problem by allowing intermediate parties to relay data transmissions. This is achieved by dividing MANET into two types of networks, namely, single-hop and multihop. MANET is capable of creating a self-configuring and self maintaining network without the help of a centralized

infrastructure, which is often infeasible in critical mission applications like military conflict or emergency recovery. Minimal configuration and quick deployment make MANET ready to be used in emergency circumstances where an infrastructure is unavailable or unfeasible to install in scenarios like natural or human-induced disasters, military conflicts, and medical emergency situations.

2.3.2 Result

Packet-dropping attack has always been a major threat to the security in MANETs. In this research paper, we have proposed a novel IDS named EAACK protocol specially designed for MANETs and compared it against other popular mechanisms in different scenarios through simulations. The results demonstrated positive performances against Watchdog, TWOACK, and AACK in the cases of receiver collision, limited transmission power, and false misbehavior report. Furthermore, in an effort to prevent the attackers from initiating forged acknowledgment attacks, we extended our research to incorporate digital signature in our proposed scheme. Although it generates more ROs in some cases, as demonstrated in our experiment, it can vastly improve the network's PDR when the attackers are smart enough to forge acknowledgment packets.We think that this tradeoff is worthwhile when network security is the top priority. In order to seek the optimal DSAs in MANETs, we implemented both DSA and RSA schemes in our simulation. Eventually, we arrived to the conclusion that the DSA scheme is more suitable to be implemented in MANETs.

2.3.3 Drawback

- Ambiguous collisions

2.4 A Comparative Study of EAACK Based Security Mechanism for MANETs

Brijal J. Patel1, Krunal Panchal, A Comparative Study of EAACK Based Security Mechanism for MANETs, Vol-2 Issue-6 2016 IJARIIE-ISSN(O)-2395-4396

2.4.1 Introduction

A mobile ad hoc network (MANET) is a one of the wireless method. The device are moving in randomly different directions and communicating with one to other within each nodes communication range. To extend the nodes communication range , the other nodes in the network act as router. MANET is a collection of mobile nodes equipped with both a wireless transmitter and a receiver that communicate with each other via bidirectional wireless links either directly or indirectly. One of the major advantages of wireless networks is its ability to allow data communication between different parties and still maintain their mobility. However, this communication is limited to the range of transmitters. This means that two nodes cannot communicate with each other when the distance between the two nodes is beyond the communication range of their own. MANET solves this problem by allowing intermediate parties to relay data transmissions. This is achieved by dividing MANET into two types of networks, namely, single-hop and multihop.

2.4.2 Result

In this paper, EAACK and IDS system for prevent and detect malicious attacks. Watch dog has a total of six weaknesses such as ambiguous collisions, receiver collisions, limited transmission power, false misbehavior report, collusion, and partial dropping in which three are handled with this system such as receiver collisions, limited transmission power, false misbehavior report. This gives an optimal solution for EAACK scheme and to reduce the network overhead in the case of authentication. Clustering routing algorithm provide security which find the secure routing and also provides some cryptography algorithms. In future work to solve other attacks and also work on security with energy efficient scheme for MANETs.

2.4.3 Drawbacks

- Ambiguous collisions
- Receiver collisions

2.5 Performance Enhancement of Intrusion Detection System Using Advance Adaptive EAACK for MANETs

Shraddha Kamble1, Dr.B.K Mishra2, Dr.Rajesh Bansode, International Journal of Computational Engineering Research (IJCER), ISSN (e): 2250 – 3005 || Volume, 06 || Issue, 06|| June – 2016

2.5.1 Introduction

A mobile ad hoc network (MANET) is a self-organizing and self-configuring multi-hop wireless network, where the nodes are free to move randomly. Ad hoc wireless network are self-creating and self-organizing. One advantage of wireless networks is the ability to transmit data among users in a local area while remaining mobile. The communication between the nodes is limited to their range of transmitter. This means that two nodes cannot communicate with each other when the distance between the two nodes is beyond the communication range of their own. MANET solves this problem they allow intermediate node to transmit data between two other nodes. To achieve this by MANETs are divided into two types into two types of networks, namely, single-hop and multi-hop. In a single-hop network, all nodes within the same radio range communicate directly with each other. On the other hand, in a multi-hop network, nodes rely on other intermediate nodes to transmit if the destination node is out of their radio range. In contrary to the traditional wireless network, MANET has no fix structure; thus, all nodes are free to move randomly. Moreover due to distributed nature of market centralized monitoring system is not feasible. In such case, it is crucial to develop an intrusion-detection system (IDS) specially designed for MANET

2.5.2 Result

In this paper the main focus has been laid on comparative study of EAACK approach and its limitation with EAACK protocol using advance EAACK. Here we have study the behavior of EAACK technique. SACK & MRA scheme but in scenario of link breakage and source maliciousness performance of existing EAACK degrades so the proposed protocol advance EAACK is compared against popular mechanism such as

TWOACK,AACK and EAACK in different scenario through simulation. Simulation parameters that are considered in this paper is packet delivery ratio and delay. The results demonstrated positive performances against TWOACK, AACK and EAACK in the cases of link breakage and source maliciousness.

2.5.3 Drawbacks

- Delay
- Link breakage
- Source maliciousness

2.6 Acknowledgement Based Intrusion Detection System in Mobile Ad-Hoc Networks using EAACK

Ms. Pallavi N. Ratnaparkhi, Mr. Ravindra D. Kale, International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 3 Issue 4, April – 2014

2.6.1 Introduction

A Mobile Ad-hoc NETwork (MANET) is an infrastructure-less network consisting of self- configuring mobile nodes connected by wireless links 10. Nodes rely on each other to store and forward packets. The self-configuring ability of nodes in MANET made it popular among critical mission applications like military use or emergency recovery, network security is of vital importance. In this case, it is crucial to develop efficient intrusiondetection mechanisms to protect MANET from attacks. This technique for intrusion-detection will be used to enhance the proposed system performance merits by reducing the power consumption, reduced network delays and improved efficiency in MANETs with secure and authentic data transmission using more efficient hybrid cryptography techniques.

2.6.2 Result

In this paper we have studied the various IDS techniques that are used in MANETs to trap the intruders in the network. From this study it is conclude that packet-dropping attack has always been a major threat to the security in MANETs. The functions of such intrusion detection schemes all largely depend on the acknowledgment packets. Hence, the proposed IDS may guarantee that

- The acknowledgement packets are valid and authentic with more secure data packet transmission.
- The proposed IDS system will reduce the energy consumption and delays in network with less routing overhead during data packet transmission and also enhance the efficiency of MANETs.

2.6.3 Drawbacks

- False misbehavior result
- Partial droping

2.7 An Improvised Intrusion Detection System for MANETs

R.Gowtham, Celeste Fatima, R.G.Gopeeka, A.Chandrasekar, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 3 Issue 5, May 2014

2.7.1 Introduction

MANET is a collection of mobile nodes equipped with both a wireless-transmitter and receiver that correspond with each other via bi- directional wireless links either directly or indirectly. Industrial remote access and control via wireless network becoming more and more popular these days. One of the key advantages of wireless networks is its ability to allow data communication between different parties and still maintain their mobility. MANET has a decentralized network infrastructure. Attack prevention measures, such as validation and encryption, can be used as the first line of

defence for reducing the possibilities of attacks. However, these techniques have a restriction on the effects of prevention techniques in general and they are designed for a set of known attacks. They are unlikely to prevent newer attacks that are designed for circumventing the existing security measures. In this paper we are implementing the method of digital signature with multiple key generation schemes to enhance security by dividing the key into slots and sending it to the receiver.

2.7.2 Result

Mobile Ad Hoc Network has always been prone to security attacks. Since the existing methods concentrate only on detecting the malicious nodes we are not aware of the validity of the acknowledgement packets on which we fully rely on. So to ensure to validate the acknowledgement packets we digitally sign the keys and transmit the keys. We also implement a method of generating multiple key by dividing keys into slots. This leads to maximum network security for the present scenario without the loss of network performance.

2.7.3 Drawbacks

- Limited transmission power
- Collision

2.8 Secure EAACK to detect DoS Attacks in MANET

R.Anandakumar, Avinash Premanath, Fadle Ahmed, International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 4, April 2014

2.8.1 Introduction

Wireless Adhoc Network

A wireless ad hoc network is a decentralized type of wireless network. The network is adhoc because it does not rely on a pre existing infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks.

Instead, each node participates in routing by forwarding data for other nodes, so the determination of which nodes forward data is made dynamically on the basis of network connectivity. In addition to the classic routing, ad hoc networks can use flooding for forwarding data.

Mobile Adhoc Network (Manet)

A mobile ad hoc network is a self-configuring infrastructure less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet.

2.8.2 Result

Packet-dropping attack has always been a major threat to the security in MANETs. EAACK protocol is specially designed for MANETs which outperforms Watchdog, TWOACK, and AACK in the cases of receiver collision, limited transmission power, and false misbehavior report. Using AES – Rijndael and RSA algorithm as a hybrid encryption scheme we can improve confidentiality, availability and integrity of the system. So our proposed system ensures more security to the network and also improves throughput.

2.8.3 Drawback

- Error will occur

2.9 An Enhanced Intrusion detection system for MANETS using Hybrid key cryptography

B.Suruthi1 Mr.N.V.Rajeesh kumar, International Journal of Computer Science and Information Technologies, Vol. 5 (2), 2014, 1152-1154

2.9.1 Introduction

MANETS are wireless networks, and decentralised and no fixed topology. Each node in network act both as transmitter and receiver. Nodes communicate with each other either directly or indirectly (with the help of their neighbors).Hence this is possible by single hop network and Multi-hop networks. In Single-hop network, all the nodes within the same radio range communicate with each other. In Multi-hop network, nodes depend on neighbors to transmit if destination node is out of their radio range. MANET is highly vulnerable to attacks because, node configuration and maintenance are done on its own. Then Enhanced Adaptive ACKnowledgement scheme is used to overcome the disadvantage of false misbehaviour report. MANET are mostly preferred for military, areas that include natural disaster, medical emergency.

2.9.2 Result

The newly proposed scheme called EAACK, and it provides better performances comparing to all other existing approaches. The EAACK scheme implements digital signature which causes network overhead which can be further reduced by hybrid key cryptography. This cryptography technique uses RSA, AES for providing security and Zone Routing Protocol (ZRP) to find the route between source and destination.

2.9.3 Drawback

- Implementation is difficult.

2.10 Extended EAACK- An secure intrusion detection system with detection and localization of multiple spoofing attackers in MANET

Aditya P. Tapaswi, Pratik P. Nashikkar, Rohit S. Barge, Aniket M. Shinde, Prof. Pramod Patil, International Journal of Scientific and Research Publications, Volume 4, Issue 12, December 2014

2.10.1 Introduction

With constantly changing technology, people prefer to have information on their fingertips anywhere - anytime Thus increasing in the use of wireless networks. MANET one of the promising technology in wireless networking has features like dynamic configurability, low cost of deployment. MANET does not need a fixed infrastructure. MANET is dynamically configurable network in which nodes set up paths among themselves to transmit packets. Without getting help of fixed infrastructure MANET forms self-configuring network by collection of mobile nodes. Transmitter and receivers both are equipped in a MANET node, so node can act as a Router and a Host at the same time. There are two scenarios concerning topology in MANET. Thus acting like a Router to relay mes-sages to other nodes outside each others range have to rely on some other nodes to relay messages.

2.10.2 Result

Packet Dropping and Identity based attacks have always been main threats to MANET. In this paper, we proposed a fully equipped system named E-EAACK primarily in-tended for MANET and made it efficient in comparison to other popular mechanisms. It also overcomes the issues in MANET such as limited transmission power, receivers collision and false misbehavior report. We also propose the use of RSS based spatial correlation associated with each node that is hard to falsify for detecting identity based attacks. Our system can do both, detect the attack and decide the number of invaders and exclude them.

2.10.3 Drawback

- Collision will occur

2.11 Summary of Literature Review

The summary of the literature review is given by table 2.1 it contains title of the paper, technique and its drawback.

Table 2.1 Summary of Literature Review

S.No	Title	Technology	Drawback
1.	Detection and prevention of attacks on Manets using advanced EAACK and hybrid key Cryptography	Adavnced Enhanced Adaptive Acknowledgment (EAACK) and Mobile Ad hoc Network (MANET)	Receiver collision Unable implement dynamic clustering Ambiguous collision
2.	A Survey on Secure Intrusion Detection System for MANET	ACK, EAACK and MANETs	Limited transmission power
3.	Design of EEACK Protocol for Partial Dropping in Watchdog Security Scheme	WATCHDOG,TWOACK,AACK,MRA used to implemented both DSA and RSA schemes in simulation	Ambiguous collision
4.	A Comparative Study of EAACK Based Security Mechanism for MANETs	Modified Enhanced Adaptive Acknowledgement (EAACK), Digital Signature, IDS.	Receiver collision Ambiguous collision
5.	Performance Enhancement of Intrusion Detection System Using Advance Adaptive EAACK for MANETs	Dynamic source routing (DSR) , Digital Signature Algorithm (DSA), Advanced EAACK (Enhanced Adaptive Acknowledgment)	Receiver collision

6.	Acknowledgement Based Intrusion Detection System in Mobile Ad-Hoc Networks using EAACK	Hybrid cryptograghy technique.	Ambiguous collision
7.	An Improvised Intrusion Detection System for MANETs – Defensive EAACK	Defensive Enhanced Adaptive ACKnowledgement and Multiple key generation mechanism.	False Misbehaviour Report Collision Partial Dropping
8.	Secure EAACK to detect DoS Attacks in MANET	EAACK,AES Rijndael algorithm,RSA,SHA-512	Receiver collision
9.	EAACK-Intrusion-Detection-System for MANETs	Efficient intrusion system (EAACK) for MANETs.	False Misbehaviour Report Ambiguous collision
10.	Extended EAACK-An secure intrusion detection system with detection and localization of multiple spoofing attackers in MANET	Watchdog; Extended Enhanced Adaptive Acknowledgement (E-EAACK); Digital Signature; IDS; Clustering	Limited transmission power

CHAPTER 3

THEORETICAL BACKGROUND

3.1 Existing Techniques

In traditional networks many intrusion detection systems have been proposed, the routers, gateways or switches are used for network traffic. Hence, it is easy to implement IDS in these networks. In MANETs we do not use such devices. Moreover, due to its openness so both malicious and legitimate users can access. In mobile environment it is very difficult to separate normal and unusual activities. Sometimes the false routing information can be generated by outdated node or from a malicious node due to the arbitrarily movement of nodes. Thus, the available intrusion detection techniques used in simple wired networks cannot be implemented to MANETs directly. Researchers have developed many intrusion detection systems for the MANETs. In the next section, we briefly explain three existing techniques, i.e. Watchdog, TWOACK, and (AACK).

3.2. Proposed System

The EEAACK system will consist of following techniques, model or mechanisms for intrusion detection and localization.

3.2.1 ACK

ACK is nothing but an end to end acknowledgment scheme. It acts as a crossbreed scheme in EEAACK. When there are no misbehaving nodes the transmission from source to destination is successful. Then destination sends an acknowledgement packet to source within predefined time constraint, otherwise source will switch to S-ACK mode.

3.2.2 S-ACK

Source sends S-ACK packet in the intention of detecting misbehaving nodes in the route. S-ACK sends acknowledgment back to source after the packet reaches consecutive three nodes ahead the route. The third node required to send a S-ACK acknowledgement to first node. S-ACK mode facilitates easy detection of misbehaving nodes in the presence of receiver collision and limited power for transmission.

3.2.3 MRA

Misbehaviour Report Analysis (MRA) is a scheme to confirm misbehaviour report generated in S-ACK mode. This report may be a false one as attacker may interfere in S-ACK scheme generating a false misbehaviour report. As a result, this may cause destruction of network by compromising guiltless nodes

3.3 Proposed Architecture

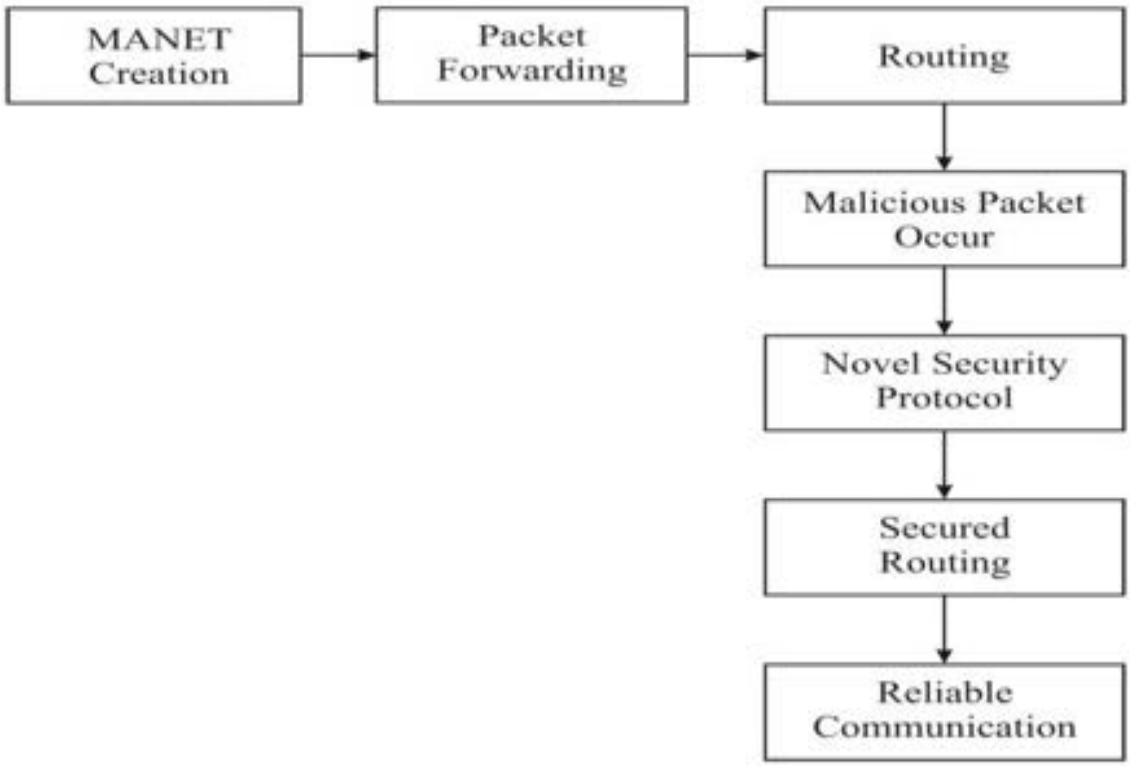


Figure 3.1 Proposed Architecture

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware Requirements

Processor : Dual core

Processor speed : 1.5 GHZ

Memory (RAM) : 2GB

Hard disk : 40GB

4.2 Software Requirements

Operating System : Linux 8.0(fedora 13)

Language : TCL Scripting

Software : ns2.33

4.3 Software Description

4.3.1 The Network Simulator 2.33 (Ns2)

Network Simulator (NS2) is a discrete event driven simulator developed at UC Berkeley. It is part of the VINT project. The goal of NS2 is to support networking research and education. It is suitable for designing new protocols, comparing different protocols and traffic evaluations. NS2 is developed as a collaborative environment. It is distributed freely and open source. A large amount of institutes and people in development and research use, maintain and develop NS2. This increases the confidence in it. Versions are available for FreeBSD, Linux, Solaris, Windows and Mac OS X.

4.3.2 Structure Of Ns2

NS2 is built using object oriented methods in C++ and OTcl (object oriented variant of Tcl) NS2 interprets the simulation scripts written in OTcl.

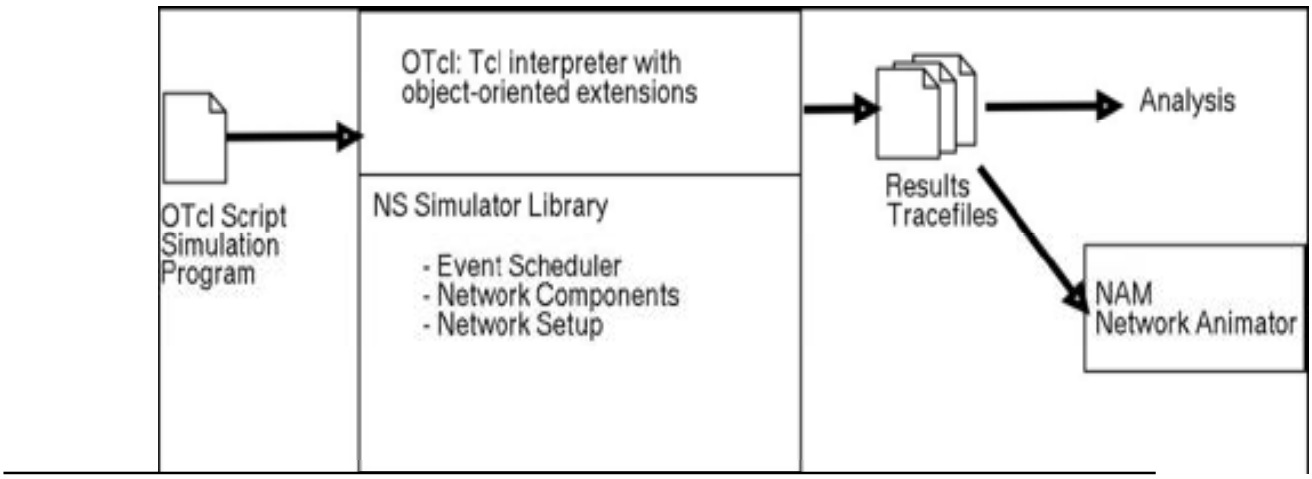


Figure 4.1 Simplified User's View Of Ns

A user has to set the different components (e.g. event scheduler objects, network components libraries and setup module libraries) up in the simulation environment. The user writes his simulation as a OTcl script, plumbs the network components together to the complete simulation. If he needs new network components, he is free to implement them and to set them up in his simulation as well. The event scheduler as the other major component besides network components triggers the events of the simulation (e.g. sends packets, starts and stops tracing). Some parts of NS2 are written in C++ for efficiency reasons. The data path (written in C++) is separated from the control path (written in OTcl). Data path object are compiled and then made available to the OTcl interpreter through an OTcl linkage (tclcl) which maps methods and member variables of the C++ object to methods and variables of the linked OTcl object. The C++ objects are controlled by OTcl objects. It is possible to add methods and member variables to a C++ linked OTcl object.

4.4 Functionalities Of Ns2.33

Functionalities for wired, wireless networks, tracing, and visualization are available in NS2.

• Support for the wired world include

– Routing DV, LS, and PIM-SM.

– Transport protocols: TCP and UDP for unicast and SRM for multicast.

– Traffic sources: web, ftp, telnet, cbr (constant bit rate), stochastic, real audio.

– Different types of Queues: drop-tail, RED, FQ, SFQ, DRR.

– Quality of Service: Integrated Services and Differentiated Services.

– Emulation.

• Support for the wireless world include

– Ad hoc routing with different protocols, e.g. AODV, DSR, DSDV, TORA

– Wired-cum-wireless networks

– Mobile IP

– Directed diffusion

– Satellite

– Senso-MAC

– Multiple propagation models (Free space, two-ray ground, shadowing)

– Energy models

• Tracing

• Visualization

– Network Animator (NAM)

– Trace Graph

• Utilities

– Mobile Movement Generator

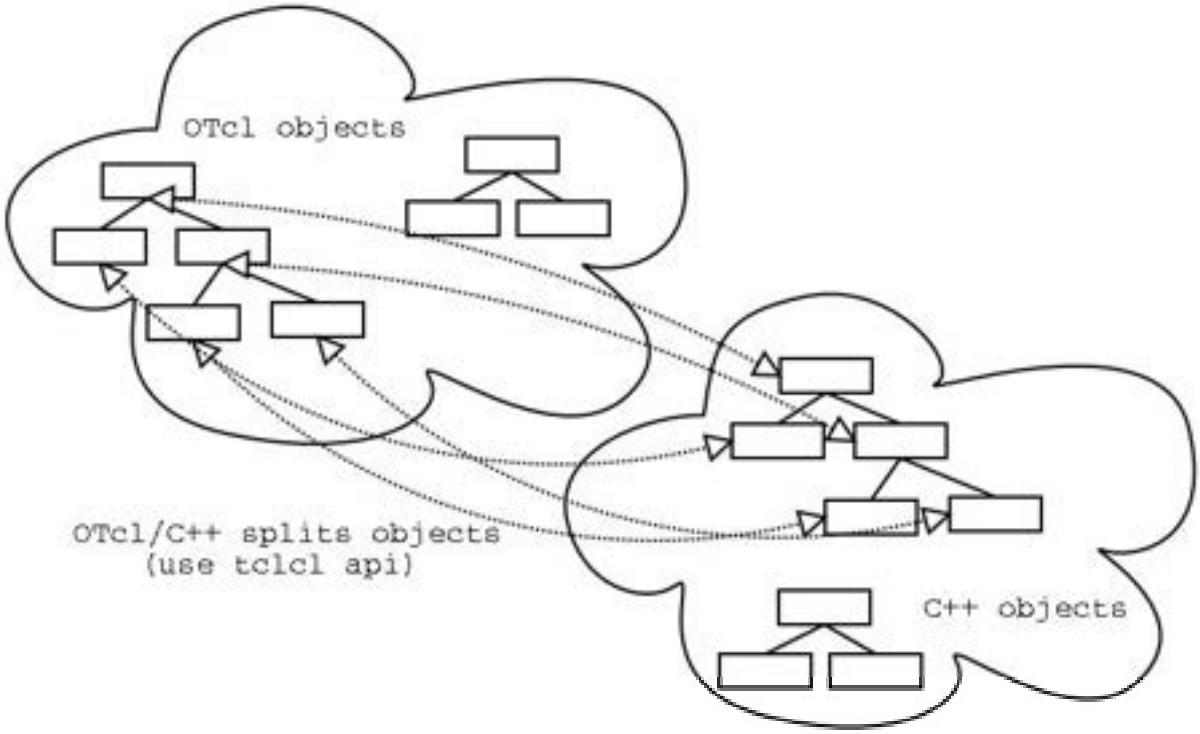


Figure 4.2 OTcl and C++: the duality

4.4.1 Mobile Networking In Ns2.33

This section describes the wireless model that was originally ported as CMU's Monarch group's mobility extension to NS2. The first section covers the original mobility model ported from CMU/Monarch group. In this section, we cover the internals of a mobile node, routing mechanisms and network components that are used to construct the network stack for a mobile node. The components that are covered briefly are Channel, Network interface, Radio propagation model, MAC protocols, Interface Queue, Link layer and Address resolution protocol model (ARP). CMU trace support and Generation of node

movement and traffic scenario files are also covered in this section. The original CMU model allows simulation of pure wireless LANs or multihop ad-hoc networks. Further extensions were made to this model to allow combined simulation of wired and wireless networks. MobileIP was also extended to the wireless model.

4.4.2 The Basic Wireless Model In Ns

The wireless model essentially consists of the MobileNode at the core, with additional supporting features that allows simulations of multi-hop ad-hoc networks, wireless LANs etc. The MobileNode object is a split object. The C++ class MobileNode is derived from parent class Node. A MobileNode thus is the basic Node object with added functionalities of a wireless and mobile node like ability to move within a given topology, ability to receive and transmit signals to and from a wireless channel etc. A major difference between them, though, is that a MobileNode is not connected by means of Links to other nodes or mobilenodes. In this section we shall describe the internals of MobileNode, its routing mechanisms, the routing protocols dsdv, aodv, tora and dsr, creation of network stack allowing channel access in MobileNode, brief description of each stack component, trace support and movement/traffic scenario generation for wireless simulations.

4.4.3 Mobile Node: Creating Wireless Topology

Mobile Node is the basic *ns* Node object with added functionalities like movement, ability to transmit and receive on a channel that allows it to be used to create mobile, wireless simulation environments. The class Mobile Node is derived from the base class Node. Mobile Node is a split object. The mobility features including node movement, periodic position updates, maintaining topology boundary etc are implemented in C++ while plumbing of network components within Mobile Node itself (like classifiers, dmux , LL, Mac, Channel etc) have been implemented in Otcl.

Table 4.1 Available Options For Node Configuration

Option	Available Values	Default
General		
Address type	Flat, Hierarchical	Flat
MPLS	ON,OFF	OFF
Both Satellite and Wireless Oriented		
Wired Routing	ON,OFF	OFF
II Type	LL,LL/sat	OFF
Mac Type	Mac/802_11,Mac/Csma/ Ca, Mac/Sat/Unslotted/Aloha ,Mac/Tdma	OFF
ifq Type	Queue/DropTail, Queue/Droptail/PriQueue	OFF
Phy Type	Phy/wirelessPhy,Physat	OFF
Option	**Available Values**	**Default**
Satellite Oriented		
SatNodeType	Polar,Geo,Terminal, Geo- repeater	OFF
DownlinkBW	<bandwidth value, e.g “2MB”>	OFF
Wireless Oriented		

Adhoc Routing	DIFFUSION/RATE,DIFFUSION/PROB, DSDV,FLOODING,OMNICAST,AODV,TORA	OFF
PropType	Propagation/2RayGround,Propagation Shadowing	OFF
PropInstance	Propagation/2RayGround,Propagation Shadowing	OFF
antType	Antenna/Omni Antenna	OFF
Channel	Channel/Wireless Channel,Channel/sat	OFF
TopoInstance	<toplogy file>	OFF
MobileIP	ON,OFF	OFF
Energy model	Energy model	OFF
Initial Energy	<value in joules>	OFF
rxPower	<value in W>	OFF
txPower	<value in W>	OFF
Idle Power	<value in W>	OFF
AgentTrace	ON,OFF	OFF
RouterTrace	ON,OFF	OFF
MacTrace	ON,OFF	OFF
MovementTrace	ON,OFF	OFF
Errproc	UniformErrorProc	OFF

FECProc	?	?
ToraDebug	ON,OFF	OFF

Implementation Environment

Network simulator 2 is used as the simulation tool in this project. NS was chosen as the simulator partly because of the range of features it provides and partly because it has an open source code that can be modified and extended. There are different versions of NS and the latest version is ns-2.1b9a while ns-2.1b10 is under development

4.5 Network Simulator (Ns)

Network simulator (NS) is an object–oriented, discrete event simulator for networking research. NS provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. The simulator is a result of an ongoing effort of research and developed. Even though there is a considerable confidence in NS, it is not a polished product yet and bugs are being discovered and corrected continuously.

NS is written in C++, with an OTcl1 interpreter as a command and configuration interface. The C++ part, which is fast to run but slower to change, is used for detailed protocol implementation. The OTcl part, on the other hand, which runs much slower but can be changed very fast quickly, is used for simulation configuration. One of the advantages of this split-language program approach is that it allows for fast generation of large scenarios. To simply use the simulator, it is sufficient to know OTcl. On the other hand, one disadvantage is that modifying and extending the simulator requires programming and debugging in both languages.

NS can simulate the following:

1. **Topology:** Wired, wireless
2. **Scheduling Algorithms:** RED, Drop Tail,
3. **Transport Protocols:** TCP, UDP

4. Routing: Static and dynamic routing

5. Application: FTP, HTTP, Telnet, Traffic generators

4.6 User's View Of Ns-2

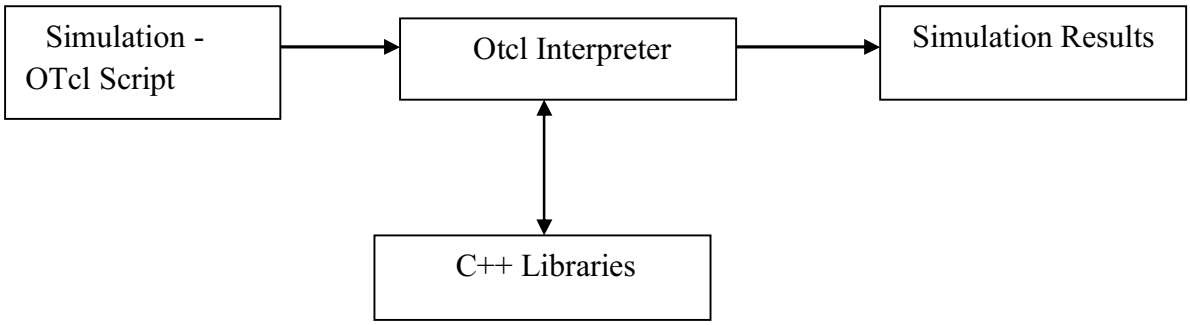


Figure 4.3 Block diagram of Architecture of NS-2

4.7 Network Components

This section talks about the NS components, mostly compound network components. Figure 4.2 shows a partial OTcl class hierarchy of NS, which will help understanding the basic network components.

The root of the hierarchy is the TclObject class that is the super class of all OTcl library objects (scheduler, network components, timers and the other objects including NAM related ones). As an ancestor class of TclObject, NsObject class is the super class of all basic network component objects that handle packets, which may compose compound network objects such as nodes and links. The basic network components are further divided into two subclasses, Connector and Classifier, based on the number of the possible output DATA paths.

The basic network and objects that have only one output DATA path are under the Connector class, and switching objects that have possible multiple output DATA paths are under the Classifier class.

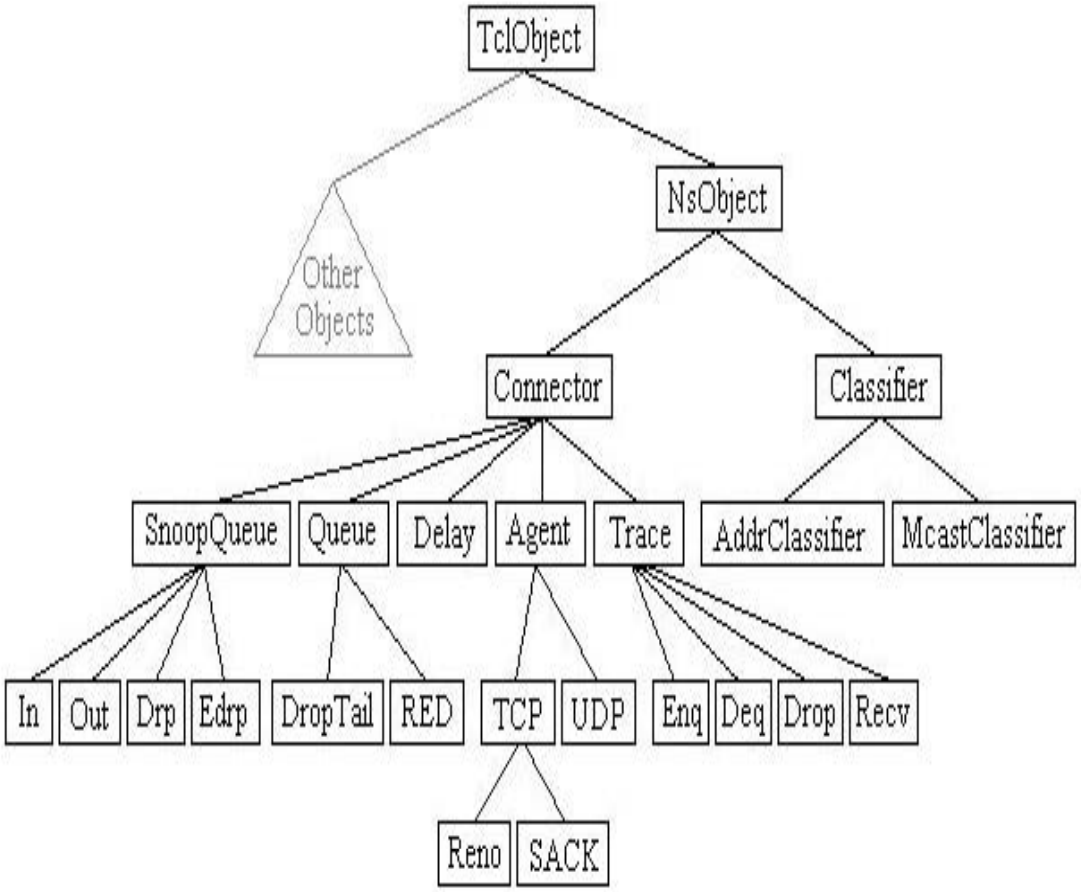


Figure 4.4 OTcl Class Hierarchy

4.8 Class Tcl

The class Tcl encapsulates the actual instance of the OTcl interpreter and provides the methods to access and communicate with that interpreter, code. The class provides methods for the following operations:

1.obtain a reference to the Tel instance

2.invoke OTcl procedures through the interpreter

3.retrieve, or pass back results to the interpreter

4.report error situations and exit in an uniform manner

5.store and lookup "TclObjects"

4.8.1 Obtain a Reference to the class Tcl instance

A single instance of the class is declared in -tclcl/Tcl.cc as a static member variable. The statement required to access this instance is Tel& tel = Tcl::instance();

4.8.2 Invoking OTcl Procedures

There are four different methods to invoke an OTcl command through the instance, tcl. They differ essentially in their calling arguments. Each function passes a string to the interpreter that then evaluates the string in a global context. These methods will return to the caller if the interpreter returns TCL_OK. On the other hand, if the interpreter returns TCL_ERROR, the methods will call tkerror{}. The user can overload this procedure to selectively disregard certain types of errors.

1. **Passing Results to/from the Interpreter :** When the interpreter invokes a C++ method, it expects the result back in the private member variable, tcl-> result.
2. **Error Reporting and Exit:** This method provides a uniform way to report errors in the compiled code.

4.9 Command Methods: Definition And Invocation

For every Tcl Object that is created, ns establishes the instance procedure, cmd{}, as a hook to executing methods through the compiled shadow object. The procedure cmd{} invokes the method command() of the shadow object automatically, passing the arguments to cmd{} as an argument vector to the command() method. The user can invoke the cmd {} method in one of two ways, by explicitly invoking the procedure, specifying the desired operation as the first argument, or implicitly, as if there were an instance procedure of the same name as the desired operation. Most simulation scripts will use the latter form.

Consider the distance computation in SRM is done by the compiled object. It is often used by the interpreted object. It is usually invoked as $srmObject distance? (agentAddress)If there is no instance procedure called distance? the interpreter

will invoke the instance procedure unknown{}, defined in the base class TclObject. The unknown procedure then invokes

$srmObject cmd distance? (agentAddress)

To execute the operation through the compiled object's command() procedure. The user could explicitly invoke the operation directly. One reason for this might be to overload the operation by using an instance procedure of the same name.

For example,

```
Agent/SRM/Adaptive instproc distance? addr {
$self instvar distanceCache_($addr)
if![info exists distanceCache_($addr)] {
set distanceCache_($addr) [$self cmd distance? $addr]
}
set distanceCache_($addr)
}
```

The following shows how the command() method using SRMAgent::command()

```
int ASRMAgent::command(int argc, const char*const*argv) {
Tcl& tcl = Tcl::instance();
if (argc == 3) {
if (strcmp(argv[1], "distance?") == 0) {
int sender = atoi(argv[2]);
SRMinfo* sp = get_state(sender);
tcl.tesultf("%f", sp->distance_);
return TCL_OK;  '
}
}
```

return (SRMAgent::command(argc, argv));

The following observations are made from this piece of code:

The function is called with two arguments. The first argument (argc) indicates the number of arguments specified in the command line to the interpreter. The command line arguments vector (argv) consists of argv[0] contains the name of the method, "cmd" and argv[1] specifies the desired operation. If the user specified any arguments, then they are placed in argv[2...(argc - 1)]. The arguments are passed as strings. They must be converted to the appropriate data type.If the operation is successfully matched, the match should return the result of the operation,command () itself must return either TCL_OK or TCL_ERROR to indicate success or failure as its return code. If matched in this method, it must invoke its parent's command method, and return the corresponding result. This permits the user to conceive of operations as having the same inheritance properties as instance procedures or compiled methods.In the event that this command method is defined for a class with multipleinheritance, one of two implementations can be chosen

1.Either they can invoke one of the parent's command method, and return the result of that invocation.
2.They can each of the parent's command methods in some sequence, and return the result of the first invocation that is successful. If none of them are successful, then they should return an error.

4.10 Mobile Networking In Ns

The wireless model essentially consists of the Mobile Node at the core with additional supporting features that allows simulations of multi-hop ad-hoc networks, wireless LANs etc. The Mobile Node object is a split object. The C++ class Mobile Node is derived from parent class Node. A Mobile Node thus is the basic Node object with added functionalities of a wireless and mobile node like ability to move within a given topology, ability to receive and transmit signals to and from a wireless channel etc. A major difference between them is that a mobile Node is not connected by means of Links to other nodes or mobile nodes.

Mobile Node is the basic nsNode object with added functionalities like movement, ability to transmit and receive on a channel that allows it to be used to create mobile, wireless simulation environments. The class Mobile Node is derived from the base class Node. The four ad-hoc routing protocols that are currently supported are, Dynamic Source Routing (DSR), Temporally ordered Routing Algorithm (TORA) and Adhoc On-demand Distance Vector (AODV).

The general structure for defining a mobile node in ns2 is described as follows:

$ns node-config -adhocRouting $opt (adhocRouting)

-IIType $opt (II)

-macType $opt (mac)

-ifqType $opt (ifq) -ifqLen $opt (ifqlen)

-antType $opt (ant)

-proplnstance [new $opt (prop) -phyType $opt (netif)

-channel [new $opt (chan)]

-topolnstance $topo

-wiredRouting OFF

-agentTrace ON

-routerTrace OFF

-macTrace OFF

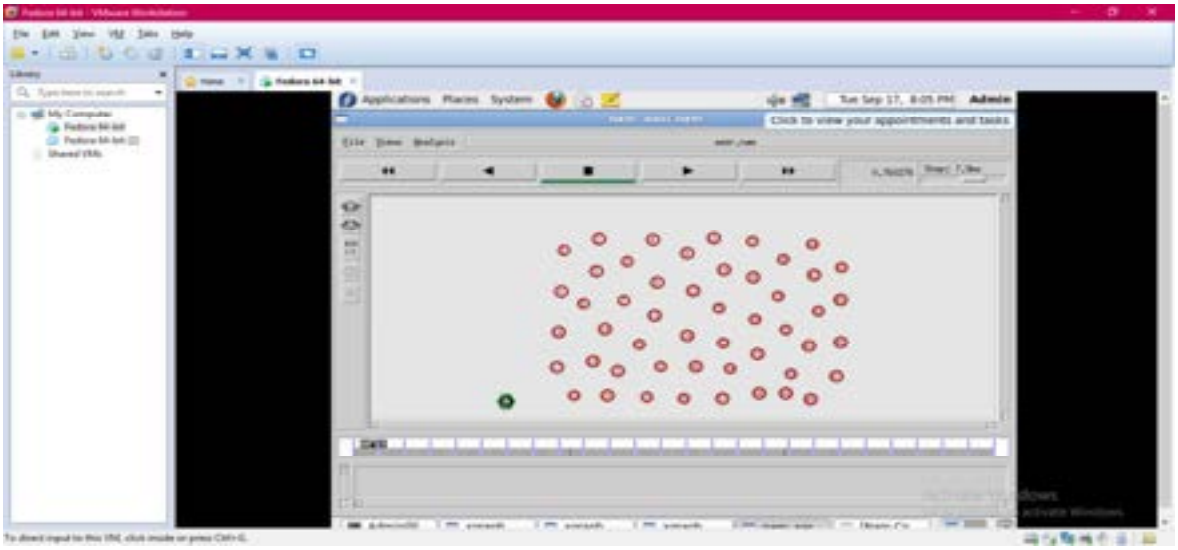
The above API configures for a mobile node with all the given values of ad hoc-routing protocol, network stack, channel, topography, propagation model, with wired routing turned on or off (required for wired-cum-wireless scenarios) and tracing turned on or off at different levels (router, mac, agent).

CHAPTER 5

SIMULATION RESULT

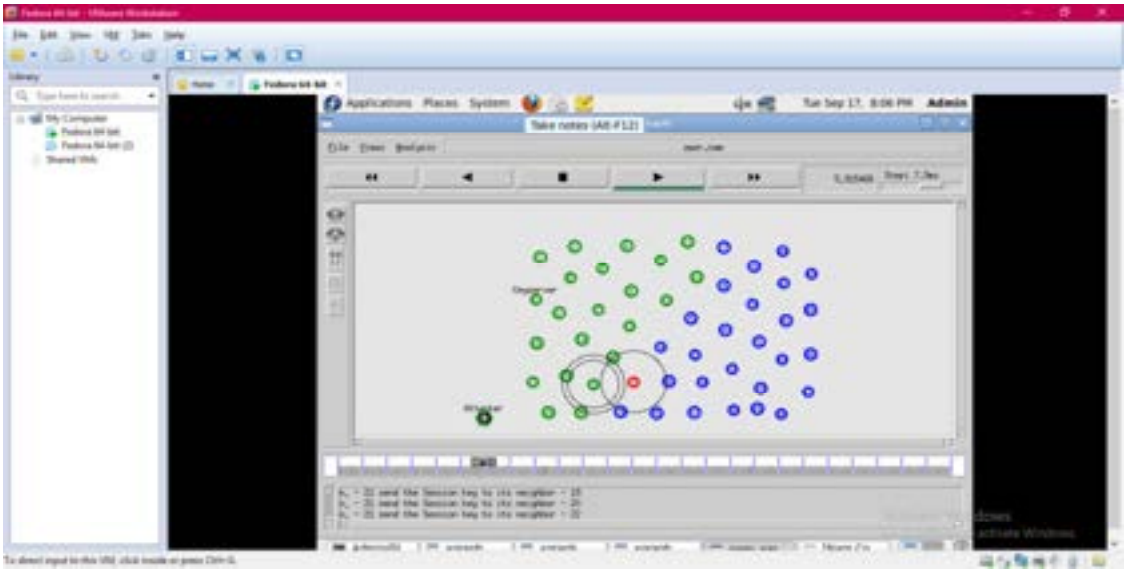
The simulation is conducted is with the Network Simulator (NS). The system is running on laptop with core 2 Duo t7250 CPU and 3GB RAM. The maximum hops allowed in this configuration setting are four. Both the physical layer and the 802.11 MAC layer are included in the wireless extension of NS2. The moving speed of mobile node is limited to 20m/s.

1. Declaring the nodes

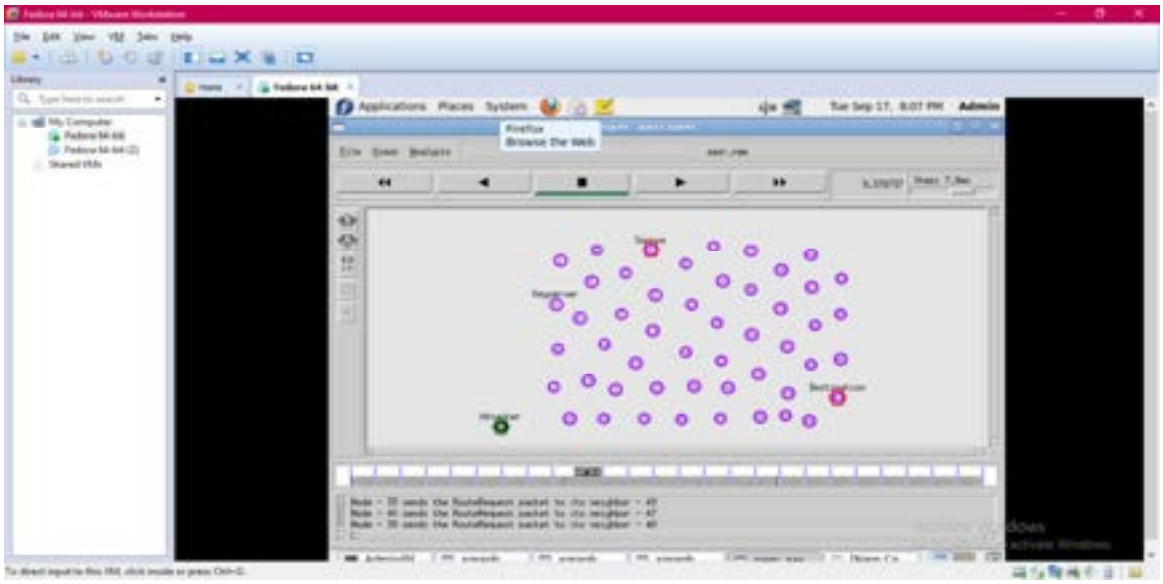


2. Broadcasting for finding the route for packet transmission.

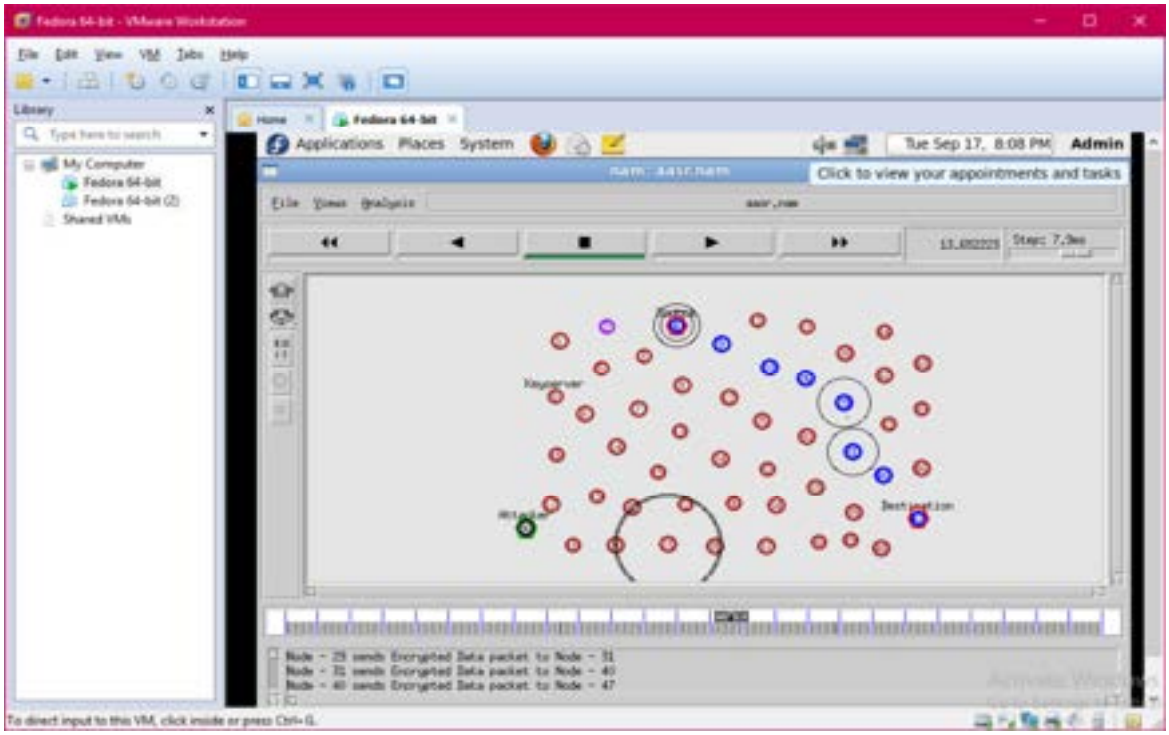
3. A path is chosen from source to destination.



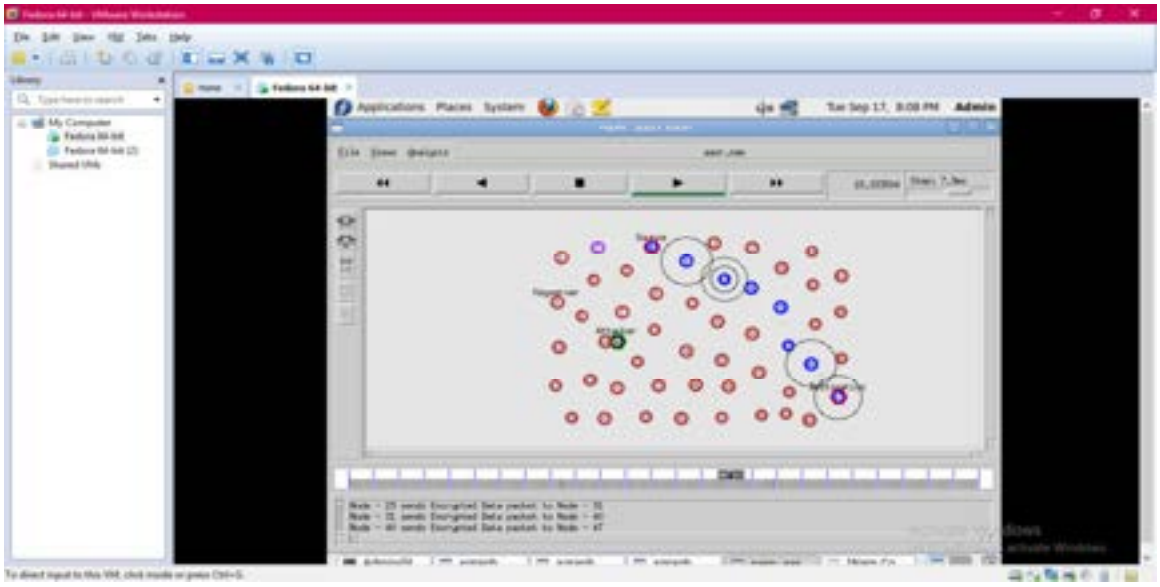
4. Declaring the source and destination nodes



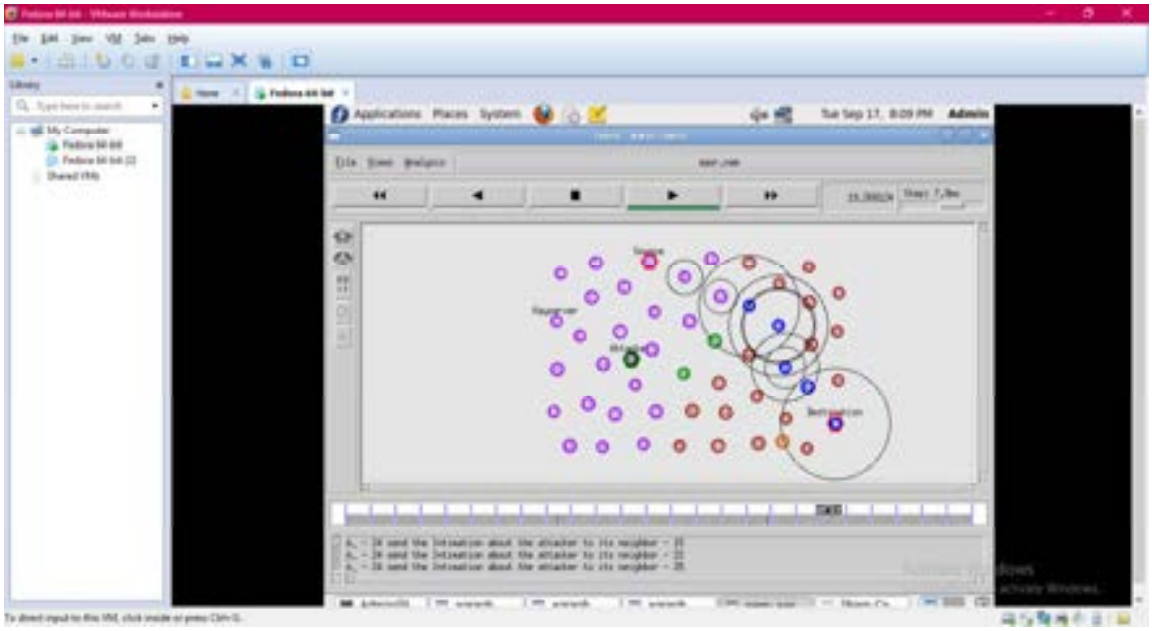
5. Searching the alternative path.



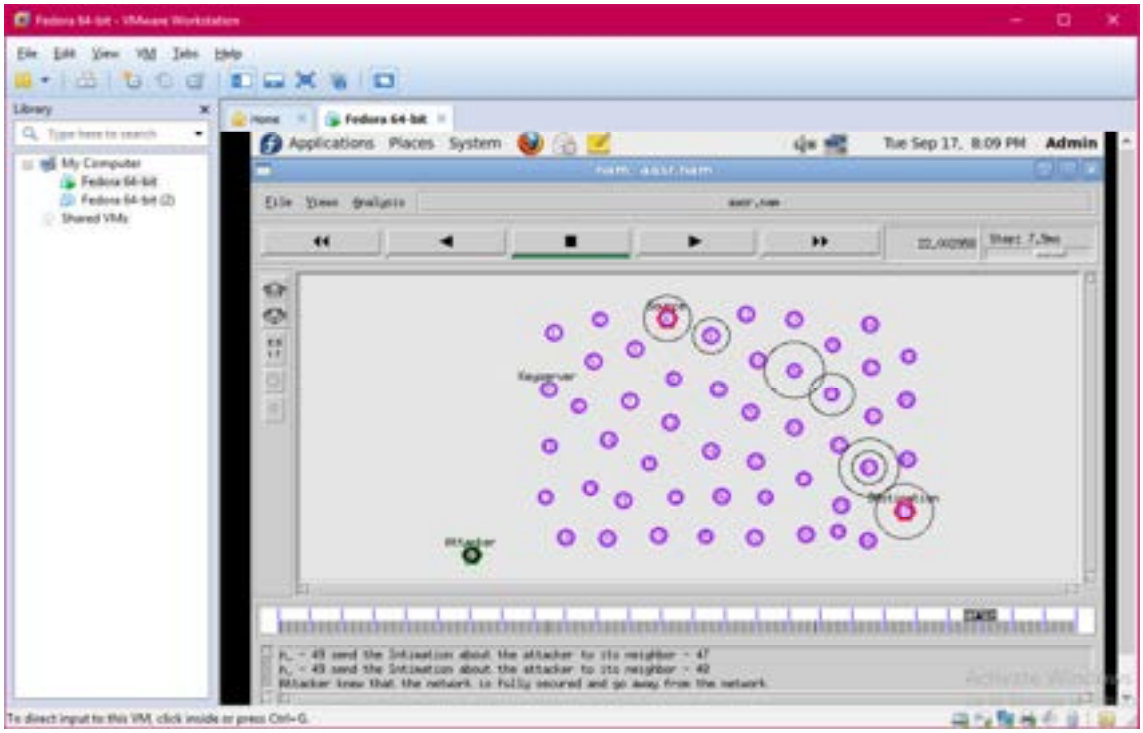
6. An alternative path is found.



7. A centralized node is formed for monitoring the nodes and the attacker nodes are detected in the current path so searching for an alternative path without malicious nodes.



8. The message was sent.



CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 Conclusion

To solve the security issue in MANETS we implemented new IDS based on enhanced adaptive Acknowledgment (EAACK). In this method every acknowledgment packet is digitally signed before sending in network and accepted only after verification. The limited transmission power and false misbehavior of nodes are completely removed in this scheme. Every acknowledgment packet received are authentic and untainted. This reduces the need for costly secure routing behaviors designed to mitigate the effects of an untrusted environment (and untrusted nodes) on the routing process. By preventing the entry of potentially untrustworthy nodes to the network, and thus the routing process, a MANET may be protected from subversion of its routing services at a lower cost, as malicious nodes are barred from the process entirely. This provides security to all data communicated over a MANET. It specifically targets the attributes of MANETs, it is not suitable for use in other types of network at this time. It sacrifices adaptability to a range of networks, to ensure that MANET communication is protected completely and efficiently. A single efficient method protects routing and application data, ensuring that the MANET provides reliable, confidential and trustworthy communication to all legitimate nodes.

6.2 Future Enhancement

This project can be extended further for many applications in real time environment. Further studies on improving the encryption technique is needed. it is time consuming process for reconstructing the message, which can be reduced further. The optimized routing techniques can be incorporated the finding shortest path.

CHAPTER 7

APPENDIX

Source Code:

Mod.tcl:

```
#..... Environmental Settings .....
 set Nn              50                    ;# Number of Mobilenodes
 set val(x)          900                           ;# X Co-ordinate
 set val(y)          600                           ;# Y Co-ordinate
 set chan          [new Channel/WirelessChannel] ;# Chaneel Type
#..... Simulator Object Creation .....
set ns [new Simulator]
#..... Trace File to record all the Events .....
set fpt [open Trace.tr w]
$ns trace-all $fpt
$ns use-newtrace
#..... NAM Window creation .....
set fpn [open Nam.nam w]
$ns namtrace-all-wireless $fpn $val(x) $val(y)
#..... Topology Creation .....
set tpy [new Topography]
$tpy load_flatgrid $val(x) $val(y)
#..... General Operational Director .....
create-god $Nn
#..... Node Configuration .....
$ns node-config -adhocRouting DSR \
```

```
                -llType LL \
                -macType Mac/802_11 \
                -ifqType CMUPriQueue \
                -ifqLen 500 \
                -antType Antenna/OmniAntenna \
                -propType Propagation/TwoRayGround \
                -phyType Phy/WirelessPhy \
                -topoInstance $tpy \
                -channel $chan \
                -agentTrace ON \
                -routerTrace ON \
                -macTrace ON \
                -movementTrace ON \
                -idlePower 1.2 \
                -rxPower 1.0 \
                -txPower 1.5 \
                -sleepPower 0.000015 \
                -initialEnergy 200 \
                -energyModel EnergyModel
#..... Node Creation .....
for { set i 0 } { $i < $Nn } { incr i } {
                                        set node($i) [$ns node]
                                        $ns initial_node_pos $node($i) 30
                                        $node($i) color black
                                }
#..... Agent Creation .....
proc Connecting-Agent { src sink pkt itv } {
                                                global ns
```

```
                                        #--- Source Agent ---
                                        set udp [new Agent/UDP]
                                        $ns attach-agent $src $udp
                                        #- Create a Traffic Apllication -
                                        set cbr [new Application/Traffic/CBR]
                                        $cbr attach-agent $udp
                                        $cbr set packetSize_ $pkt    ;# Set Packet size
                                        $cbr set interval_ $itv      ;# Set Intervel
                                        #-- Attach CBR source to sink --
                                        $ns connect $udp $sink
                                        return $cbr
                                    }
#..................................... Destination Agent .....................
for { set i 0 } { $i<$Nn } { incr i  }  {
                                        $ns at 0.0 "$node($i) label-color black"
                                        $ns at 0.0 "$node($i) color #808000"
                                        set sink($i) [new Agent/LossMonitor]
                                        $ns attach-agent $node($i) $sink($i)
                                    }
#.............................. Neighbors Distance Calculation .....................
proc Distance {  } {
                    global node ns Nn
                    set fpd [open "Distance.Cal" w]
                    puts $fpd "-------------------------------------------------------------------"
                    puts $fpd "Node\t\tNeighbors\tx-cor\ty-cor \tDistance"
                    puts $fpd "-------------------------------------------------------------------"
                for { set i 0 } { $i <$Nn } {  incr i } {
                                                set tn 0
```

```
                                                    set x1 [$node($i) set X_]
                                                    set y1 [$node($i) set Y_]
                        for { set j 0 } { $j <$Nn } { incr j } {
                                                    set x2 [$node($j) set X_]
                                                    set y2 [$node($j) set Y_]
                                                    set dis [expr int(sqrt(pow([expr $x2-
$x1],2)+pow([expr $y2 - $y1],2)))]
                                        if { $dis <240 && $i!= $j } { incr tn
                                                    puts $fpd "$i\t\t $j\t\t[expr int($x1)]\t[expr
int($y1)]\t$dis" } }
                                                    puts $fpd "Total_Neighbors $i = $tn"
                                                    }
                    close $fpd
                }
#..................................... Node Deployment .....................................
set dyn(0) -1
set sp(0)  -1
set tv(0)  -1
proc Deploy { tm ntm upt } {
                        global ns node Nn dyn sp tv
                    if { $ntm==0 } {
                        #------------- Random Value Generate -------------
                        if { $upt==1} {   set ff [open "Mobility.Cal" w]
                                            puts $ff "--------------------------------------"
                                            puts $ff "Node\tMobility\tTrustValue"
                                            puts $ff "--------------------------------------"
                                            #------ Execute number of time --------
                                            set sp(0) 5
                                            set tv(0) 9
```

```
                    puts $ff "0\t  $sp(0)\t\t$tv(0)"
                for { set i 1 } { $i<$Nn } { incr i } {
            set sp($i) [expr int(rand()*10)]
            set tv($i) [expr int(rand()*10)]
            puts $ff "$i\t  $sp($i)\t\t$tv($i)"          }
            #----- Repeat execuation-----
            for { set i 0 } { $i<$Nn } { incr i } {  set flg 1
        while { $flg } {
                        set chk 1
                        set val [expr int(rand()*$Nn)] ; #--- Random value
Generate ----
                        #----- Check Duplicate Value --------
                        for { set j 0 } { $j<$i } { incr j } { if {
$val==$dyn($j) } { set chk 0 } }
                        #----- Store In Array ----------
                        if { $chk==1 } {  set dyn($i) $val  ;  set flg 0  }
                    } }
                    close $ff }
```

CHAPTER 8

REFERENCE

[1] A. Mishra, K. Nadkarni, and A. Patcha, \Intrusion Detection in Wireless Ad Hoc Networks," IEEE Wireless Communications, Vol. 11, Issue 1, pp. 48-60, February 2004.

[2] A. Singh, M. Maheshwari, and N. Kumar, "Security and trust management in MANET," in Communications in Computer and Information Science, vol. 147. New York: Springer-Verlag, 2011, pt. 3, pp. 384–387.

[3] D. Dondi, A. Bertacchini, D. Brunelli, L. Larcher, and L. Benini, "Modeling and optimization of a solar energy harvester system for self-powered wireless sensor networks," IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2759–2766, Jul. 2008.

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[5] G. Jayakumar and G. Gopinath, "Ad hoc mobile wireless networks routing protocol—A review," J.Comput. Sci., vol. 3, no. 8, pp. 574–582, 2007.

[6] K.Liu, J. Deng, P. K. Varshney, And K. Balakrishnan, "An Acknowledgment Based Approach For The Detection Of Routing Misbehaviour In Manets," Ieee Trans. Mobile Comput., Vol. 6, No. 5, Pp. 536–550, May 2007.

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[10] Y. Hu, D. Johnson, and A. Perrig, "SEAD: Secure efficient distance vector routing for mobile wireless ad hoc networks," in Proc. 4th IEEEWorkshop Mobile Comput. Syst. Appl., 2002, pp. 3–13.

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Secured Intrusion Protection System through EAACK in MANETS

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ABSTRACT

Achieving reliable routing has always been a major issue in the design of communication networks, due to the absence of fixed infrastructure among which mobile ad hoc networks (MANETs) that can take control of the most adversarial networking environment, and the dynamic network topology the nature of open transmission media. In the MANETs these characteristics also more challenging to make the design of routing protocols. The network topology varies so to determining feasible routing paths for distributing messages in a decentralized is a difficult job. Factors such as the extensive distribution of nodes and open medium, variable wireless link quality topological changes, and propagation path loss become pertinent issues and make MANET unprotected to instructions. Thus, it becomes central to develop a systematic intrusion detection scheme to secure Mobile Ad Hoc networks from intruders. In this project, we put forward and applied an efficient IDS mechanism based on Enhanced Adaptive Acknowledgment (EAACK) especially made for MANETs which performs better than the earlier techniques such as AACK, TWOACK and Watchdog.

KEYWORDS: *Mobile Ad hoc Network (MANET), Acknowledgment (ACK), Network Simulator (NS2), Enhanced Adaptive Acknowledgement (EAACK), Misbehavior Report Authentication (MRA), Secure Acknowledgment (S-ACK), Digital Signature Algorithm (RSA)*

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1. INTRODUCTION

Wireless networking is the need of hour for many applications because of its easier network expansion, increased mobility improved responsiveness, better access to information, and enhanced guest access. In addition, with the increasing standard of industry and use of lightweight network hardware devices that is even smaller and largely mobile. The wireless communication is enhanced by Mobile ad hoc networks (MANETs) having high degree of node mobility.

Mobile Ad hoc Network (MANETs):

The Wireless cellular system is used in 1980s. The Wireless systems operate with the help of a centralized supporting structure access point. The adaptability of wireless systems limits the presence of a fixed supporting structure. Also known as, in there is no fixed infrastructure the technology cannot work effectively. The Future generation requires the wireless systems easy and quick. In the current system this quick network deployment is not possible. There will be a need for the rapid deployment of independent mobile users for the next generation of the wireless communication systems. Significant examples include establishing efficient, survivable, military networks, dynamic communication for emergency/rescue operations and disaster relief efforts. This network scenarios cannot depend on centralized and organized connectivity, and can be conceived as applications of Mobile Ad Hoc Networks. The Mobile ad-hoc networks networks operate in the absence of fixed infrastructure. It is not possible otherwise in they offer quick and easy network deployment in situations where. The Ad-hoc is a Latin word, it means "for this only." The each node in the mobile ad hoc network is connected by wireless links; every node operates as an end system.

Mobile Ad Hoc Network Applications

The Mobile ad-hoc network (MANET) can be used in crisis situations like military conflicts, emergency medical situation, natural disasters etc.

2. Literature Review

2.1. Detection And Prevention of Attacks on Manets Using Advanced Eaack And Hybrid Key Cryptography

In this paper we study different attacks on Mantes Such as Gray hole Attack Man in Middle attack, wormhole Attack, HTTP GET Food Attack. MANET having decentralized architecture in which all the node communicating in wireless manner. Thus, to increase the scalability of network there is need all node properly work together. MANETs are self-forming, self –maintained and Self-configuring allowing extreme network Scalability, & flexibility, which is often used in military conflict and medical emergency recovery. it oprets on single hop network and multihope network. Mantes is useful in emergency requirements where network range not possible and difficult to install network. Because it supports easy deployment, low cost, faster speed.

MANETS having distributed architecture therefore providing security to MANETS is very difficult. MANETs are an attractive technology used diplomatic and risky or planned applications due to facility provided by MANET's infrastructure. But MANETS moves from security issue. Security is measure problem because it not having central point control, it support dynamic topology, and it having wireless medium. Hence, it is crucial to develop an intrusion detection system in MANETs. In this paper, we aim to develop such an efficient and reliable intrusion detection system (IDS). Elliptic Curve Cryptography (ECC) algorithm is used to provide security to the data that is sent between the nodes. to reduce network overhead caused by digital signature Hybrid key cryptography technique is used. The disadvantage are ambiguous collision occur and receiver collision.

2.2. A Survey on Secure Intrusion Detection System for MANET

MANET (Mobile Ad hoc network) is an IEEE 802.11 framework which is a collection of mobile nodes equipped with both a wireless transmitter and receiver communicating via each other using bidirectional wireless links. MANETs are self-forming, self maintained and self-healing allowing for extreme network flexibility, which is often used in critical mission applications like military conflict or emergency recovery. Unfortunately, the remote distribution and open medium of MANET makes them susceptible to various attacks. For example, due to lack of protection for nodes, malicious attackers can easily capture and compromise the mobile nodes to achieve attacks. Hence, it is crucial to develop an intrusion detection system in MANETs. In this paper, we aim to develop such an efficient and reliable intrusion detection system (IDS).

In this research paper, we have study a novel INTRUSION-DETECTION SYSTEM named EAACK protocol specially designed for MOBILE AD-HOC NETWORKs and compared it against other popular mechanisms in different scenarios through simulations. The demonstrated positive performances against Watchdog, TWOACK, and AACK. We also surveyed some intrusion detection systems that deals with various attacks. Attacker may find some new way to attack the system. Therefore system need to much robust so that it prevents new vulnerabilities and themselves. It is important to develop network security policies and deploy into MANET, this can be good research area. There should be system that learns from the knowledge of previous attacks and able to infer and detect new attacks; this can be potential research area. The drawback of this paper is limited transmission power.

2.3. Performance Enhancement of Intrusion Detection System Using Advance Adaptive EAACK for MANETs

A mobile ad hoc network (MANET) is a self-organizing and self-configuring multi-hop wireless network, where the nodes are free to move randomly. Ad hoc wireless network are self-creating and self-organizing. MANET solves this problem they allow intermediate node to transmit data between two other nodes. To achieve this by MANETs are divided into two types into two types of networks, namely, single-hop and multi-hop. Thus, all nodes are free to move randomly.

Considering the fact that MANET [1][2] is becoming popular among critical mission applications, network security is of most importance. Because of open medium and remote distribution of nodes in MANET they are vulnerable to various types of attacks. Moreover due to distributed nature of market centralized monitoring system is not feasible. In such case, it is crucial to develop an intrusion- detection system (IDS) specially designed for MANETs.

To detect misbehaving nodes with the presence of false misbehavior report and to authenticate whether the destination node has received the reported missing packet through a different route and to achieve this we have to focus on the comparative study of ACK, SACK & MRA scheme so the proposed protocol advance EAACK is compared against popular mechanism such as TWOACK,AACK and EAACK in different scenario through simulation. Simulation parameters that are considered in this paper is packet delivery ratio and delay. The results is positive performances against TWOACK, AACK and EAACK in the cases of link breakage and source maliciousness. The drawbacks are delay and link breakage.

2.4. An Improvised Intrusion Detection System for MANETs

MANET is a collection of mobile nodes. It is more popular these days MANET has a decentralized network infrastructure. Thus all nodes are free to move randomly. A centralized infrastructure, which is often infeasible in mission vital applications like military conflict or emergency recovery. Intrusion detection is the act of detecting surplus traffic on a network or a device. To detect unwanted activity and events such as illegal, traffic that violates security policy, and traffic that violates acceptable use policies. Attack prevention measures, such as validation and encryption, can be used as the first line of defence for reducing the possibilities of attacks. However, these techniques have a restriction on the effects of prevention techniques in general and they are designed for a set of known attacks. They attacks that are designed for circumventing the existing security measures. In this paper we are implementing the method of digital signature with multiple key generation schemes to enhance security by dividing the key into slots and sending it to the receiver

Mobile Ad Hoc Network has always been prone to security attacks. Since the existing methods concentrate only on

detecting the malicious nodes we are not aware of the validity of the acknowledgement packets on which we fully rely on. So to ensure to validate the acknowledgement packets we digitally sign the keys and transmit the keys. We also implement a method of generating multiple key by dividing keys into slots. This leads to maximum network security for the present scenario without the loss of network performance.

3. Proposed system

In traditional networks many intrusion detection systems have been proposed, the routers, gateways or switches are used for network traffic. Hence, it is easy to implement IDS in these networks. In MANETs we do not use such devices. Moreover, due to its openness so both malicious and legitimate users can access. In mobile environment it is very difficult to separate normal and unusual activities. Sometimes the false routing information can be generated by outdated node or from a malicious node due to the arbitrarily movement of nodes. Thus, the available intrusion detection techniques used in simple wired networks cannot be implemented to MANETs directly. Researchers have developed many intrusion detection systems for the MANETs. In the next section, we briefly explain three existing techniques, i.e. Watchdog, TWOACK, and (AACK).

3.1. ACK

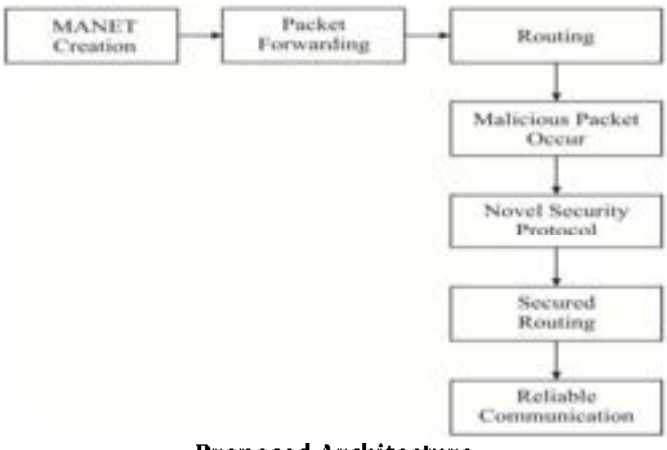
ACK is an end to end acknowledgment scheme. In EEACK it acts as a crossbreed scheme. The transmission from source to destination is successful when there is no misbehaving nodes. Then destination sends an acknowledgement packet to the source.

3.2. S-ACK

In the route the source sends S-ACK packet in the intention of detecting misbehaving nodes. After the packet reaches consecutive three nodes ahead the route the S-ACK sends the acknowledgement back to source. The third node is required to send the S-ACK acknowledgement to first node. S-ACK mode is the easy detection of misbehaving nodes in the limited power for transmission and the presence of receiver collision.

3.3. MRA

Misbehaviour Report Analysis (MRA) is a scheme. It is used to confirm misbehaviour report generated in S-ACK mode. This may be a false one as attacker may interfere in S-ACK scheme generating a false misbehaviour report.



Proposed Architecture

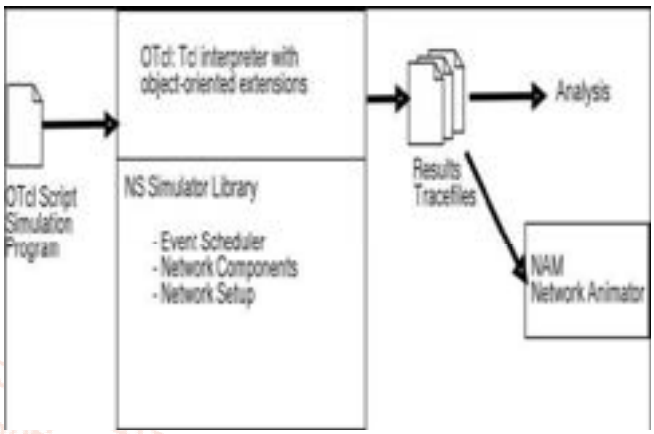
4. Explanation

4.1. The Network Simulator 2.33 (Ns2)

NS2 is developed at UC Berkeley it is a discrete event driven simulator. It is part of the VINT project. The objective of NS2 is to support networking research and education. NS2 is developed as a collaborative environment.

4.2. Structure of Ns2

Network simulator2 is built using object oriented methods in C++ and OTcl (object oriented variant of Tcl), NS2 interprets the simulation scripts written iOTcl.



Simplified User's View Of Ns

A subscriber has to set the different components up in the simulation environment. The user creates his simulation as a OTcl script. The event scheduler as the other component besides network components triggers the events of the simulation (e.g. sends packets, starts and stops tracing). Some parts of Network simulator2 are written in C++ for efficiency reasons.

4.3. Functionalities Of Ns2.33

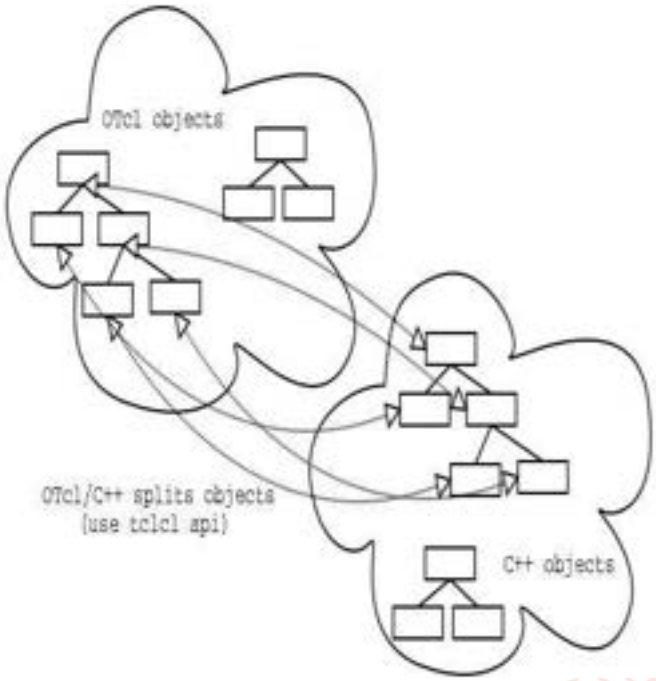
Functionalities for wired, wireless networks, tracing, and visualization are available in network simulator2.

- Support for the wired world include
- Routing DV, LS, and PIM-SM.
- Transport protocols: TCP and UDP for unicast.
- Traffic sources: web, ftp, telnet, cbr (constant bit rate), real audio.
- Different types of Queues: drop-tail, FQ, SFQ, DRR.
- Quality of Service: Integrated and Differentiated Services.
- Emulation.

- Support for the wireless world include
- Ad hoc routing with different protocols, e.g.
- AODV, DSR, DSDV, TORA
- Wired-cum-wireless networks
- Mobile IP
- Directed diffusion
- Satellite
- Senso-MAC
- Multiple propagation models (Free space, two-ray ground)
- Energy models

- Tracing
- Visualization
- Network Animator (NAM)
- Trace Graph

- Utilities
- Mobile Movement Generator



OTcl and C++: the duality

4.4. Mobile Networking In Ns2.33

This section describes the wireless model that was originally ported as CMU's(cracks me up) Monarch group's mobility extension to NS2. In this first section covers the original mobility model ported from CMU/Monarch group. Here we cover the internals of a mobile node, routing mechanisms and network components that are used to construct the network sk for a mobile node. The real CMU model allows simulation of pure wireless LANs or multihop ad-hoc networks.

4.5. The Basic Wireless Model In Ns

The wireless model fundamentally consists of the Mobile Node at the core, with additional supporting features that allows simulations of multi-hop ad-hoc networks.

The Mobile Node object is a split object. A major difference between them, though, is that the Mobile Node is not connected by means of Links to mobile nodes.

4.6. Mobile Node: Creating Wireless Topology

Mobile Node is the basic NS node object. It can be added with functionalities, ability to transmit and receive on a channel. It allows to be used wireless simulation environments, to create mobile.

Implementation Environment

NS2 can be used as the simulation tool. NS2 was chosen as the simulator partly because of the range of features it provides and partly because it has an open source code that can be modified and extended.

Network Simulator (Ns)

NS2 is an object–oriented, discrete event simulator for networking research. Even though the considerable confidence in NS, it is not a polished product yet and bugs are being finded and corrected continuously.

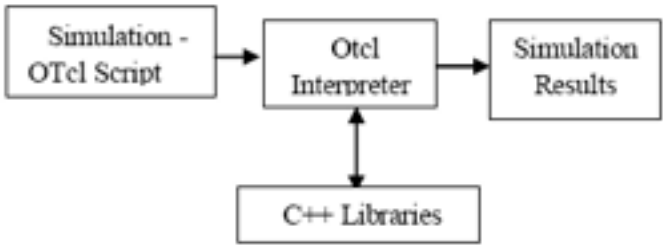
Network simulator2 is written in C++, with an OTcl1 interpreter as a command and configuration interface.

The C++ part, it is fast to run but slower to change, is used for detailed protocol implementation. One of the advantages of this split-language program approach is that it allows for fast generation of large events.

To simply use of simulator, it is sufficient to know OTcl NS can simulate the following:

1. **Topology:** Wired, wireless
2. **Scheduling Algorithms:** RED, Drop Tail,
3. **Transport Protocols:** TCP, UDP
4. **Routing:** Static and dynamic routing
5. **5.Application:** FTP, HTTP, Telnet, Traffic generators

4.7. User's View Of Ns-2



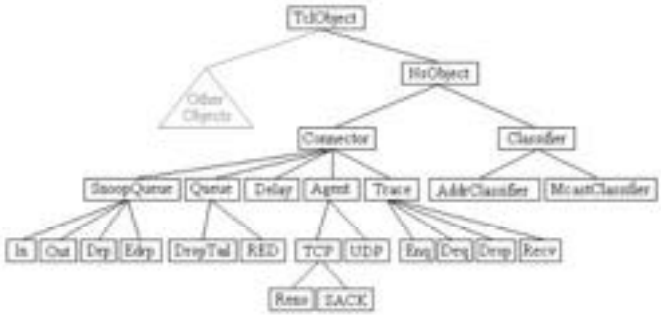
Block diagram of Architecture of NS-2

This section talks about the network simultor components, mostly compound network components. A partial OTcl class hierarchy of NS, which will used to help understanding the basic network components.

4.8. Class Tcl

The class Tcl (Telephone communication limited) encapsulates the actual instance of the OTcl interpreter and provides the methods to access and communicate with that interpreter, code. In this class provides methods for the following operations:

1. Obtain a reference to the Tel instance.
2. Invoke OTcl procedures through the interpret.
3. Store and lookup "Tcl Objects".



OTcl Class Hierarchy

4.8.1. Obtain a Reference to the class Tcl instance

A single instance of this class is declared in - tdcl/Tcl.cc as a static member variable.

4.8.2. Invoking OTcl Procedures

There are different methods to invoke an OTcl command through the instance, tcl.

1. **Passing Results to/from the Interpreter:** When the interpreter invokes a C++ scheme, it expects the result back in the private member variable, tcl-> result.

2. **Error Reporting and Exit:** In this method provides a uniform way to report errors in the compiled code.

4.9. Command Methods: Definition And Invocation

In every Tcl Object that is created, network simulator establishes the instance procedure, cmd{}, as a hook to executing methods through the compiled shadow object.

If there is no instance procedure called distance? the interpreter will invoke the instance procedure unknown{},it defined in the base class Tcl Object. The unknown procedure then invokes

$srmObject cmd distance? (agentAddre To show the operation through the compiled object's command()procedure. The user could explicitly invoke the operation directly.

For example,

```
        Agent/SRM/Adaptive instproc distance?
addr    {
        $self instvar distanceCache_($addr)
        if![info exists distanceCache_($addr)] {
        set distanceCache_($addr) [$self cmd distance? $addr]
        }
        set distanceCache_($addr)
        }
```

The following shows how the command() scheme using SRMAgent::command()

```
        Int ASRMAgent::command (int argc, const char*const*argv) {
        Tcl& tcl = Tcl::instance();
        if (argc == 3) {
        if (strcmp(argv[1], "distance?") == 0) {
        int sender = atoi(argv[2]);
        SRMinfo* sp = get_state(sender);
        tcl.tesultf("%f", sp->distance_);
        return TCL_OK; '
        }
        }
        return (SRMAgent::command(argc, argv));
```

The following observations are made from this code:
The function is called with two arguments. The argument (argc) indicates the number of arguments specified in the command line to the interpreter. The command line arguments vector (argv) consists of argv[0] contains the name of the method, "cmd" and argv[1] specifies the operation. In that this command method is defined for a class with multiple inheritance, one of two implementations can be chosen

1. Either they can invoke one of the parent's command method, and back to the result of that invocation.
2. They can each of the parent's command methods in some sequence, and back to the result of the first invocation that is successful. If none of them are successful, then they should back an error.

4.10. Mobile Networking In Ns

A major difference between them is that a mobile Node is not connected by means of Links to mobile nodes.

The common structure for defining a mobile node in ns2 is described as follows:

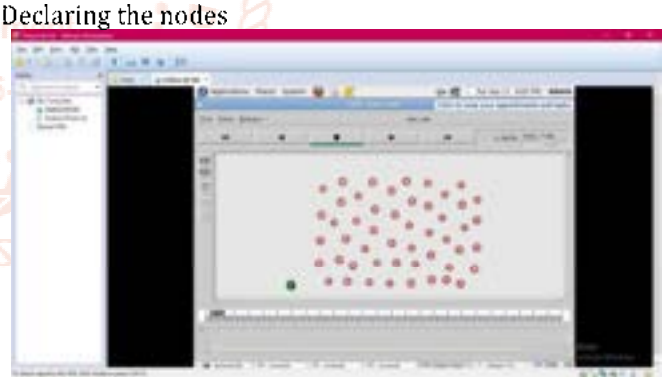
```
$ns node-config -adhocRouting $opt (adhocRouting)
        -IfType $opt (II)
        -macType $opt (mac)
        -ifqType $opt (ifq) -ifqLen $opt (ifqlen)
        -antType $opt (ant)
        -propInstance [new $opt (prop) -phyType $opt (netif)
        -channel [new $opt (chan)]]
        -topoInstance $topo
        -wiredRouting OFF
        -agentTrace ON
        -routerTrace OFF
        -macTrace OFF
```

The above API (application program interface) configures for a mobile node with all the given values of ad hoc-routing protocol, network stack, topography, propagation model, with wired routing turned on or off (required for wired-cum-wireless) and tracing turned on or off at different levels (router, mac, agent).

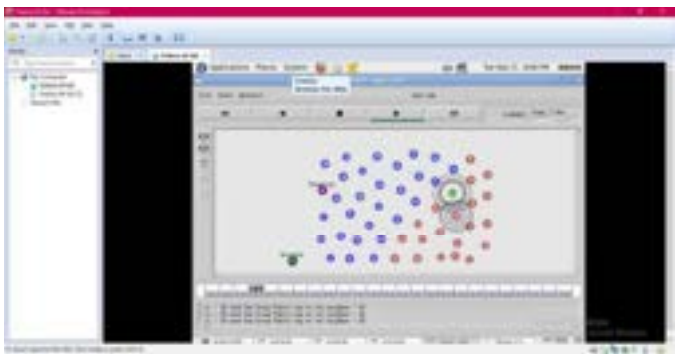
5. Result:

The simulation is conducted is with the Network Simulator (NS). The system is running on laptop with core 2 Duo t7250 CPU and 3GB RAM. The maximum hops allowed in this configuration setting are four. Both the physical layer and the 802.11 MAC layer are included in the wireless extension of NS2. The moving speed of mobile node is limited to 20m/s

Declaring the nodes



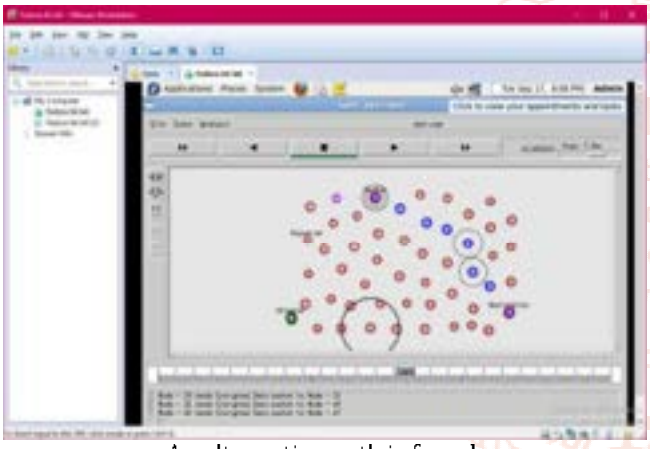
Broadcasting for finding the route for packet transmission.



A path is chosen from source to destination.

Declaring the source and destination nodes

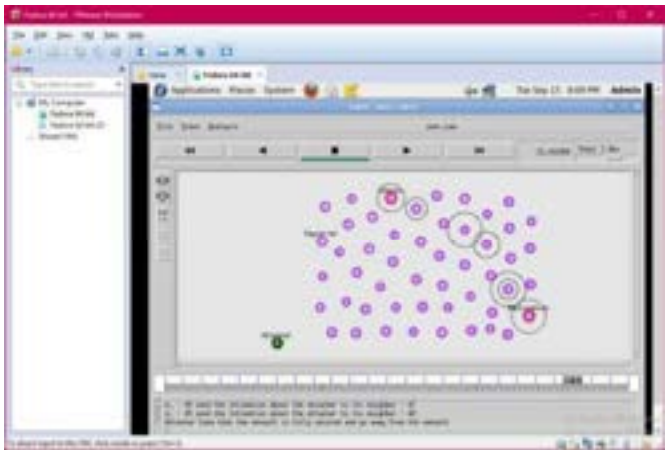
Searching the alternative path



An alternative path is found.

The attacker nodes are detected in the current path so searching for an alternative path without malicious.

The message was sent.



The implementation of the system to detect malicious attackers in MANETs is done and the message was sent without any attacks.

6. Conclusion:

To solve the security issue in MANETS we implemented new IDS based on enhanced adaptive Acknowledgment (EAACK). In this method every acknowledgment packet is digitally signed before sending in network and accepted only after verification. The limited transmission power and false misbehavior of nodes are completely removed in this scheme. Every acknowledgment packet received are authentic and untainted. This reduces the need for costly secure routing behaviors designed to mitigate the effects of an untrusted environment (and untrusted nodes) on the routing process. By preventing the entry of potentially untrustworthy nodes to the network, and thus the routing process, a MANET may be protected from subversion of its routing services at a lower cost, as malicious nodes are barred from the process entirely. This provides security to all data communicated over a MANET. It specifically targets the attributes of MANETs, it is not suitable for use in other types of network at this time. It sacrifices adaptability to a range of networks, to ensure that MANET communication is completely and efficiently protected. A single efficient method protects routing and application data, ensuring that the MANET provides reliable, confidential and trustworthy communication to all legitimate node.

In real time environment this project can be extended further for many applications . To improving the encryption technique further studies is needed. it is time consuming process for reconstructing the message, which can be reduced further. The optimized routing techniques can be incorporated the finding shortest path.

REFERENCES

[1] A. Mishra, K. Nadkarni, and A. Patcha, \Intrusion Detection in Wireless Ad Hoc Networks," IEEE Wireless Communications, Vol. 11, Issue 1, pp. 48-60, February 2004.

[2] A. Singh, M. Maheshwari, and N. Kumar, "Security and trust management in MANET," in Communications in Computer and Information Science, vol. 147. New York: Springer-Verlag, 2011, pt. 3, pp. 384–387.

[3] D. Dondi, A. Bertacchini, D. Brunelli, L. Larcher, and L. Benini, "Modeling and optimization of a solar energy harvester system for self-powered wireless sensor

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[4] D. Johnson and D. Maltz, "Dynamic Source Routing in ad hoc wireless networks," in Mobile Computing. Norwell, MA: Kluwer, 1996, ch. 5.

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[7] N. Kang, E. Shakshuki, and T. Sheltami, "Detecting forged acknowledgements in MANETs," in. IEEE 25th Int. Conf. AINA, Biopolis, Singapore, Mar. 22–25, 2011, pp. 488-494.

[8] T. Anantvalee And J. Wu, "A Survey On Intrusion Detection In Mobile Ad Hoc Networks," In Wireless/Mobile Security. New York: Springer-Verlag, 2008.

[9] V. C. Gungor and G. P. Hancke, "Industrial wireless sensor networks: Challenges, design principles, and technical approach," IEEE Trans. Ind. Electron., vol. 56, no. 10, pp. 4258–4265, Oct.2009.

[10] Y. Hu, D. Johnson, and A. Perrig, "SEAD: Secure efficient distance vector routing for mobile wireless ad hoc networks," in Proc. 4th IEEE Workshop Mobile Comput. Syst. Appl., 2002, pp. 3-13.

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A MICROCONTROLLER BASED LPG CYLINDER BOOKING AND LEAKAGE DETECTION USING GSM

A PROJECT PHASE-II REPORT

Submitted by

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In partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

Gas leakage is a major problem with industrial sector, residential premises etc. One of the preventive methods to stop accident associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to present such a design that can automatically gas booking, detect, alert and control gas leakage.LPG cylinders have become an integral part of every home. Our kitchens are occupied with LPG cylinders which help us make delicious food. But it can be dangerous and life threatening. The aim of this project is to design a safety-oriented system which will alert the user about any threat in the kitchen through mobile and given the buzzer sound. This system will detect leakage of LPG and send an alert message to the user, at the same time it will switch off the gas supply of LPG by switching regulator-switch using BO motor. It is also used to monitoring the high voltage passing through the home appliances and it will reduce the voltage level in the power supply. It ensures safety from any gas leakage accident like explosion. As an additional advantage, this system has a weighing sensor which can measure the weight of the cylinder and regularly update user about gas left in the cylinder and automatically booking the cylinder. This project proposes a system that will make entire LPG cylinder booking procedure automated without human intervention. This system continuously measures the weight of the cylinder and once it reaches minimum threshold it will automatically sends SMS to the authorized LPG Agent so that they can deliver the LPG cylinder in time. Along with the Automated cylinder booking we also designed feature related to the safety of the user in which it continuously monitor the leakage of LPG gas and alerts the user regarding leakage to avoid major accidents which costs human lives mostly.

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LIST OF ABBREVIATIONS

ACRONOYM	ABBREVIATION
LPG	Liquefied Petroleum Gas
LCD	Liquid Crystal Display
LED	Light Emitting Diode
RF	Radio Frequency
GSM	Global System for Mobile Communication
RFID	Radio Frequency Identification
OS	Operating System
CMOS	Complementary Metal Oxide Semiconductor
PAN	Personal Area Network
PC	Personal Computer
IDE	Integrated Development Environment
EPROM	Erasable Programmable Read –Only Memory
OSS	Operation and Support System
SS	Switching System
BSS	Base Station System
SMS	Short Message System
PCB	Printed Circuit Board
UV	Ultra Violet
SCL	Serial Clock
WSN	Wireless Sensor Network
IR	Infrared Radiation
PWM	Pulse Width Modulation
RPM	Revolutions per minute
GPS	Global Positioning System

CHAPTER 1
INTRODUCTION

1.1 **Introduction**

Liquefied petroleum gas is being used for the past decades as industrial fuel and for domestic purpose. It has a characteristic of smokeless burning in the air. The main constituents of LPG are propane and butane and depending on the applications their proportions vary. Gas leakage detection in residential houses has become one of the fundamental issues in the recent times. Accidents mainly occur due to the negligence and technical fault. Electronic and press media have reported many accidents which were caused mainly because of gas leakage in residential houses and industries. A better system needs to be developed to reduce the accidents because of gas leakage. The gas is generally stored in metallic cylinders as its boiling point is lower than ambient temperature. Gas is molecularly heavy than other gases present in the air.

So whenever the gas is leaked it settles closest to the ground level. And unless you provide a powerful exhaust system it cannot be forcefully disposed into open atmosphere. Now-a-days LPG leakage detection in homes, restaurants has been a common issue and the detection systems find applications in the market. Presently they are using load cell to measure the weight of the cylinder. When they find it become empty, consumer will order for a new cylinder. There may be a delay in providing the cylinder for few reasons like we may inform the service provider at the last moment when the gas is empty or there may be a delay in informing the gas provider. So in this system we will use a load cell to measure the amount of gas present in the cylinder and also book the gas automatically when it reaches to a certain level.

This system helps you to upgrade your safety standards, complete statutory requirements on environmental commitments and most important and basic function being prevented accidents and protect life and property from disaster. In the past, it has been a conventional practice to employ combustion apparatus such as a furnace, heater, stove or LPG kit in cars, which utilizes a combustible vapor or gas to produce heat energy when properly ignited. In the use of combustible apparatus in which a combustible gas such as

natural or liquid propane gas is burned in heating boilers, domestic water heaters, ovens, stoves and the like, the apparatus or appliance is generally of an automatic recycling type.

That is to say, the equipment is generally in operation for short periods of time after which is shut down for a short period of time. The equipment has intermediate operation and the appliance is generally started and stopped at the signal of an automatic controller, such as a thermostat, which may be actuated by temperature, pressure, or the like. The LPG Kit installed is many times installed inside the car creating possibilities of large accidents.

This type of appliance/Kits is normally unattended by any operating personnel, since it is automatic in operation and, therefore, one hazard encountered in the use of such an appliance is the possibility that during a standby period or a period in which it is not in operation, a gas leak may occur thereby resulting in a large accumulation of combustible gas which can produce an explosion if the detection is not quickly notice.

CHAPTER 2
LITERATURE SURVEY

2.1 Arduino Based LPG gas Monitoring and automatic Cylinder booking with Alert system

R.NareshNaik, P.SivaNagendra Reddy, S.Nanda Kishore, K.Tharun Kumar Reddy " LPG gas Monitoring and automatic Cylinder booking with Alert system" IOSR Journal of Electronics and Communication Engineering, .Volume 11, Issue 4, Ver. I (Jul.-Aug .2016),

2.1.1 Introduction

There are approximately 30crore LPG users in the country in which mostly 40% of the population. The Several standards have been implemented for the gas leakage detection system. The existing systems provides an alarm system which is mainly meant to detect an Gas leakage in the house and commercial premises. The objective of the proposed system is to continuously measure the weight of the cylinder and as soon as it reaches the minimum threshold it will automatically sends an SMS alert to the user as well as Authorized LPG agent so that they can act accordingly. This system also designed to detect LPG gases such as propane and butane. The allowed level for butane is 600ppm above which it is considered to be of high level and poses a danger. The threshold level of weight of the cylinder is used for automatic cylinder booking.

2.1.2 Techniques

- Arduino board is powerful development platform based on ATMEGA328 microcontroller.
- Bluetooth HC-05 module is used.
- LM35 temperature sensor is used to sense the temperature.

2.1.3 Result

In Arduino Based LPG gas Monitoring & Automatic Cylinder booking with Alert System MQ-4 gas sensor, LM-35 Temperature sensor, and 10 kg load cell (for prototype) as input devices and piezoelectric buzzer, 16x2 LCD display and GSM module used as output devices.

2.1.4 Drawback

- Gas sensor shouldn't be enough sensitive to detect gas leakage.

2.2 Smart LPG monitoring & automatic gas booking system

Shashikumar, PranitaPadole, Shweta salve, Adityasachdev, Prof. M.P. Wankhade5 "smart LPG monitoring & automatic gas booking system" International Research Journal of Engineering and Technology, Volume: 05 Issue: 04 | Apr-2018

2.2.1 Introduction

Today in this present area where technological advances are at its vertex, there is not even a single sector which remains untouched by technology. Technology has not merely established our lives simpler, but also offers a high level of safety and security wherever required. Technological devices are available which provides refuge for all the mankind. In our day to day lives, we all use cooking fuel for cooking our daily meals, but if this fuel gets leaked due to some or the other way and then there is a large possibility of a calamity to occur around. Hazards due to gas leakage are dangerous can cause loss of consciousness or even death. Overall health of a person is badly affected causing dizziness, fatigue, nausea, headache, irregular breathing.

Several standards have been implemented for the gas leakage detection system. There are many existing systems which can detect leakage using different gas sensors. Developed systems have used arduino mega, MQ-2 gas sensor, and some other components. For automatic cylinder booking there is an existing system that does booking using GSM.

2.2.2 Techniques

- Arduino board is powerful development platform based on ATMEGA328 microcontroller.
- Bluetooth HC-05 module is used.
- LM35 temperature sensor is used to sense the temperature.

2.2.3 Result

This monitoring system can be further enhanced by using Ethernet in place Bluetooth module in order to operate from anywhere, which supports the another real-time application. For industrial purposes , robot can be developed for detecting multiple gas concentrations and fire.

2.2.4 Drawback

- Gas sensor shouldn't be enough sensitive to detect gas leakage.

2.3 Gas Leakage Detection and Automatic Gas Booking Alert System using IOT

Anusuya, Kanimozhi, Ruthann, "Gas Leakage Detection and Automatic Gas Booking Alert System using IOT"International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181(2019).

2.3.1 Introduction

The main objective of this research is automatic protection from the LPG (Liquefied Petroleum Gas) leakage or reduction of the hazards that can be caused due to unawareness of the user about the gas leakage and also providing an automatic gas booking facility by applying advance communication technology. If there is any gas leakage from storage tank, service station or from the automobile then a buzzer will turn ON and an alert message will be sent to a pre-set mobile number by using GSM (Global System for Mobile communication) technology.

Sound from the alarm as well as message in the mobile number will give valuable suggestion to the users so that they can prevent themselves from dangerous effect of LPG gas leakage. Proposed model notifies alert to people before any leakage from the

gas cylinder and also automatically books for refilling of gas from the gas booking center before the cylinder gets empty. Here we have developed an Arduino based LPG gas detector alarm. If gas leakage occurs, this system detects it and makes an alert by buzzing the buzzer attached with the circuit.

2.3.2 Techniques

- GSM is used to convey the information to the user.Weight sensor is used to measure the gas level of the cylinder.MQ-2 sensor response time is very fast.

2.3.3 Result

This model, gas spillage recognition has been given a most elevated need. MQ2 set in the region of the gas chamber. In the appearance of spillage, the obstruction of the sensor diminishes expanding its conductivity. Relating beat is sustained to microcontroller and at the same time switches on the ringer and fumes fan which we can reset by a manual reset switch.

2.3.4 Drawback

- MQ-2 sensor is very low sensitive and cost is high.
- It doesn't have capability monitor the any short to present in the home appliances.

2.4 LPG leakage detection and smart gas booking

PurvaDuggal, AkshayPawar, PoorvaKalkatte, Prof. RushikeshBhalerao, "LPG leakage detection and smart gas booking"International Research Journal of Engineering and Technology, Volume: 05 Issue: 11 | Nov 2018

2.4.1 Introduction

The smart phones aren't only used for business purpose however they need innumerable uses. Gas Detectors are within the marketplace for a really very long time and are immensely used.In leakage detection module the leakage in pipe is detected using the

MQ-2 sensor which is interfaced with the android application .User gets the notification when leakage is detected in pipe and respected actions can be taken.

There are several existing systems which can discover leakage using completely different gas sensors. Developed systems have used arduino mega, MQ-2 gas device, and some alternative parts. Systems developed until date has either a gas detection module or automatic cylinder booking module. We've got developed a paradigm that has both the options that are of leakage detection and gas booking.

The system detects the escape of the LPG using MQ-2 gas sensor and alerts the consumer regarding the gas escape by sending SMS. Once the system identifies that LPG concentration within the air reaches the specified level then it alert the consumer by sending SMS to registered mobile phone and blinks the light. It should additionally enable the service supplier to look at all such requests and to notify the users once their requests are met.

2.4.2 Techniques

- GSM is used to convey the information to the user.Weight sensor is used to measure the gas level of the cylinder.MQ-2 sensor response time is very fast.

2.4.3 Result

The proposed gas leakage detector is promising within the field of safety. The attempt whereas creating this paradigm has been to bring a revolution within the field of safety against the leak of harmful and toxic gases to minimize and thus nullify any major or minor hazard being caused due to them. Our system is reasoned to assist customers to upgrade their safety norms, act in consequently with minimum needs on environmental problems and largely the basic function being prevented by major disasters and protect life and property from reputed Accidents.

2.4.4 Drawbacks

- MQ-2 sensor is very sensitive.

- Cost is very high.

2.5 Gas Leakage Detection System byUsing ZigBee Technology

Jading, Juwan, Yuan, and Pan, "The Monitoring System of Leakage Accidents in Crude Oil Pipeline based on ZigBee Technology", IEEE Changzhou University, 2011.

2.5.1 Introduction

In recent years, the leakage accidents in the pipeline transportation occur frequently. So how to make the effective detection and accurate localization for pipeline leakage is an important work, which could help maintaining safe running of pipeline transportation. Traditionally, the pipeline leakage monitoring system is realized by communication cable system. The cost of installation and maintenance are very expensive and difficult.

In order to overcome these restrictions, wireless sensor network for monitoring is definitely the best choice in the situation above. ZigBee is a good wireless networking technology with features of low power consumption, low cost and self-organized. For these features the technology is wildly used in the pipeline leakage monitoring application field. The goal in this paper is to propose and develop a pipeline leakage monitoring system for running of pipeline transportation based on ZigBee technology.

2.5.2 Techniques

- ATmega128L is a low power CMOS.MQ-2 gas sensor has high sensitivity to Natural gas, Methane and could be used to detect both Methane and Propane.
- The sensor could be used to detect different combustible gas especially Methane, its low cost and suitable for different application.

2.5.3 Result

The sensor nodes could get into sleep if there is no task or event and wake up as external triggers occur. The routing node chooses a channel after scanning the RF environment for existing networks and then starts the PAN. When the sensor nodes are permitted to join the PAN, the pressure sensors start to collect data and transmit the data package to the routing nodes.

2.5.4 Drawback

- The drawback that there is no control action taken, which need manual control which increase risk to human handling.
- The second method has the disadvantage that if the wiring of the exhaust fan is not proper then it will directly cause the explosion due to the flow of AC.

2.6 Gas Leakage Detection and Auto ON-OFF System.

R.NareshNaik, P.SivaNagendra Reddy, S.Nanda Kishore, K.Tharun Kumar Reddy " LPG gas Monitoring and automatic Cylinder booking with Alert system" IOSR Journal of Electronics and Communication Engineering, .Volume 11, Issue 4, Ver. I (Jul.-Aug .2016),

2.6.1 Introduction

This system helps you to upgrade your safety standards, completely statutory requirements on environmental commitments and most important and basic function being prevent accidents and protect life and property from disaster. In the past, it has been a conventional practice to employ combustion apparatus such as a furnace, heater, stove or LPG kit in cars, which utilizes a combustible vapor or gas to produce heat energy when properly ignited. In the use of combustible apparatus in which a combustible gas such as natural or liquid propane gas.

That is to say, the equipment is generally in operation for short periods of time after which is shut down for a short period of time. The equipment has intermediate

operation and the appliance is generally started and stopped at the signal of an automatic controller, such as a thermostat, which may be actuated by temperature, pressure, or the like. The LPG Kit installed is many times installed inside the car creating possibilities of large accidents. This type of appliance/Kits is normally unattended by any operating personnel, since it is automatic in operation and, therefore, one hazard encountered in the use of such an appliance is the possibility that during a standby period or a period in which it is not in operation, a gas leak may occur thereby resulting in a large accumulation of combustible gas which can produce an explosion if the detection is not quickly notice.

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense is butane, propane, LNG and cigarette smoke

2.6.2 Techniques

- GSM is used to convey the information to the user.
- MQ2 sensor response time is very fast and it convey the information very fastly.

2.6.3 Result

The leakage is detected by gas sensor and the information is convey to the user. The message "gas is low recharge soon" is sent to the user when the LPG gas reaches to minimum threshold level. So the user comes to know to when to book the cylinder to avoid delay in delivering cylinder. The message "gas is empty recharge immediately" is sent when the weight of the gas is fully empty.

2.6.4 Drawback

- It work only when at 5V power supply is given.
- Its sensitivity depends on Humidity and temperature.

2.7 Automatic gas booking and leakage detection using embedded system with safety guards

G.Rathanasabhapathy1, B.Durga Devi2, N.Gopi Krishnan3, S.Gowsalya4, M.Jagadeesan5,1Assistant Professor, 2,3,4,5UG students

2.7.1 Introduction

The main objective of our project is to continuously measures the weight of the cylinder by load cell and when the weight of the cylinder goes below the set value it sends message to the gas agency for the booking and another message to the owner. It also reduces the human efforts also became easy for illiterate person. When the temperature of the room goes above 50C it turns ON the buzzer and sends message "Your kitchen temperature is very high than normal" to the owner. The main purpose of our project is to avoid accidents due to leakage of LPG as safety is an important part. This system is also detects LPG gases such as butane and propane. The range of MQ6 sensor is from 200-10000 ppm. When the level of butane goes above 600 ppm which is considered as dangerous for human the system sends a message "LPG leakage is detected in your kitchen" to the owner.

Home automation or smart homes (also known as domestic) can be described as introduction of Technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants. With the introduction of IOT, the research and implementation of home automation are getting more popular. Various wireless technologies that can support some form of remote data transfer, sensing and control such as Bluetooth, WI-FI, RF Id and cellular network have been utilised to embed various levels of intelligence in the home.

2.7.2 Techniques

- MQ-4 gas sensor is used in gas leakage detection equipment.LM35-integrated circuit sensor that can be used to measure the temperature. GSM is used to convey the information to the user.

2.7.3 Result

In this paper we have used automatic gas booking with alert system without human intervention. Our system helps customers to upgrade their safety and protect life and property from reputed accidents. The main objective of our system is to measure the gas present in cylinder when the weight of cylinder is below the fixed load by using weight sensor. The gas agency gets the order of new cylinder and owner received the messages regarding the status .

2.7.4 Drawback

- Gas sensor shouldn't be enough sensitive to detect gas leakage.

2.8 LPG Gas Auto Booking By GSM and Leakage Detection with Auto Switchable Exhaust Fan

Anusuya, Kanimozhi, Ruthann, **"**Gas Leakage Detection and Automatic Gas Booking Alert System using IOT"(International Journal of Engineering Research & Technology (IJERT)), ISSN: 2278-0181(2019).

2.8.1 Introduction

LPG gases have been widely used in home appliances, industry and motor fuel, More than 50% of the heaters use LPG as cooking is well done using LPG , Most important task is detection and identifying LPV (linear parameter varying) model used in the gas industry , Leakage detection is used in household safety ,The main causes of accidents in gas pipeline are corrosion, external interference, construction defects, ground movement and material failure. Transport, through the pipes is the safest but it does not mean that pipes are risk-free .

Leakage detection is classified according to technical nature , Non-technical leakage detection like are hearing, smelling and seeing or looking. Sometimes trained dogs are also used , Technical nature means both hardware and software. Hardware methods mean acoustic, cable sensor, optical, soil monitoring. Software based means continuously

monitoring the state of pressure, flow rate or other pipeline parameters , Low levels of LPG leak can avoid any possible accidents.

2.8.2 Techniques

- Arduino board is powerful development platform based on ATMEGA328 microcontroller.
- Bluetooth HC-05 module is used.
- LM35 temperature sensor is used to sense the temperature.

2.8.3 Result

By testing the system prototype model it is found that when a small amount of LPG is introduced near the gas sensor the system detects the leakage and sends an alert message to the consumer by using the GSM module. Simultaneously the audio-visual indicator is activated and the exhaust fan is switched ON. The system prototype also monitors the gas level of the cylinder, books the new cylinder automatically and also sends an alert message to the consumer to remind about the refilling of the cylinder before the cylinder becomes empty.

2.8.4 Drawback

- MQ-2 sensor is very low sensitive and cost is high.
- It doesn't have capability monitor the any short to present in the home appliances.

2.9 GSM Based Gas Leakage Warning System

Taveras Ismail1, Devoleena Das2, Jyotirmoy Saikia3, Jyotirmoy Deka4, Raj Kumar Sarma5 Assistant Professor, Department of ECE,, Guwahati, India1, Guwahati, India2, 3, 4, 5 Assam Don Bosco University.

2.9.1 Introduction

This type of appliance/Kits is normally unattended by any operating personnel, since it is automatic in operation and, therefore, one hazard encountered in the

use of such an appliance is the possibility that during a standby period or a period in which it is not in operation, a gas leak may occur thereby resulting in a large accumulation of combustible gas which can produce an explosion if the detection is not quickly noticed. Although some sophisticated detector means have been provided, it is contemplated that the indicator means should be simple and economical so that the entire system may be readily incorporated into mobile trailers, campers, boats and other vehicles or living quarters having appliances dependent upon storage of pressurized gas.

Gas leakage detection is not only important but stopping leakage is equally essential. This paper provides a cost effective and highly accurate system, which not only detect gas leakage but also alert (Beep) and turn off main power and gas supplies, and send an SMS. GSM module is used which alert the user by sending an SMS. In order to provide high accuracy gas sensor MQ-6 has been used.

2.9.2. Techniques

- GSM is used to convey the information to the user.Weight sensor is used to measure the gas level of the cylinder.
- MQ-2 sensor response time is very fast.

2.9.3 Result

Gas leakages in households and industries cause risk to life and property. A huge loss has to be incurred for the accident occurred by such leakages. A solution to such a problem is to set up a monitoring system which keeps on monitoring the leakage of any kind of flammable gases and protects the consumer from such accidents. In addition to this, it activates an alarm as well as sends a message to the user.

2.9.4 Drawback

- MQ-2 sensor is very low sensitive and cost is high.
- It doesn't have capability monitor the any short to present in the home appliances.

2.10 Gas Level Monitoring and Auto Booking Using IOT with Leakage Alert

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SCOPE,VIT University, Tamil Nadu, 632014,India

2.10.1 Introduction

LPG is comprised of Commercial-Propane and Commercial-Butane having immersed too some sun soaked hydrocarbons. On account of its flexible nature of LPG, It is utilized as a part of numerous necessities, for example, household fuel, mechanical fuel, auto-versatile fuel, light and so on and the interest for LPG is consistently expanding step by step. The condensed oil gas is utilized generally in houses,

LPG makes less smoke and does not create much problem to the earth. Gaseous petrol is another generally utilized fuel in houses. The two consumes to create clean vitality, however there is a bona fide chance about the spillage. The gases being 5 times heavier than air don't scramble easily and may provoke suffocation when breathed in additionally the spillage gases when touched off may prompt blast. The quantity of passing's because of the blast of gas barrels has been expanding as of late.

Different techniques for gas booking are available in current framework. The framework demonstrates that some is additional time required to convey LPG in the wake of booking. There is no such office of consistent gas level observing framework. And furthermore there is no arrangement for gas spillage discovery and control activity on gas spillage. We as a whole are extremely occupied in our day by day life and it is hard to know the status of LPG gas chamber. On the off chance that LPG will complete without advising us it can make exceptionally troublesome condition for cooking and so forth. There is no office for gas spillage discovery and control activity.

2.10.3 Techniques

- GSM is used to convey the information to the user.
- MQ2 sensor response time is very fast and it convey the information very fastly.

2.10.3 Result

In micro-controller Based gas Monitoring and Automatic Cylinder booking with notification System MQ-2 gas sensor, LM-35 Temperature sensor, 10 kg stack cell (for model) as info gadgets and Piezoelectric bell, 16x2 LCD show and IOT Terminal utilized as yield gadgets.

2.10.4 Drawback

- The per-unit charge on roaming calls is higher in GSM.
- Initial cost is very high

2.11. Summary of Literature Survey

Table 2.1.Summary of Literature Survey

S.NO	TITLE	TECHNIQUES	DRAWBACK
1.	Arduino Based LPG gas Monitoring and automatic Cylinder booking with Alert system.	MQ-4 gas sensor is used in gas leakage detection eqsuipment.LM35-integrated circuit sensor that can be used to measure the temperature.	MQ-4 gas sensor is very high sensitive and cost is very high.
2.	Smart LPG Monitoring and Automatic Gas Booking System.	Arduino board is powerful development platform based on ATMEGA328 microcontroller.	Gas sensor shouldn't be enough sensitive to detect gas leakage.

3.	Gas Leakage Detection and Automatic Gas Booking Alert System using IOT.	GSM is used to convey the information to the user.Weight sensor is used to measure the gas level of the cylinder.MQ-2 sensor response time is very fast.	MQ-2 sensor is very high sensitive and cost is high. It doesn`t have capability moniter the any short to present in the home appliances.
4.	LPG leakage detection and smart gas booking	GSM is used to convey the information to the user.MQ2 sensor response time is very fast and it convey the information very fastly.	MQ-2 sensor is very sensitive. Cost is very high.
5.	LPG Gas leakagedetection and Alert system.	GSM is used to convey the information to the user.Weight sensor is used to measure the gas level of the cylinder.MQ-2 sensor response time is very fast.	It only gives alarm sound and does not give any information to the user. The gas sensor is very sensitivity.
6.	Gas leakage detection and Auto ON-OFF	Ideal sensor is use to detect the gas leakage.	It only used for detection purpose it cannot give any information about

	Gas system.		the cylinder weight.
7.	Automatic gas booking and leakage detection using embedded system with safety guards	Weight sensor is measured for cylinder weight	It only used for detection purpose it cannot give any information about the cylinder weight.
8.	LPG Gas Auto Booking By GSM and Leakage Detection with Auto Switchable Exhaust Fan	MQ-2 gas sensor is used to detect the gas leakage. It is made of sno2.	It detect only gas leakage and doesn't booking the cyclinder automatically.
9.	GSM Based Gas Leakage Warning System.	MQ-6 sensor is used detect the gas leakage. It is made up of sno2. GSM is used to convey the information to the user . LCD and RF link used to display the fault of the Stepper motor IC used to turn off the gas supplies	Gas sensor shouldn't be enough sensitive to detect gas leakage.
10.	LPG gas auto booking by GSM and leakage detection with auto	MQ-2 gas sensor is used to detect the gas leakage. It is	It only gives alarm sound and does not give any

	switchable exhaust fan.	made of sno2. PIC16F628A 8 bit microcontroller is as the brain of the whole system to control all the processes.It has an inbuilt ADC.	information to the user. The gas sensor is very sensitivity. It does not ON and OFF the gas cylinder while the gas leaking.

CHAPTER 3
THEORETICAL BACKGROUND

3.1 Existing System

This existing project is to sense the LPG Gas leakage in the house and automatically trip an EB main power in RF technology with the help of microcontroller. In this project used for wireless energy transmitter with house security system, using Energy meter and also monitoring it through PC via wireless technology**.** This project is very useful to the EB board because there is no need of employee to take consumed power unit in the every house.

Existing block diagram

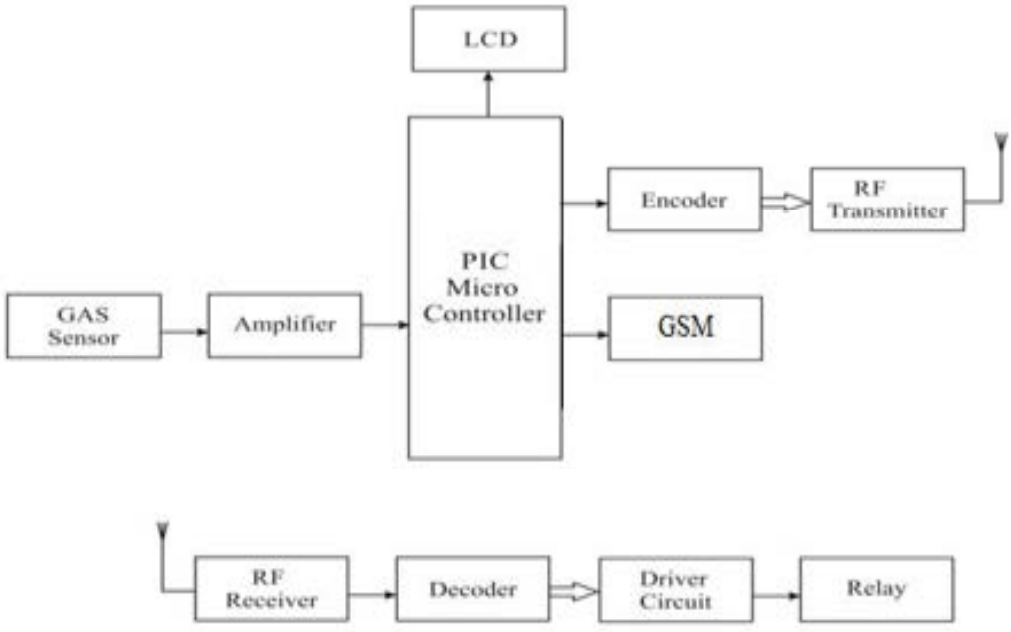


Figure 3.1 Existing System Block Diagram

3.2 Proposed Method

This proposed system used electronic instrument, which is used to measure the LPG gas cylinder weight. Its goes to lower weight means it will send a SMS

automatically. If LPG gas leakage detection find at home it automatically shut down the EB and make the alarm.

Proposed block diagram

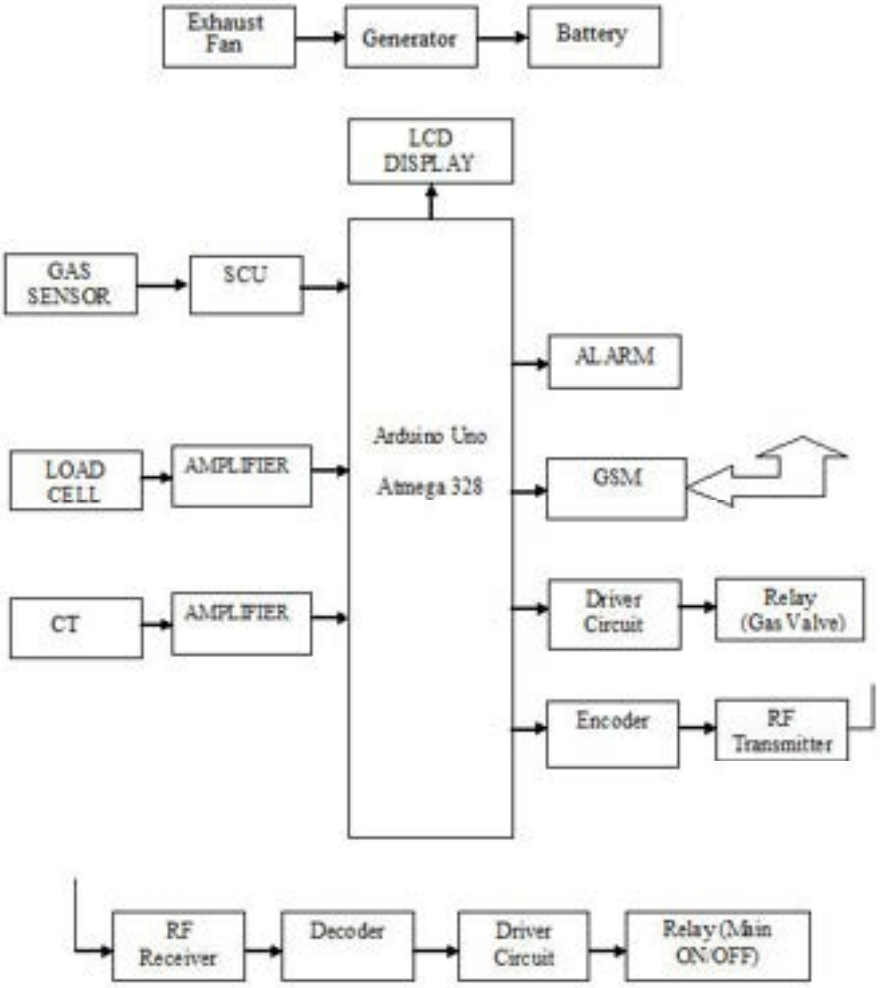


Figure 3.2 Proposed System Block Diagram

Gas leakage is a major problem with industrial sector, residential premises etc. One of the preventive methods to stop accident associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this project is to present such a design that can automatically gas booking, detect, alert and control gas leakage. LPG cylinders have become an integral part of every home. Our kitchens are occupied with LPG cylinders which help us make delicious food. But it can be dangerous and life

threatening. The aim of this project is to design a safety-oriented system which will alert the user about any threat in the kitchen through mobile and given the buzzer sound. This system will detect leakage of LPG and send an alert message to the user, at the same time it will switch off the gas supply of LPG by switching regulator-switch using BO motor. It is also used to monitoring the high voltage passing through the home appliances and it will reduce the voltage level in the power supply. It ensures safety from any gas leakage accident like explosion.

As an additional advantage, this system has a weighing sensor which can measure the weight of the cylinder and regularly update user about gas left in the cylinder and automatically booking the cylinder. This project proposes a system that will make entire LPG cylinder booking procedure automated without human intervention. This system continuously measures the weight of the cylinder and once it reaches minimum threshold it will automatically sends SMS to the authorized LPG Agent so that they can deliver the LPG cylinder in time. Along with the Automated cylinder booking we also designed feature related to the safety of the user in which it continuously monitor the leakage of LPG gas and alerts the user regarding leakage to avoid major accidents which costs human lives mostly.

CHAPTER 4
SYSTEM SPECIFICATIONS

4.1 SOFTWARE REQUIREMENTS

- Arduino IDE
- PCB Designing
- Embedded C

4.1.1 ARDUINO SOFTWARE (IDE)

- Writing Sketches
- File
- Edit
- Sketch
- Tools
- Help
- Sketchbook
- Tabs, Multiple Files, and Compilation
- Uploading
- Libraries
- Third-Party Hardware
- Serial Monitor
- Preferences
- Language Support
- Boards

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

4.1.2 PCB Designing

Design and Fabrication of Printed circuit boards

4.1.2.1 Introduction

Printed circuit boards, or PCBs, form the core of electronic equipment domestic and industrial. Some of the areas where PCBs are intensively used are computers, process control, telecommunications and instrumentation.

4.1.2.2 Manufacturing

The manufacturing process consists of two methods; print and etch, and print, plate and etch. The single sided PCBs are usually made using the print and etch method. The double sided plate through – whole (PTH) boards are made by the print plate and etch method.

The production of multi-layer boards uses both the methods. The inner layers are printed and etch while the outer layers are produced by print, plate and etch after pressing the inner layers.

4.1.2.3 Software

The software used in our project to obtain the schematic layout is MICROSIM.

4.1.2.4 Panelisation

Here the schematic transformed in to the working positive/negative films. The circuit is repeated conveniently to accommodate economically as many circuits as possible in a panel, which can be operated in every sequence of subsequent steps in the PCB process. This is called penalization. For the PTH boards, the next operation is drilling.

4.1.2.5 Drilling

PCB drilling is a state of the art operation. Very small holes are drilled with high speed CNC drilling machines, giving a wall finish with less or no smear or epoxy, required for void free through whole plating.

4.1.2.6 Plating

The heart of the PCB manufacturing process. The holes drilled in the board are treated both mechanically and chemically before depositing the copper by the electro less copper platting process.

4.1.2.7 Etching

Once a multiplayer board is drilled and electro less copper deposited, the image available in the form of a film is transferred on to the outside by photo printing using a dry film printing process. The boards are then electrolytic plated on to the circuit pattern with copper and tin. The tin-plated deposit serves an etch resist when copper in the unwanted area is removed by the conveyor's spray etching machines with chemical etch ants. The etching machines are attached to an automatic dosing equipment, which analyses and controls etch ants concentrations

4.1.2.8 Soldermask

Since a PCB design may call for very close spacing between conductors, a solder mask has to be applied on the both sides of the circuitry to avoid the bridging of conductors. The solder mask ink is applied by screening. The ink is dried, exposed to UV, developed in a mild alkaline solution and finally cured by both UV and thermal energy.

4.1.2.9 Hot Air Leveling

After applying the solder mask, the circuit pads are soldered using the hot air leveling process. The bare bodies fluxed and dipped in to a molten solder bath. While removing the board from the solder bath, hot air is blown on both sides of the board through air knives in the machines, leaving the board soldered and leveled. This is one of the common finishes given to the boards. Thus the double sided plated through whole printed circuit board is manufactured and is now ready for the components to be soldered.

4.1.3 Embedded C

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming

requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/Ooperations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing. Embedded C use most of the syntax and semantics of standard C, e.g., main () function, variable definition, datatype declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, unions,etc.

4.2 Hardware Requirements

- Arduino UNO
- LCD display
- Gas sensor
- Load cell
- Relay
- GSM modem
- RF transmitter and receiver
- DC motor
- Gas valve
- Generator

4.2.1 Arduino Uno

Arduino/Genuine Uno is a microcontroller board based on the Atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Figure 4.1 Pin diagram of Arduino Uno

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Table 4.1 Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

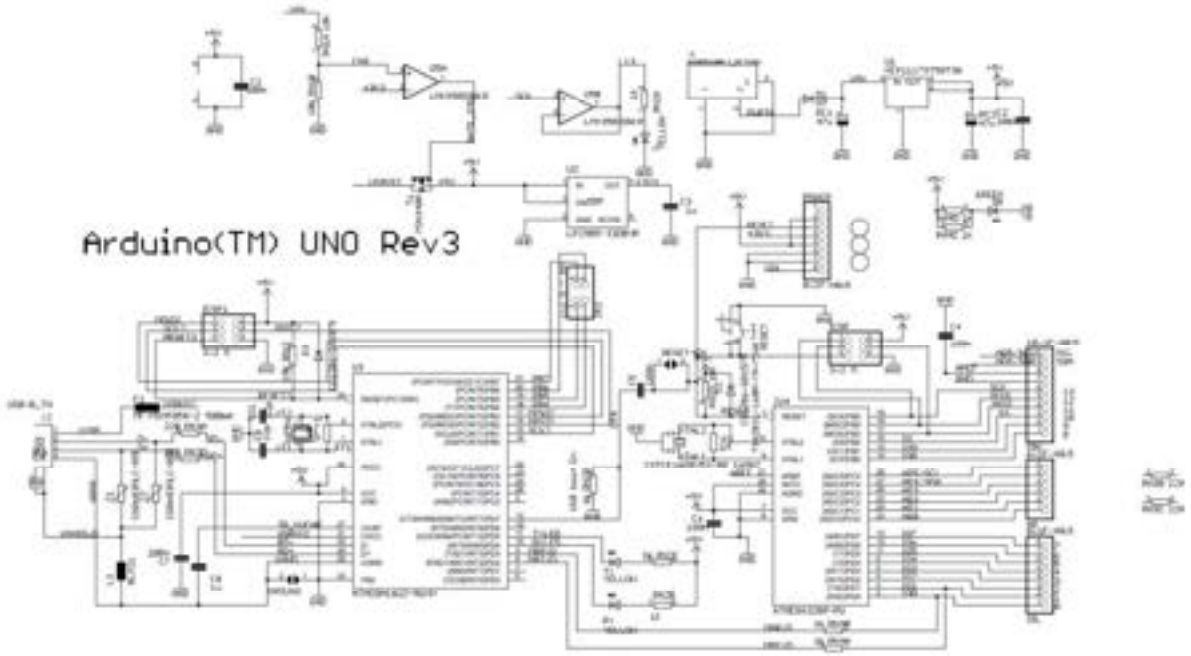


Figure 4.2 Circuit diagram for Arduino UNO

Power

The Arduino/Genuine Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.The power pins are;

- Vin. The input voltage to the Arduino/Genuine board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND. Ground pins.
- IOREF. This pin on the Arduino/Genuine board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8, 168, and 328 is identical.

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog reference() function.

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analog reference( ).
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

Arduino/Genuine Uno has a number of facilities for communicating with a computer, another Arduino/Genuine board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuine Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

Revisions

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.

4.2.2 LCD Display

Figure 4.3 LCD Display

A **liquid crystal display** (**LCD**) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly.

They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube(CRT) displays in most applications.

They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in.LCD's are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically-modulated optical device made up of any number of pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome. The earliest discovery leading to the development of LCD technology, the discovery of liquid crystals, dates from 1888. By 2008, worldwide sales of televisions with LCD screens had surpassed the sale of CRT units.

4.2.3 GAS Sensors

Electrochemical gas sensors are gas detectors that measure the concentration of a target gas by oxidizing or reducing the target gas at an electrode and measuring the resulting current.

Figure 4.4 Gas sensor

Construction

The sensors contain two or three electrodes, occasionally four, in contact with an electrolyte. The electrodes are typically fabricated by fixing a high surface area precious metal on to the porous hydrophobic membrane. The working electrode contacts both the electrolyte and the ambient air to be monitored usually via a porous membrane. The electrolyte most commonly used is a mineral acid, but organic electrolytes are also used for some sensors. The electrodes and housing are usually in a plastic housing which contains a gas entry hole for the gas and electrical contacts.

Theory of operation

The gas diffuses into the sensor, through the back of the porous membrane to the working electrode where it is oxidized or reduced. This electrochemical reaction results in an electric current that passes through the external circuit. In addition to measuring,

amplifying and performing other signal processing functions, the external circuit maintains the voltage across the sensor between the working and counter electrodes for a two electrode sensor or between the working and reference electrodes for a three electrode cell. At the counter electrode an equal and opposite reaction occurs, such that if the working electrode is an oxidation, then the counter electrode is a reduction.

Diffusion controlled response

The magnitude of the current is controlled by how much of the target gas is oxidized at the working electrode. Sensors are usually designed so that the gas supply is limited by diffusion and thus the output from the sensor is linearly proportional to the gas concentration. This linear output is one of the advantages of electrochemical sensors over other sensor technologies, (e.g. infrared), whose output must be linearized before they can be used. A linear output allows for more precise measurement of low concentrations and much simpler calibration (only baseline and one point are needed).

Diffusion control offers another advantage. Changing the diffusion barrier allows the sensor manufacturer to tailor the sensor to a particular target gas concentration range. In addition, since the diffusion barrier is primarily mechanical, the calibration of electrochemical sensors tends to be more stable over time and so electrochemical sensor based instruments require much less maintenance than some other detection technologies. In principle, the sensitivity can be calculated based on the diffusion properties of the gas path into the sensor, though experimental errors in the measurement of the diffusion properties make the calculation less accurate than calibrating with test gas.[1]

Cross sensitivity

For some gases such as ethylene oxide, cross sensitivity can be a problem because ethylene oxide requires a very active working electrode catalyst and high operating potential for its oxidation. Therefore gases which are more easily oxidized such as alcohols and carbon monoxide will also give a response. Cross sensitivity problems can be eliminated though through the use of a chemical filter, for example filters that allows the target gas to pass through unimpeded, but which reacts with and removes common interferences.

While electrochemical sensors offer many advantages, they are not suitable for every gas. Since the detection mechanism involves the oxidation or reduction of the gas, electrochemical sensors are usually only suitable for gases which are electrochemically active, though it is possible to detect electrochemically inert gases indirectly if the gas interacts with another species in the sensor that then produces a response.[2] Sensors for carbon dioxide are an example of this approach and they have been commercially available for several years.

4.2.4 Load Cell

Load cell is a transducer that is used to convert a force into electrical signal. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge converts the deformation (strain) to electrical signals. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one strain gauge (quarter bridge) or two strain gauges (half bridge) are also available. The electrical signal output is typically in the order of a few mill volts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer is plugged into an algorithm to calculate the force applied to the transducer.

Although strain gauge load cells are the most common, there are other types of load cells as well. In industrial applications, hydraulic (or hydrostatic) is probably the second most common, and these are utilized to eliminate some problems with strain gauge load cell devices. As an example, a hydraulic load cell is immune to transient voltages (lightning) so might be a more effective device in outdoor environments.

Other types include piezoelectric load cells (useful for dynamic measurements of force), and vibrating wire load cells, which are useful in geo mechanical applications due to low amounts of drift.

Every load cell is subject to "ringing" when subjected to abrupt load changes. This stems from the spring-like behavior of load cells. In order to measure the loads, they have to deform. As such, a load cell of finite stiffness must have spring-like behavior, exhibiting vibrations at its natural frequency. An oscillating data pattern can be the result of ringing. Ringing can be suppressed in a limited fashion by passive means. Alternatively, a control

system can use an actuator to actively damp out the ringing of a load cell. This method offers better performance at a cost of significant increase in complexity

4.2.5 GSM

A digital communication system used for mobile technology is the Global System for Mobile Communication (GSM), which is the most popular standard for mobile phones today. The GSM system transmits the digital information through the atmosphere by conveying the information to an analog waveform. The GSM Receiver is used to receive the digital data in remote area from work place. The digital data contains information about various parameters measured by the sensors in the work place. A GSM transmitter module is used at the transmitter side which is connected to the PIC controller and a GSM receiving module like mobile phone is used to receive the digital information in remote area.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA.

A GSM modem exposes an interface that allows applications such as nowSMS to send and receive messages over the modem interface. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages, as defined in the ETSI GSM 07.05 and and 3GPP TS 27.005 specifications.

A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, such as the Falcom Samba 75 used in this document. (Other manufacturers of dedicated GSM modem devices include Wavecome, Multitech and

iTegno.) To begin, insert a GSM SIM card into the modem and connect it to an available USB port on your computer.

Any phone that supports the "extended AT command set" for sending/receiving SMS messages, as defined in ETSI GSM 07.05 and/or 3GPP TS 27.005, can be supported by the Now SMS & MMS Gateway. Note that not all mobile phones support this modem interface.

Due to some compatibility issues that can exist with mobile phones, using a dedicated GSM modem is usually preferable to a GSM mobile phone. This is more of an issue with MMS messaging, where if you wish to be able to receive inbound MMS messages with the gateway, the modem interface on most GSM phones will only allow you to send MMS messages. This is because the mobile phone automatically processes received MMS message notifications without forwarding them via the modem interface.

It should also be noted that not all phones support the modem interface for sending and receiving SMS messages. In particular, most smart phones, including Blackberries, iPhone, and Windows Mobile devices, do not support this GSM modem interface for sending and receiving SMS messages at all at all. Additionally, Nokia phones that use the S60 (Series 60) interface, which is Symbian based, only support sending SMS messages via the modem interface, and do not support receiving SMS via the modem interface.

When you install your GSM modem, or connect your GSM mobile phone to the computer, be sure to install the appropriate Windows modem driver from the device manufacturer. To simplify configuration, the Now SMS & MMS Gateway will communicate with the device via this driver. If a Windows driver is not available for your modem, you can use either the "Standard" or "Generic" 33600 bps modem driver that is built into windows. A benefit of utilizing a Windows modem driver is that you can use Windows diagnostics to ensure that the modem is communicating properly with the computer.

The Now SMS & MMS gateway can simultaneously support multiple modems, provided that your computer hardware has the available communications port resources.

4.2.6 Relay

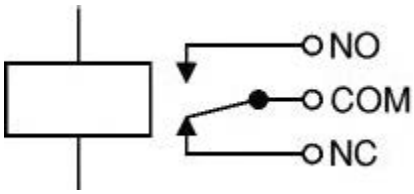
A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Figure 4.5 Relay

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a

lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this, it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

4.2.7 ALARM CIRCUIT

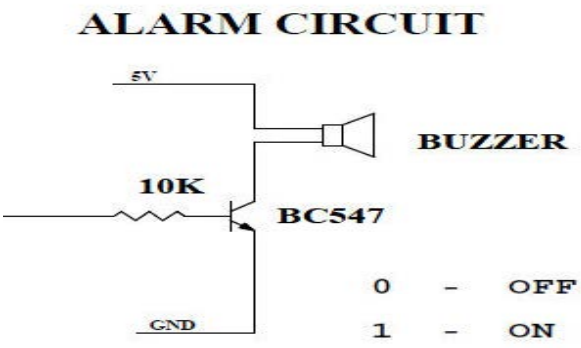


Figure 4.6 Circuit diagram of Alarm circuit.

Circuit description

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the NPN transistor (BC 547). The buzzer is connected in the transistor collector terminal.

When high pulse signal is given to base of the transistors it will be turned on and now alarm get ground so it will be on.

If low pulse is given to the NPN transistor base means it will be off and also alarm goes to the off state.

Table 4.2 Voltage Signal from Microcontroller

Voltage Signal from Microcontroller or PC	Transistor	Buzzer
1	ON	ON
0	OFF	OFF

4.2.8 Encoder and Decoder

An encoder is a device, circuit, transducer, software program, algorithm or person that converts information from one format or code to another, for the purposes of standardization, speed, secrecy, security, or saving space by shrinking size.

A decoder is a device which does the reverse of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode.

In digital electronics, a decoder can take the form of a multiple-input, multiple-output logic circuit that converts coded inputs into coded outputs, where the input and output codes are different. e.g. n-to-2^n, binary-coded decimal decoders. Enable inputs must be on for the decoder to function, otherwise its outputs assume a single "disabled" output code word. Decoding is necessary in applications such as data multiplexing, 7 segment display and memory address decoding.

The example decoder circuit would be an AND gate because the output of an AND gate is "High" (1) only when all its inputs are "High." Such output is called as "active High output". If instead of AND gate, the NAND gate is connected the output will be "Low" (0) only when all its inputs are "High". Such output is called as "active low output".

A slightly more complex decoder would be the n-to-2^n type binary decoders. These type of decoders are combinational circuits that convert binary information from 'n'

coded inputs to a maximum of 2^n unique outputs. We say a *maximum* of 2^n outputs because in case the 'n' bit coded information has unused bit combinations, the decoder may have less than 2^n outputs. We can have 2-to-4 decoder, 3-to-8 decoder or 4-to-16 decoder. We can form a 3-to-8 decoder from two 2-to-4 decoders (with enable signals).

Similarly, we can also form a 4-to-16 decoder by combining two 3-to-8 decoders. In this type of circuit design, the enable inputs of both 3-to-8 decoders originate from a 4th input, which acts as a selector between the two 3-to-8 decoders. This allows the 4th input to enable either the top or bottom decoder, which produces outputs of D(0) through D(7) for the first decoder, and D(8) through D(15) for the second decoder.

A decoder that contains enable inputs is also known as a decoder-demultiplexer. Thus, we have a 4-to-16 decoder produced by adding a 4th input shared among both decoders, producing 16 outputs.

4.2.9 RF Transmitter Receiver

Radio frequency (RF) radiation is a subset of electromagnetic radiation with a wavelength of 100km to 1mm, which is a frequency of 3 KHz to 300 GHz,[1] respectively. This range of electromagnetic radiation constitutes the spectral corresponds to the frequency of alternating current electrical signals used to produce and detect radio waves. RF can refer to electromagnetic oscillations in either electrical circuits or radiation through air and space. Like other subsets of electromagnetic radiation, RF travels at the speed of light.

Radio communication

In order to receive radio signals, for instance from AM/FM radio stations, a radio antenna must be used. However, since the antenna will pick up thousands of radio signals at a time, a radio tuner is necessary to tune in to a particular frequency (or frequency range). This is typically done via a resonator (in its simplest form, a circuit with a capacitor and an inductor). The resonator is configured to resonate at a particular frequency (or frequency band), thus amplifying sine waves at that radio frequency, while d

ignoring other sine waves. Usually, either the inductor or the capacitor of the resonator is adjustable, allowing the user to change the frequency at which it resonates.

Special properties of RF electrical signals

Electrical currents that oscillate at RF have special properties not shared by direct current signals. One such property is the ease with which they can ionize air to create a conductive path through air. This property is exploited by 'high frequency' units used in electric arc welding, although strictly speaking these machines do not typically employ frequencies within the HF band. Another special property is an electromagnetic force that drives the RF current to the surface of conductors, known as the skin effect. Another property is the ability to appear to flow through paths that contain insulating material, like the dielectric insulator of a capacitor. The degree of effect of these properties depends on the frequency of the signals.

Radio spectrum

Radio spectrum refers to the part of the electromagnetic spectrum corresponding to radio frequencies – that is, frequencies lower than around 300 GHz (or, equivalently, wavelengths longer than about 1 mm).

Different parts of the radio spectrum are used for different radio transmission technologies and applications. Radio spectrum is typically government regulated in developed countries, and in some cases is sold or licensed to operators of private radio transmission systems (for example, cellular telephone operators or broadcast television stations). Ranges of allocated frequencies are often referred to by their provisioned use (for example, cellular spectrum or television spectrum)

Notes

- Above 300 GHz, the absorption of electromagnetic radiation by Earth's atmosphere is so great that the atmosphere is effectively opaque, until it becomes transparent again in the infrared and optical window frequency ranges.

- The ELF, SLF, ULF, and VLF bands overlap the AF (audio frequency) spectrum, which is approximately 20–20,000 Hz. However, sounds are transmitted by atmospheric compression and expansion, and not by electromagnetic energy.
- The SHF and EHF bands are sometimes not considered to be a part of the radio spectrum, forming their own microwave spectrum.

4.2.10 Power Supplies

4.2.10.1 Introduction

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit is shown in fig 19.1. The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

4.2.10.2 Voltage Regulator

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external

operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to a desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milliwatts to tens of watts.

4.2.10.3 Three Terminal Voltage Regulator

Fig shows the basic connection of a three-terminal voltage regulator IC to a load. The fixed voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated output dc voltage, Vo, from a second terminal, with the third terminal connected to ground. For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current.

Fixed Positive Voltage Regulators:

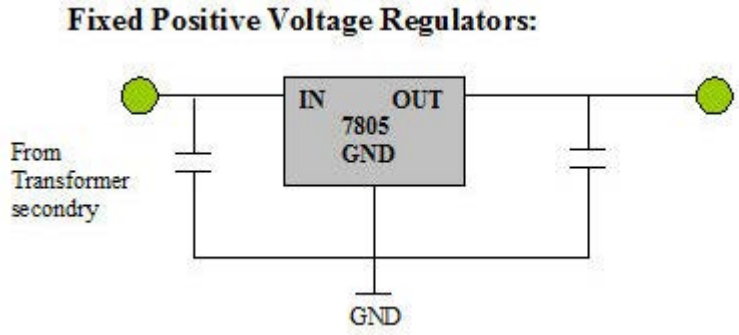


Figure 4.7 Fixed Positive Voltage Regulators

The series 78 regulators provide fixed regulated voltages from 5 to 24 V. Figure 19.26 shows how one such IC, a 7812, is connected to provide voltage regulation with output from this unit of +12V dc. An unregulated input voltage Vi is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a regulated + 12V which is filtered by capacitor C2 (mostly for any high-frequency noise).

The third IC terminal is connected to ground (GND). These limitations are spelled out in the manufacturer's specification sheets.

Positive Voltage Regulators in 7800 series

Table 4.3 Positive Voltage Regulators in 7800

IC Part	**Output Voltage (V)**	**Minimum Vi (V)**
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6

CHAPTER 5

RESULT AND DISCUSSIONS

In Arduino Based gas Monitoring and Automatic Cylinder booking with notification System gas sensor, 10 kg stack cell as info gadgets and relay, 16x2 LCD show and GSM Terminal utilized as yield gadgets.

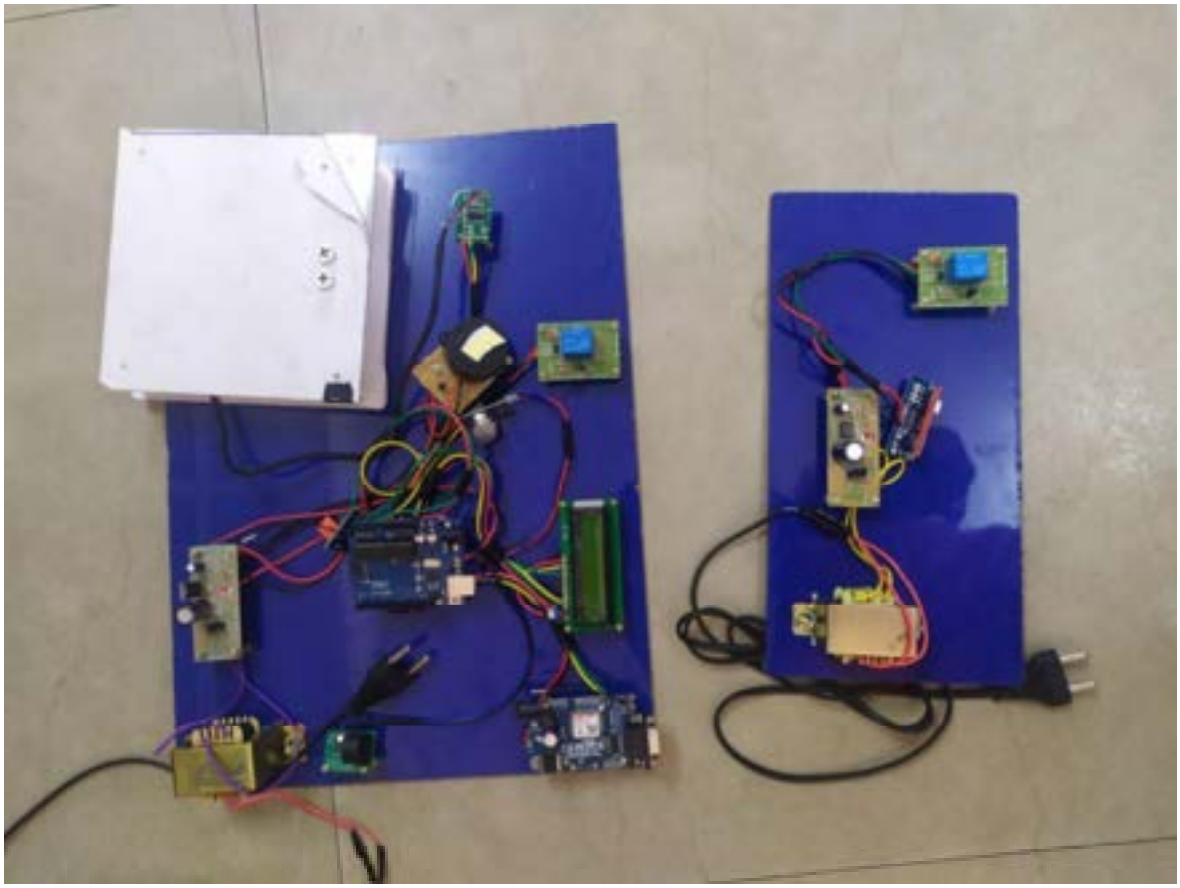


Figure 5.1 A Microcontroller Based LPG Cylinder Booking and Leakage Detection Using GSM

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

In this paper we have used automatic gas booking with alert system without human intervention. Our system helps customers to upgrade their safety and protect life and property from reputed accidents. The main objective of our system is to measure the gas present in cylinder when the weight of cylinder is below the fixed load by using weight sensor. The gas agency gets the order of new cylinder and owner received the messages regarding the status .Thus the system developed by us will somehow help the LPG Gas consumer to lead a safety life and comfortable life

6.2 FUTURE ENHANCEMENT

Future Scope This monitoring system can be further enhanced by using Ethernet in place Bluetooth module in order to operate from anywhere, which supports the another real-time application. For industrial purposes , robot can be developed for detecting multiple gas concentrations and fire. Instead of load cell sensor we can also be used as pressure sensor which detects the amount of gas in the cylinder and also detects pressure of gas in cylinder pipe, alerting owner via call and Monitoring by using Android device from any remote location.

Appendix

```
#include "HX711.h"
#include <LiquidCrystal.h>
LiquidCrystal lcd(13,12,11,10,9,8);

HX711 scale(3, 2); //HX711 scale(6, 5);

char mobile_no[12],s_val[20],count,rcv[100],en=0,m,sip=0,cip=0;
unsigned char gas,cur,ir=0;
int countTrueCommand,sec=0,rr,qq;
void Lcd_Decimal3(unsigned int val);
int countTimeCommand;
boolean found = false;
int valSensor = 100;

// const int ir = 6;
// const int key1 = A0;
// const int key2 = A1;
// const int key3 = A2;
  int alarm=A4;
   int rly=A2;
   int rf=A3;

//HX711 scale(3, 2); //HX711 scale(6, 5);

float calibration_factor = 300;
```

```
float units;
float ounces;
void setup()
{
  Serial.begin(9600);
//   pinMode(ir,INPUT);
//   pinMode(key1,INPUT_PULLUP);
//   pinMode(key2,INPUT_PULLUP);
//   pinMode(key3,INPUT_PULLUP);
     pinMode(alarm,OUTPUT);
     pinMode(rly,OUTPUT);
     pinMode(rf,OUTPUT);
     digitalWrite(alarm,LOW); digitalWrite(rf,LOW); digitalWrite(rly,LOW);
     lcd.begin(16, 2);
     scale.set_scale(calibration_factor);
     scale.tare();
     lcd.print("    Init over    ");delay(2000); delay(2000);
     lcd.setCursor(0,0);
     lcd.print("GAS LEAKAGE DETE");
     lcd.setCursor(0,1);
     lcd.print("AUTOMTIC BOOKING");
     delay(1000); delay(1000); delay(1000);
     Serial.println("AT");delay(1000);
     Serial.println("AT+CMGF=1");delay(1000);
     Serial.println("AT+CNMI=2,2,2,0,0");delay(1000);
     lcd.clear();
```

```
digitalWrite(alarm,LOW); digitalWrite(rf,HIGH); digitalWrite(rly,HIGH);
units=400.00;
}

void loop()
{
 gas=analogRead(A1)>>2;
 lcd.setCursor(0,0);
 lcd.print("GAS:");
 Lcd_Decimal3(4,0,gas);
 cur=analogRead(A0)>>2;
 lcd.setCursor(8,0);
 lcd.print("I:");
 Lcd_Decimal3(10,0,cur);

 if(units>300.00)
 {lcd.setCursor(10,1);
 lcd.print("NORMAL ");
digitalWrite(alarm,LOW);
// http_send1();delay(1000);
 }
 if(gas<=100 && cur<=80)
  { digitalWrite(rly,HIGH);
     digitalWrite(rf,HIGH);
  }
   if(gas>100 || cur>80 || units<300.00)
```

```
{
 if(gas>100){
   lcd.setCursor(10,1);
   lcd.print("GAS LEAKAGE");
   digitalWrite(rly,LOW);
   digitalWrite(rf,LOW);
   digitalWrite(alarm,HIGH);
   ir=2;
    http_send1();delay(1000);
        }
 if(cur>80){
   lcd.setCursor(10,1);
   lcd.print("SHORT CKT");
   digitalWrite(rly,LOW);
   digitalWrite(rf,LOW);
   digitalWrite(alarm,HIGH);ir=3;
    http_send1();delay(1000);
   }
 if(units<300.00)
 {lcd.setCursor(10,1);
   lcd.print("WEIGHT LOW");ir=1;
  digitalWrite(alarm,HIGH);delay(2000);
   http_send1();delay(1000);
}
 }
   units = scale.get_units(3),10;
```

```
 if (units < 0)
 {
  units = 0.00;
 }
 ounces = units * 0.035274;
  lcd.setCursor(0,1);
  lcd.print(units);
  lcd.print("g  ");
  delay(100);
}
void serialEvent()
{
 if(Serial.available())
 {
  unsigned int rec = Serial.read();
  s_val[count] = rec;
  if(s_val[0]=='*'){count++;}
  else{count=0;}
 }
}
 void http_send1()
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("SENDING MESSAGE ");
 Serial.print("AT+CMGS=\"");delay(500);
```

```
  Serial.print("6380820064");
  Serial.println("\"");
  delay(1000);delay(1000);
  Serial.write(0x0d);Serial.write(0x0a);
  if(ir==1){Serial.println("LPG GAS LEVEL LOW");
    Serial.print("LEVEL:");
    Serial.print(units);}
  if(ir==2){Serial.println("GAS LEAKAGE");}
  if(ir==3){Serial.println("SHORT CIRCUIT");}
  Serial.write(0x0d);Serial.write(0x0a);
 delay(1000);delay(1000);
 Serial.write(0x1A);
 delay(1000);delay(1000);delay(1000);delay(1000);
   // Serial.println("erase");
 }
void http_send()
{
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("SENDING MESSAGE ");
 Serial.print("AT+CMGS=\"");delay(500);
 Serial.print("6380820064");
Serial.println("\"");
delay(1000);delay(1000);
Serial.write(0x0d);Serial.write(0x0a);
```

```
 Serial.print(units);
 Serial.write(0x0d);Serial.write(0x0a);
delay(1000);delay(1000);delay(1000);delay(1000);
 Serial.write(0x1A);
delay(1000);delay(1000);delay(1000);delay(1000);
  // Serial.println("erase");
}
void Lcd_Decimal3(unsigned char com,unsigned char com1,unsigned int val)
{
    unsigned int Lcd_h,Lcd_hr,Lcd_t,Lcd_o;
    lcd.setCursor(com,com1);
    Lcd_h=val/100;
    Lcd_hr=val%100;
    Lcd_t=Lcd_hr/10;
    Lcd_o=Lcd_hr%10;
    lcd.setCursor(com,com1);
    lcd.write(Lcd_h+0x30);
    lcd.setCursor(com+1,com1);
    lcd.write(Lcd_t+0x30);
    lcd.setCursor(com+2,com1);
    lcd.write(Lcd_o+0x30);
}
```

REFERENCES

1. K. Galatsis, W. Woldarsla, Y.X. Li and K. Kalantar-zadeh, "A Vehicle air quality monitor using gas sensors for improved safety", report in Recent Researches in Applications of Electrical and Computer Engineering.

2. K. Galatsis, W. Wlodarsla , K. Kalantar-Zadeh and A. Trinchi, "Investigation of gas sensors for vehicle cabin air quality monitoring", National Conference on Synergetic Trends in engineering and Technology (STET-2014), International Journal of Engineering and Technical Research ISSN: 2321- 0869

3. "Design and Implementation of an Economic Gas Leakage Detector" A. Mahalingam, R. T. Naayagi,1, N. E. Mastorakis Department of Engineering Systems school of Engineering, University of Greenwich (Medway Campus)Chatham Maritime, Kent ME4 4TBUNITED KINGDOM, article in Recent Researches in Applications of Electrical and Computer Engineering.

4. Huseynov, J., Baliga, S., Bagherzadeh, N., Bic, L., Dillencourt, M.,"Gas-leak localization using distributed ultrasonic sensors", 16th SPIE Conference on Smart Sensor Phenomena, Technology, Networks, and Systems II, San Diego, CA, 2009

5. Weimer, J., Sinopoli, B., Krogh, B. H., "Multiple source detection and localization in advectiondiffusion processes using wireless sensor networks", 30th IEEE Real-Time Systems Symposium (RTSS), IEEE, 2009

6. Abid Khan, Neju K. Prince, Shailendra Kumar Dewangan, Praveen Singh Rathore (2014), "GSM based automatic LPG ordering system with leakage alert", IJRET: International Journal of Research in Engineering and Technology, Volume: 03 Special Issue: 12 | ICAESA - 2014 | Jun-2014.

7.R.NareshNaik, P.SivaNagendra Reddy, S.Nanda Kishore, K.Tharun Kumar Reddy " LPG gas Monitoring and automatic Cylinder booking with Alert system" IOSR Journal of Electronics and Communication Engineering, .Volume 11, Issue 4, Ver. I (Jul.-Aug .2016)

8. Anusuya, Kanimozhi, Ruthann, "Gas Leakage Detection and Automatic Gas Booking Alert System using IOT" International Journal of Engineering Reseaech& Technology (IJERT),ISSN:2278-0181(2019).

9.Taveras Ismail1, Devoleena Das2 ,Jyotirmoy Saikias3, Jyotirmoy Deka4, Raj kumar Sarma5 Assistant Professor, Department of ECE, Guwahait,India1, Guwhait, India2,3,4,5Assam Don Bosco University.

10. Purval Duggal,AkshayPawar,PoorvaKalkatte,prof.RushikeshBhalerao, "LPG leakage detection and smart gas booking" Intertional Research Journal of Engineering and Technology, Volume:05 Lssue:11|NOV 2018.

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A Microcontroller Based LPG Cylinder Booking and Leakage Detection using GSM

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ABSTRACT

Gas leakage is a major problem with industrial sector and also home applications etc. To avoid the gas leakage is to install a gas leakage detection system at the society. The main aim of this project is used to design that can automatically gas booking system, gas leakage detection system, alert system and control gas leakage. LPG cylinders have become an integral part of every home. Our kitchens are occupied with LPG cylinders which is used to make delicious food. But it can be very dangerous to make problems in our life. The aim of this project is to design a safety-oriented system which will alert the user about any problem in the kitchen through mobile by using GSM and give the buzzer sound by using alert system. This system will detect the gas leakage of LPG and send an alert information to the user, at the same time it will switch off the gas supply of LPG by switching regulator-switch using BO(Battery Operating) motor. It is also used to monitoring the high voltage passing through the home appliances and also industrial sector it will used to reduce the voltage level in the power supply. It also measures safety from any gas leakage accident like explosion. In additional advantage, this system has a load cell used to continuously monitoring the cylinder weight and send information to the user. The project is very helpful to check the entire LPG cylinder booking procedure automated Without human intervention and also Automated cylinder booking we also designed feature related to the safety to the user. And also the LPG Cylinders are produced some heat energy. The heat energy is generating the power by using generator through exhaust fan.

KEYWORDS: *Arduino Uno At-mega, Gas Sensor, GSM Module, BO motor*

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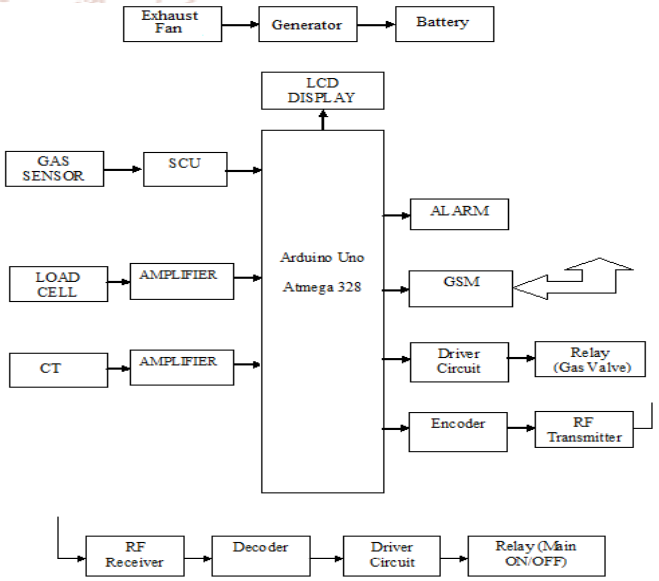
INTRODUCTION

Liquefied petroleum gas is used for industrial applications and domestic purposes. It has a smoke less gassing system. The main constituents of LPG are propane and butane. Gas leakage is a major problem in a residential houses and create fundamental issue on the society. Fire accidents mainly occur due to technical fault on the cylinder. A better systems on need to reduce the accident due to gas leakage. LPG gas is more higher sensitivity compared to gas is present in the air. The weight of the cylinder is continuously measured by load cell and the information is convey to the user by using GSM. The gas leakage is detected by the electro chemical cell and give the buzzer sound and convey the information to the user. The main objective of the project is used to reduce the voltage level in the main power supply. It is used to identify the any short circuit present in the industrial domain and also home appliances.

PROPOSED APPROACH

In proposed system, which is used to measure the LPG gas cylinder weight. When it goes lower level it will intimate to the user through mobile phone automatically. And it will also sense the gas leakage present in the home in addition to its if the gas leakage present in home it will automatically drop the voltage level in the main supply.

BLOCK DIAGRAM



GAS SENSOR

A gas sensor is a device which is used to detect the presence of gases in the atmosphere. In this we have use the electrochemical sensor. The construction of the gas sensor is Gas sensor layer, Heater coil, Electrode Line, Tubular ceramic, Electrode.

Gas sensor: It is used to sensing the gas, the sensing element is made up of Tin dioxide (sno2).

Heater coil: It is made up of Nickel chromium which has high melting point so that it can stay heated up without getting melted.

Features
1. High Sensitivity to LPG
2. Low Sensitivity to alcohol, Smoke.
3. Fast Response Time: <10s.

LCD DISPLAY

A Liquid crystal display is the flat panel display or other electronically modulated optical device. It does not emit the light directly. It consume less power when compare to LED and gas display. LCD is made up of millions of pixels.

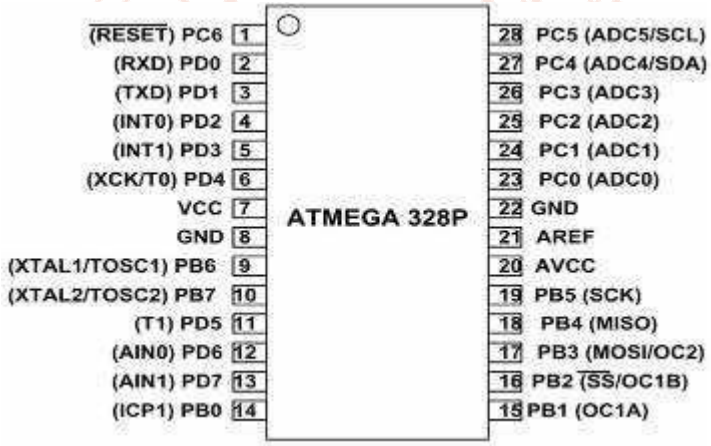
In here we can use the 16*2 display. It is mainly used to display the cylinder weight and current status of the cylinder

BUZZER

It is mainly used to indicate the gas leakage has occurred.

ATMEGA328

Arduino Uno is the 8-bit microcontroller. The microcontroller board is based on the ATmega328. It has 14 digital input pins and output pins and also have 6 analog pins and it has 16MHZ quartz crystal. AT mega memory has 1KB (EEPROM) Electrical Erasable Programmable Read Only Memory. The output voltage is 5V and input voltage is 7-12V. The clock speed is16 MHZ. We can use the IDE (Integrated circuit Environment) software. It is mainly used to allow to write the software and also uploaded on the board. A program written with the IDE for the board is called as sketch.



GSM MODULE

GSM (Global System for Mobile communication) it is a digital mobile network. It is mainly used in mobile phones. GSM phone can sent and receive the data packet while making call.GSM mainly used to transfer the message to mobile phone. It operated at frequency either 900MHZ, 1800MHZ. The system transmits the digital information through atmosphere and convert in to analog waveform.

DRIVER CIRCUIT

It is circuit or components used to control any another circuit or components, such as high power transistor, liquid crystal display. It also control the current flow of the system.

RELAY

Relay is also called as switch. Relay that open and close circuit electromechanically or electronically. Relay are widely used to switch starting coil.

LOAD CELL

Load cell is the type of transducer. It convert force such as tension, compression, pressure or torque into an electrical signal. The load cell is mainly used measure the cylinder weight and also monitoring every day.

RESULT AND DISCUSSION

In this system is used to detect the gas leakage and automatic gas booking system. Electro chemical sensor is used to sense the gas leakage and give alert to the user by using mobile and also buzzer system. The information is displayed on the LCD display in the mobile devices. And also the system is used to reduce the voltage level in the main power supply and it will identify any high voltage is possible to the home appliances and industrial side. This system is very simple and reliable.

CONCLUSION

As we discussed about the microcontroller based LPG cylinder booking and leakage detection using GSM this will be verified. This project is very useful to prevent from fire accident and save the human life.

REFERENCE

[1] K. Galatsis, W. Woldarsla, Y.X. Li and K. Kalantar-zadeh, "A Vehicle air quality monitor using gas sensors for improved safety", report in Recent Researches in Applications of Electrical and Computer Engineering.

[2] K. Galatsis, W. Wlodarsla , K. Kalantar-Zadeh and A. Trinchi, "Investigation of gas sensors for vehicle cabin air quality monitoring", National Conference on Synergetic Trends in engineering and Technology (STET-2014), International Journal of Engineering and Technical Research ISSN: 2321- 0869

[3] "Design and Implementation of an Economic Gas Leakage Detector" A. Mahalingam, R. T. Naayagi,1, N. E. Mastorakis Department of Engineering Systems school of Engineering, University of Greenwich (Medway Campus)Chatham Maritime, Kent ME4 4TBUNITED KINGDOM, article in Recent Researches in Applications of Electrical and Computer Engineering.

[4] Huseynov, J., Baliga, S., Bagherzadeh, N., Bic, L., Dillencourt, M., "Gas-leak localization using distributed ultrasonic sensors", 16th SPIE Conference on Smart Sensor Phenomena, Technology, Networks, and Systems II, San Diego, CA, 2009

[5] Weimer, J., Sinopoli, B., Krogh, B. H., "Multiple source detection and localization in advection diffusion processes using wireless sensor networks", 30th IEEE Real-Time Systems Symposium (RTSS), IEEE, 2009

[6] Abid Khan, Neju K. Prince, Shailendra Kumar Dewangan, Praveen Singh Rathore (2014), "GSM based automatic LPG ordering system with leakage alert", IJRET: International Journal of Research in Engineering and Technology, Volume: 03 Special Issue: 12 | ICAESA - 2014 | Jun

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AUTOMATION OF WASTE PAPER REJECT HANDLING SYSTEM USING DCS

A PROJECT PHASE - II REPORT

Submitted by

ABI.R (16105002)

GAYATHRI.C (16105034)

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

The main objective of this project to dispose the reject material properly and reduce the environmental impacts. In our project done by Tamilnadu Newsprint and Papers Limited (TNPL). This is a Deinking process (DIP). Deinking process is the one in which the ink from the office waste and newspaper and removed in order to prevent it from dispersion into the pulp sodium soap is used for removing the ink. The sodium soap produced in conveyer. The existing method have only one conveyer. It carries the reject material and it create the environmental hazards. But our proposed method has two conveyers. These conveyers are worked with the help of DCS. It reduces the environmental pollution and reduce the need for more manual labour. The conveyer 1 has a magnetic separator which separate the metal, iron and its components. The conveyer 2 has a reject material like polythene and reject material. Those materials are conveyed Baling machine by using the conveyer 2. Finally, these reject materials are bundled with the help of baling machine.

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LIST OF ABBREVIATIONS

ACRONOYM	ABBREVIATION
DCS	Distributed Control System
PLC	Programmable Logic Control
FBD	Function Block Diagram
NO	Normally Open
NC	Normally Closed
DIP	Deinking process
LCU	Local Control Unit
FCS	Field Control System
OBA	Optical Brightening Agent
HMI	Human Machine Interface
RTD	Resistance Temperature detector
PID	Proportional Integral Derivative
SCADA	Supervisory Control And Data Acquisition
DOL	Direct Online
DP	Differential Pressure
AWL	Anweisungs Liste

CHAPTER 1

INTRODUCTION

1.1 Introduction

A distributed control system (DCS) refers to a control system usually of a manufacturing system, process or any kind of dynamic system, in which the controller elements are not central in location (like the brain) but are distributed throughout the system with each component sub-system controlled by one or more controllers. The entire system of controllers is connected by networks for communication and monitoring. DCS is a very broad term used in a variety of industries, to monitor and control distributed equipment. Before the beginning of the DCS era there were pneumatic devices that controlled process and engineers manually turned valves on the site. Modeling of the systems was made possible by DCS as it allowed the ability to record and manages process from comfort of a computer screen. Because of DCS we are able to control processes remotely and gain a better understanding of how the process operate and how they can be improved to both increase safety and increase profit possibilities. The input modules receive information from input instruments in the process (or field) and transmit instructions to the output instruments in the field. Computer buses or electrical buses connect the processor and modules through multiplexer or demultiplexers. Buses also connect the distributed controllers with the central controller and finally to the Human–machine interface (HMI) or control consoles.

Figure 1.1 Image of DCS hardware

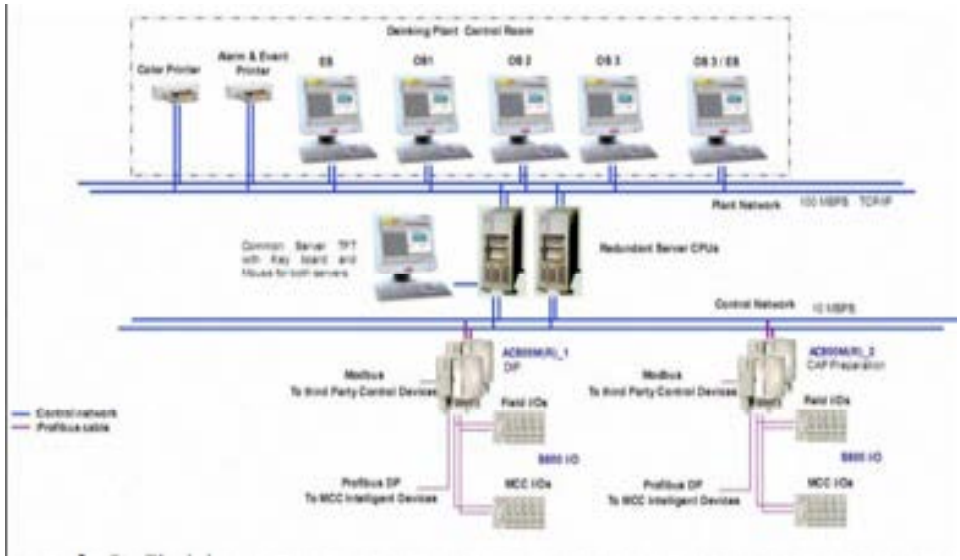

Figure 1.2 DCS structure

1.2 DCS vs PLC

DCS systems are deployed in operations where downtime due to a malfunction may cause material and personnel losses. To prevent them it's possible to include redundant solutions, with in turn are increasing the investments to the control system. Redundancy and sophisticated diagnostics are nowadays standard built-in options for DCS and it's not necessary for them to write a custom program. Downtime is related with online and offline application changes. A typical DCS runs non-stop for years.

In the case of DCS, the center for control is HMI because for the continuous control it's not possible to see the product (it's located in enclosed tangs, pipelines, ...) On the other hand in PLC control used for discrete control, the operator can see the product. Therefore, the operator must have as much information about the process on the screens to know to monitor and control it.

1.3 DCS application

Distributed control systems (DCSs) are dedicated systems used to control manufacturing processes that are continuous or batch-oriented, such as oil refining, petrochemicals, central station power generation, fertilizers, pharmaceuticals, food and beverage manufacturing, cement production, steelmaking, and papermaking. DCSs are connected to sensors and actuators and use setpoint control to control the flow of material through the plant. The most common example is a setpoint control loop consisting of a pressure sensor, controller, and control valve. Pressure or flow measurements are transmitted to the controller, usually through the aid of a signal conditioning input/output (I/O) device. Large oil refineries have many thousands of I/O points and employ very large DCSs.

1.4 Basic configuration of DCS system

There are many manufacturers that have designed and built distributed control systems (DCSs) with a large selection of features and enhancements to choose from. No matter what the control systems platform's structure is the tag name/point name implementation methodology is basically the same. There are some things that can be done before the actual plant implementation is done onsite to make this process more efficient. Once the necessary research and proper investigation of interface circuitry for field instruments is done, the configuration process is more reliable and cost-effective for the client-especially during a plant turnaround with time restraints.The control systems engineer is familiar with the software connections and the main DCS parts through the control system configuration. To understand what type of devices an engineer will be interfacing with, the following considerations are noted:

- **Hardwired inputs:** These physical wires make the connection between the DCS and the field. For example, the analog input signal by voltage, thermocouple type and resistance temperature device.
- **Other field devices such as control valves:** When considering the implementation of control valves, care must be given to the regulatory controller action inside the DCS whether the valves is a fail open or fail close type. The process and I&E engineers verify the information and pass it on to the control systems engineer for correct configuration of controllers.
- **Digital representation:** This is another signal represented by a square wave that is either high or low, on or off. They control the interactions of devices such as pumps, motor starters and solenoid valves. The I&E technician would have to know what device and circuitry to pass this information to the control systems engineer.
- **Tag name/point name configuration:**This configuration is the measuring boundaries that may also be known as 'process variable engineering unit low and process variable engineering unit high.' Based on process engineering and I&E technical information, a value should be determined and given to the control systems engineer.
- **Alarming values must be determined:**This will give the control system an indication that a trip valve has been reached. These valves are significant because this lets the process operator know what adjustments to make to keep the process in a safe condition and protect personnel and equipment.

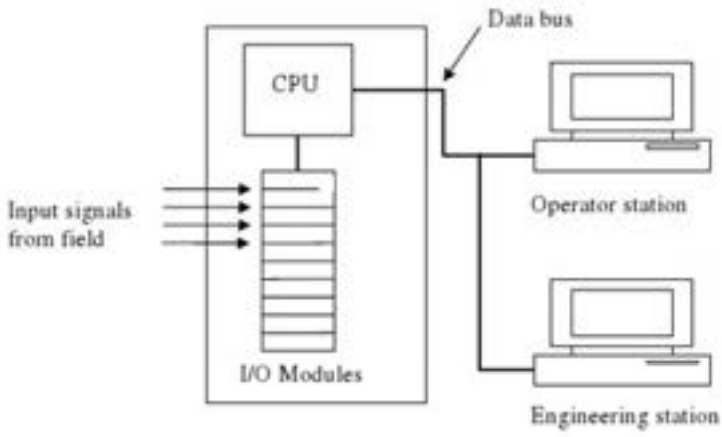

Figure 1.3 Basic configuration of DCS

1.5 Field Control Station (FCS)

It consists of input/output modules, CPU and Communication bus.The last evolution step of PAS which can be characterized as total functional and spatial distribution of functions for processing information is often designated as Field Control Systems(FCS). They are based on intelligent field devices and industrial digital communication systems used on field level(field bus).A series of points whose relative positions and elevations are known. These positions are used in basic data in mapping and charting.

1.6 Operator station

It is basically human interface machine with monitor, the operator man can view the process in the plant and check if any alarm is presents and he can change any setting, print reports..etc. Different station types are available to meet user needs. Experion Console Station is designed for control room operations in large process plants including refining, petrochemicals and mineral processing. Experion Flex Station is an option for less demanding or geographically distributed operations such as Pulp and Paper, Oil and Gas and pharmaceutical production. Flex Stations also support large number of users for casual access such as engineering or maintenance. Different Experion Station types can be used together on one system in any combination. Experion Console Stations can be grouped together to form a single operator workspace for process control and monitoring, event handling, alarm acknowledgement, alarm silencing and display manipulation. Flex stations share a pool of connections to allow a large number of casual users access to the system.Out of the box, state-of-the-art alarm management improves the operator's ability to minimize process interruptions and powerful trending allows the operator to maintain appropriate situational awareness and keep the process within desired limits. Group and detail displays are available to monitor and manage process variables. Configurable pull-down menus and toolbars allow easy, intuitive navigation and fast access to key process data.The HMIWeb solution pack library is available to quickly and efficiently build powerful and high performance custom displays incorporating the process optimization features developed by the Abnormal Situation Management consortium.

1.7 Engineering station

It is used to configure all input & output and drawing and anything required to be monitored on Operator station monitor. Engineering notation or engineering form is a version of scientific notation in which the exponent of ten must be divisible by three (i.e., they are powers of a thousand, but written as, for example, 10^6 instead of 1000^2). As an alternative to writing powers of 10, SI prefixes can be used, which also usually provide steps of a factor of a thousand. Commodore scientific calculators offer the possibility of changing the exponent at will, therefore allowing the full choice of the unit in which the display may be read. This device, however, is limited to displaying only those numeric quantities for which there exists a commonly accepted alphabetic exponent notation. This device is also limited in the range of data that it can display. As an alternative to writing powers of 10, SI prefixes can be used, which also usually provide steps of a factor of a thousand. Commodore scientific calculators offer the possibility of changing the exponent at will, therefore allowing the full choice of the unit in which the display may be read. This device, however, is limited to displaying only those numeric quantities for which there exists a commonly accepted alphabetic exponent notation.

1.8 General Architecture of DCS

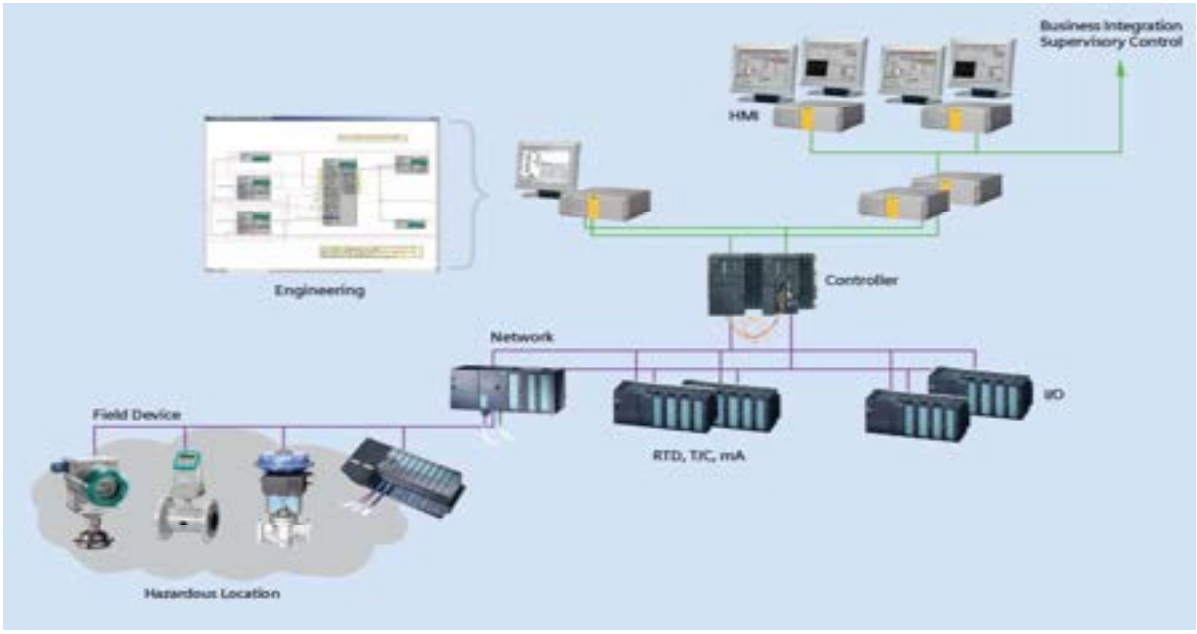

Figure 1.4 General DCS architecture

1.8 Basic elements of DCS

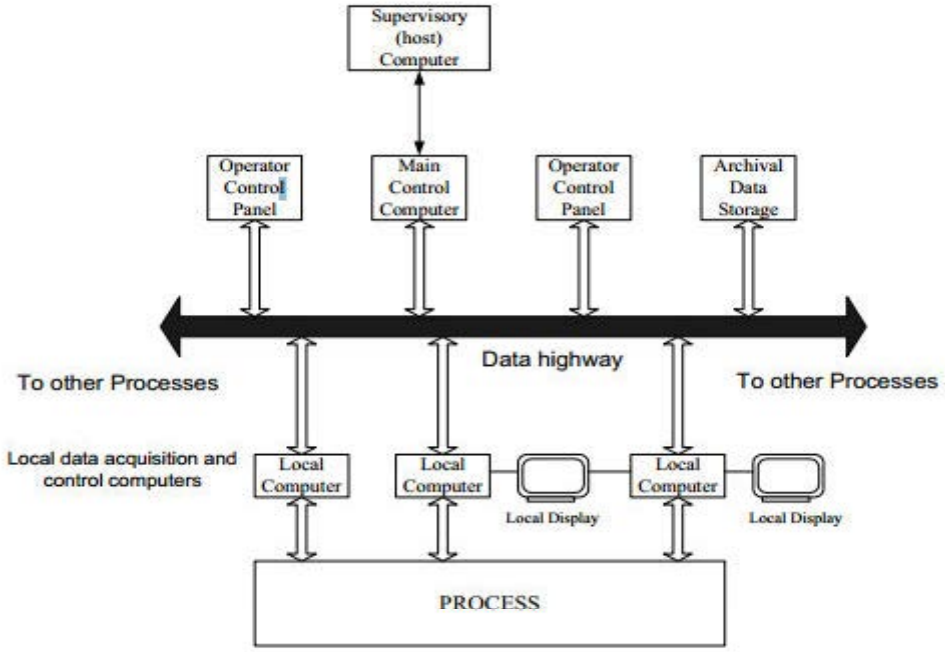

Figure 1.5 The elements of a commercial DCS network

- **Local Control Unit (LCU**):This is denoted as local computer in Figure 3. This unit can handle 8 to 16 individual PID loops, with 16 to 32 analog input lines, 8 to 16 analog output signals and some a limited number of digital inputs and outputs.
- **Data Acquisition Unit**: This unit may contain 2 to 16 times as many analog input/output channels as the LCU. Digital (discrete) and analog I/O can be handled. Typically, no control functions are available.
- **Batch Sequencing Unit:**Typically, this unit contains a number of external events, timing counters, arbitrary function generators, and internal logic.
- **Local Display:** This device usually provides analog display stations, analog trend recorder, and sometime video display for readout.
- **Bulk Memory Unit**:This unit is used to store and recall process data. Usually mass storage disks or magnetic tape are used.
- **General Purpose Computer**: This unit is programmed by a customer or third party to perform sophisticated functions such as optimization, advance control, expert system, etc.

- **Central Operator Display:** This unit typically will contain one or more consoles for operator communication with the system, and multiple video color graphics display units.
- **Data Highway:** A serial digital data transmission link connecting all other components in the system may consist of coaxial cable. Most commercial DCS allow for redundant data highway to reduce the risk of data loss.
- **Local area Network (LAN):** Many manufacturers supply a port device to allow connection to remote devices through a standard local area network

1.10 System Analysis

1.10.1 Existing System

The existing system of our project have only one reject conveyor.It collect reject material and It creates the environmental hazards.

1.10.2 Disadvantage

- It creates more environmental impacts.
- It need more manul power.
- It takes more time and money.

CHAPTER 2

LITERATURE REVIEW

2.1 Sorting of Objects Based on Color Type on A Conveyor Line Using PLC

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2.1.1 Introduction

Automation is the use of control systems for handling different processes and machineries to replace human efforts. Automated systems generally use complex algorithms which increase the cost of the design and the power consumed. But this not only reduces manual efforts, time consumed, but gives more time to work on factors like aesthetics. Using automation also prevents danger which might occur when humans are made to work in hazardous environments. Thus, use of automation is effective in manufacturing industry. Sorting based on colour, weight and type is done in many industries to ensure the quality of the object is consistent and up to the mark. Automated sorting also reduces the labour cost and the production time. The error cased due to human negligence are avoided by the use of automated system by colour based sorting using a colour sensor. Sorting of products in an industry is a tedious industrial process, which is generally carried out manually. Continuous manual sorting creates quality consistency issues. Segregation based on different characteristics like weight, colour, type require different equipment for weighing and then separating. We have proposed an efficient method which uses load cell, inductive sensor and TCS 230 colour sensor for identifying and segregating on the basis of weight, colour and type (metal or non-metal) of object and Siemens 300 Series PLC to control the overall process of sorting two types of objects. We have proposed an efficient method which uses load cell, inductive sensor A circular container, having three partitions is used to collect objects of three different colours. Two conveyor belts were used, each controlled by separate DC motors.

2.1.2 Proposed Method

In this project, we have proposed a Low Cost Automation System for sorting coloured objects on the basis of their colour, weight variation and type(metal or non-metal). The project mainly focuses on sorting 2different weighing non-metallic objects which are available in 3 different coloursusing load cell, TCS230 coloursensor, inductive sensor and DC geared motors interfaced with Programmable Logic Controller (PLC, which is operated using the DC motor. It comprises of a bridge on which the DC motor is mounted to which the flipper is attached. As soon as the PLC receives a signal from the load cell or the inductive sensor for a particular object, the flipper is initiated and if the object has undesired properties than the required ones, it slides the object into the rejection system; or the flipper slides it on the secondary conveyor line if it has the weighs as the weight set for secondary conveyor belt. If neither of the above conditions hold true and the object weighs as per the weight limit set for the primary line, the flipper leaves the object undisturbed and it continues on the primary conveyor line. The system consists of total 2colour sensors, an inductive sensor and a load cell, all used to detect the colour, type and weight respectively.

2.1.3. Drawbacks

- Increase the cost of the design.
- This not only reduces manual efforts.
- Time consumed, but gives more time to work on factors like aesthetics.

2.2 State-of-the-Art Reject Treatment Systems for Recycled Fiber Lines

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2.2.1 Introduction

Waste from paper mills has long been neglected and simply sent to landfills. This situation is changing rapidly due to legal requirements, and even more because of the huge economic benefits that can be accomplished by converting the rejects into valuable

sources of energy or new raw materials. These benefits include avoiding costs for transportation, handling, and disposal saving energy costs by generation of RDF (refuse-derived fuels): burning the reject fraction with high calorific value instead of purchasing fossil fuels, especially as energy and fuel prices are steadily rising income generated from selling various fractions of the reject compound government subsidies and funding By way of example, the following figures show price trends for various fuels and for electricity over the last decade. These trends show clearly that alternatives for energy generation and greater independence from market energy prices are the main drivers for "waste-to-energy" reject treatment. Rejects can be split into two major categories: coarse and fine rejects. While the coarse rejects mainly come from the pulping process, including de-trashing, the fine components originate from the cleaning and screening stages. Both categories – coarse and fine – can be divided into light and heavy rejects. A ballistic separator is applied very early on in the process, either directly after coarse metal separation or even before it. It is recommended particularly in reject systems for drum pulping lines, where the heavy particles enter along with the main reject stream, while these stones and bricks typically end up in the heavy fraction in conventional pulping lines.

2.2.2 Proposed Method

In many mills, both pulping methods are applied and thus, the mills need a reject treatment system that can handle rejects from both. In addition to the rag shredder, a coarse shredder is also recommended for the loose pulping rejects. This homogenizes the reject stream, reduces the size of very large particles and cuts the longish, rag-like components that can come from drum pulping – especially if there are too many wires entering the drum pulper. A first separation stage removes large metal pieces and the bulk of the wires from the rag. After passing through an optional ballistic separator for the pulping rejects, both streams are then compacted and dewatered together. often with additional waste and rejects delivered from external sources. The loose rejects from drum pulping or from wash drums in conventional pulping are often dewatered particle size for the subsequent sorting processes and for the boiler.As an additional step, a sieving unit is recommended. Only the larger particles (larger than approx. 15 to 20 mm) reach the optical sorting stage. nd are finally bunkered. In many cases, one mill location contains several lines. It makes sense to treat those rejects centrally in a single reject system .

2.2.3. Drawbacks

- It cannot be Achieved with certain recycled fractions.
- It consume more power.

2.3 Color/Metal sensing sorting system

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2.3.1 Introduction

A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these days. Robots are now more than a machine, as robots have become the solution of the future as cost labour wages and customers demand. Robot and automation is employed in order to replace human to perform those tasks that are routine, dangerous, complex and in hazardous area.[6] This article is based on the research project which is a fully automated material handling system to be use in industry. Even though the cost of acquiring robotic system is quite expensive but as today's rapid development and a very high demand in quality with International Standard Organization (ISO) standards, human are no longer capable of such demands [14]. Research and development of future robots is moving at a very rapid pace due to the constantly improving and upgrading of the quality standards of products. This paper aims at fully automated material handling system. This can be done by using sensors interfaced with Micro Controller Unit. It synchronizes the movement of robotic arm to pick the objects moving on a conveyor belt. It aims in classifying the coloured objects which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place. Thereby eliminating the monotonous work done by human, achieving accuracy and speed in the work. This robot involves colour sensors that senses the object's colour and sends the signal to the microcontroller. This paper aims at fully automated material handling system. This can be done by using sensors interfaced with Micro Controller Unit.

2.3.2 Proposed Method

The pick and place robotic arm with conveyor belt is a system that detects the object on the conveyor belt, picks that object from source location and places at desired location based on colour identified or metal/nonmetal. For detection of object, firstly infrared sensors are used which detect presence of object as the transmitter to receiver path for infrared sensor is interrupted by placed object. Also the colour of the object is detected by the colour sensor. Its metallic nature is detected by the metal detector. Now As soon as robotic arm receives the signal from the controller, it picks with end effectors and places it on the respective destination depending on the respective colour of the object that is red, green or blue. If another object causes interrupt, it again does the same job. The system uses AT89S52 Micro Controller Unit as its controller for performing different operations by the robot. An Infrared sensor is an electronic device that measures infrared (IR) light radiating from objects in its field of view. IR sensors are often used in the construction of IR-based motion detectors apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. It is the same principle in all Infra-Red proximity sensors. The basic idea is to send infra red light through IR-LEDs, which is then reflected by any object in front of the sensor.

2.3.3 Drawbacks

- It has less quality.
- They have low efficiency.
- poor consistency.
- It can be operate only less flexibility.

2.4 Automatic waste segregator

International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue4S, February 2019.

2.4.1 Introduction

The rising population of India poses serious threats with regard to the availability of living space, utilization of natural resources and raw materials, education and employment. But another serious peril that follows is the escalating amount of waste

generated each minute by an individual. Every city is grappling with the menace of ever increasing waste. An astounding 0.1 million tonnes of waste is generated each day in our country. Sadly, only 5% of this colossal amount of waste is recycled. In India, the collection, transportation and disposal of MSW are unscientific and chaotic. Uncontrolled dumping of waste on outskirts of towns and cities has created overflowing landfills which are not only impossible to reclaim because of the haphazard manner of dumping but also has serious environmental implications. When viewed on a larger scale, the poor recovery rate has impeded the growth of the country as well as the economy of the nation. One possible solution for this problem could be segregating the waste at the disposal level itself. We have thus come up with an Automatic waste segregator that categorizes the waste as wet, dry or metal. An 8051 microcontroller forms the heart of the system. Inductive proximity sensor is used to detect if the waste is a metal. Wet and dry waste can be distinguished based on their weight. A high speed blower system is used to blow dry waste off the belt while most of the wet waste remains. It then falls off as the belt rotates and is collected later. This cost effective system is particularly suitable for installation in apartments and colonies.

2.4.2 Proposed Method

The open close mechanism acts as a regulator to control the waste that falls on the belt. A 12V DC geared motor receives inputs from microcontroller to monitor the clockwise and anti clockwise motion of the motor. This mechanism is initiated only if the IR sensor detects a waste in its vicinity. An inductive proximity sensor based on the eddy current principle suitable for detecting buried conductive targets has been used. Three 12V inductive proximity sensors are used to detect if the incoming waste is metallic or not. This is fed as input to the microcontroller. As and when the inductive proximity sensors detect a metallic waste, a slider movement is initiated which sweeps the waste away after it falls on the belt. Permanent magnets within the metallic bin aid in sorting magnetic metals from non-magnetic ones. Dry and wet separation is based on their weight. Due to its high density and weight, wet waste refuses to be blown off even in the presence of a high speed blower. This technique is made use of to distinguish wet and dry waste. A relay will control the on and off of a high speed AC blower. As blower blows, the belt halts and dry waste is thrown out into the dry bin via a collecting chamber. Wet waste stays on the belt. It then falls off due to gravity at the end of the belt as it rolls. Permanent magnets within the metallic bin aid in

sorting magnetic metals from non-magnetic ones. Dry and wet separation is based on their weight. Due to its high density and weight, wet waste refuses Dry and wet separation is based on their weight. Due to its high density and weight, wet waste refuses to be blown off even in the presence of a high speed blower. It then falls off as the belt rotates and is collected later. This cost effective system is particularly suitable for installation in apartments and colonies.

2.4.3. Drawbacks

- Segregation of waste consumes more time.
- Segregation is very complex.

2.5 Automatic Broke Feeding System for the Finishing House Pulper in Paper Machine

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2.5.1 Introduction

Paper mill is a factory that makes paper from vegetable fibers, wood pulp, old rags and other materials. Large scale paper mills produce nearly 4,00,000 tons of paper annually. The non ending demand for papers makes it necessary to minimize the losses and improve the efficiency of paper machine. Hence all paper mills recycle the wastes produced in each stage of paper production. Once such recycling process is broke feeding in finishing house pulper. About 10% of paper wastes called brokes are produced daily due to improper paper size ,creases, etc. These wastes are converted back to pulp and send to pulp tower from where it will return to the initial stage to get converted back to paper. This will improve the production of the paper mill. This broke feeding process is carried out manually, by collecting all the brokes and then making it to pulp by mixing it using agitator. The pulp is then pumped to the pulp tower. By automating the broke feeding the productivity of the paper mill can be increased. The collection of brokes cannot be automated. Hence the brokes are collected manually. The rest of the process can be automated using PLC. The broke feeding section has hydraulic lift, broke cage, broke remover, conveyor belt and an agitator. The sensors used are load cell and proximity sensor. Paper mill is a factory that makes paper from vegetable fibers, wood pulp, old rags and other materials. Large scale paper mills

produce nearly 4,00,000 tons of paper annually. The non ending demand for papers makes it necessary to minimize the losses and improve the efficiency of paper machine. Hence all paper mills recycle the wastes produced in each stage of paper production. Once such recycling process is broke feeding in finishing house pulper. About 10% of paper wastes called brokes are produced daily due to improper paper size ,creases, etc.

2.5.2 Proposed Method

In a paper mill, there are several paper cutting machines and pulp mixer. They produced 1500 MT of paper per day. About 10% of this production will be considered as waste, due to incorrect GSM (paper size), paper cutting, etc. This waste papers are called as brokes. These kinds of wastes are recycled by the industry. Workers collects the whole broke, broke is nothing but the paper waste. This broke is brought to the finishing house pulper section. The brokes are then lifted to put the broke into the pulper. Then tap is opened till the water reaches the prescribed level. Next the mixeris started. The whole process is done manually now. At least 3 workers are needed for this continuous process and it s also time consuming. This is the existing system for recycling the brokes in a paper mill. Fig 3 shows the existing broke feeding method in a paper mill. The brokes are collected from various stages of the paper machine. As the opening of the mixer is on the top the brokes are lifted using a lift. Then the brokes are transferred to the mixer manually. Also small paper wastes from various stages are bought to the mixer by pulp vessel. After the brokes are filled in the mixer, water is filled. Only 70% of the mixer is filled with water to avoid spilling. Then the agitator is turned ON. After thirty minutes the brokes will become pulp and will be transferred to pulp tower using a pump. Also small paper wastes from various stages are bought to the mixer by pulp vessel. After the brokes are filled in the mixer, water is filled. Only 70% of the mixer is filled with water to avoid spilling. Then the agitator is turned ON. After thirty minutes the brokes will become pulp and will be transferred to pulp tower using a pump.

2.5.3 Drawbacks

- It also reduces the time taken for broke recycling.
- It reduces 2 men’s workload.

2.6 Potential benefits of recovered paper sorting by advanced technology

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2.6.1 Introduction

Quality is the major prerequisite for extending the use of recovered paper (RP) as a raw material for paper and board manufacturing. Several studies related to furnish quality focus on recovered paper from household collection, which is the main source with potential for further increasing the recycling rates. The first part of the paper analyses the role of household collection for future development of paper recycling and trends of RP quality in Europe. Many studies have demonstrated that an extended household collection is always detrimental to RP quality. Without the adequate actions of all actors from the recycling chain, quality decrease could jeopardize the sustainability of paper recycling. In this context, many researches on the improvement of recovered paper quality are being carried out in Europe. A representative example for this research field is FP7 project – SORT IT (Recovered Paper SORTing with Innovative Technologies), whose objectives of RP quality improvement and expected benefits are analysed briefly in the second part of this paper. In the survey on the general parameters influencing the future competitiveness of paper recycling in Europe, the partners of COST Action E48 were asked to rank the importance of different means in improving paper collection efficiency in their country. The general results, expressed as average levels of 19 countries, show15 that advanced sorting of recovered paper is, after the collection system, the second most important area for extending the limits of paper recycling in European countries.

2.6.2 Proposed Method

Due to its low price, recovered paper is a very attractive fibre raw material for paper and board manufacturing. Generally, mixed grades (1.01, 1.02) are sorted to obtain more homogenous and higher quality grades (deinking grade 1.11 and packaging grade 1.04), traded at higher prices. Therefore, until recently, a low manufacturing cost was the most important driving force for substituting virgin pulp with the recycled pulp obtained from recovered paper processing. The benefits of substituting recycled for virgin fibre are

generally greater for higher grades (especially for paper made from chemical pulp) than for lower grades, such as newsprint, liner and fluting for corrugated boxes, and hygienic paper. Actually, the use of recycled fibre pulp in producing high grades is limited to about 10%, the main causes of this limitation being the high quality demand for fibre pulp quality and the quality decrease of the recovered paper available for recycling. tending the use of recovered paper as a raw material, and the major threat – if sufficient quality cannot be assured. A considerable amount of research related to furnish quality is carried out in Europe, most of it focusing on the recovered paper from household collection. Generally, mixed grades (1.01, 1.02) are sorted to obtain more homogenous and higher quality grades (deinking grade 1.11 and packaging grade 1.04), traded at higher prices. Unfortunately, today's sorting technologies cannot overcome the low and variable quality of recovered paper input. As documented below, the trend of quality decrease for mixed grades is translated into both deinking and packaging grades obtained by mixed grades sorting. Several studies of the SORT IT project30 evidenced the following composition ranges for grade 1.04: non-paper components from 1.5 to 3%; non-recyclable paper and board from 3 to 6%; graphic papers from 5 to 30%.

2.6.3 Drawbacks

- Energy consumption is less.
- lower contamination of recovered paper grades.

2.7 Development of Automatic Smart Waste Sorter Machine

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2.7.1 Introduction

Modern world meets lots of challenges that includes Smart waste management system. It is become matter of big concern if proper disposal system is not managed. Managing waste effectively and recycling efficiently, a nation can ahead one step forward. In this work, an automatic sorter machine is developed which can sort out the wastes in various categories to make waste management easier and efficient. It can be possible to sort

out metal, paper, plastics and glass by developing an electromechanical system using microcontroller and operational amplifier. For sorting metal and glass conventional sensors are used and for sorting paper and plastics a sensor using LASER and LDR is developed. A weight sensor and counter is used to find out the amount of sorted materials. By using the proper recycling system, the curse of waste will turn into blessings for the civilization. The sorting procedure will make recycling more efficient. By means of this waste sorter, the conventional waste management system will be transformed into SMART system. This SMART system will help to make our environment more suitable for living, reducing global warming and making the world healthier. From the beginning of the human civilization, people used various methods of waste disposal to get rid of unwanted material. Sometimes it was buried in the land, thrown in the sea, fed to the animal or burnt. Getting rid of unwanted material is always a major concern for the modern society.By means of this waste sorter, the conventional waste management system will be transformed into SMART system. This SMART system will help to make our environment more suitable for living, Trash has played a tremendous role in history. The Bubonic Plague, cholera and typhoid fever, to mention a few, were diseases that altered the populations of Europe and influenced monarchies.

2.7.2 Proposed Method

The system activates when the IR detects some sorts of material is being put on the system tray. Then at first the weight sensor activates and find out the weight of the trash, then the metal sensor and glass sensor starts their actions. If metal sensor detects the material as metal, then a servo motor will put that trash in the bin 3 (which is dedicated for metals). If the glass sensor detects glass then it will perform same action and put the trash in bin 4. If both sensors fail to detect then the LASER and LDR activates. If the LASER passes through the trash then it is decided as a transparent and moves to bin 2. If the LASER fails to pass then the material is decided as Paper and move to bin. The sorting system consists of Light Dependent Resister (LDR), LASER, Infrared (IR) transmitter and receiver, Metal Sensor (Capacitive proximity sensor E2K-C) glass sensor (Omron E3SCR67C), Weight Sensor (MLC900 micro weight sensor) and a Liquid Crystal Display (Alpha-numeric 16*4 LCD). The whole program is run by a microcontroller (PIC 16f877A). The Servo motor is controlled by sending a pulse of variable width by the microcontroller. The control wire is

used to send this pulse. The parameters for this pulse are that it has a minimum pulse, a maximum pulse, and a repetition rate. Given the rotation constraints of the servo, neutral is defined to be the position where the servo has exactly the same amount of potential rotation in the clockwise direction as it does in the counter clockwise direction. It is important to note that different servos will have different constraints on their rotation but they all have a neutral position, and that position is always around 1.5 milliseconds (ms). If the LASER passes through the trash then it is decided as a transparent and moves to bin 2. If the LASER fails to pass then the material is decided as Paper and move to bin. The sorting system consists of Light Dependent Resister (LDR), LASER, Infrared (IR) transmitter and receiver, Metal Sensor (Capacitive proximity sensor E2K-C) glass sensor (Omron E3SCR67C), Weight Sensor (MLC900 micro weight sensor) and a Liquid Crystal Display (Alpha-numeric 16*4 LCD).

2.7.3 Drawbacks

- Reduction of Cost is high.
- It doesn't have Primary Recycling and Reusing Unit.

2.8 Fiber Recovery from Waste Paper: A Breakthrough in Re-Pulping Technology

Jerry Aue, Energy Center of Wisconsin Keith Picard, Fiber Recycling Technologies, Inc. Kevin Grabner, Energy Center of Wisconsin Alan Button, Buttonwood Consulting, LLC

2.8.1 Introduction

Paper mills and converters produce large quantities of waste paper. Paper trim from the process, roll ends, off-quality product and overruns are all sources of waste. Where feasible, process scraps are re-pulped and blended back into the feedstock. Converting paper to its final product sometimes produces wastes that are difficult if not impossible to re-pulp with conventional technology. For example, many paper products are laminated with plastic. Many mills either process laminated waste paper into pellets for boiler fuel or pay to have the wastes land filled. This paper describes a new technology that cost-effectively recovers quality fiber from papers currently being sent to landfill. Fiber Recycling Technologies, Inc. (FRT) has developed a low-energy, mechanical re-pulping method that gently separates fibers while leaving contaminants largely whole, so that fiber can be readily screened from

contaminants. Trials were run on a range of recovered papers and landfill waste, including poly-laminated paper trimmings, multilaminated food packaging, and unsorted municipal solid waste. Success from the trials encouraged FRT to start a commercial re-pulping operation using their own technology. This expanding new business re-pulps high-grade landfill waste papers, creating 18 new jobs. Recovered papers can use considerably less energy in pulping than wood-based pulp, so making secondary fibers competitive with virgin ones can save significant energy. A 20- ton per day FRT pulper now operating commercially annually saves about 7,000 tons of waste fiber from being land filled, and requires 11 to 30 kWh per ton for pulping. By comparison, refiner-mechanical pulping of virgin wood requires about 1,972 kWh per ton (Martin, N., et al 2000). Other mechanical and kraft pulping processes have similar or greater energy intensities.

2.8.2 Proposed Method

The U.S. pulp and paper industry is made up of three primary types of producers: 1) pulp mills, which manufacture pulp from solid wood or other materials, primarily wastepaper; 2) paper mills, which manufacture paper from wood pulp and other fiber pulp; and 3) paperboard mills, which manufacture paperboard products from wood pulp and other fiber pulp. In 1994, virgin wood pulps accounted for 68% of paper production by weight, with used paper covering the remaining 32%, when 82.46 million tons of paper were produced in the U.S. (Martin, N., et al 2000). More than 5.3 million tons of paper and over one million tons of paperboard are produced annually in Wisconsin (Wisconsin Paper Council 2003). Since recovered papers can use considerably less energy in pulping than wood-based pulp, making secondary fibers competitive with virgin ones can save significant energy in the mill (Martin, N., et al 2000). As the United States paper industry approaches its 50% recovered paper target, getting that last couple of percent has gotten difficult. While there is potentially significant additional recovered paper tonnage, the paper industry faces a difficult challenge to collect and process much of this material in an economically attractive fashion. Among the obstacles to increasing the recovered paper percentage are papers with difficult to remove and separate contaminants and quantities of particular recovered paper grades that are too small to justify separating and/or marketing. Difficult to process recovered papers include those with coatings and laminations (such as plastic or foil) that

are easily fragmented and difficult to remove in conventional cleaning and screening operations.

2.8.3 Drawbacks

- Paper rapidly with low specific energy usage.
- Pulp properties were comparable to a highly efficient.

2.9 A critical review on waste paper sorting techniques

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2.9.1 Introduction

Efficient waste paper recycling has a significant role in the sustainable environment. Recyclable waste paper as a fundamental ingredient of municipal solid wastes (MSWs) is indeed an ‘‘urban ore’’. Waste papers are considered as the solid recovered fuel which is recovered from MSW. Recyclable waste papers are segregated into various grades to produce high-quality products. Moreover, sorted paper streams save energy, chemicals, and water, as well as reduce sludge and rejects. Information technology is widely integrated with the waste management industry into its operations such as recycling, reuse, segregating based on categories and so on. This review article focuses on the life cycle of waste paper and existing waste paper sorting techniques. In the paper industry, many types of sensors are used in different mechanical and optical waste paper sorting systems. Such sensors include lignin, gloss, stiffness, mid-infrared, infrared, and color sensors. In this review, also described the effectiveness of different waste paper sorting systems, and finally, recommended appropriate waste paper. Paper comprises a network of plant fibers laid down as a flat sheet that is made from a suspension of plant tissues in water, known as pulp. Etymologically, ‘‘paper’’ is derived from ‘‘papyrus,’’ the Ancient Greek word for Cyperus papyrus. The plant fiber of waste paper is reusable for six to seven times (Villanueva and Wenzel 2007). Hence, the demand for recyclable waste paper is rapidly increasing in the global market of pulp production. Although the total production capacity of all Malaysian paper mills reaches 1,300,000 tons/year, consumption remains higher than production

capacity (Asia Pro Eco Program 2006). The Malaysian pulp and paper industry is heavily dependent on imported fiber, particularly virgin pulp. Hence, the industry has to find a new source of fiber to strengthen and retain the quality of secondary fibers given the growing use of recycled paper in Malaysia.

2.9.2 Proposed Method

In recycled pulp production, pulp from recyclable waste paper is manufactured by grinding collected waste paper in water. After deinking and the removal of impurities, the pulp is ready for paper production. Waste paper fibers are worn down or downgraded when they undergo recycling. Hence, fibers may be recycled for only six to seven times (Villanueva and Wenzel 2007). Moreover, the addition of virgin pulp is necessary to retain the total stock of paper during recycled paper production from collected waste paper. Waste paper pulping generally requires less energy per ton of pulp than pulping processes that use virgin fibers. In addition, this process saves virgin fiber inputs in paper production. Compared with the chemical pulping of wood from virgin sources, waste paper pulping generates no wood wastes nor dissolved chemicals for energy generation. Consequently, when waste paper utilization is increased, the availability of biomass energy is reduced, and the dependence on purchased energy, such as fossil fuels, increases. The vendor–customer entity is considered the initial source of waste paper. The end user of the finished paper/paper products stores the paper in a bin or in a collection area for recycling after use. The vendor–customer represents the bin or collection area. The dealer collects the waste paper from vendor–customers. The collected waste paper contains both relevant and non-relevant waste. The dealer supplies the collected waste paper to the godown owner. At this stage, the recyclable and non-recyclable waste papers are segregated. Thereafter, the recyclable waste papers are sorted into categories according to the demand of the paper manufacturer or of the paper industry for appropriate pricing. The supplier collects the relevant waste paper for recycling from the godown owner and supplies it to the paper industry or manufacturers.

2.9.3 Drawbacks

- Paper consumption is less.
- It produces a low-quality product.

Summary of Literature Review

The summary of literature review is given in the table 2.1 contains the title of the paper,techniques used and its drawback.

Table 2.1 Summary of literature

S.NO	TITLE	OBJECTIVE	DRAWBACK
1.	potential benefits of recovered paper sorting by advanced technology	It is used to recovered paper (RP) as a raw material for paper and board manufacturing	▪ Energy consumption is less. ▪ lower contamination of recovered paper grades
2.	colour/metal sensing sorting system	To increase the manufacturing capacity for industries and eliminate the manual based tasks and operations.	▪ Less quality & efficiency. ▪ poor consistency & flexibility**.**
3.	Sorting of Objects Based on Color, Weight and Type on A Conveyor Line Using PLC	To sort objects depending upon the color. To design easy and simplified operational system.	▪ Paper consumption is less. ▪ It produces a low-quality product
4.	A critical review on waste paper sorting techniques	Recyclable waste papers are segregated into various grades to produce high-quality paper.	▪ Paper consumption is less.

			▪ It produces a low-quality product
5.	Automatic waste segregator	It deals with the minimization of blue-collar method utilization for exclusion of waste into an automated panache.	▪ Segregation of the waste consumes time
6.	Automatic broke feeding system for the finishing house pulper in paper machine	The ultimate aim of this project is to automate and control the above process by designing a control system using Programmable Logic Controller.	▪ It also reduces the time taken for broke recycling. ▪ It reduces 2 men's workload
7.	Development of Automatic Smart Waste Sorter Machine.	In this work, an automatic sorter machine is developed which can sort out the wastes in various categories to make waste management easier and efficient.	▪ Reduction of Cost is high. ▪ It doesn't have Primary Recycling and Reusing Unit.
8.	State of the art reject treatment systems for recycled fibre lines	mechanical dewatering and compacting, cutting and shredding to set the desired particle size, sorting of unwanted materials and impurities.	▪ It cannot be Achieved with certain recycled fractions.

9.	Fiber recovery from waste paper a breakthrough in re-pulping technology	Converting paper to its final product sometimes produces wastes that are difficult if not impossible to re-pulp with conventional technology.	▪ Paper rapidly with low specific energy usage. ▪ Pulp properties were comparable to a highly efficient.

CHAPTER 3

PROPOSED SYSTEM

3.1 Proposed system

In this proposed method ,the waste paper is obtained from the waste products. It has two reject conveyors. The two reject conveyors are connected in serious connection. The two reject conveyors are operated in based on time.The reject conveyor I consist of metal separator which is used to separate the metal from the reject wastage. Then the reject waste material are passed through the bailing machine with the help of reject conveyor II. The reject conveyor II carries the waste materials such as polythene and etc. The metal separator attracks the metals and iron components. The obatained metals are passes to the scrap yard .In this scrap yard this metals are melted and its used to reproduce the another metal product. The polythene papers are send to the kiln and its used in cement plant for raise the temperature. The reject conveyor II having the waste papers which is passes to the bailing machine. After receiving the bailing machine the papers are compressed and its bundled with the help of iron strip. Then the reject conveyor I and reject conveyor II works at simultaneously before filling the bailing machine. When the bailing machine was filled the reject conveyor II works based on the timer, we set the run time and stop time.

3.2 Block diagram

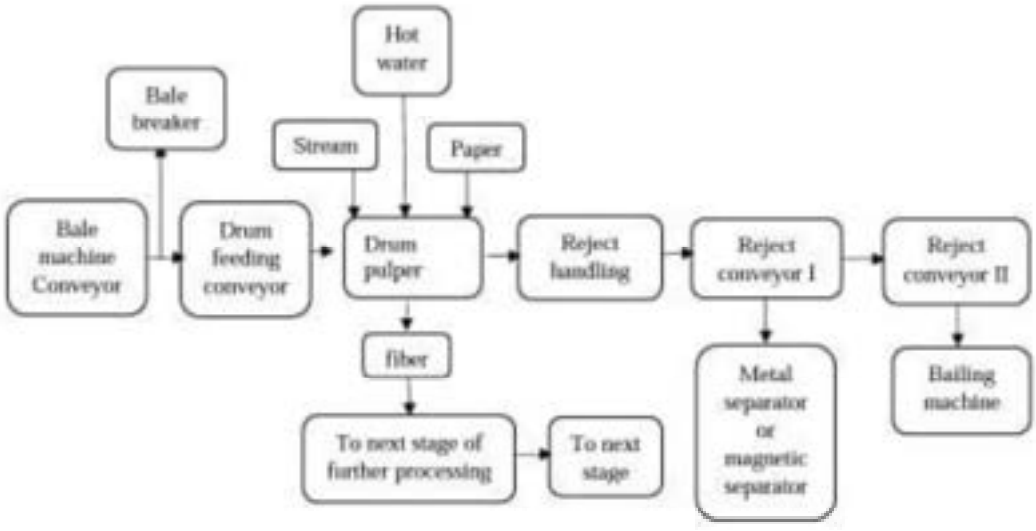


Figure 3.1 Block diagram of proposed system

3.2.1 Bale machine conveyor

A baler, most often called a hay baler is a piece of farm machinery used to compress a cut and raked crop (such as hay, cotton, flax straw, salt marsh hay, or silage) into compact bales that are easy to handle, transport, and store. Often, bales are configured to dry and preserve some intrinsic (e.g. the nutritional) value of the plants bundled. Different types of balers are commonly used, each producing a different type of bale – rectangular or cylindrical, of various sizes, bound with twine, strapping, netting, or wire.Industrial balers are also used in material recycling facilities, primarily for baling metal, plastic, or paper for transport.A type of baler that produces small rectangular (often called "square") bales was once the most prevalent form of baler, but is less common today. It is primarily used on small acreages where large equipment is impractical, and also for the production of hay for small operations, particularly horse owners who may not have access to the specialized feeding machinery used for larger bales. Each bale is about 15 by 18 by 40 inches (38 cm × 46 cm × 102 cm). The bales are usually wrapped with two, but sometimes three, or more strands of knotted twine. The bales are light enough for one person to handle, about 45 to 60 pounds (20 to 27 kg), depending upon the crop and pressure applied (can be 100 lbs for a 16"x18" 2-string bale). Many balers have adjustable bale chamber pressure and bale length, so shorter, less-dense bales can be produced for ease of handling.

3.2.2 Bale breaker

In order to transport recyclable materials economically over long distances after the first treatment stage, they are pressed into bales of different sizes. These bales must be broken up after transport in order to feed the recyclable materials to the following processing steps. Work safety has the highest priority today. Removing wires from wrapped bales is a dangerous operation when carried out manually. For this reason, our customers have entrusted us with the development of the bale breaker. These machines can process the following types of bales without any problems,

- Mixed Plastic Bales
- Paper Bales
- Bottle Bales

3.2.3 Feeding Conveyor

Feeding Conveyor as a solution in the material handling equipment. Our range of conveyor are designed and manufactured to give high durability and efficient performance. Our range of conveyors is rich in reliability and thus helps in the reduction of the maintenance and cost of the equipment. Made from Mild steel plates, our Material Feeding Conveyors are useful in the functioning of the oil mill plants. These are used in the feeding of seeds and cakes. Our conveyors are available in various sizes, capacities and specifications. These sizes vary from 6 inches to 15 inches. Our company also offers customization facility to our clients as per their needs and requirements.

In our conveyor, the screw is enclosed in a flexible or rigid plastic tube, or a rigid steel tube, which is driven by an electric motor and is normally, located at the discharge end of the conveyor. Also, a removable clean-out cap is placed to cover the intake end of the conveyor tube, thus enabling the conveyor for rapid emptying and flushing tube. It also helps in the disassembling and washing down of the components. Thus, making our range of conveyors more appropriate for the related industries.

3.2.4 Drum pulper

Pulpers play an important role in recovered paper stock preparation. The pulpers mechanically break down the recovered paper under simultaneous addition of water. The pulping system significantly affects both the cost-effective designing of the entire stock preparation line and also the finished stock quality. All pulping systems slush down the paper completely, without damaging fibers and without breaking down nonpaper components. Minimum investment and operating costs and also minimum energy consumption are further important requirements. The function of the pulper is to gently slush the recycled paper raw material into a pumpable pulp, which is suitable for processing in stock preparation while facilitating the efficient removal of contaminants from the pulp. The design of the pulping and detrashing equipment should satisfy a number of process requirements presented as follows:

- Slush down the recycled paper to individual fibers without causing any fiber damage and reducing fragmentation of contaminants enabling efficient removal in the downstream cleaning and screening processes

- An efficient detrashing system for removing contaminants in the first stage of the stock preparation process
- Undertake ink detachment
- Effective blending of chemicals

To meet these process requirements, several pulping and detrashing systems have been developed and operated successfully.Vat-type pulpers often with batch operation are being used in many deinking plants. Recovered paper and water are charged to the vat, repulped, and afterwards drained from the vat. A batch process consumes more energy. Power demand peaks when the pulper is charged with paper. A batch pulper has a higher downtime because it is offline when being unloaded. Installing continuous drum or dry pulpers will reduce energy consumption. This may also reduce water use and associated water heating requirements.

3.3 Deinking Process

Deinking chemicals are generally added to the pulper (Lassus 2000). During pulping the recovered paper is slushed into a pulp at high consistency. The combination of chemical and mechanical action is favourable. Additionally, by dosing early in the process to the pulper the reaction time is increased as well as the more effective dosage of some chemicals as the result of a high consistency. Figure shows a schematic layout of a typical deinking process for the production of pulp for graphical grade paper. Often all deinking chemicals are added to the pulper, but sometimes some or all of the deinking aid can also be added to the flotation cell.Schematic layout of a deinking process for the production of deinked pulp for graphical grades showing possible addition places for deinking and bleaching chemicals. A variety of deinking aids exist. In traditional alkaline deinking these aids are often composed of fatty acids and/or non-ionic surfactants. Sodium hydroxide (NaOH) is also added for reasons such as ink detachment and ink dispersion. It is commonly believed that ink detachment is improved using sodium hydroxide both because of fibre swelling effects as well as chemical hydrolysis of some bonds between the substrate and some ink species. The pH at the exit of the pulper is often between 8.5-10.5 when deinking a newspaper/magazine furnish.

3.3.1 Neutral and low alkali deinking

A new trend for certain processes and mills in the deinking of newspaper and magazine based raw materials is to move away from traditional alkaline deinking and towards lower pH levels which are commonly referred to as "true neutral" deinking (pH about 6.8-7.2) and "reduced or low alkali" deinking (pH about 7.2-8.8). Often these desires are driven by chemical cost savings and/or environmental factors. In true neutral deinking only surfactant, usually a blend of different synthetic surfactants, is added to the pulper.

3.3.2 Surfactants

Surfactants are surface active agents. This chemically unique species have a dual character. This character consists of hydrophilic and hydrophobic portions of the chemical structure. In an aqueous environment, the hydrophilic portion is water loving and relatively polar while the hydrophobic part of the surfactant is water hating and relatively non-polar (Figure 2). Surfactants can be non-ionic, anionic, or cationic. For the anionic and cationic species the hydrophobic part normally includes a hydrocarbon chain (-CH2-CH2-) and the hydrophilic part includes a variety of chemical functionalities. These can include entities such as an amine group (-NH3), a carboxyl (-COOH), sulphonate (-SO3), or sulphate (-SO4) group among others. Non-ionic synthetic surfactants generally contain blocks or units of various alkoxylates, most commonly derived from either ethylene or propylene oxides.

3.3.3 Fatty acids

Fatty acids have been used to produce fatty acid salts (soaps) for centuries. These soaps have been used to remove dirt from different surfaces. Saturated fatty acids, such as stearic acid (18 carbons) or palmitic acid (16 carbons) are solid at room temperature while unsaturated fatty acids, like linoleic acid (18 carbons with two double bonds at the 9 and 12 positions) can be liquid . Fatty acid products are normally mixtures of several fatty acids with different structure.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware Specification

- Motor(3phase)
- Conveyors
- Magenetic Seperator
- Bailing Machine
- Selector Switch

4.1.1 Motor(3 Phase)

A 3 phase motor is a motor which uses a 3 phase AC supply to work 3 phases means three circuit are used in which current lag from each other by 120 degree.

4.1.1.1 Stator

Stator of three phase induction motor is made up of numbers of slots to construct a 3 phase winding circuit which is connected to 3 phase AC source. The three phase winding are arranged in such a manner in the slots that they produce a rotating magnetic field after 3Ph. AC supply is given to them.

4.1.1.2Rotor

Rotor of three phase induction motor consists of cylindrical laminated core with parallel slots that can carry conductors. Conductors are heavy copper or aluminum bars which fits in each slots & they are short circuited by the end rings. The slots are not exactly made parallel to the axis of the shaft but are slotted a little skewed because this arrangement reduces magnetic humming noise & can avoid stalling of motor.

4.1.1.3 Working of Three Phase Induction Motor

The stator of the motor consists of overlapping winding offset by an electrical angle of 120°. When the primary winding or the stator is connected to a 3 phase AC source, it establishes a rotating magnetic field which rotates at the synchronous speed. Secret behind

the rotation, according to Faraday's Law an emf induced in any circuit is due to the rate of change of magnetic flux linkage through the circuit.

As the rotor winding in an induction motor are either closed through an external resistance or directly shorted by end ring, and cut the stator rotating magnetic field, an emf is induced in the rotor copper bar and due to this emf a current flows through the rotor conductor. Here the relative speed between the rotating flux and static rotor conductor is the cause of current generation; hence as per Len's Law theYIOP rotor will rotate in the same direction to reduce the cause i.e. the relative velocity.

Thus from the working principle of three phase induction motor it may observed that the rotor speed should not reach the synchronous speed produced by the stator. If the speeds equals, there would be no such relative speed, so no emf induced in the rotor, and no current would be flowing, and therefore no torque would be generated. Consequently the rotor can not reach the synchronous speed. The difference between the stator (synchronous speed) and rotor speeds is called the slip. The rotation of the magnetic field in an induction motor has the advantage that no electrical connections need to be made to the rotor. Thus the three phase induction motor is,

- Self-starting.
- Less armature Reaction and brush sparking because of the absence of commutators and brushes that may cause sparks.
- Robust in construction.
- Economical.
- Easier to maintain.

Figure 4.1 3 phase motor

If the speeds equals, there would be no such relative speed, so no emf induced in the rotor, and no current would be flowing, and therefore no torque would be generated. Consequently the rotor can not reach the synchronous speed If the speeds equals, there would be no such relative speed, so no emf induced in the rotor, and no current would be flowing. The difference between the stator (synchronous speed) and rotor speeds is called the slip. The rotation of the magnetic field in an induction motor has the advantage that no electrical connections need to be made to the rotor.

Table 4.1 Specification of motor

Parameter	Specification
Power	7.5 HP
Connetion	220V Double star
Coil	1-7
Line Voltage	208-230/460
Current	3.2-3/1.5
Magnetic Core Length	2"1/2

4.1.2 Conveyor

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium the conveyor belt that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more. Belt conveyors can be used to transport product in a straight line or through changes in elevation or direction. For conveying Bulk Materials like Grains, Ore, Coal, Sand etc., over gentle slopes or gentle curvatures, a

troughed belt conveyor is used. The trough of the belt ensures that the flowable material is contained within the edges of the belt. However, in this case the idler frame completely surrounds the conveyor belt helping it to retain the pipe section, while pushing it forward. In the case of travel paths requiring high angles and snake-like curvatures, a Sandwich Belt is used.

The trough is achieved by keeping the idler rollers in an angle to the horizontal at the sides of the idler frame. A Pipe Conveyor is used for material travel paths that require sharper bends and inclines up to 35 degrees. A pipe conveyor features the edges of the belt being rolled together to form a circular section like a pipe. Like a Troughed Belt Conveyor, a Pipe Conveyor also uses idler rollers. However, in this case the idler frame completely surrounds the conveyor belt helping d. In the case of travel paths requiring high angles and snake-like curvatures, a Sandwich Belt is used.

Figure 4.2 Conveyor

The sandwich belt design enables materials carried to travel along a path of high inclines up to 90 degree angles, enabling a vertical path as opposed to a horizontal one. This transport option is also powered by idlers.

Table 4.2 Specification of Conveyor

Parameter	**Specification**
Horizontal Length	148.5m
Width	650mm
Rated Capacity	100t/h
No of plies	3
Total thickness of belt	14.1mm
Belt speed	1.25 m/s

4.1.3 Magnetic Seperator

A magnetic separator is a device that uses a magnet to remove impurities and other magnetic materials from metal. Magnetic separators can be used before, during and after the production of a material and can be adjusted to attract different types of magnetic materials at different intensity levels.Although its use is almost always industrial in nature, a magnetic separator is used for a wide variety of applications. Magnetic separators can be ferromagnetic or paramagnetic and can vary in size from a table version to a large, heavy drum used in recycling and other manufacturing applications.

A magnetic separator consists of a powerful magnet that is placed or suspended from a ceiling or device. Materials can be passed over a table top magnetic separator, while suspended magnetic separators often hang over a material to remove its impurities. Magnetic separators can also be cylinders through which objects pass. The material that purifies a magnetic separator can be in the form of parts, a finished product or even a liquid metal. With this, a magnetic separator is characterized by,

- To be an excellent machine to separate magnetic materials from concentrates.
- Removes natural magnetic minerals such as magnetite, as well as steel filings from metal processing material and iron particles.
- Remove magnetic like gold concentrates, because it allows gold to recover much more easily.

Figure 4.3 Magnetic separator

Magnetic cell separation is on the rise. It is currently being used in clinical therapies, more specifically in cancers and hereditary diseases researches. Magnetic cell separation took a turn when, Zborowski, an Immunomagnetic Cell Separation (IMCS)

pioneer, analyzed commercial magnetic cell separation. Zborowski uncovered crucial revelations that were then used, and are still used today, in the human understanding of cell biology. Today, the manufacture of therapeutic products concerning cancers and genetic diseases, are being innovated due to these discoveries. Zborowski uncovered crucial revelations that were then used, and are still used today,Magnetic separation techniques are also used in microbiology. In this case, binding molecules and antibodies are used in order to isolate specific viable organisms, nucleic acids, or antigens. Magnetic separation techniques are also used in microbiology. In this case, binding molecules and antibodies This technology helps isolating bacterial species to identify and give diagnostics of genes targeting certain organisms. When magnetic separation techniques are combined with PCR (polymerase chain reaction), the results increase in sensitivity and specificity.

Table 4.3 Specification of Conveyor

Parameter	Specification
Size	1200mm and 916mm
Length	3000mm
Operating Temperature	250 Degree C
Magenet size	400*400*100mm

4.1.4 Bailing Machine

A baler, most often called a hay baler is a piece of farm machinery used to compress a cut and raked crop (such as hay, cotton, flax straw, salt marsh hay, or silage) into compact bales that are easy to handle, transport, and store. Often, bales are configured to dry and preserve some intrinsic (e.g. the nutritional) value of the plants bundled. Different types of balers are commonly used, each producing a different type of bale – rectangular or cylindrical, of various sizes, bound with twine, strapping, netting, or wire.

Industrial balers are also used in material recycling facilities, primarily for baling metal, plastic, or paper for transport. Due to the ability for round bales to roll away on a slope, they require specific treatment for safe transport and handling. Small round bales can typically be moved by hand or with lower-powered equipment. Large round bales, due to

their size and weight (they can weigh a ton or more) require special transport and moving equipment.

The most important tool for large round bale handling is the bale spear or spike, which is usually mounted on the back of a tractor or the front of a skid steer. It is inserted into the approximate center of the round bale, then lifted and the bale is hauled away. Once at the destination, the bale is set down, and the spear pulled out. Careful placement of the spear in the center is needed or the bale can spin around and touch the ground while in transport, causing a loss of control. When used for wrapped bales that are to be stored further, the spear makes a hole in the wrapping that must be sealed with plastic tape to maintain a hermetic seal.

Alternatively, a grapple fork may be used to lift and transport large round bales. The grapple fork is a hydraulically driven implement attached to the end of a tractor's bucket loader. When the hydraulic cylinder is extended, the fork clamps downward toward the bucket, much like a closing hand. To move a large round bale, the tractor approaches the bale from the side and places the bucket underneath the bale. The fork is then clamped down across the top of the bale, and the bucket is lifted with the bale in tow. Grab hooks installed on the bucket of a tractor are another tool used to handle round bales, and be done by a farmer with welding skills by welding two hooks and a heavy chain to the outside top of a tractor front loader bucket.

Figure 4.4 Bailing machine

The rounded surface of round bales poses a challenge for long-haul, flat-bed transport, as they could roll off of the flat surface if not properly supported. This is particularly the case with large round bales their size makes them difficult to flip, so it may not be feasible to flip many of them onto the flat surface for transport and then re-position

them on the round surface at the destination. One option that works with both large and small round bales is to equip the flat-bed trailer with guard-rails at either end, which prevent bales from rolling either forward or backward. Another solution is the saddle wagon, which has closely spaced rounded saddles or support posts in which round bales sit. The tall sides of each saddle prevent the bales from rolling around while on the wagon, as the bale settles down in between posts. so it may not be feasible to flip many of them onto the flat surface for transport and then re-position them on the round surface at the destination. One option that works with both large and small round bales is to equip the flat-bed trailer with guard-rails at either end, which prevent bales from rolling either forward or backward. Another solution is the saddle wagon, On 3 September 2010, on the A381 in Halwell near Totnes, Devon, UK an early member of British rock group ELO Mike Edwards was killed when his van was crushed by a large round bale. The cellist, 62, died instantly when the 600-kilogram (1,300 lb) bale fell from a tractor on nearby farmland before rolling onto the road and crushing his van. . so it may not be feasible to flip many of them onto the flat surface for transport and then re-position.

Table 4.4 Specification of Bailing machine

Parameter	Specification
Bale Size	12 *15*T
Bale Weight	25-30Kg Ferrous
Chamber Size	45''*15"*18''
Electric motor	15 Hp 3phase 1440Rpm

4.1.5 Selector Switch

Selector switches are available in a variety of styles including illuminated, non-illuminated, and non-illuminated key operated. Styles offered range from maintained or spring return, incandescent or LED, and 3-50 amps. Work with a selector switch specialist to determine the best product for your application.This product overview focuses mainly on the construction and functionality of Non-Illuminated Selector Switches. The Non-Illuminated Selector Switch is represented in both the Selector Switch Diagram as well as

the Selector Switch Video Overview. Selector switches use cams in combination with contact blocks to provide a wide range of circuit openings and/or closings. In the following diagram, "X" designates a closed circuit (energized or "on") for a particular selector switch position, and "O" to designate an open circuit (not energized or "off"). The Non-Illuminated Selector Switch is represented in both the Selector Switch Diagram as well as the Selector Switch Video Overview. Selector switches use cams in combination with contact blocks to provide a wide range of circuit openings and/or closings. In the following diagram, "X" designates a closed circuit (energized or "on") for a particular selector switch position, and "O" to designate an open circuit (not energized or "off").. The fork is then clamped down across the top of the bale, and the bucket is lifted with the bale in tow. Grab hooks installed on the bucket of a tractor are another tool used to handle round bales, and be done by a farmer with welding skills by welding two hooks and a heavy chain to the outside top of a tractor front loader bucket.

Figure 4.5 Reject Conveyor II switch

Contact blocks are an integral part of selector switches. The contact block can have normally open (NO) and/or normally closed (NC) configurations. twice the

functionality to a switch because one switch operates two circuits. You can add multiple contact blocks to increase functionality. For example, you can mount 4 dual circuit blocks to a 30mm pushbutton for a total of 8 circuits. Dual circuits offer two contacts in a single contact block. The combinations include,

- 1 normally open and 1 normally closed contact
- normally open contacts
- normally closed contacts

Combinations with special delayed opening or early closing contacts.Dual circuit contact blocks save space in enclosures and add twice the functionality to a switch because one switch operates two circuits. a single circuit is an efficient, inexpensive way to get the job done.For example, you can mount 4 dual circuit blocks to a 30mm pushbutton for a total of 8 circuits.

Figure 4.6 Selector Switch

The automotive sector plants produced by BRIZIO BASI use multiple technologies, for: fluid treatment (brake systems, engine, etc.), Each system is designed by the engineers of BRIZIO BASI according to customer needs, and is entirely made at our factory. Contact blocks are an integral part of selector switches. The contact block can have normally open (NO) and/or normally closed (NC) configurations. Single circuits contain a contact block of either one normally open or one normally closed circuit. For applications that need only one contact, a single circuit is an efficient, inexpensive way to get the job done. Dual circuits offer two contacts in a single contact block. Indicating lights are part of selector switches. Setting a selector switch is how we tell machines how to operate.

Indicating lights tell us what the machine is do or failing to do. When a light is connected to a machine process, and the light is on, the machine shows that it's working. Contact blocks are an integral part of selector switches. The contact block can have normally open (NO) and/or normally closed (NC) configurations. Single circuits contain a contact block of either one normally open or one normally closed circuit. For applications that need only one contact, a single circuit is an efficient, inexpensive way to get the job done.

Table 4.5 Specification of Selector switch

Parameter	Specification
Rated carry current	10A
Rated insulation voltage	600V
Insulation Resistance	100 M ohms (min)
Contact Resistance	100 m ohms (max)

4.2 Software Specification

4.2.1 800 XA Control Software AC 800M Engineering

AC 800M control applications can be created in any of the five IEC 61131-3 dialects by using Engineering workstation, and then be downloaded to controllers using the Control Builder. Control applications can be distributed and executed on several controllers and communicate with each other on Control Network using named variable communication. Parts of the application can be downloaded to different controllers .The functionality range for control applications is wide, from binary control to closed loop control, with advanced functions like auto tuning PIDs, fuzzy control, etc. Pre-defined process objects like motor objects,valve objects, etc. are available. It is possible to build user-defined function blocks, and also to hide its content in order to protect the intellectual property. User-defined serial protocols can be developed in structured text with the support of special functions needed. The rich function block library includes several types of control loops, including advanced control and auto- tune capabilities as well as integration for ABB drives and motors. The controller communication by means of Ethernet includes on board RNRP redundancy along with a broad set of communication modules to connect to third-

party devices. A superior redundancy concept allows for fast switch-over times and topologically separated CPU-modules. Several CPU modules are available, varying in terms of processing power, memory size and redundancy support. Priority controlled, time-based tasks allow the highest stability control tasks.Supporting standard IEC 61131-3 programming languages, Compact Control Builder is the tool for engineering the control code and the hardware layout of AC 800M. It creates logic, sequential and analog control-intensive automation solutions for all existing controllers in the automation system to be handled in one database. The flash memory card allows loading applications without the need to utilize the engineering tool to support OEM and remote solutions.The AC 800M for Compact Control Builder is a family of PACs built as rail - mounted modules, consisting of CPUs, communication modules, power supply modules and various accessories. There are 7 CPUs to choose from, ranging from medium processor power and low cost to high processor power and support for full redundancy. Compact Control Builder is the tool for engineering the control code and the hardware layout of AC 800M. It creates logic, sequential and analog control-intensive automation solutions for all existing controllers in the automation system to be handled in one database.

4.2.2 Benefits

- Full modularity and flexibility for all environments for future expansion of control applications
- Compact Control Builder software offers a wide range of powerful control solutions and reusable libraries for efficient configuration
- Robust design and redundancy options in all critical areas of the controller and its components eliminates single-point failures and secures maximum availability
- Supports a broad range of I/O products that can be integrated into a spectrum of industrial processing applications.

4.2.3 The programming languages

4.2.3.1 Function Block Diagram

Function Block is a graphical language for depicting signal and data flows by means of library-stored software elements and interconnecting signals. Function block programs are easy to develop and, thanks to the resulting graphical diagrams, also easy to

read. Many specific types of functional block diagrams have emerged. For example, the functional flow block diagram is a combination of the functional block diagram and the flow chart. Many software development methodologies are built with specific functional block diagram techniques. An example from the field of industrial computing is the Function Block Diagram (FBD), a graphical language for the design of programmable logic controllers. The functional block diagram can picture,

- Functions of a system pictured by blocks
- input and output elements of a block picured with lines
- the relationships between the functions, and
- the functional sequences and paths for matter and or signals

4.2.3.2 Structured Text

Structured text (ST) is a high-level programming language. It has a comprehensive range of constructs for assignments, function calls, expressions, conditional statements, iterations, etc. ST lends itself well to writing advanced, compact - yet easily understandable - programs thanks to its logical and structured layout. It has a comprehensive range of constructs for assignments, function calls, expressions, conditional statements, iterations, etc. ST lends itself well to writing advanced, compact - yet easily understandable - programs thanks to its logical and structured layout.

4.2.3.3 Ladder Diagram

Ladder diagram (LD) is a graphical language based on relay ladder logic. Hence it is suitable for those who prefer to define interlocks and control actions in terms of relay contacts and coils, and other functions as "black boxes".

4.2.3.4 Sequential Function Chart

Sequential function chart (SFC) is a graphical language for depicting the sequential behavior of a control system. It is used for defining time- and event-driven control sequences.

4.2.3.5 Instruction List

Instruction list (IL) is a low-level, execution-efficient PLC language where each statement corresponds to a single or only a few processor instructions. It has a structure similar to Assembler. Instruction List (IL) is one of the 5 languages supported by the initial versions of IEC 61131-3 standard, and subsequently deprecated in the third edition. It is designed for programmable logic controllers (PLCs). It is a low level language and resembles assembly. All of the languages share IEC61131 Common Elements. The variables and function call are defined by the common elements so different languages can be used in the same program.Program control (control flow) is achieved by jump instructions and function calls (subroutines with optional parameters).The file format has now been standardized to XML by PLCopen. Many vendors whilst incorporating the full IEC 61131-3 requirements have additional vendor specific calls/function blocks to suit their hardware such as reading or writing to I/O. Siemens PLC instruction list language is known as "Statement List" or "STL" in English, and "Anweisungs-Liste" or "AWL" in German, Italian and Spanish. The user of a Simatic development package may choose between German and International mnemonics to represent instructions. For example, "A" for "AND" or "U" for "UND", "I" for "Input" or "E" for "Eingang". It was from the automotive industry in the USA that the PLC was born. Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was mainly composed of relays, cam timers, drum sequencers, and dedicated closed-loop controllers. Since these could number in the hundreds or even thousands, the process for updating such facilities for the yearly model change-over was very time consuming and expensive, as electricians needed to individually rewire the relays to change their operational characteristics.

4.2.4 Program Changes

4.2.4.1 Configuration and Downloading

Applications can either be loaded into the target controller(s) by non-volatile Flash memory cards or over a serial link or The former approach is suitable for smaller and more standardized As it is based on IEC61131-3 and various standard fieldbus options are included, you will experience more freedom in designing your application.Ethernet network into battery backed-up RAM. The former approach is suitable for smaller and more

standardized duties where users can be spared involvement in the application software development and handling process.

4.2.4.2 Program Structure

You are gaining engineering productivity as there is only one tool covering the entire range of AC500 PLCs, from the compact AC500-eCo, the scalable AC500 including the safety PLC to the high availability and extreme conditions variants. Applications can either be loaded into the target controller(s) by non-volatile Flash memory cards or over a serial link or Ethernet network into battery backed-up RAM. The former approach is suitable for smaller and more standardized As it is based on IEC61131-3 and various standard fieldbus options are included, you will experience more freedom in designing your application.

4.2.4.3 Advantages

- Easy and fast programming in all IEC61131-3 languages plus CFC.
- Parameterization of all PLC I/O, network and fieldbus modules with specific device editors.
- Diagnostics is set up automatically for online monitoring of inputs and outputs.
- Debugging & diagnostics with multiple, comprehensive watch lists.

CHAPTER 5

SIMULATED RESULT

5.1 Simulated Result

In industries DCS controller, Separate conveyor ,waste material selection, metal separator are install physically on field. Using the control builder we creating the powerful control solution.It's done in a Windows based environmental,offering a wide range of control functionality for ABB's industrial controller AC800M.

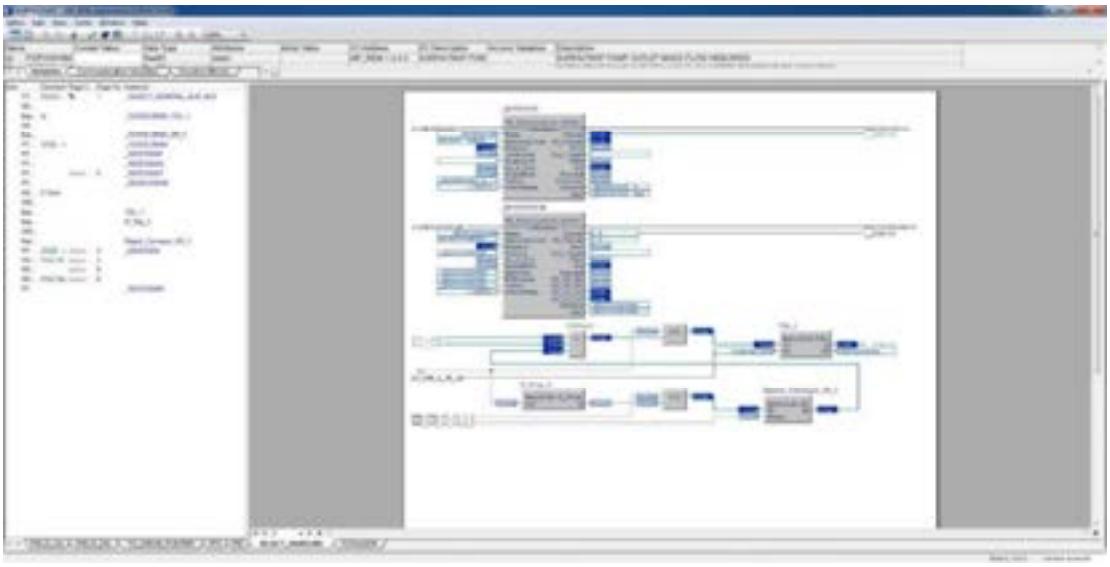


Figure 5.1 Control builder program logic 1

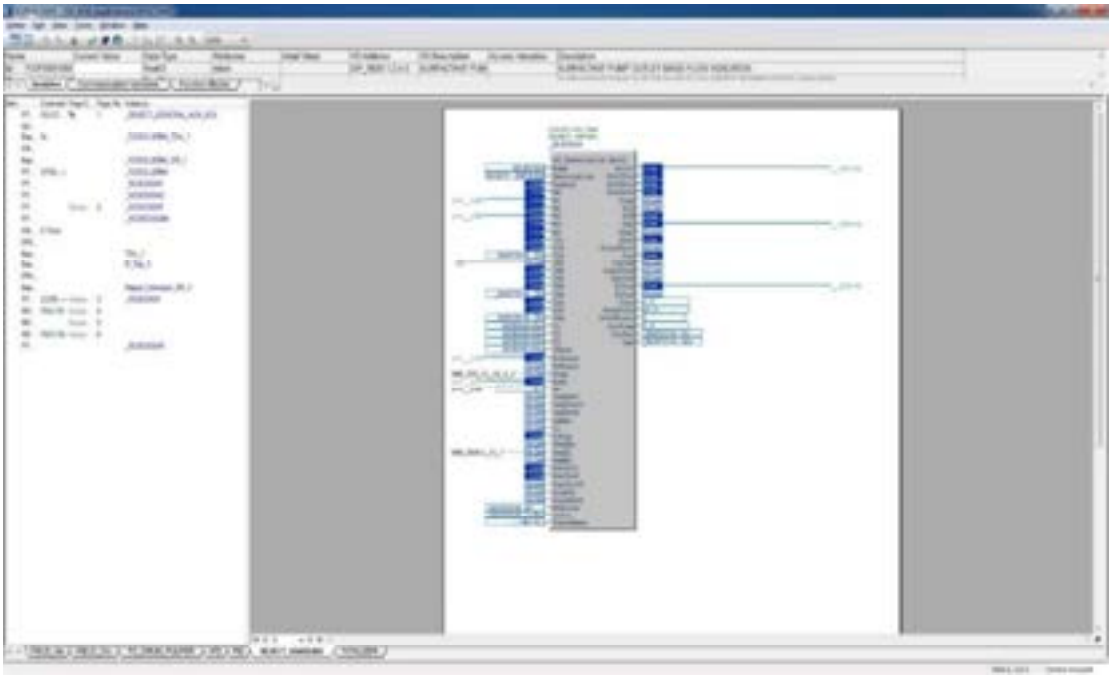


Figure 5.2 Control builder program logic 2

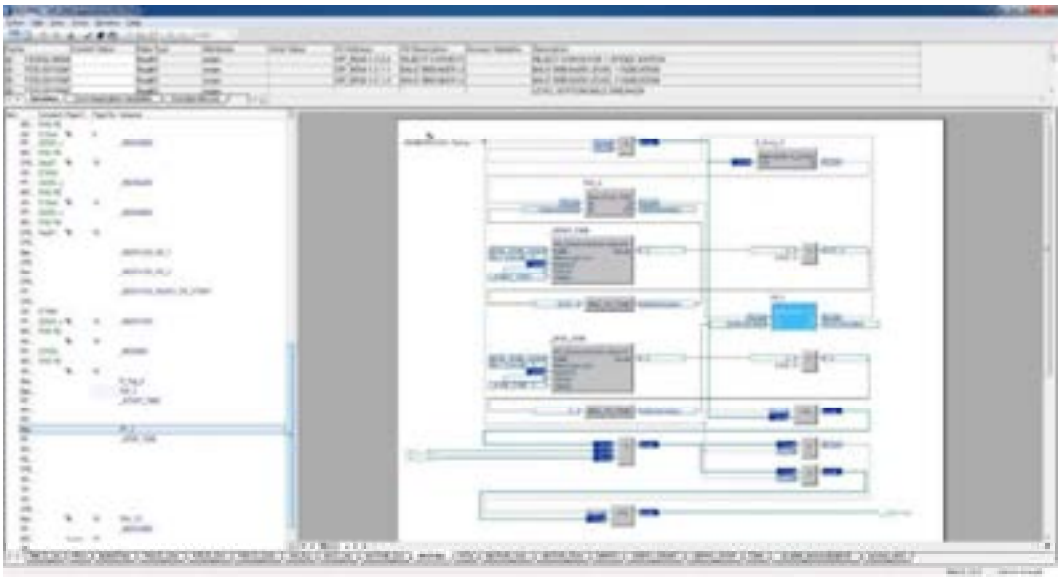


Figure 5.3 Control builder program logic 3

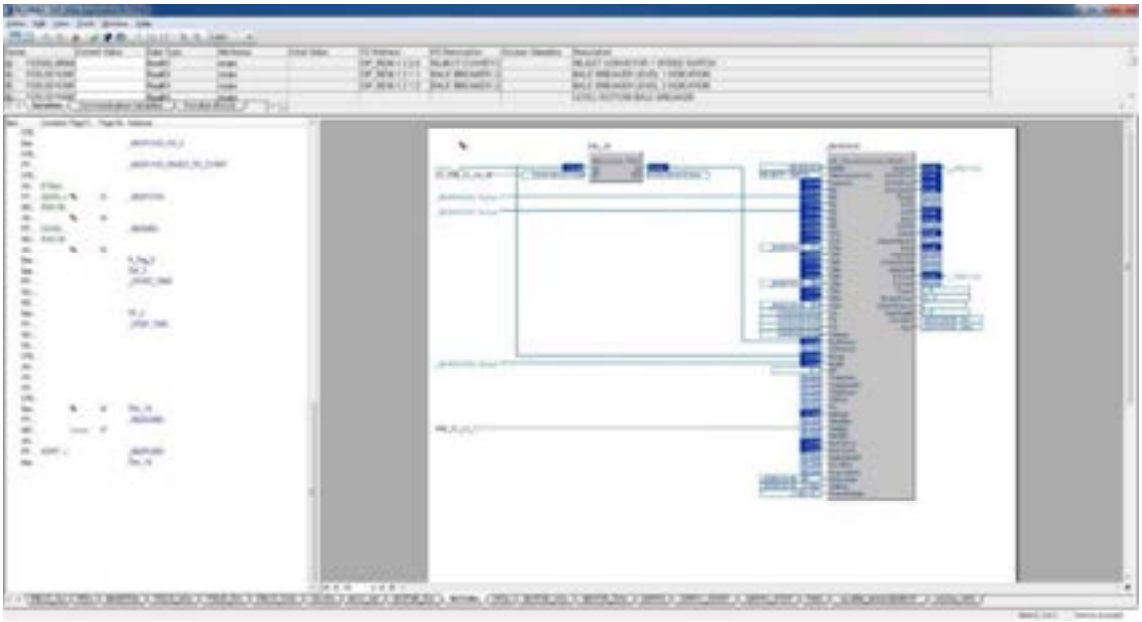


Figure 5.4 Control builder program logic 4

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 Conclusion

In here we have introduced the another reject conveyor for controlling the reject material levels during increase waste material. The reject conveyor II is plays the major role in our project. Here the reject handling conveyor II is used to saving the time and controlling the environmental impacts and reducing the more manual power and it's furtherly used some other purpose like cementplant,scrap yard.

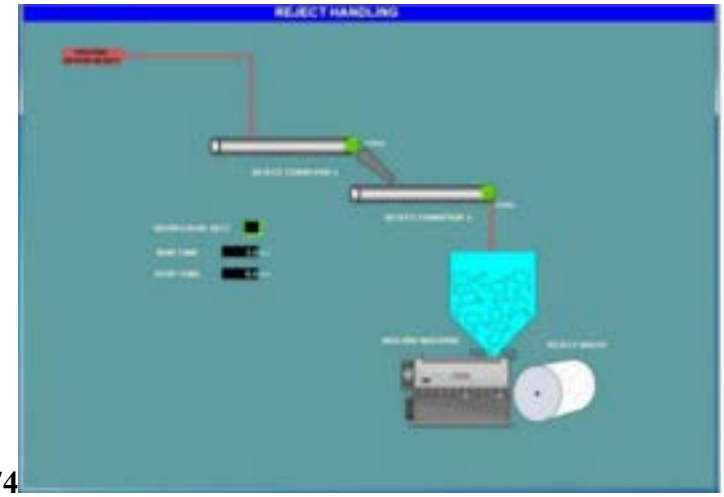
/874 

Figure 6.1 Reject Handling System

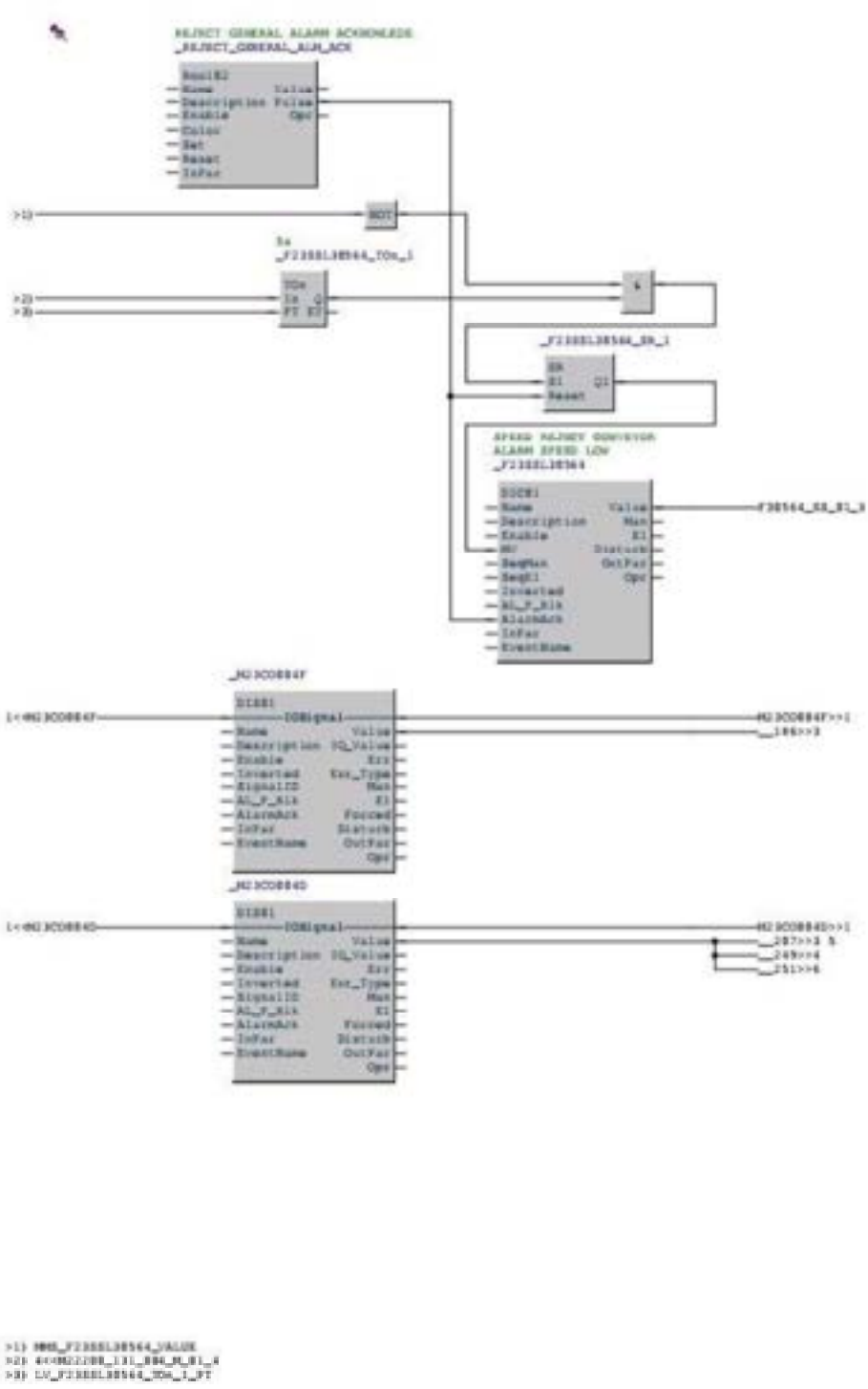
6.2 Future Enhancement

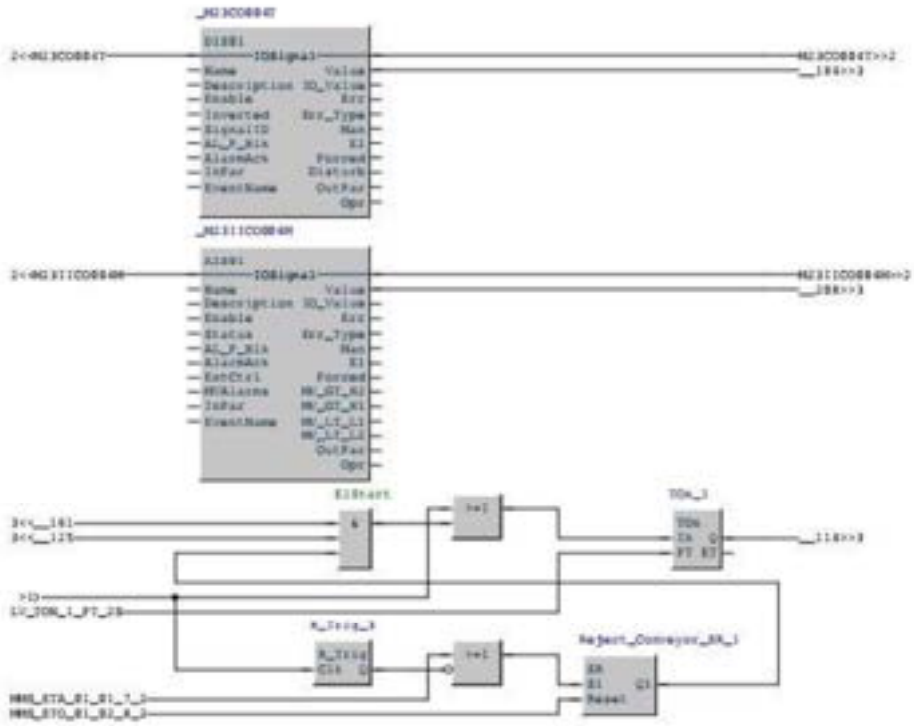
Future implementation of this reject handling system can be further enhancement of increasing the capacity of conveyor I and conveyor II, which is used to handle the reject materials properly and also now we bundle the reject material with the help of human being. In future may be we will make automatic Bailing machine which is used to handle the reject material automatically.

CHAPTER 7

APPENDIX

7.1 Source Code





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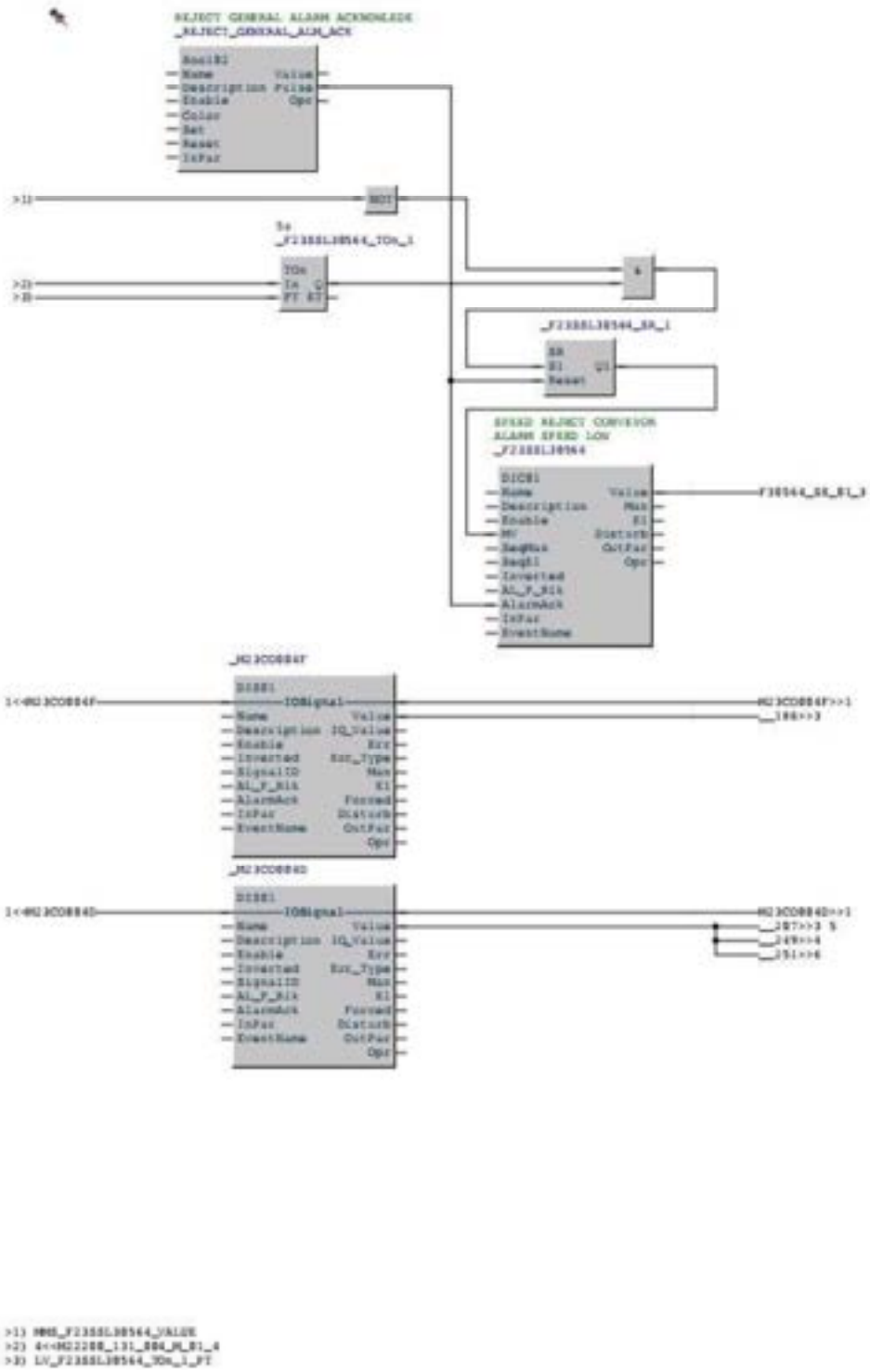
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Pulse
Opc
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TON
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Q
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>2)
>3)
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SwgMax
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S1
Distorb
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Opc
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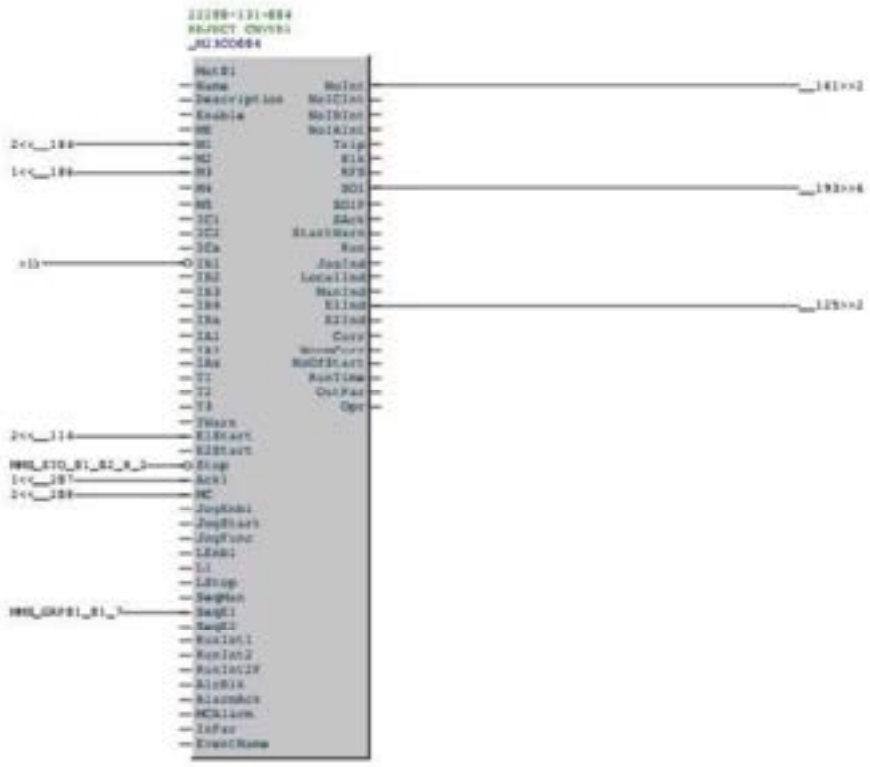

>1) LV_F2SELCT38198_VALUE

REFERENCES

1. Automatic waste segregator,International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue4S, February 2019.
2. Automatic Broke Feeding System for the Finishing House Pulper in Paper Machine,V. Ravichandran 1, Aravinth S.A.S 2, Dinesh M 2, Midhun Johny 2, Mohanasundaram K.S Asst. Prof., Department of EEE, Nandha Engineering College, Erode, India 2 UG scholar, Department of EEE, Nandha Engineering College, Erode, India.
3. A critical review on waste paper sorting techniques, M. O. Rahman A. Hussain H. Basri . Received: 20 September 2012 / Revised: 10 January 2013 / Accepted: 23 February 2013 Published online: 4 April 2013 Islamic Azad University (IAU) 2013.
4. Color/ Metal sensing sorting system, Pankaj Agarwal ,Ratnesh Kumar tiwari, Samardeep Banyal, Santosh Kanigicherla, Shivang Chaudhary Department of Electronics and communication, SRM Institute of Management & Technology, SRM University, NCR Campus
5. Development of Automatic Smart Waste Sorter Machine,Mahmudul Hasan Russel1* , Mehdi Hasan Chowdhury1 , Md. Shekh Naim Uddin1 ,Ashif Newaz1 , Md. Mehdi Masud Talukder2 Department of Electrical and Electronics Engineering1 , Department of Mechanical Engineering2 Chittagong University of Engineering and Technology (CUET) Chittagong-4349, Bangladesh.
6. Fiber Recovery from Waste Paper: A Breakthrough in Re-Pulping Technology,Jerry Aue, Energy Center of Wisconsin Keith Picard, Buttonwood Consulting, LLM.
7. Sorting of Objects Based on Color, Weight and Type on A Conveyor Line Using PLC,S. V. Rautu, A. P. Shinde, N. R. Darda,A. V.Vaghule, C. B.Meshram, S.S.Sarawade (Department of Mechanical Engineering, M.E.S. College of Engineering, Pune, S.P. Pune University, India).
8. State-of-the-Art Reject Treatment Systems for Recycled Fiber Lines, Avinash P. Kaldate 1, Sachin A. Kulkarn, Assistant Professor, Sinhgad college of engineering, Vadgaon(B.K.), Associate Professor, Sinhgad college of engineering, Vadgaon (B.K.), Pune.
9. Potential benefits of recovered paper sorting by advanced technology,"Gheorghe Asachi" Technical University of Iasi, Faculty of Chemical Engineering and Environmental Protection, 71, Dimitrie Mangeron Blvd., 700050 Iasi, Romania.

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Automation of Waste Paper Reject Handling System using DCS

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[3]Karur, Tamil Nadu, India

ABSTRACT

The main objective of this project to dispose the reject material properly and reduce the environmental impacts. This is a Deinking process (DIP). Deinking process is the one in which the ink from the office waste and newspaper and removed in order to prevent it from dispersion into the pulp sodium soap is used for removing the ink. The sodium soap produced in conveyer. The existing method have only one conveyer. It carries the reject material and it create the environmental hazards. But our proposed method has two conveyers. These conveyers are worked with the help of DCS. It reduces the environmental pollution and reduce the need for more manual labor. The conveyer 1 has a magnetic separator which separate the metal, iron and its components. The conveyer 2 has a reject material like polythene and reject material. Those materials are conveyed Baling machine by using the conveyer 2. Finally, all the reject materials are bundled by using the baling machine.

KEYWORDS: *Motor (3 phase), Magnetic separator, Conveyor, ABB-DCS, AC800M controller*

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I. INRODUCTION

A distributed control system is a computerized control system for a process. It has many control loops. A distributed throughout the system with each component sub-system controlled by one or more controllers. The control systems is connected to the communication medium. It is used to monitoring the networks. DCS is a broad term. It is used in many types of application. Its monitor and control the distributed components. Beginning of the DCS devices that controlled process and turned valves on the site modeling of the system is made by DCS and it allow the ability to record and managing process. Because DCS is used to control process control remotely and gain of how they can be improved to both increase safety and profit and how the process operates the possibilities. Transmit information is used to find the output of the instrumentation in field. In this process we are using electrical buses and multiplexer buses. It connects to the processor and modules and multiplexer buses are connected to the central controller to distributed controller. It is used in HMX (human-machine interface). DCS system are deployed in operations may cause material and personnel losses. Increasing the investments to the control system to prevent the possible to include redundant solution. Redundancy are nowadays standard built in options for DCS and also its not necessary for them to write a custom program. It is related with online and offline applications changes. A DCS acts to run non-stop for gears. DCS (distributed control system) systems denoted as dedicate systems. It is used to manufacturing processes. central station power generation is used to generate the power. It is also used to more application like cement production, paper making and steel making. The most popular example is a setpoint control loop which consist of pressure sensor, controller and control valve. The flow measurements are transmitted in signal controlling of input/output(I/O) device.

II. PROPOSED SYSTEM

In this proposed method, the waste paper is obtained from the waste products. It has two reject conveyors. The two reject conveyors are connected in serious connection. The two reject conveyors are operated in based on time. The reject conveyor I consist of metal separator which is used to separate the metal from the reject wastage. Then the reject waste material is passed through the bailing machine with the help of reject conveyor II. The reject conveyor II carries the waste materials such as polythene and etc. The metal separator attracts the metals and iron components. The obtained metals are passes to the scrap yard. In this scrap yard this metal is melted and its used to reproduce another metal product. The polythene papers are sent to the kiln and its used in cement plant for raise the temperature. The reject conveyor II having the waste papers which is passes to the

bailing machine. After receiving the bailing machine, the papers are compressed and its bundled with the help of iron strip. Then the reject conveyor I and reject conveyor II works at simultaneously before filling the bailing machine. When the bailing machine was filled the reject conveyor II works based on the timer, we set the run time and stop time

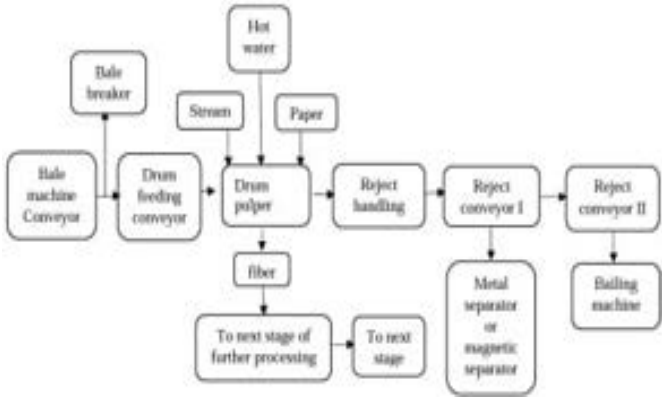

Fig1. Block Diagram

III. HARDWARE IMPLEMENTATION

A. MOTOR (3PHASE)

A electric motor converts the electrical energy into mechanical energy which has different types of loads. A.C (Alternating Current) motors operates on a power supply which has classified into

- Synchronous motor
- Single phase motor
- 3phase motor

When a 3phase induction motors are most widely used for industrial applications mainly because they do not require any starting device.

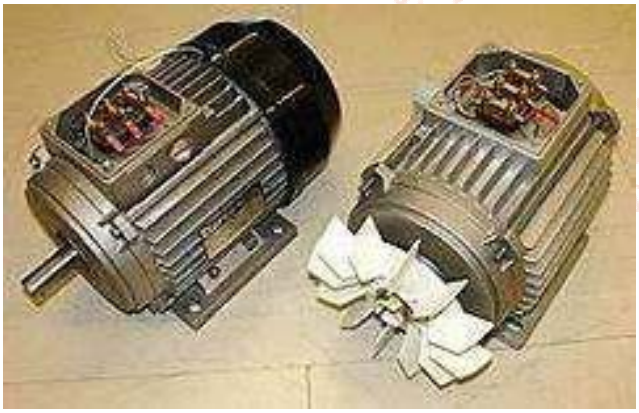

Fig2. Motor (3Phase)

In an 3phase induction motor, the rotor current is introduced by the magnetic field, instead of electrical connection. The principle of this motor is based on the production of RMF. (rotating magnetic field) which is used to rotates the motor at synchronous speed. The direction of rotation of the motor is depends on the sequence of supply lines and these lines are connected to the stator. Motors are commonly configured to have 2,4,6 or 8 poles.

Synchronous speed of rotation = (120*supply frequency) / Number of poles on the stator

B. CONVEYOR

A conveyor belt is used to carrying medium of a belt conveyor system. The many types of conveyor based upon the work. A belt conveyor is one of the conveyors. In this belt conveyor system having of two or more pulleys. It's carries the medium conveyor belt that rotates. These two pulleys are more powered. It moving the belt and these material passes to the forward direction. There are two types of pulley available one is Powered pulley another one is Unpowered pulley.

This Powered pulley is known as drive pulley and Unpowered pulley is known as idler pulley. This material is used to transport large volume resources. Finally, it produced agriculture material like sand, ore, coal, salt, grain and etc., Transport product through changes in elevation or Its direction by using belt conveyor. It produces the bulk materials like grains, coal, sand and ore etc.,

Fig3. Conveyor

C. MAGNETIC SEPERATOR

A magnetic separator is a device which is used to remove the impurities and magnetic materials. It can be used to make the production of a materials and It can be adjusted to attract different types of materials at different intensity levels. It is use almost industrial in nature. A magnetic separator is used for variety of application. It can be ferromagnetic or paramagnetic and It can vary in size. Heavy drum used in recycling and more manufacturing application.

Fig4. Magnetic Separator

D. BAILING MACHINE

A bailing machine is used to bundle the waste material with help of humans. A baler is called hay baler is used to compress a cut and raked crop. The compact baler is easy to handle. Transport and store bales to preserve by using some intrinsic valve plants are bundled. Each of the plants producing a different type of bale which is find out in cylindrical of various size, strapping. the different types of balers are used in this method of bailing machine Due to this ability for bales. They require specific treatment for safe transport and handling.

Fig5. Bailing Machine

E. SELECTOR SWITCH

Selector switches are available in various of styles and also it has illuminated, non-illuminated key operated. The styles offered range from maintained or sprains return and 3-50 amps. The selector switch work with specialist to determine the best product for your application. In this product is mainly focus on the construction and functionality of non-illuminated selector switches.

Fig6. Selector Switch

IV. SOFTWARE IMPLEMAENTATION

A. 800 XA CONTROL SOFTWARE AC 800M ENGINEERING

AC800M control application can be created in any of the five IEC 61131-3 dialects using the control bulider. It can be downloaded to controllers using the control builder. It can be distributed and excuted on several controllers and control network using named variable communication. Part of the application can be downloaded to different controllers. The fuctionality range for control application is wide and it's control to closed loop control with more advanced functions like fuzzy control, auto tunning PID, etc., Predefined process objects like valve objects, motor objects, etc., User define function block are possible to build and also to protect the intellectual property. User define serial protovals can be developed in structured text and it's support the special fuctions needed.

It have several type of control loops, including advanced control and auto tune capabilities as well as integration for ABB drives and motors. The controller communication is an ethernet. It's includes on broad RNRP redundancy. This broad set of communication modules is connect to third party devices. Superior redundancy allows for fast swich-overtimes. In this superior redundancy topologically seperated CPU modules and It have several CPU modules available. It varying the terms of processing power, memory ize and redundancy support.

Fig7. Control Builder Logic 1

V. CONCLUTION

In here we have introduced another reject conveyor for controlling the reject material levels during increase waste material. The reject conveyor II is playing the major role in our project. Here the reject handling conveyor II is used to saving the time and controlling the environmental impacts and reducing the more manual power. Then the reject material passes to the bailing machine and it's furtherly used some other purpose like cement plant, scrap yard.

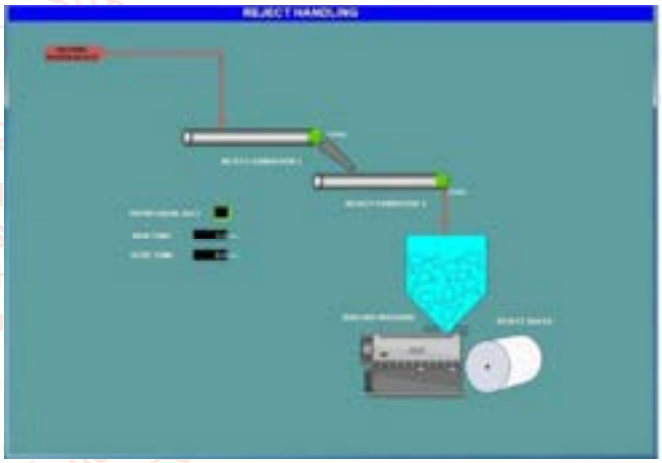

Fig8. Reject Handling System

REFERENCES

[1] Automatic waste segregator, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue4S, February 2019.

[2] Automatic Broke Feeding System for the Finishing House Pulper in Paper Machine. Ravichandran 1, Aravinth S. A. S 2, Dinesh M 2, Madhu Johny 2, Mohanasundaram K.S Asst. Prof., Department of EEE, Nandha Engineering College, Erode, India 2 UG scholar, Department of EEE, Nandha Engineering College, Erode, India.

[3] A critical review on waste paper sorting techniques, M. O. Rahman A. Hussain H. Basri. Received: 20 September 2012 / Revised: 10 January 2013 / Accepted: 23 February 2013 Published online: 4 April 2013 Islamic Azad University (IAU) 2013.

[4] Color/ Metal sensing sorting system, Pankaj Agarwal, Ratnesh Kumar tiwari, Samardeep Banyal, Santosh Kanigicherla, Shivang Chaudhary Department of Electronics and communication, SRM Institute of Management & Technology, SRM University, NCR Campus

[5] Development of Automatic Smart Waste Sorter Machine, Mahmudul Hasan Russel1*, Mehdi Hasan Chowdhury, Md. Shekh Naim Uddin1, Ashif Newaz1, Md. Mehdi Masud Talukder2 Department of Electrical and Electronics Engineering1, Department of Mechanical Engineering2 Chittagong University of Engineering and Technology (CUET) Chittagong-4349, Bangladesh.

[6] Fiber Recovery from Waste Paper: A Breakthrough in Re-Pulping Technology, Jerry Aue, Energy Center of Wisconsin Keith Picard, Buttonwood Consulting, LLM.

[7] Sorting of Objects Based on Color, Weight and Type on A Conveyor Line Using PLC, S. V. Rautu, A. P. Shinde, N. R. Darda, A. V. Vaghule, C. B.Meshram, S. S. Sarawade (Department of Mechanical Engineering, M.E.S. College of Engineering, Pune, S. P. Pune University, India).

[8] State-of-the-Art Reject Treatment Systems for Recycled Fiber Lines, Avinash P. Kaldate 1, Sachin A. Kulkarn, Assistant Professor, Sinhgad college of engineering, Vadgaon(B.K.), Associate Professor, Sinhgad college of engineering, Vadgaon (B.K.), Pune.

[9] Potential benefits of recovered paper sorting by advanced technology, "Gheorghe Asachi" Technical University of Iasi, Faculty of Chemical Engineering and Environmental Protection, 71, Dimitrie Mangeron Blvd., 700050 Iasi, Romania.

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SPEED CONTROL OF PERMANENT MAGNET SYNCHRONOUS MOTOR FOR THE RATE CONTROL OF WEAPON (GUN)

A PROJECT PHASE-II REPORT

Submitted by

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in partial fulfillment for the award of the degree of

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PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

The main objective of the project is to stabilize the gun against the disturbances and to position the gun precisely against the target as well as to control the rate of the gun. All ac electrical gun control system is composed of permanent magnetic synchronous machine driven control system and ball-screw by replacing the complicated electro hydraulic systems. At the same time, the variable-structure system sliding modes makes the gun control system to have higher performances using the only rate flexure gyroscope. Elevation axis model of a barrel stabilization system is constructed. The nonlinearities which are considered in the model are orifice flow characteristics, coulomb friction, hard-stop limits, kinematics of the system and unbalance on the barrel. A Simulink model for the servo valve, actuation system and barrel is constructed. Servo valve identification is made via the actual test data. Compressibility of the hydraulic fluid is taken into consideration while modeling the actuation system. Friction model is simulated for different cases. Controller of the system is constructed by two PIDs, one for each of the velocity and the position loops. Velocity feed forward can reduce the time to make a quick move by the system. The disturbance is evaluated from a given road profile and disturbance feed forward is applied to the system.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATION
AFV	Armoured Force Vehicle
CCH	Commander's Control Handle
DC	Direct Current
FE	Fine Element
GCH	Gunner's Control Handle
GCS	Gun Control System
GES	Gun Elevation Sensor
IFCS	Integrated Fire Control System
LVDT	Linear Variable Differential Transducer
MATLAB	Matrix Laboratory
MBT	Main Battle Tank
MRS	Muzzle Reference System
PID	Proportional-Integral-Derivative
SCP	Super Coiled Polymer
TCP	Twisted and Coiled Polymer
TPS	Turret Position Sensor
WCS	Weapon Control Systems

CHAPTER 1

INTRODUCTION

1.1 Introduction

Weapons used in the battlefield are demanded to be lighter, more mobile, easily controllable and able to shoot with a high accuracy. One of these weapons used in land is the Main Battle Tank (MBT). MBT is probably the most important weapon because of its being mobile, armoured and having heavy-fire capacity. Developments of MBT are parallel to the improvements in heavy weaponry, Weapon Control Systems (WCS) and hull mobility. Heavy weapons have became more effective with the improvements in material science and chemistry. Mounting of these weapons to the hull produces some problems. Control systems become more important while the system become larger and more complex. Drive technology and control systems determine the size of the MBT. Hull mobility depends on the vehicle technology to overcome the problems of cross-country movement. Mobility demands in battlefield lead to the requirement of firing while moving instead of stopping at each time the MBT engages a target. This demand can be achieved by WCS by minimizing the tank's hull movement effects on the barrel.

This is followed by the use of hydraulic drive systems. After electrical motors were used for slewing the barrel, rapid and precise control has been satisfied. Improvements in traversing the turret were applied to the powered control of the elevation control of tank guns. This adoption has led to the stabilization of the barrel.

1.2 Stabilization of Barrel on a Main Battle Tank

Motion of vehicles causes some unwanted movements on the barrel. These movements must be minimized in order to hit a target while moving.

Gunners are expected to minimize this effect especially in elevation by rotating the barrel in the opposite direction of the hull's motion. But the frequency of this kind of motion varies from 0 to 3- 4 Hz while the response of the human operators is not more than 0.5 Hz.

In this situation, the effects of vehicle motion on the barrel can be minimized by stabilization systems which are designed to maintain the barrel position according to the earth. Figure 1 and Figure 2 illustrate the problem in detail.

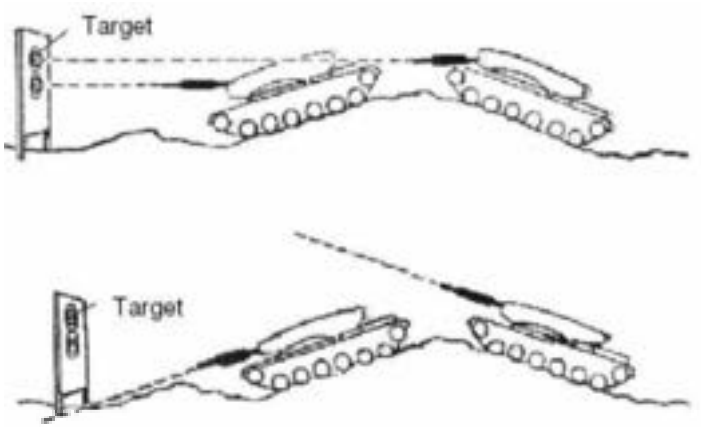

Figure 1.1 Barrel Motion in Elevation

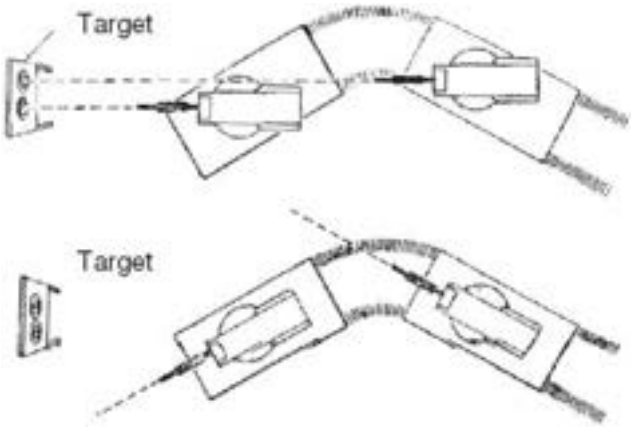

Figure 1.2 Barrel Motion in Azimuth

In 1998, Purdy enhanced the stabilization ratio by using the hull rate gyroscope for feed forward. This study gave the results of the simulations of linear and nonlinear model with and without disturbance feed forward and nonlinear model with feed forward and friction compensation. In another study in 1999, Purdy made a simple elevation model and examined the out of balance effect on WCS. These studies deal about the electrical drive technology. They also have no model in a computer program revealed in the publications.

Systems aimed to do this stabilization basically closed loop servo systems which control the movement of the barrel relative to the earth by using gyroscopes and feedback signals produced by them. Simplest stabilization systems are assigned to cope with the elevation changes and made up of a single closed loop system with a rate gyroscope mounted on the barrel to sense its angular velocity.

For the existing gun systems without making substantial modifications, MRS could be useful in controlling the deflections of gun barrels with estimation/prediction algorithms. The vibration levels could be cut into half by the use of optimised vibration absorbers for an existing gun. A new gun system with a longer barrel can be as accurate as the one with a short barrel with the appropriate structural modifications.

Tank stabilizer is a control system keeping the bore axis in the desired sighting angle. For the control problem of the stabilizer in the case of uncertain parameters, the adaptive control method is introduced to design the vertical tank stabilizer with the nonlinear dynamic model of vertical stabilizer given in the paper. In the design, the multiple parameter uncertainties of the hydraulic servo system are fully considered and the linear feedback control is used to improve the asymptotic stability of the system. The vertical stabilizer of tank is simulated in MATLAB/Simulink environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Hydraulics Control System

2.1.1 Introduction

The stabilization of the barrel on a MBT in elevation axis is considered. Only the elevation axis is considered because it is affected much more than the azimuth axis from the road profile. Since a stabilization system improve an ability of hitting targets while the tank is moving without stopping, the effects of disturbances on the barrel should be taken into account.

Sometimes modelling so many details becomes harmful instead of being helpful as the system may not be settled with the desired accuracy because of the problems mentioned above. While modelling, critical case is to determine the modelling criteria and assumptions. While constructing the elevation axis model, the following assumptions are made:

- There is a stable source of hydraulic fluid supply at constant pressure.
- Effects of hydraulic fluid inertia are negligible.
- Gage pressures are used.
- No temperature change exists.
- There is no leakage.

2.1.2 System Model

In this study, the "system" will represent the union of the servo valve, the actuator and the barrel. Hull dynamics is not included in the system mentioned in this study. While it is assumed that road profile is known and correctly transformed via the gyroscopes on the hull, it is included in the system

as disturbance representing the hull motion.

2.1.3 System Identification

Computer simulations of systems give the opportunity to the users to study on the computer to make the design instead of constructing real systems. But it should not be expected that the response of the simulations will be the same as the real system even parameters of the real system are known.

Matlab and similar programs introduce us many methods to identify the systems. The output plots can be seen in the figure. The valve was controlled by a PID while the position of the third stage spool (LVDT) is fed back.

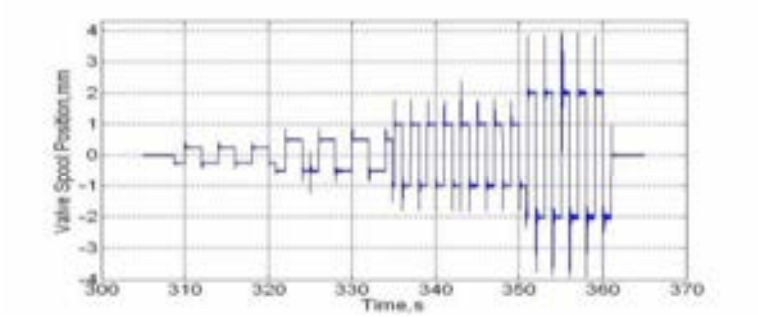

Figure 2.1 The LVDT Output of Servo Valve Test

In this study, this identification is repeated while taking the input as the position demand corresponding to the electrical input in mm. As seen in figure 5there are transition periods and some disturbances which cannot be used in identification.

2.1.4 Feedback

The servo valve is used to control the velocity of the actuator. Pressure feedback is a way of adding damping to this subsystem. Pressure feedback is able to increase damping based on the fact that the cylinder pressure is related to the derivative of the cylinder velocity. Feeding back the derivative of the cylinder velocity increases the damping of the system, thus improves the transient performance. The only problem with this strategy is that the pressure

information also contains the effect of external forces. A high-pass pressure filter is introduced to deal with this problem. A high-pass pressure filter is introduced to deal with this problem.

2.1.5 Dither Signal

Behaviour of a hydraulic servo valve can be unpredictable because of striation which keeps the valve spool from moving when input signal changes are small. When the signal finally becomes large enough to initiate a movement, the spool will tend to overshoot the position required for accurate control. Dither is a rapid, small movement of the spool around the desired position. It is intended to keep the spool moving to avoid striation. Dither amplitude must be large enough and the frequency slow enough for the spool to respond, and yet small and fast enough to avoid creating a noticeable pulsation in the hydraulic output of the valve. By its nature, dithering introduces pattern into an image the theory being that the image will be viewed from such a distance that the pattern is not discernible to the human eye. Unfortunately this is often not the case, and often the patterning is visible. In these circumstances it has been shown that a blue noise dither pattern is the least unsightly and distracting. The error diffusion techniques were some of the first methods to generate blue noise dithering patterns. However, other techniques such as ordered dithering can also generate blue noise dithering without the tendency to degenerate into areas with artifacts.

2.1.6 Actuator Model

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a mover. An actuator requires a control signal and a source of energy. The control signal is relatively low energy and may be electric voltage or current, pneumatic or hydraulic pressure, or even human power. Its main energy source may be an electric current, hydraulic fluid pressure, or pneumatic pressure. When it receives a control signal, an actuator responds by converting the signal's energy into mechanical motion. An actuator is the

mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.

The unknown parameter which is the variable edge of the triangle for this mechanism is the length of the actuator.

2.1.7 Barrel Model

United States Navy guns typically used rifling depth between one-half and one percent of caliber. Projectile bourrelet diameter specification was 0.015 inches (0.38 mm) less than land to land diameter with a minus manufacturing tolerance so average clearance was about 0.012 inches (0.30 mm). Driving band diameter was groove to groove diameter plus 0.02 inches (0.51 mm). A longer barrel allows more propellant to be used: the propellant is all burned fairly early in the projectile's journey along the barrel, except in the very common instance where combustion is still occurring as the projectile leaves the muzzle and a visible muzzle flash is produced.

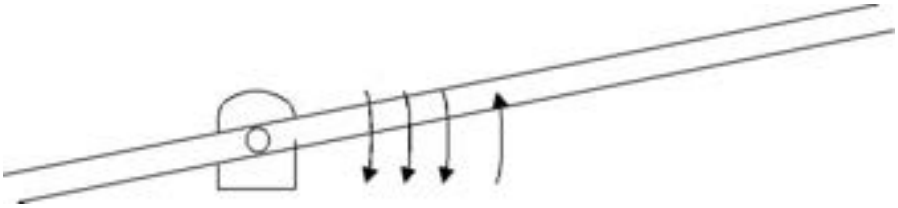

Figure 2.2 Torques acting on the Barrel

Twisted and Coiled Polymer (TCP) actuator also known as Super Coiled Polymer (SCP) actuator is a coiled polymer that can be actuated by electric power. A TCP actuator looks like a helical spring. TCP actuators are usually made from silver coated Nylon. TCP actuators can also be made from other electrical conductance coat such as gold. TCP actuator should be under a load to keep the muscle extended. The electrical energy transforms to thermal energy due to electrical resistance, which is also known as Joule heating, ohmic heating

and resistive heating. As the temperature of the TCP actuator increases by Joule heating, the polymer contracts and it causes the actuator contraction. A mechanical actuator functions to execute movement by converting one kind of motion

2.1.8 Controller

System has two outputs to be controlled namely the angular velocity and the position. Each loop, which are constructed by feeding back the system output to the comparison with the desired value, is controlled by a PID controller. The position and the velocities in the system are measured by different devices. The device used for measuring the velocity is a classical mechanical gyroscope both for the barrel and the hull. The position of the barrel is measured by an inclinometer. At first look, it seems meaningless but the feedback signals are supplied from different sources. The gyro-scopes used in the system have a bandwidth of 30 Hz and a damping ratio of 0.7. Although they are relevant, in industrial applications controllers could be used in this way.

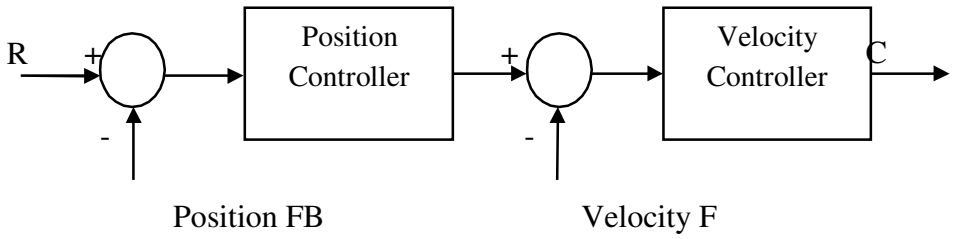

Figure 2.3 Classical Control Algorithm

New exact vibration solutions are presented for a class of non uniform beams where their density and the flexural rigidity vary along the longitudinal axis. The vibration solutions for this class of beams take the form of power functions instead of the Bessel functions of Kirchhoff and other researchers. The exact solutions are useful as reference benchmarks for assessing the validity, convergence, and accuracy of numerical and infinite series methods.

2.1.9 Unbalance Effect

The unbalance is the result of the mounting the barrel to the hull from anywhere except its centre of mass. Its effect on the barrel is an additional torque proportional to the displacement between the centre of mass and the mounting and the angular position of the barrel with respect to the hull. The hull is assumed always parallel to the ground.

However, this is not the only factor which cause torque on the barrel in vertical axis. While the tank moves on a curved surface, it rotates around an instantaneous center of rotation of ground profile. This affects the barrel as disturbance which is an angular velocity. The rate of change of the angular velocity is the acceleration and causes torque in the system in the opposite direction with the angular velocity.

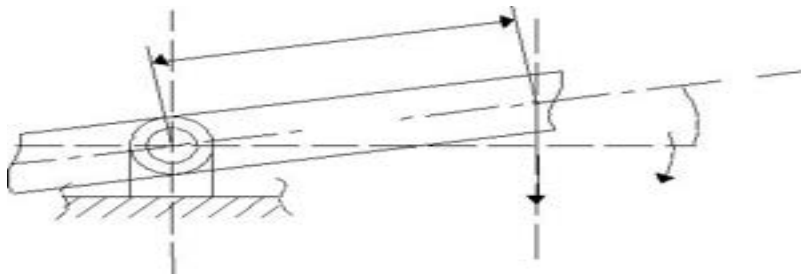

Figure 2.4 Unbalance Effect on the Barrel

2.1.10 Disturbance Feed Forward

Many process control loops are affected by large disturbances. Feedback control can act only on the result of a disturbance, which means feedback control cannot do anything until the process variable has been affected by the disturbance. Changes in process flow rate will be a major source of disturbances to the outlet temperature. If the process flow rate through the heater is increased, the original steam flow rate will not be enough to heat up the increased amount of process liquid and the outlet temperature will decrease. Feedback control will eventually increase the steam flow rate and bring the outlet temperature back to its set point, but not until there has been a significant deviation in temperature.

Review your controller documentation and take special care with scaling the feed forward signal. Many PID controllers expect the feed forward signal to be scaled between -100% and +100%.

2.1.11 Feed forward in Voltage loops

There are three types of control systems: open loop, feed-forward, and feedback. An example of a pure open loop control system is manual non-power-assisted steering of a motor car; the steering system does not have access to an auxiliary power source and does not respond to varying resistance to turning of the direction wheels; the driver must make that response without help from the steering system. In comparison, power steering has access to a controlled auxiliary power source, which depends on the engine speed. When the steering wheel is turned, a valve is opened which allows fluid under pressure to turn the driving wheels.

2.1.12 Drawback

Precise rate control cannot be achieved.

2.2 Electrical control system using induction motor

2.2.1 Introduction

Simulink models of the system components will be constructed and explained. Especially, servo valve identification and the friction model are handled in detail. Finally the complete system will be simulated for different cases. The simulations are made with a fixed time step of $5x10^{-4}$ s and the ODE5 (Dormant-Prince) solver is used. Because the fastest component of the system is the servo valve and its time constant is 0.0032 s. Since time step is very small, solution method also is selected 5^{th} order to be able to prevent the valuation error.

2.2.2 Valve Model and Identification Results

By combining these two blocks complete servo valve block is constructed. At this time, load pressure feedback is added to the valve. Load Pressure is fed back via a pressure transducer and high pass filter. High pass filter time constant is determined according to the load resonant frequency which is mentioned as 0.445 s. Scale for the input rad/s to mm is found by simulating the complete system with different inputs and takes the ratios with the angular velocity output. Corresponding valve openings are determined and the scale is obtained. At this time, load pressure feedback is added to the valve. Load Pressure is fed back via a pressure transducer and high pass filter.

2.2.3 Valve Identification

Servo valve is made up of three stages but there were the LVDT output and the command voltage as the input. The number of the step responses in Figure 14 was not equal for each amplitude. In this calculation two actual step response data are used for each amplitude. Minimum error surface and the simulations with the parameters found in this case were plotted.

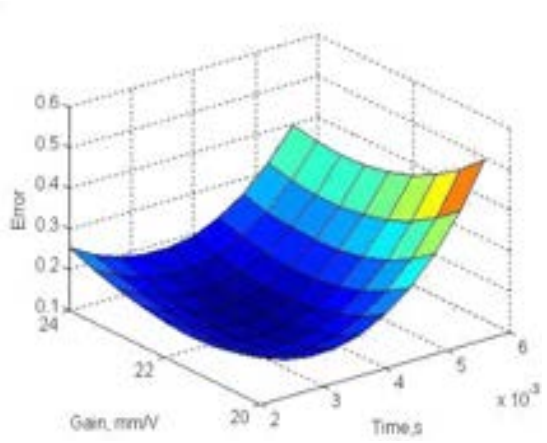

Figure 2.5 Error Surface for Servo Valve Identification

After these calculations, gain value, K, is found 21.8 and time constant, T, is found 0.0032 s. Identification is made by using the cost function via an "m" file which calculates the error between the simulation and the actual response by

simulating the servo valve model with different gain and time constant parameters. Servo valve is made up of three stages but there were the LVDT output and the command voltage as the input. The number of the step responses in Figure 14 was not equal for each amplitude. Load Pressure is fed back via a pressure transducer and high pass filter. High pass filter time constant is determined according to the load resonant frequency is 0.445 s.

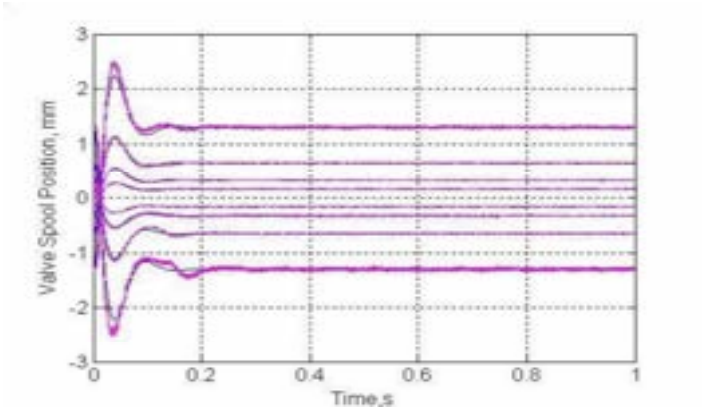

Figure 2.6 Servo Valve Simulation and Experiment Comparison

2.2.4 Actuator Model

In actuator, there are two important components which must be considered. One of them is compressibility of the hydraulic fluid and the other is the inverse kinematics of the slider-crank mechanism i.e., determination of the piston position and velocity. While finding the position of the actuator, initial condition is found by the position of the barrel. Finally it is assumed that the stroke will never touch the cylinder wall. So the corresponding dead volume in cylinder is considered in solution.

2.2.5 Friction Test Results

Friction model is considered to be done separately. The frictions and the mechanical limits are considered. Unbalance effect is not included. In this example, parameters are not the same as the original system. These are just for the representation for different cases. In this model, to determine the acceleration

of the barrel, the classical derivative block is not used. Instead of it, derivative is calculated by the help of the memory blocks in Simulink. Also another problem is the determining the point of zero cross of the relative velocity of the barrel. While the solution is made with fixed time steps "Zero Cross Detection" block cannot be used increment found by the derivative of the relative velocity and the time step. The sign change is detected between the relative velocities at the present and the next time step.

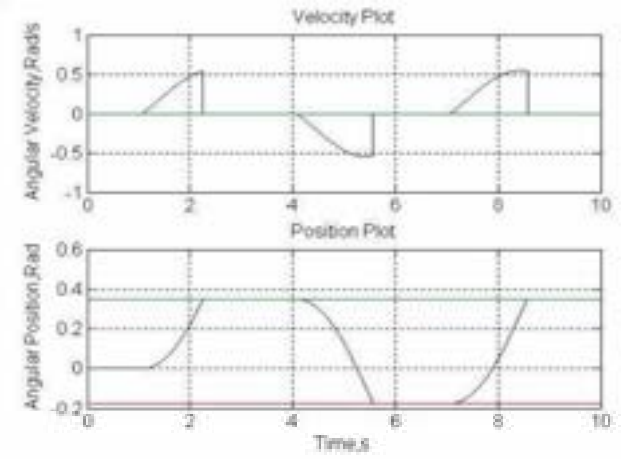

Figure 2.7 Velocity and the Position of Simplified Barrel

At first simulations, only torque was applied to the system while the disturbance is zero. Then only disturbance was applied to the system. The disturbance is an angular velocity at the joint which mounts the barrel to the hull. A series of torques and disturbances are selected to simulate. Disturbance is applied and friction is sometimes much more than the friction torque and caused the barrel rotates without touching the mechanical limits and be stuck when the friction decreases to a level less than the friction. In this situation velocity graphs have no jumps.

2.2.6 Barrel Model

The last component of the system is the barrel and it contains a logic block. This block checks the conditions which explained in Chapter 2 Section 4. According to the conditions, logic block decides whether the barrel moves or

stops at the next time step and selects the corresponding friction torque to this motion. By controlling the relative velocity and the physical limits, it defines the stop conditions and resets the integral block after this decision. Inertial torque is taken into consideration. Disturbance originates from the road profile is also used in this part of the model. The mechanical limits which are relative to the hull are demonstrated by the limited integrals.

2.2.7 System Simulation

Controller of the system consists of two PIDs. Velocity and position of the barrel are fed back. Each loop is controlled by one PID controller. In addition to this, for disturbance rejection, disturbance is fed forward to the controller.

Control strategy mentioned before is used by adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal.

Controller parameters are tuned while a step command which does not cause the barrel hit to the hard-stops is applied to the system. Tuning process used in controller is as follows.

- Set all gains zero.
- Apply a step command.
- Raise proportional gain until the system begins overshoot.
- Raise integral gain until overshoot is approximately 15 %.
- Raise derivative gain to remove some of the overshoot

Control strategy mentioned before is used by adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal. Control strategy mentioned before is used by

adding velocity feed forward to the controller. System input is a sine wave which is saturated before the peaks. Hence, the error while taking the derivatives of the command signal is prevented. Also feed forward is scaled with a gain to tune the effect of the feed forward on the command signal.

2.2.8 Drawbacks

Torque ripple occurs and precise control of the gun cannot be achieved.

2.3 Summary of Literature Review

Table 2.1 Summary of Literature Review

S.No.	Title	Technique	Drawbacks
1	Hydraulics Control System	Controls the position of the gun(weapon)	Precise rate control cannot be achieved
2	Electrical Control System using Induction Motor	Position as well as the speed can be controlled	Torque ripple occurs

CHAPTER 3

PROPOSED SYSTEM

3.1 Proposed system

ELEGANT is proposed for All Electric Drive Gun Control System of future AFVs. It would replace the electro-hydraulic systems and will offer long term solution to gun control system for a variety of AFV weight class. ELEGANT would consist of electro-mechanical actuators and digital electronics. The details of system are covered in the subsequent paragraphs. Primarily it would address the future requirement of AFVs and enables India's technological stand at par with the world scenario.

ELEGANT's primary role would be to provide precise motion control to weapon platform, stabilized mode of operation, provides man-machine interface to effectively & efficiently control gun / turret motion. The system is also to be integrated with the sighting system and offer slaved mode of operation for high first round hit probability. Secondary but major role would be to facilitate firing of main armament through its control handles in static and dynamic conditions.

3.2 System Performance – Target Specifications

An electric drive system offers many operational and maintenance advantages, apart from meeting the overall performance comparable to electro hydraulic system, and additionally provides smooth fine tracking capability. The brain of the stabilization system is the controller. PID controllers are used to control the position and the velocity of the system. To be able to tune the parameters of the controller, either an experimental setup should be used or a model should be constructed. The use of experimental setup may cause trouble and may be dangerous for the setup. To prevent from these undesired situations such as damaging the system elements, operator injury etc., a model will be

constructed and controller parameter tuning and system modifications will be realized by using this model. Considering this, the overall system performance targeted for the ELEGANT is given below.

Table 3.1 System Performance

Performance requirements		
Parameter	**Gun**	**Turret**
Operation Limits	+20 deg to -9 deg	n x 360 deg
Maximum Velocity	$\geq$7 deg/sec	$\geq$40 deg/sec
	$\leq$0.5 mil /sec	$\leq$ 0.5 mil / sec
	$\geq$2 rad/sec^2	$\geq$ 0.3 rad/sec^2
Minimum velocity	$\leq$ 0.4mils (1σ) Essential $\leq$ 0.2 mils (1σ) Desirable	$\leq$ 0.4 mils (1σ) Essential $\leq$ 0.2 mils (1σ) Desirable
Acceleration	$\leq$ 0.4mils (1σ) Essential $\leq$ 0.2 mils (1σ) Desirable	$\leq$ 0.4 mils (1σ) Essential $\leq$ 0.2 mils (1σ) Desirable

3.3 Estimated Load Parameters

The weight of the turret for the tanks beyond Arjun Mk II is expected to be smaller with less inertia compared to the existing turrets of Arjun MBT Mk I & II. However, the system proposed to be developed under this project will consider the load parameters of Arjun MBT Mk II to take care of retro-fitment provision and integrated tank performance evaluation requirements. Once developed for higher configuration, system can easily be redesigned for lower sizes. The actuation system as a slider-crank mechanism is modelled. Inverse kinematics is used to solve the relation between the barrel's angular position and the actuator position while the motion is transformed from translational movement to rotational. Keeping these requirements in view, the

load parameters estimated for this development project are as given below

Table 3.2 Physical parameters of PMSM

Physical parameters		
Parameter	**Gun**	**Turret**
Inertia	6000 Kgm^2	49 500 Kgm^2
Mass	3000 Kg	22 000 Kg
Friction	500 Nm	1100 Nm

3.4 Motor Selection – Why PMSM

DC motors are suitable for speed control applications and are being extensively used in industry because field can be controlled by the field current (i_f) and the torque is controlled by armature current (i_a).

$$Torque \propto i_f i_a$$

The speed can go as low as 5% of the base speed. The main disadvantage is that brushes cause arching and needs periodical maintenance which makes DC motors not suitable for harsh environment and mission critical application. Special class of synchronous motors called Permanent Magnet Synchronous Motor (PMSM) / Brushless DC Motor (BLDC) whose torque speed characteristic is similar to DC motor and can be controlled similar to DC motor. These synchronous motors have the field (Permanent Magnet) in the rotor and the armature winding in the stator, unlike the DC motor were field is in the stator (Field Winding) and the armature winding is in the rotor.

3.5 Controller Module

The controller module is based on Xilinx Virtex V FPGA(XC5VFX70T) with embedded POWERPC 440. The block diagram of the controller board is shown in Fig.2. The Controller is interfaced with other

systems through CAN 2.0B Bus. Parallel Flash is provided for application software storage and for logging the system data. nvRAM is provided for storing the tuned controller parameters. FPGA configuration bit file is stored in Serial Flash . The controller can be remotely accessed from Host computer through Ethernet Interface (Configurable to 10/100/1000Mbits/sec). ADC and DAC are provided for analog interface and Discrete I/O interface for interfacing Discrete signals. Synchronous Serial Intterface is for interfcing the absolute position encoder. PWM signals are generated using Space Vector Pulse Width Modulation Technique which uses DC bus voltage effectively compared to the conventional sine-triangle PWM technique. The following sensors are required for controlling the motor which are interfaced either Digitally or via Analog interface.

- Three Current Sensors for Measuring the motor Phase Current
- Optically Isolated AD converter to Measure the DC Bus voltage
- Encoder to Measure the Absolute position of the Motor Shaft
- Temperature sensor to measure the Bridge Temperature
- Current Sensor to measure the DC Bus Current.

3.6 Model of PMSM

The three phase stator winding can be transformed to equivalent two phase winding. So modeling an three phase PMSM can be now modeled as an equivalent two phase PMSM. A two phase PMSM stator with stator winding and rotor with permanent magnet is shown below. The windings are displaced in space by 90 electrical degree and rotor is at an angle or θ_r.The d- and q- axis stator voltage are the sum of resistive voltage drop and the rate of change of flux linkages in the respective winding

$$v_{qs} = R_q i_{qs} + \frac{d\lambda_{qs}}{dt}$$

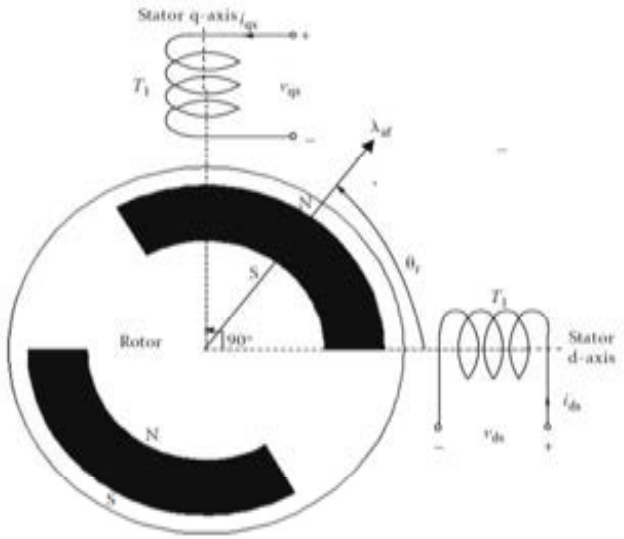

Figure 3.1 Two phase PMSM

3.7 Transformation to Rotor Reference Frame

All the above model for the PM Machines are with respect to the stator reference frame and it is seen that voltages and inductance are function of rotor position θ_r. Looking the entire systems from the rotating reference frame(Frame of reference rotating along with the rotor), the system inductance matrix will become independent of the rotor position.

3.8 Vector Control

Vector control, also known as decoupling or field orientated control. The key to the dc motor drives, performance is its ability to independently control the flux and torque. The flux is controlled by the field. Keeping the field current constant and hence the flux is constant, the torque is controlled by the armature current, Controlling the field and armature current magnitudes as they are dc variables, the flux and electromagnetic torque are controlled precisely in a separately excited dc motor drive. if such separate

and independent controls of flux and torque are feasible, will the problem of dynamic control go away. The key to it then, lies in finding an equivalent flux-producing current and torque-producing current (i.e., the armature current) in ac machines leading to the control of the flux and torque channels in them. The key to that, for ac drives, came in two forms one is the machine modeling in space phasor form, which reduced a three phase machine into a machine with one winding each on stator and rotor, thereby making it into an equivalent dc machine and other one is the ability of the inverter to produce a current phasor with absolute control of its magnitude, frequency, and phase. Both these features are exploited to make the PMSM drive system a high-performance drive system with independent control of its mutual flux and electromagnetic torque and are developed.

3.9 Voltage Selection

Conducted noise is transmitted along the electrical cables that connect the input power bus to the equipment while radiated interference occurs through the unintended transmission or reception of noise signals. EMI emission standards address noise generated by the equipment whereas EMI susceptibility standards describe the noise environments that the equipment must tolerate without malfunction.

From the design perspective, conducted emissions are further divided into common-mode and differential-mode noise. Differential-mode conducted noise results from currents flowing into one terminal of the converter and out the other, which is the normal current flow in the circuit. Common-mode current, on the other hand, flows through the chassis ground and returns in the same direction in both the power and return lines. Differential-mode current is generally associated with switching currents in the power converter whereas the common-mode currents are primarily a result of pulsating voltages in the circuit. Switching power converters are natural generators of input narrowband spectral noise currents having components at the fundamental switching frequency and higher order harmonics. The high

dV/dT associated with the switching power conversion causes Common Mode Currents, Icm = C(dV/dT), to be pumped in and out of the case corresponding to each transition of the MOSFET/IGBT and rectifiers. 270VDC input voltage based systems and motor windings may experience repeated applications of even higher than dc link/inverter voltage. It may increase electric motor drive voltages further during 4 quadrant operation in high PWM/dV/dT driven electric drives with added regenerative voltages. Higher the dV/dT, higher the common mode currents hence increased conducted emission. EMI issues can be avoided by implementing external power line filters and by proper grounding methods.

3.10 Capacitive Capacitance

The peak load requirements and braking applications of the drives can be better met by employing capacitive accumulator, instead of using very high motors. Whenever the peak load occurs in PMSM (Permanent Magnet Synchronous Motor) motors for short duration of time, the Up-Converter cannot meet the demanded power. During this time, the Capacitive Accumulator will discharge and supply the demanded surge power for short duration. Similarly whenever regenerative braking occurs in PMSM Motors then the PMSM motors will act as a power supply towards Up-Converter for short duration. During this time, the Up Converter will not be able to handle that ingress supply at the output side.

3.11 Motor

Various types of motors were studied for the applicability keeping in view the weight, volume and the smooth operation in the low speed conditions. Technological developments have recently pushed commutator-less electric motors into a new era. Advantages include high efficiency, higher power density and lower operating cost. They are also more reliable and maintenance free compared to commutator D.C motors. Thus, commutator-less electric motors have now become more attractive. By

replacing the field winding of synchronous motors with Permanent Magnets (PM), the motors can eliminate slip rings, field copper losses and conventional brushes which in turn eliminates arching and EMI issues. Therefore it is decided to use PMSM drive for this application. All world class tanks, namely Merkava, Leclerc & Leopard, have also been recently incorporated with Brushless drives.

3.12 Selection of Motor Type

AC and DC motors are studied for the applicability in the gun control system. Single phase and multiphase motors have trade off as given in the following paragraph. Single phase induction motors have problems for applications combining high power and flexible load conditions. High voltage capacitors are expensive that are essential to produce rotating magnetic field. Three phase AC motors are used for high power applications whenever multiphase AC supply is readily unavailable. Speed control circuits are quite complex in AC circuits. Also, the low speed operations, with speed of less than 1/3 of its base speed, are prohibited due to thermal considerations. DC motors are suitable for speed control applications and are being extensively used in industry. The speed can go as low as 5% of the base speed. But the brushes cause arching and needs periodical maintenance.

3.13 PMSM motor

PMSM is a permanent magnet AC Motor whose torque speed characteristics are identical to DC motor and can be controlled similar to a DC motor. It has longer life of operation as well as more compact and efficient. The motor offers higher torque as well as uniform torque over the entire speed range. Considering the merits and availability of PMSM motor, it is proposed to develop the ELEGANT with PMSM motor. These motors of required torque levels are available in the market as well as technology to develop indigenously.

3.14 Roller screw mechanism

Roller screw is the major component of Elevation actuator. The roller screw is a special mechanical unit, which translate rotary motion into linear motion. It enables Elevation actuator to impart linear motion to elevate and depress the gun. Major physical attributes of a screw are the pitch diameter, thread size and pitch. The screw has a mating nut or an internally threaded mating surface. A normal Screw-Nut with mating threads is shown in figure below. There is sliding friction acting between nut and screw at the mating surface of threads. This sliding friction is comparatively higher and results in sticking in motion and backlash. It surface contact also results in surface wear of threads which increase friction with time. It also put limitation on load bearing capacity.

In a roller screw, roller elements are added between the nut and screw threads which rolls in between the screw shaft and nut. The rollers also have threads with same pitch as screw shaft. Resulting there is no sliding motion and only rolling motion is present between the screw and nut. And the sliding friction is also replaced by rolling friction which is comparatively smaller in magnitude.

3.15 Gyros

For stabilization purpose of weapon system, Gyros are provided for important function of sensing the velocity of weapon system. Usually 3 numbers of Gyros are incorporated for complete stabilization loop, they are:

- One dual-axis rate gyro (Weapon Gyro)
- One single-axis rate gyros (Hull Gyro)
- One single-axis rate gyro(Turret Gyro)

Fiber options Gyro (FOG) are developed within the country at RCI / ELOIRA, Hyderabad. These gyros had been extensively tested and trial

evaluated to establish their reliability for Tank system. Gun control system employs rate sensor dual axis Gyro (consists of two single axis gyro mounted orthogonally in a single package) for feedback & Single Axis gyro for feed-forward signals. The dual axis gyro is fitted below the main gun and the single axis gyros are fitted on the turret roof to sense the pitch and on the hull side wall to sense the yaw. The important technical requirements of the gyros is the range up to 60 deg/s with a scale factor around 100 deg/sec, the bandwidth above 35 Hz, the cross axis sensitivity below 20mV and must be capable of withstanding up to 500 g, 2 milliseconds shock impact and EMI and EMC compliant.

3.16 Turret Position Sensor (TPS)

The turret of AFV is free to rotate 360 degree in azimuth and can take any position depending on functional requirement. Turret position sensor (TPS) senses the relative position of turret with respect to the hull. This is an important feedback for the deck-clearance function and the driver sitting in hull also need to sense the turret position with respect to hull. The contour of hull doesn't facilitate 9^o depression for the 360^o movement of the turret. Deck clearance mechanism enables automatic elevation of the Gun without colliding hull, while traversing the turret. Turret position signal is also essential to estimate tracking rate which provides an input to Ballistic computer. Presently the TPS is an independent unit which is mounted inside the turret and it is linked to the ring gear of turret. The sensor, an encoder is required to have an accuracy and resolution of 0.06^o for the deck clearance operation. The sensor selected to meet this requirement is a 14 bit encoder to sense turret position precisely, for various systems of the tank.

3.17 Gun Elevation Sensor

Gun elevation sensor is currently done in Arjun MBT using a resolver mounted in Gun Trunnion axis. This is an essential signal required for slaving the Gun to the sight or vice-versa depending on operation mode of the IFCS.

The sensor has to be very precise in line with the static and dynamic accuracy required for the tank system as well as to withstand firing shocks of the gun. The mechanical mounting arrangement to be rugged enough to meet this requirement and also to tune the same with reference to the GMS zero reference. The accuracy of mechanical alignment should be better than 0.05 mil and the positional accuracy of the sensor required is better than 10 arc secs. CVRDE could successfully develop the resolver mounting assembly and met the entire operational requirement. However, considering the latest digital technology products, it is proposed to replace the resolver with a rugged optical encoder of 14 bit (off the shelf) which can meet all the technical and operational requirement of the system.

3.18 Limit switches

In the existing configuration of Arjun MBT, 2 limit switches are provided to sense the elevation of gun in deck clearance zone. The gun can depress to maximum of 9 degree in frontal and size zone of hull, but its depression is limited to 6^o over track guard area and to 0^o deg over the engine deck. To sense this 6^o & 0^o depression angle, 2 external limit switches are provided. Images of these limit switches is given below. It is proposed to achieve this functionality as in-built in elevation actuator using internal limit switches which would give electrical trigger to control system for deck clearance function. Alternately, gun position signal can be used to operate deck clearance at desired angles.

3.19 Crew control handles

The ELEGANT requires two control handles for the crew, i.e., Gunner's control handle (GCH) which needs to be operated by the Gunner and Commander's control handle (CCH) which needs to be operated by the tank Commander. The Gunner and commander control handles form part of man-machine interface of the Gun control system of ELEGANT. These are the mechanical input devices for controlling the motion of Gun / Turret and it

also has switches for controlling various Fire control operations like laying, tracking, firing of laser, main gun / machine gun firing, etc.,. The tank Commander can override the Gunner for operation of GCS as well as to carry out the firing functions.

3.20 Gunner control box and Fire Control Box

Gunner's Control Box (GCB) is the man machine interface for Gun Control System (GCS), as it is used for selection of various modes of operation of the system namely Power Mode, STAB Ready Mode, STAB Mode, and Battle Mode. Also, GCB automatically activates the deck clearance at appropriate positions of gun based on the hull contour, by receiving the position signal from the Turret position Transmitter. GCB also indicate operation status and health conditions of the GCS.

Gunner's Control Box has four modes of operation:

1) Power Mode
2) Stab Ready Mode
3) STAB Mode
4) Battle Mode Note

3.20.1 Power Mode

This mode is generally engaged for surveillance purpose or to engage fire in stationary condition of the tank. The system will engage into Power Mode, when the rotary switch is selected to Power Mode. In this mode of operation, the system can be operated by pressing any one of the palm switch of the control handle, i.e., Gunner or Commander. Commander has override feature to take control of the gun at any point of time by pressing his palm switch.

3.20.2 Stab Ready Mode

The system will engage in to STAB Ready Mode when the rotary switch is in STAB Ready. In this mode the operation of Gun Control system function similar to the Power Mode, expect that the Fibre Optic Gyroscope

(FOG) of the system are made on. This mode is generally engaged before engaging STAB mode, and to save time for engaging stabilised mode operation of GCS.

3.20.3 Stab Mode

The system will function in stabilised (STAB) Mode, when the rotary switch is positioned / selected in 'STAB Mode' and controller is ready to engage to STAB mode. In this mode, the turret and gun are stabilised for any disturbance during dynamic condition of the tank. This mode is also known as primary mode of the Integrated Fire Control System (IFCS), if the Gunner's Main Sight (GMS) of the tank is also made ON. This mode is used for static and dynamic condition of the tank, irrespective of stationary or moving target firing.

3.20.4 Battle Mode

In Emergency situation (in operational scenario), if the system fails, to operate in Power Mode or STAB Mode, the system can be driven to operate in this mode. Engagement of this mode overrides certain safety operational features of the system based on the sensor inputs. This may lead to either permanent damage of the Hardware or few component level failures, but in case of shear necessity in operational conditions, this mode can be engaged with caution.

3.20.5 Normal Mode

When rotary switch is selected to this mode, main and machine gun firing can be done. In this mode, provision has been made to enable sub-caliber gun firing for the crew training.

3.20.6 Missile Mode

When rotary switch is selected to this mode, missile firing is possible through fire control computer (FCC). In this mode after pressing the trigger switch, FIRE output will go to the FCC to initiate the missile firing process.

3.20.7 Emergency Mode

This is a redundant mode and is used when all normal mode firing didn't take place, due to system/ firing circuit failure. To fire in this mode, the rotary switch is to be selected to Emergency and handle provided in the unit to be cranked/operated to get firing output from dynamo.

3.21 Safety switches for crew

Various safety switches are provided for safety of crew against movement of gun/turret and firing of ammunition. The details are given below.

3.21.1 Driver's Safety switch

Driver safety switch is provided to the driver of tank positioned in Hull compartment. During GCS operation the turret/gun would be moving over the hull, in that scenario, if the driver tries to come out of his compartment, his head and body may get hit by gun/turret which may cause serious injuries to him. Driver safety switch disables GCS operation and firing functionality if the driver's hatch is opened or tried to open. Only when the driver is positioned in its place and driver's hatch is closed completely, DSS will allow GCS operation and firing of ammunition.

3.21.2 Loader's traverse safety switch

Loader is located on left side of turret and is responsible for loading ammunition in main gun. He is provided with a manual 'loader's traverse safety switch' which can disable GCS and firing functionality immediately. It provides safety to Loader.

3.21.3 Loader's fire safety switch

Loader is provided with 'loader's fire safety switch' primarily for safe

firing of main ammunition. This switch is located on the rear end of main armament. Its function is to impart control and safety to loader during loading of main ammunition and to prevent any un-announced firing.

3.21.4 Turret lock

During transportation, the turret needs to be locked with hull to prevent any unwanted rotation of turret which may damage the ring gear or gearbox; hence turret lock is provided to rigidly fix turret with hull. The lock gives a signal to GCS which disables GCS operation in that condition. GCS would function only when turret lock is opened fully.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 Hardware Specifications

- Permanent magnet synchronous Motor(3 phase)
- Vector Control
- Turret Position Sensor
- Gun Position Sensor
- Limit Switches

4.1.1 Permanent Magnet Synchronous Motor

PMSM is a permanent magnet AC Motor whose torque speed characteristics are identical to DC motor and can be controlled similar to a DC motor. It has longer life of operation as well as more compact and efficient. The motor offers higher torque as well as uniform torque over the entire speed range. Considering the merits and availability of PMSM motor, it is proposed to develop the ELEGANT with PMSM motor. These motors of required torque levels are available in the market as well as technology to develop indigenously. A permanent magnet synchronous motor, like any rotating electric motor, consists of a rotor and a stator. The stator is the fixed part. The rotor is the rotating part The principle of operation of a synchronous motor is based on the interaction of the rotating magnetic field of the stator and the constant magnetic field of the rotor. The concept of the rotating magnetic field of the stator of a synchronous motor is the same as that of a three-phase induction motor.

The magnetic field of the rotor, interacting with the synchronous alternating current of the stator windings, according to the Ampere's Law, creates torque, forcing the rotor to rotate. Permanent magnets located on the rotor of the PMSM create a constant magnetic field. At a synchronous speed

of rotation of the rotor with the stator field, the rotor poles interlock with the rotating magnetic field of the stator. In this regard, the PMSM cannot start itself when it is connected directly to the three-phase current network (current frequency in the power grid 50Hz).

Figure 4.1 Permanent Magnet Synchronous Motor

4.1.1.1 Permanent magnet synchronous motor control

A permanent magnet synchronous motor requires a control system, for example, a variable frequency drive or a servo drive. There are a large number of control techniques implemented control systems. The choice of the optimal control method mainly depends on the task that is put in front of the electric drive.

4.1.1.2 Trapezoidal control

One of the simplest methods of control of a permanent magnet synchronous motor is - trapezoidal control. Trapezoidal control is used to control the PMSM with trapezoidal back EMF. At the same time, this method also allows you to control the PMSM with a sinusoidal back EMF, but then the average torque of the electric drive will be lower by 5%, and the torque ripples will be 14% of the maximum value. There is a trapezoidal control without feedback and with feedback by the rotor position.The open loop control (without feedback) is not optimal and may lead to the release of the PMSM out of synchronism, i.e. to loss of controllability. The closed loop control can be divided into:

- Trapezoidal control by position sensor (usually by Hall sensors)
- Trapezoidal control without sensor (sensor less trapezoidal control).

As a rotor position sensor for three-phase trapezoidal control, three Hall sensors built into an electric motor are commonly used, which allow determining the angle with an accuracy of ± 30 degrees. With this control, the stator current vector takes only six positions for one electric period, as a result of which there is ripple torque at the output.

4.1.1.3 Field oriented control

Field-oriented control (FOC) allows you to smoothly, accurately and independently control the speed and torque of a brushless motor. For the operation of the field oriented control algorithm, it is necessary to know the position of the rotor of the brushless motor.

There are two ways to determine the rotor position:

- By the position sensor
- Sensorless - by calculating the angle by the real-time control system based on the information available.

4.1.1.4 PMSM field oriented control by position sensor

The following types of sensors are used as angle sensors:

- Inductive: Resolver
- Optical
- Magnetic: Magneto resistive sensors

4.1.1.5 Field-oriented control of PMSM without a position sensor

Since the 1970s sensorless vector control methods for brushless AC motors began to be developed, thanks to the rapid development of microprocessors. The first sensorless methods for estimating the angles were based on the property of the electric motor to generate back EMF during rotation. The motor back EMF contains information about the position of the rotor, therefore, by calculating the value of the back EMF in the stationary coordinate system, you can calculate the position of the rotor. But when the rotor is not rotating, the back EMF is absent, and at low speed the back EMF

has small amplitude, which is difficult to distinguish from noise, therefore this method is not suitable for determining the position of the motor rotor at low speed.

Table 4.1 Specifications of PMSM motor

Parameters	**Value**	**Unit**
Max Speed	3600	Rpm
Peak Torque	36	Nm
Continuous Torque @3600rpm	11.25	Nm
Power	4.2	kW
Bus Voltage	270	V
D-axis Inductance	0.584	mH
Q-axis Inductance	0.612	mH
Per Phase Resistance	0.057	Ω
EMF Constant	0.627	V_{pk}/rad/s
Torque Constant	0.777	Nm/A_{rms}
No Of Poles	12	
Inertia	$22x10^{-4}$	Kgm^2

The dynamic model of the permanent magnet synchronous machine (PMSM) is derived using a two-phase motor in direct and quadrature (hereafter referred to as dq) axis. The rotor has no windings, only magnets. The magnets are modeled as a current source or a flux linkage source, concentrating all its flux linkages along only one axis. The flux linkages of the stator q and d windings are derived from first principles. Constant inductance for windings is obtained by a transformation to the rotor, by replacing the stator windings with a fictitious set of dq windings rotating at the electrical speed of the rotor. The equivalence between the three-phase machine and its model using a set of two-phase windings is derived from a simple observation and graphical projections. The concept of power invariance is introduced whereby the power in the three-phase machine and

its equivalent two-phase model must be equal. These motors of required torque levels are available in the market as well as technology to develop indigenously.

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4.2 Vector Control

Vector control, also known as decoupling or field orientated control. The key to the dc motor drives, performance is its ability to independently control the flux and torque. The flux is controlled by the field. Keeping the field current constant and hence the flux is constant, the torque is controlled by the armature current, Controlling the field and armature current magnitudes as they are dc variables, the flux and electromagnetic torque are controlled precisely in a separately excited dc motor drive. if such separate and independent controls of flux and torque are feasible, will the problem of dynamic control go away. The key to it then, lies in finding an equivalent flux-producing current and torque-producing current (i.e., the armature current) in ac machines leading to the control of the flux and torque channels in them. The key to that, for ac drives, came in two forms one is the machine modeling in space phasor form, which reduced a three phase machine into a

machine with one winding each on stator and rotor, thereby making it into an equivalent dc machine and other one is the ability of the inverter to produce a current phasor with absolute control of its magnitude, frequency, and phase. Both these features are exploited to make the PMSM drive system a high-performance drive system with independent control of its mutual flux and electromagnetic torque and are developed.

4.3 Turret Position Sensor (TPS)

The turret of AFV is free to rotate 360 degree in azimuth and can take any position depending on functional requirement. Turret position sensor (TPS) senses the relative position of turret with respect to the hull. This is an important feedback for the deck-clearance function and the driver sitting in hull also need to sense the turret position with respect to hull. The contour of hull doesn't facilitate 9^{o} depression for the 360^{o} movement of the turret. Deck clearance mechanism enables automatic elevation of the Gun without colliding hull, while traversing the turret. Turret position signal is also essential to estimate tracking rate which provides an input to Ballistic computer. Presently the TPS is an independent unit which is mounted inside the turret and it is linked to the ring gear of turret. The sensor, an encoder is required to have an accuracy and resolution of 0.06^{o} for the deck clearance operation. The sensor selected to meet this requirement is a 14 bit encoder to sense turret position precisely, for various systems of the tank.

4.4 Gun Elevation Sensor

Gun elevation sensor is currently done in Arjun MBT using a resolver mounted in Gun Trunnion axis. This is an essential signal required for slaving the Gun to the sight or vice-versa depending on operation mode of the IFCS. The sensor has to be very precise in line with the static and dynamic accuracy required for the tank system as well as to withstand firing shocks of the gun. The mechanical mounting arrangement to be rugged enough to meet this requirement and also to tune the same with reference to the GMS zero

reference. The accuracy of mechanical alignment should be better than 0.05 mil and the positional accuracy of the sensor required is better than 10 arc secs. CVRDE could successfully develop the resolver mounting assembly and met the entire operational requirement. However, considering the latest digital technology products, it is proposed to replace the resolver with a rugged optical encoder of 14 bit (off the shelf) which can meet all the technical and operational requirement of the system.

4.4.1 Hall effect sensor

A Hall effect sensor is a device that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it. Hall effect sensors are used for proximity sensing, positioning, speed detection, and current sensing applications. Frequently, a Hall sensor is combined with threshold detection so that it acts as and is called a switch. Commonly seen in industrial applications such as the pictured pneumatic cylinder, they are also used in consumer equipment; for example some computer printers use them to detect missing paper and open covers. They can also be used in computer keyboards, an application that requires ultra-high reliability. Another use of a Hall Sensor is in the creation of MIDI organ pedal-boards, where the movement of a 'key' on the pedal-board is translated as an on/off switch via Hall Sensors.

4.4.2 Hall probe

A Hall probe contains an indium compound semiconductor crystal such as indium antimonide, mounted on an aluminum backing plate, and encapsulated in the probe head. The plane of the crystal is perpendicular to the probe handle. Connecting leads from the crystal are brought down through the handle to the circuit box. When the Hall probe is held so that the magnetic field lines are passing at right angles through the sensor of the probe, the meter gives a reading of the value of magnetic flux density (B). A current is passed through the crystal which, when placed in a magnetic field has a "Hall effect" voltage developed across it. The Hall effect is seen when a

conductor is passed through a uniform magnetic field. The natural electron drift of the charge carriers causes the magnetic field to apply a Lorentz force(the force exerted on a charged particle in an electromagnetic field) to these charge carriers. The result is what is seen as charge separation, with a buildup of either positive or negative charges on the bottom or on the top of the plate. The crystal measures 5 mm square. The probe handle, being made of a non-ferrous material, has no disturbing effect on the field. A Hall probe should be calibrated against a known value of magnetic field strength. For a solenoid the Hall probe is placed in the centre.

In a Hall effect sensor, a thin strip of metal has a current applied along it. In the presence of a magnetic field, the electrons in the metal strip are deflected toward one edge, producing a voltage gradient across the short side of the strip (perpendicular to the feed current). Hall effect sensors have an advantage over inductive sensors in that, while inductive sensors respond to a changing magnetic field which induces current in a coil of wire and produces voltage at its output, Hall effect sensors can detect static (non-changing) magnetic fields. In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced. When a beam of charged particles passes through a magnetic field, forces act on the particles and the beam is deflected from a straight path. The flow of electrons through a conductor forms a beam of charged carriers. When a conductor is placed in a magnetic field perpendicular to the direction of the electrons, they will be deflected from a straight path. As a consequence, one plane of the conductor will become negatively charged and the opposite side will become positively charged. The voltage between these planes is called the Hall voltage.

When the force on the charged particles from the electric field balances the force produced by the magnetic field, the separation of them will stop. If the current is not changing, then the Hall voltage is a measure of the magnetic flux density. Basically, there are two kinds of Hall Effect sensors,

linear, which means the output of voltage linearly depends on magnetic flux density; and threshold, which means there will be a sharp decrease of output voltage at each magnetic flux density. This experiment was the one to demonstrate that there are only negative charges free to move in a conductor. Before this, it was believed that positive charges move in a current carrying conductor. This experiment is known as the Hall Experiment.

4.5 Limit switches

In the existing configuration of Arjun MBT, 2 limit switches are provided to sense the elevation of gun in deck clearance zone. The gun can depress to maximum of 9 degree in frontal and size zone of hull, but its depression is limited to 6^o over track guard area and to 0^o deg over the engine deck. To sense this 6^o & 0^o depression angle, 2 external limit switches are provided. Images of these limit switches is given below. It is proposed to achieve this functionality as in-built in elevation actuator using internal limit switches which would give electrical trigger to control system for deck clearance function. Alternately, gun position signal can be used to operate deck clearance at desired angles.

Figure 4.2 Limit switch

They are used for controlling machinery as part of a control system, as a safety interlocks, or to count objects passing a point. A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection. Limit

switches are used in a variety of applications and environments because of their ruggedness, ease of installation, and reliability of operation. They can determine the presence or absence, passing, positioning, and end of travel of an object. They were first used to define the limit of travel of an object, hence the name "Limit Switch".

Standardized limit switches are industrial control components manufactured with a variety of operator types, including lever, roller plunger, and whisker type. Limit switches may be directly mechanically operated by the motion of the operating lever. A reed switch may be used to indicate proximity of a magnet mounted on some moving part. Proximity switches operate by the disturbance of an electromagnetic field, by capacitance, or by sensing a magnetic field. Rarely, a final operating device such as a lamp or solenoid valve will be directly controlled by the contacts of an industrial limit switch, but more typically the limit switch will be wired through a control relay, a motor contactor control circuit, or as an input to a programmable logic controller.

Miniature snap-action switch may be used for example as components of such devices as photocopiers, computer printers, convertible tops or microwave ovens to ensure internal components are in the correct position for operation and to prevent operation when access doors are opened. A set of adjustable limit switches are installed on a garage door opener to shut off the motor when the door has reached the fully raised or fully lowered position. A numerical control machine such as a lathe will have limit switches to identify maximum limits for machine parts or to provide a known reference point for incremental motions.

CHAPTER 5

CONCLUSION AND FUTURE ENHANCEMENT

5.1 Conclusion

System elements are examined one by one and modelled in Matlab, Simulink environment. System controller, electro hydraulic servo valve, actuating system (slider-crank mechanism), barrel are elements of the Main Battle Tank system. Control system is constructed by using PID controllers. Velocity feed forward is used to make the system more rapid. It has two PID controllers one for position loop and the other for the velocity loop.

With the available technology, resources, expertise and knowledge base with CVRDE and the Industry and also based on the pre-project work done, it is very much feasible and viable to develop and integrate the "Electric Gun and Turret Drive System (ELEGANT)" meeting the performance requirements of the futuristic Gun Control System for Armoured Fighting Vehicle with an Indian Industry partner.

5.2 Future Enhancement

Hull dynamics is neglected in this study and output of the hull gyro is used directly. Hull model may be constructed and actual road profiles may be used. The servo valve is identified in this study with very limited data. A better valve can be used or may be done additional tests on the valve to make a better model of the servo valve. Coulomb and viscous frictions are modelled but it is assumed that they exist only in the joint which mounts the barrel to the hull. The other mountings such as the one between the piston and the barrel and the one between the cylinder and the hull, actuation system have also frictions.

CHAPTER 6

APPENDIX

Source code

```
#include <stdio.h>
#include <stdlib.h>
#include "Math_function.h"
void abc_to_qd_transformation(float ia, float ib, float ic, float angle, float *iq, float *id)
{

                *iq = 2*((cos_fun(angle)*ia)+(cos_fun(angle-
120)*ib)+(cos_fun(angle+120)*ic))/3;
                        *id = 2*((sin_fun(angle)*ia)+(sin_fun(angle-
120)*ib)+(sin_fun(angle+120)*ic))/3;
}
int main(void)
{
        int i;

          float ia;
                float ib;
                float ic;
          float id;
                float iq;

                        float angle;

                        for ( i = 0; i< 10000; i++)
                        {
                                angle = 2*180*10*i*0.0001;
                        ia  = 10*sin_fun(angle + 90);
                        ib =  10*sin_fun(angle - 120 + 90);
                         ic = 10*sin_fun(angle + 120
                                        );
                        abc_to_qd_transformation(ia,ib,ic,angle,&iq,&id);
                        printf("%f , %f, %f, %f, %f, %f\n",ia,ib,ic,angle,iq,id);
```

```
                                }
        return EXIT_SUCCESS;
}



#include <stdio.h>
#include <stdlib.h>
#define FILTER_LEN 11

const float coeff[] = {0.274,0.302,0.286,0.224,0.123,0,-0.123,-0.224,-0.286,-0.302,-0.274};
struct diff
{
        float f32_x[FILTER_LEN];
        float f32_output;
        float f32_coeff[FILTER_LEN];
}s_pos_diff;
void ASW_init_diff(struct diff *s_diff)
{
        int i;
        for ( i= 0; i <FILTER_LEN ; i++)
        {
                s_diff->f32_x[i] = 0;
                s_diff->f32_coeff[i] = coeff[i];
        }
        s_diff->f32_output = 0;
}
float ASW_differenciator(struct diff *s_diff, float f32_input)
{
        int i;

        for(i=FILTER_LEN-1;i>0;i--)
        {
                s_diff->f32_x[i]= s_diff->f32_x[i-1];
        }
        s_diff->f32_x[0] = f32_input;

        if(s_diff->f32_output > 0)
        {
```

```
                if ( s_diff->f32_x[0] <  s_diff->f32_x[1])
                {
                        printf("Reached Here\n\n\n");
                        if ((s_diff->f32_x[1] -  s_diff->f32_x[0]) > 25)
                        {

                                for(i=FILTER_LEN-1;i>0;i--)
                                {
                                        s_diff->f32_x[i]= s_diff->f32_x[i] -
50;
                                }
                        }
                }
        }
        else
        {
                if ( s_diff->f32_x[0] >  s_diff->f32_x[1])
                {
                        if ((s_diff->f32_x[0] -  s_diff->f32_x[1]) > 25)
                        {
                                printf("Reached Here\n\n\n");
                                for(i=FILTER_LEN-1;i>0;i--)
                                {
                                        s_diff->f32_x[i]= s_diff->f32_x[i] +
50;
                                }
                        }
                }
        }
        s_diff->f32_output = 0;
  for(i=0;i<FILTER_LEN ; i++)
  {
          s_diff->f32_output = s_diff->f32_output + s_diff->f32_coeff[i] * s_diff-
>f32_x[i];
  }

  s_diff->f32_output = s_diff->f32_output / 8;
        return s_diff->f32_output;
```

```
}
int main(void) {
        int i;
        float out;
        ASW_init_diff(&s_pos_diff);

        for ( i= 0; i<200; i= i + 1)
        {
                out = ASW_differenciator(&s_pos_diff,i%50);
                printf (" %d,  %f \n",i%50,out);
        }
        return EXIT_SUCCESS;
}
```

Code for controller

```
void initEMIOS_g(void){
EMIOS.MCR.B.GPRE = 9;   //Divide clock freq. by (9+1)=10; 100Mhz/10=10Mhz
EMIOS.MCR.B.ETB = 0;    //Disable external time base
EMIOS.MCR.B.GPREN = 1;  //Enable global pre-scaler
EMIOS.MCR.B.GTBE = 1;   //Enable global time base (100Mhz)
EMIOS.MCR.B.FRZ = 1;    //Freeze registers for debugging
}

void ISR_emios0()
{
    static int y=0;
    static int x = 0;
    y++;
    if(y%1 == 0)
    {
        if (x == 0)
        {
            SIU.GPDO[445].R = 0;
            x = 1;
```

```
                }
                else
                {
                        SIU.GPDO[445].R = 1 ;
                        x = 0;
                }
        }
        EMIOS.CH[0].CSR.B.FLAG = 1;
    }
    void initEMIOS_ch0(void){
        EMIOS.CH[0].CADR.R = 10000 - 1;   //A=10000 for 1ms
        EMIOS.CH[0].CCR.B.MODE = 0x12; //Mode=Modulus up counter (internal
    clock)
        EMIOS.CH[0].CCR.B.BSL = 3;     //All channels configured with internal clock;
        EMIOS.CH[0].CCR.B.UCPRE = 0;   //Set internal pre-scaler; divide ratio = 1
        EMIOS.CH[0].CCR.B.UCPREN = 1;  //Enable internal pre-scaler
        EMIOS.CH[0].CCR.B.FREN = 1;    //Enable register freeze for ch0
        EMIOS.CH[0].CCR.B.FEN = 1;    //
        INTC.PSR[51].R = 2;          //Interrupt
    }
```

The code for PI Controller is given below:

```
/*
 ================================================================
============
 Name        : second.c
 Author      : Abbar
 Version     :
 Copyright   : Your copyright notice
 Description : Hello World in C, Ansi-style
 ================================================================
============
 */
#include <stdio.h>
```

```
#include <stdlib.h>
#include "math.h"
#define SAMPLING_TIME 0.001          //1ms
#define Kp        1 // Proportional gain
#define Ki        1          //Integral gain


struct intg
{
        float f32_past_input;
        float f32_past_output;
        float f32_input;
        float f32_output;

}s_pos_intg;

void init_intg (struct intg *s_intg)
{
        s_intg->f32_past_output = 0;
        s_intg->f32_past_input = 0;
        s_intg->f32_input = 0;
        s_intg->f32_output = 0;

}

float integrator(struct intg *s_intg, float f32_input)
{

        s_intg->f32_output = s_intg->f32_past_output+((s_intg->f32_past_input
+f32_input)*SAMPLING_TIME)/2;
        s_intg->f32_past_input = f32_input;
        s_intg->f32_past_output = Ki*s_intg->f32_output ;

                return s_intg->f32_output;
```

```
}

float proportional(struct intg *s_intg, float f32_input)
{
	s_intg->f32_output = Kp*f32_input;

	return s_intg->f32_output;
}

float PI_controller(struct intg *s_intg, float f32_input)
{
	float I_out,P_out;
	I_out = integrator(&s_pos_intg,f32_input);
	P_out = proportional(&s_pos_intg,f32_input);
	s_intg->f32_output = I_out + P_out;

	return s_intg->f32_output;

}
int main(void)
{
	float I_out,P_out,in,out,out1;
	static int i =0;
	init_intg(&s_pos_intg);

	for (i =0; i< 1000 ;i ++)
	{
		in = sin(2*3.14*10*SAMPLING_TIME*i);
		I_out = integrator(&s_pos_intg,in);
		P_out = proportional(&s_pos_intg,in);
		out =     PI_controller(&s_pos_intg,in);
		out1 = I_out + P_out;
		printf("%d, %f, %f, %f ,%f, %f\n",i, in,I_out,P_out, out,out1);
	}
```

```
	//printf("%f",out);
	return EXIT_SUCCESS;
}
/*
 * SVPWM.c
 *
 *  Created on: 07-Jan-2020
 *      Author: Mathi_Abbar
 */
#include "SVPWM.h"
#include "MPC5674F.h"
#include "DD_eMIOS.h"
#include"math.h"

float Vr;
float Vl;
uint32_t Tu;
uint32_t Tv;
uint32_t Tw;
uint32_t Tr;
uint32_t Tl;
uint32_t T0;
uint8_t sec_no;

void Calc_time(float Vr, float Vl)
{
	if(Vr<0)
		Vr=-Vr;
	if(Vl<0)
			Vl=-Vl;

	Tr= Ts*(Vr/Vdcmax);
	Tl= Ts*(Vl/Vdcmax);
```

```
        T0=Ts-(Tr+Tl);
}

void PWM_gen(uint32_t Tu,uint32_t Tv,uint32_t Tw)
{
        DD_eMIOS_ch_time_update(17, Tu);
        DD_eMIOS_ch_time_update(18, Tu);
        DD_eMIOS_ch_time_update(19, Tv);
        DD_eMIOS_ch_time_update(20, Tv);
        DD_eMIOS_ch_time_update(21, Tw);
        DD_eMIOS_ch_time_update(22, Tw);

//      DD_eMIOS_ch_init(17, EMIOS_OPWMCB_TD, EMIOS_COUNTER_8_CH, Tu,
20, 1, 0);
//      DD_eMIOS_ch_init(18, EMIOS_OPWMCB_LD, EMIOS_COUNTER_8_CH, Tu,
20, 1, 1);
//      DD_eMIOS_ch_init(19, EMIOS_OPWMCB_TD, EMIOS_COUNTER_8_CH, Tv,
20, 1, 0);
//      DD_eMIOS_ch_init(20, EMIOS_OPWMCB_LD, EMIOS_COUNTER_8_CH, Tv,
20, 1, 1);
//      DD_eMIOS_ch_init(21, EMIOS_OPWMCB_TD, EMIOS_COUNTER_8_CH, Tw,
20, 1, 0);
//      DD_eMIOS_ch_init(22, EMIOS_OPWMCB_LD, EMIOS_COUNTER_8_CH, Tw,
20, 1, 1);
}


void PWM_UVWgen(uint8_t sec_no) /* Calculate ON times of switches based on sector */
{
        switch(sec_no)
        { case 1:               //Sector 1: Ur = 1 0 0
                                                        //              Ul = 1 1 0
                Tu=Tr+Tl+(T0/2);    //          u v w
                Tv=Tl+(T0/2);           //
                Tw=(T0/2);          //
```

```
                break;              //

 case 2:
                    Tu=Tl+(T0/2);     //Sector 2: Ur = 1 1 0
                    Tv=Tr+Tl+(T0/2);  //          Ul = 0 1 0
                    Tw=(T0/2);        //              u v w
                    break;

 case 3:
                Tu=(T0/2);           //Sector 3: Ur = 0 1 0
                Tv=Tr+Tl+(T0/2);     //          Ul = 0 1 1
                Tw=Tl+(T0/2);        //              u v w
                break;               //

case 4:
                Tu=(T0/2);           //Sector 4: Ur = 0 1 1
                Tv=Tl+(T0/2);        //          Ul = 0 0 1
                Tw=Tr+Tl+(T0/2);     //              u v w
                break;

case 5:
                Tu=Tl+(T0/2);        //Sector 5: Ur = 0 0 1
                Tv=(T0/2);           //          Ul = 1 0 1
                Tw=Tr+Tl+(T0/2);     //              u v w
                break;

case 6:
                Tu=Tr+Tl+(T0/2);     //Sector 6: Ur = 1 0 1
                Tv=(T0/2);           //          Ul = 1 0 0
                Tw=Tl+(T0/2);        //              u v w
                break;
}

PWM_gen(Tu,Tv,Tw);
```

```
}

void Sector_id(float Valpha, float Vbeta, float theta_f)
{
	if(Valpha<0)
	{
		Valpha=-Valpha;
	}
	if(Vbeta<0)
	{
		Vbeta=-Vbeta;
	}

	int theta ;
	theta = (int32_t)theta_f;

	if(theta<0)
	{
		theta = -theta;
	}
	else if(theta>360)
	{
		theta = theta%360;
	}
	else {}

	if((theta>=0)&&(theta<60))                                    //Sector 1
	{
		Vr = Valpha - (one_by_sqrt3)*Vbeta;
		Vl = two_by_sqrt3*Vbeta;
		sec_no=1;
	}
```

```
else if((theta>=60)&&(theta<90))                    //Sector 2
{
        Vr = Valpha + (one_by_sqrt3)*Vbeta;
        Vl = -(Valpha) + (one_by_sqrt3)*Vbeta;
        sec_no=2;
}

else if((theta>=90)&&(theta<120))
{
        Vr = -(Valpha) + (one_by_sqrt3)*Vbeta;
        Vl =  (Valpha) + (one_by_sqrt3)*Vbeta;
        sec_no=2;
}

else if((theta>=120)&&(theta<180))                  //Sector 3
{
        Vr = two_by_sqrt3*Vbeta;
        Vl = Valpha - (one_by_sqrt3)*Vbeta;
        sec_no=3;
}

else if((theta>=180)&&(theta<240))                  //Sector 4
{
        Vr = Valpha - (one_by_sqrt3)*Vbeta;
        Vl = two_by_sqrt3*Vbeta;
        sec_no=4;
}

else if((theta>=240)&&(theta<270))                   //Sector 5
{
        Vr = Valpha + (one_by_sqrt3)*Vbeta;
        Vl = -(Valpha) + (one_by_sqrt3)*Vbeta;
        sec_no=5;
}
```

```
        else if((theta>=270)&&(theta<300))
        {
                Vr = -(Valpha) + (one_by_sqrt3)*Vbeta;
                Vl =  (Valpha) + (one_by_sqrt3)*Vbeta;
                sec_no=5;
        }

        else if((theta>=300)&&(theta<360))                    //Sector 6
        {
                Vr = two_by_sqrt3*Vbeta;
                Vl = Valpha - (one_by_sqrt3)*Vbeta;
                sec_no=6;
        }
        else{}
        Calc_time(Vr,Vl);
        PWM_UVWgen(sec_no);
}
```

REFERENCES

[1] Balman, M. R., (1984), "Time Optimal Control of a Manipulator with Two Angular Degrees of Freedom", METU Mechanical Engineering Department, Ankara.

[2] Batu, U., Gürcan, M. B., Balkan, T., "Hidrolik Servo Valfler in Dinamik Modellerive Performans Testleri", III. Ulusal Hidrolik Pnömatik Kongresive Sergisi, 4-7 Aralýk 2003, Ýzmir, pp. 13-26.

[3] Çelik, M., Aykan, M., (2004), "Tank Namlusunun Operasyonelve"

[4] De Boer, C. C., Yao, B., (2001), "Velocity Control of Hydraulic Cylinders with Only Pressure Feedback", Proceedings of IMECE'01, ASME, 11-16 November 2001, New York.

[5] Ogorkiewicz, R. M., (1991), "Technology of Tanks", Vol.1, Jane's Information Group Limited.

[6] Ogorkiewicz, R. M., (1978), "Stabilised Tank Gun Controls", International Defence Review, pp. 725-728.

[7] Purdy, J. D., (1999), "On the Stabilization of Out-Of-Balance Guns", Journal of Battlefield Technology, Vol. 2, No. 3, pp. 1-7.

[8] Şahin, S., (2001), "Stabilization and Orientation of Tank Gun", M.S.Thesis, METU Mechanical Engineering Department, Ankara.

[9] Thayer, W. J., (1965), "Technical Bulletin 103", MOOG Inc. Control Division, East Aurora.

TWO IN ONE DOOR BELL SYSTEM

A MINI PROJECT REPORT

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ABSTRACT

A doorbell is a signaling device typically placed near an entry door to a building. When a visitor presses a button the bell rings inside the building, alerting the occupant to the presence of visitor. In most wired systems, a button on the outside next to the door, located around the height of the doorknob, activates a signaling device. In this bell, it uses two push button switches. The switches connected in a one door bell in the first switch is placed in first door and the second switch is placed in second door then the door bell are placed in hall.

Now press the first switch in the door bell make a voice on "door 1 calling" then press the second switch doorbell make a voice on "door 2 calling". The two in one doorbell working with the help of Arduino Nano. It will operate 5V DC supply. Arduino Nano transmitting data indicator white LED. Arduino Nano receiving data indicator Red LED. The Arduino Nano used to control digital pins and comes with a crystal oscillator of frequency 16 MHz. In this project, also used a SD card module to store audio in the form of wave signal. The Audio plays with the help of SD card module. The voice output is based on the Arduino board the if condition used to store the audio in the SD card module.

The SD card module is a simple solution for transferring data from and to a standard SD card. The operating voltage of SD card module is 3.3V. The pin out is directly compatible with the Arduino. Here used audio amplifier TDA 7297. It operates 12V supply. This amplifier output positive and negative connected in speaker delivers a message in the form of audio. The purpose of speakers is to produce audio output that can be heard by the listener. Speakers are transducers that convert electromagnetic waves into sound waves. More over this project is identified which doorbell is calling. This project is more suitable for home applications.

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LIST OF ABBREVATIONS

LED	Light Emitting Diode
SPST	Single Pole Single Through
USB	Universal Serial Bus
PWM	Pulse Width Modulation
SRAM	Static Random-Access Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
USART	Universal Synchronous Asynchronous Receiver Transmitter
DIY	Do It Yourself
SPI	Serial Peripheral Interface
RMS	Root Means Square
IMPP	Injected Modulated Polypropylene
CRT	Cathode Ray Tube
SVR	Static Voltage Regulator

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CHAPTER 1

INTRODUCTION

1.1 TWO IN ONE DOORBELL SYSTEM

A doorbell is a signalling device typically placed near an entry door to a building. When a visitor presses a button the bell rings inside the building, alerting the occupant to the presence of visitor. It is wired doorbell.

Most wired systems, a button on the outside next to the door, located around the height of the doorknob, activates a signalling device (usually A speaker) inside the building. Pressing the doorbell button, a single-pole, single-throw (SPST) pushbutton switch momentarily closes the doorbell circuit. Here every door has ringtones or music. Each door varied music for identification.

When the doorbell button is released, the spring snaps the piston back to its original position and the piston hits the tone bar on the other side of the arrangement. The two-tone bars are made and arranged in such a way that the hitting action produces a ding-dong sound.

Sometimes the simplest things are the ones that people are most unaware of. Take the case of a doorbell. How many people have ever taken a moment out of their busy schedule to think about a doorbell works. This simple machine is actually fascinating in the way it uses a basic principle of electromagnetism to work in an innovative way. Science of simplicity at its best.

If you have a doorbell at your home, you probably take it for granted. You press a button that completes a circuit that triggers a sound. Compared to modern technology, a doorbell may seem a bit boring.

The heart of a doorbell is an electromagnet. Electromagnets are coils of wire wrapped around a small piece of magnetic metal. When electricity passes through the wire, it creates a magnetic field around the wire.

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1.2 DESCRIPTION

This project is based on the Arduino Nano software. in the two-way doorbell working on the two-push button switches the switch connected in a one doorbell in the first switch is placed in first door and the second switch is placed in second door then the doorbell is placed in hall. the doorbell using a computer voice. Now press the first switch in the doorbell make a voice on door 1 calling then press the second switch bell make a voice door 2 calling. So, the voice output is based on the Arduino board the if condition used to store the audio in the SD card module.

A doorbell, as we all know, is basically an electrical or electronic device used as an audible indicator. This is considered an essential home appliance through which a visitor is able to make known his or her presence by pressing a button on the outside of the home. This has become an indispensable piece of equipment.

Basic structure of two in one doorbell system is shown in figure 1.1.

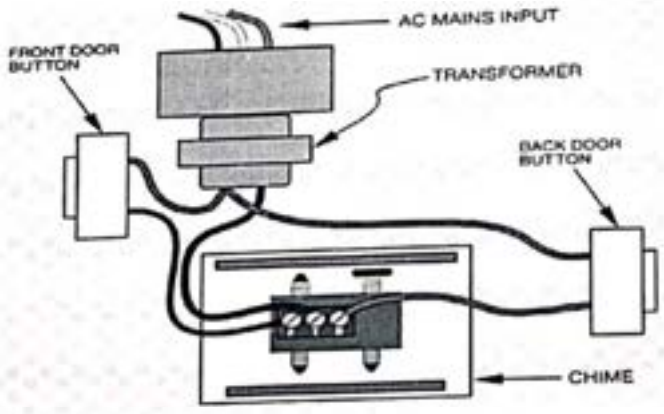

Figure 1.1 Basic structure of two in one doorbell system

When you press a doorbell button, you complete an electrical circuit that allows household electricity to flow through the doorbell's internal electromagnet. The magnetic field generated by the electromagnet is then used to power a mechanism that creates the doorbell sound.

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1.3 LITERATURE AND SURVEY

Braun, D., (2003): A doorbell arrangement identifies visitors. The doorbell arrangement includes a user interface that allows a visitor to enter his visitor or user code. The doorbell system is configured to identify visitors by recognizing user codes. The doorbell system generates response signals specific to each visitor. The response signals include audible sounds such as musical tones or voice recordings. The response signals also include radio frequency signals transmitted to remote locations. The doorbell arrangement may include a computer such as a personal computer.

Davis, G., (2014): Provided in various example embodiments is a system, apparatus, and method specially adapted to replace conventional doorbell systems in environments having access to wireless networks connected to the Internet, which provides wireless communication between the doorbell button unit and mobile devices without requiring additional or different power sources or wiring, aside from preexisting, conventional doorbell wiring.

Langer, P. and Cinzori, D.C., (2009): A peripheral load driver that utilizes the power, wiring, and primary load of a conventional doorbell system to drive a doorbell system peripheral load at a higher current without risk of inadvertently energizing the primary load of the conventional doorbell system. The peripheral load driver comprising a power converting means for converting power extracted from the conventional doorbell system from a higher-voltage-at-a-lower-current to a lower-voltage-at-a-higher current wherein the higher-voltage-at-a-lower-current is insufficient to energize the primary load of the conventional doorbell system and the lower-voltage-at-a-higher-current is compatible with the doorbell system peripheral load.

Scalisi, J.F., (2015): Doorbells can be used to detect visitors. A picture taken by the doorbell can be sent to a computing device. A user of the computing device

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can select areas within the picture. The doorbell can then detect visitors within the selected areas. Subsequent pictures from the doorbell can be analyzed according to the selected areas.

Tylicki, S., Raper, W., Atkins, B. and Cornett, R., (2007): A door chime system includes a microcontroller having a processor and a data memory for storing digital sound files. The microcontroller includes an input and an output representative of digital sound files; a door chime actuator having an output responsive to the depression of the doorbell electrically connected to the input of said microcontroller and an amplifier stage for converting a one of said digital sound files into sound. The output from the microcontroller representative of a digital sound file is supplied to the input of the amplifier stage responsive to the door chime output.

Yeh, J., (2004): A monitor system includes an outdoor doorbell module integrated with video and audio transmission, an indoor remote receiver and a signal transmission interface. The doorbell module includes a depressible button and a micro-camera and a sound detector actuated by the button to obtain visual image and sounds of the visitor. The remote receiver includes a signal receiver circuit to receive the doorbell actuation signal and the visual image and sounds from the doorbell module, an alarm generator activated by the doorbell actuation signal to ring, and a driver circuit generating control signals to control a monitoring device and a recording device. When the button is actuated by the visitor, the remote receiver receives the doorbell actuation signal and generates the ring. At the same time, the doorbell module activates the micro-camera and the sound detector to obtain visual image and sounds of the visitor. The visual image and sounds are transmitted to the remote receiver and then displayed by the monitoring device and selectively recorded by the recording device.

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CHAPTER 2

METHODOLOGY

This project is based on the Arduino Nano software. in the two-way doorbell working on the two-push button switches the switch connected in a one doorbell in the first switch is placed in first door and the second switch is placed in second door then the doorbell is placed in hall. the doorbell using a computer voice. Now press the first switch in the doorbell make a voice on "door 1 calling" then press the second switch bell make a voice "door 2 calling". So, the voice output is based on the Arduino board the if condition used to store the audio in the SD card module.

2.1 BLOCK DIAGRAM

The block diagram model is shown in figure 2.1.

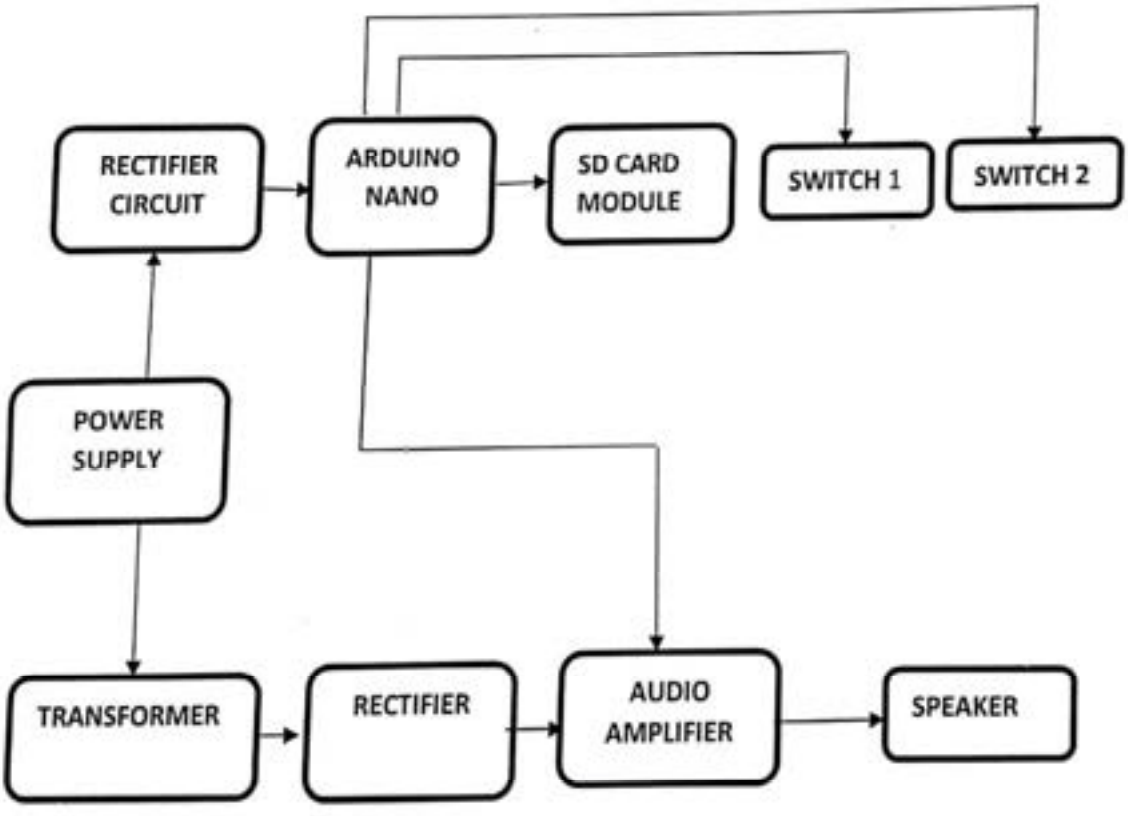

Figure 2.1 Block diagram model

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2.2 CIRCUIT DIAGRAM

The circuit diagram model of project is shown in figure 2.2.

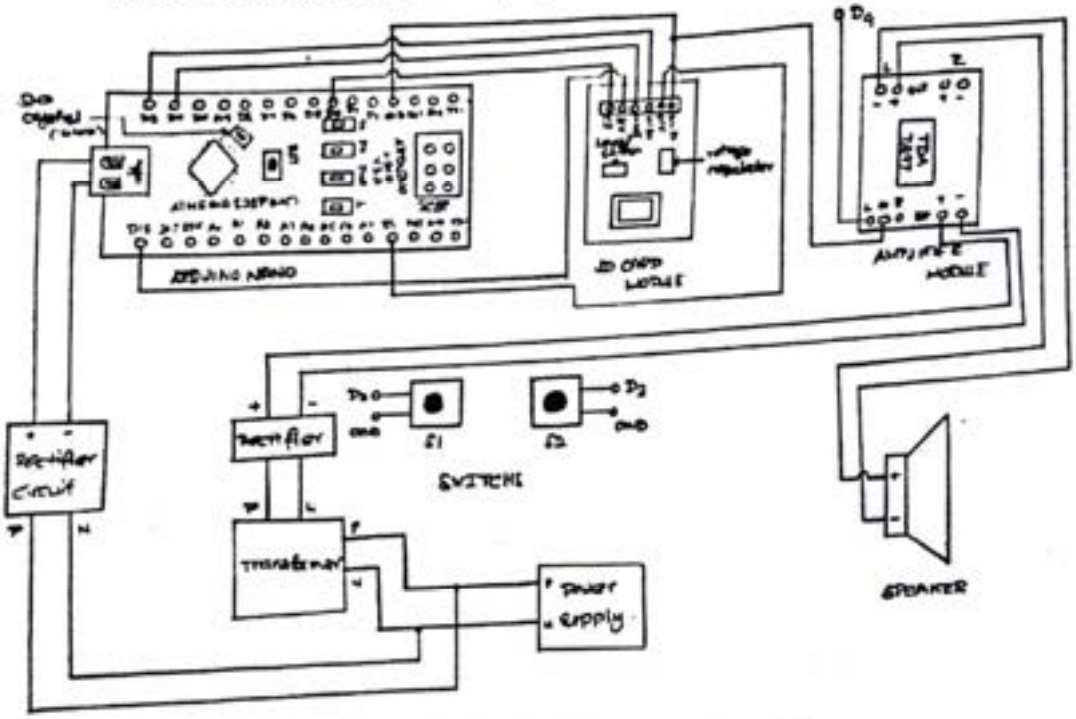

Figure 2.2 Circuit diagram model

2.3 COMPONENTS & RATING

COMPONENTS	RATING
Arduino Nano	Version 3.0
SD card module	Micro SD
Rectifier circuit	230V AC – 5V DC
Transformer	12-0-12V AC
Rectifier	12V AC – 12V DC
Audio amplifiers	12V, 8W+8W
Speaker	4ohm, 8W

Table 2.1 Components and Rating

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CHAPTER 3

COMPONENTS AND MATERIALS

3.1 ARDUINO NANO

Arduino Nano diagram is shown in figure 3.1.

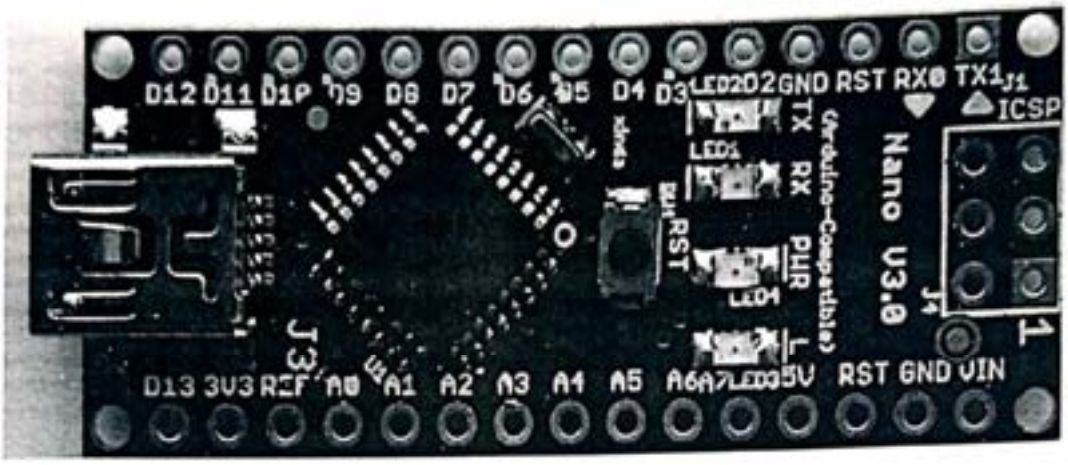

Figure 3.1 Arduino nano Diagram

Arduino is an Open-source electronic prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects.

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surround environments by controlling lights, motors and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer.

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. Nano's got the breadboard-ability of the Board Nano and the Mini USB with smaller footprint than either, so users have more breadboard space. This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable.

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ARDUINO NANO SPECIFICATIONS

An Arduino Nano specification is shown in table 3.1.

Microcontroller	Atmega328p
Operating voltage	5V
Input voltage	7 - 12V
Digital I/O pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40Ma
USB	Mini
Analog pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512 bytes or 1KB
USART	Yes

Table 3.1 Arduino Nano specifications

ARDUINO NANO FEATURES

- It has 22 input/output pins in total.
- 14 of these pins are digital pins.
- Arduino Nano has 8 analogue pins.
- It has 6 PWM pins among the digital pins.
- It has a crystal oscillator of 16MHz.
- operating voltage varies from 5V to 12V.

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PIN DIAGRAM

Arduino Nano pin diagram is shown in figure 3.2.

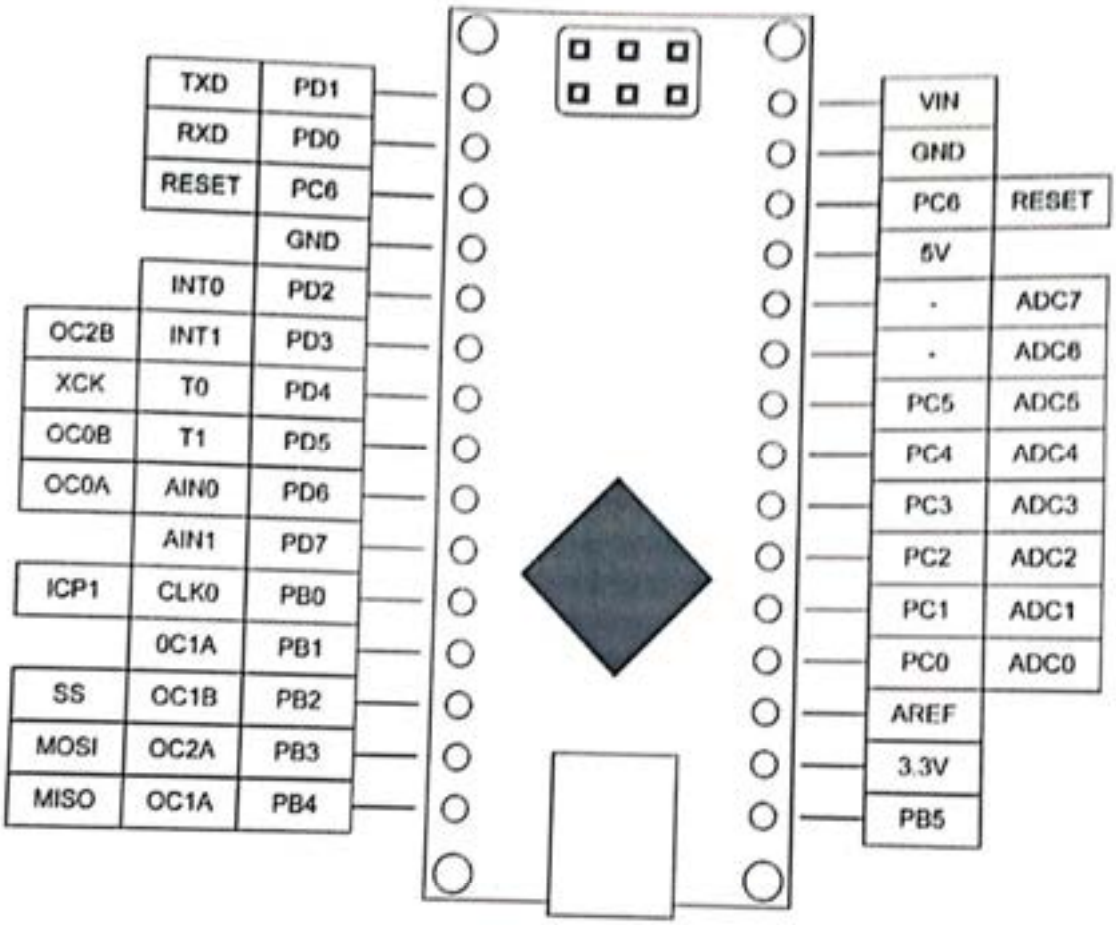

Figure 3.2 Arduino Nano pin diagram

APPLICATIONS

- Prototyping of Electronics Products and Systems
- Multiple DIY Projects.
- Easy to use for beginner level DIY's and makers.
- Projects requiring Multiple I/O interfaces and communications.

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PIN DESCRIPTION

Arduino nano pin description diagram is shown Figure 3.3.

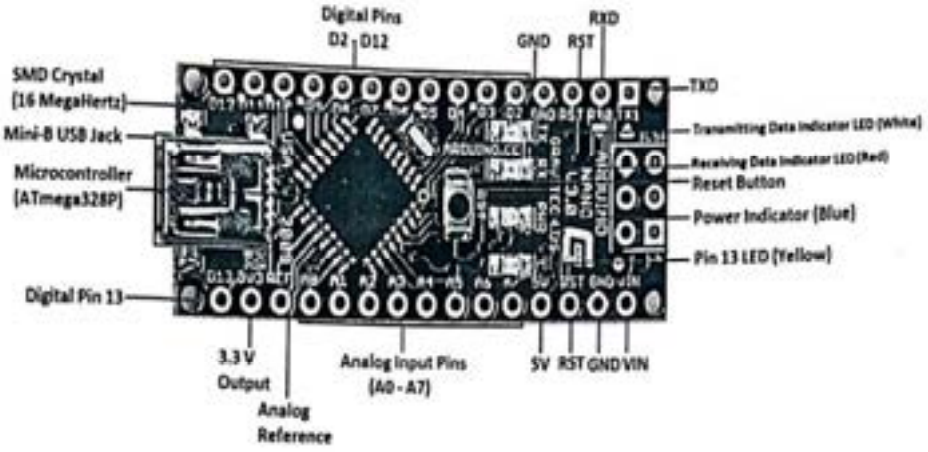

Figure 3.3 Pin description

TABULATION FOR PIN DESCRIPTION

An Arduino Nano pin description is shown in table 3.2.

S.NO	PIN NUMBER	PIN DESCRIPTION
1	D0 – D13	Digital Input / Output Pins.
2	A0 – A7	Analog Input / Output Pins.
3	Pin # 3, 5, 6, 9, 11	Pulse Width Modulation Pins.
4	Pin # 0 (RX), Pin # 1 (TX)	Serial Communication Pins.
5	Pin # 10, 11, 12, 13	SPI Communication Pins.
6	Pin # A4, A5	I2C Communication Pins.
7	Pin # 13	Built-In LED for Testing.
8	D2 & D3	External Interrupt Pins.

Table 3.2 Arduino Nano pin description

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3.2 SD CARD MODULE

The micro SD removable miniaturized Secure Digital flash memory cards were originally named T-Flash or TF, abbreviations of Trans Flash and micro SD cards are functionally identical allowing either to operate in devices. Initially, micro SD cards were available in capacities of 32, 64, and 128 MB.

The micro- SD Card Module is a simple solution for transferring data to and from a standard SD card. The pin out is directly compatible with Arduino, but can also be used with other microcontrollers. It allows you to add mass storage and data logging to your project. SD card module is shown in figure 3.4.

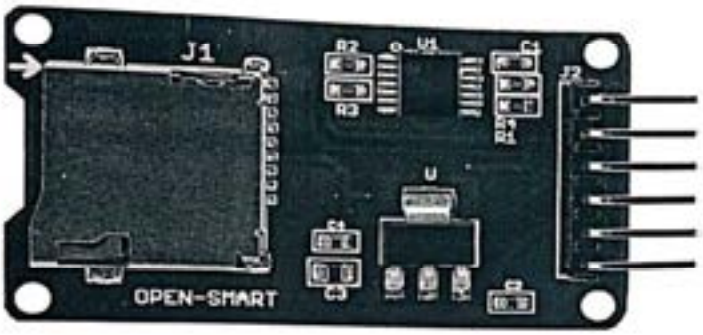

Figure 3.4 SD card module

It allows you to add mass storage and data logging to your project. This module has SPI interface which is compatible with any SD card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega.

SD card module is used for transferring data to and from a standard SD card. This module has SPI interface which is compatible with any SD card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega. SD module has various applications such as data logger, audio, video, graphics.

The micro- SD Card Module is a simple solution for transferring data to and from a standard SD card. It allows you to add mass storage and data logging to your project. This module has SPI interface which is compatible with any SD card and it use 5V or 3.3V power supply which is compatible with Arduino UNO/Mega.

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PIN OUT

Since Arduino operates at 5V and the Micro SD Card operates at 3.3V, a typical Micro SD Card Adapter or an SD Card Module basically consists of two important components. They are the 3.3V Voltage Regulator IC and a 5V to 3.3V Level Converter IC for the communication pins. Talking about pins, A Micro SD Card supports only SPI Communication, the SD Card Module has pins for SPI Communication. SD card pin out diagram is shown in figure 3.5.

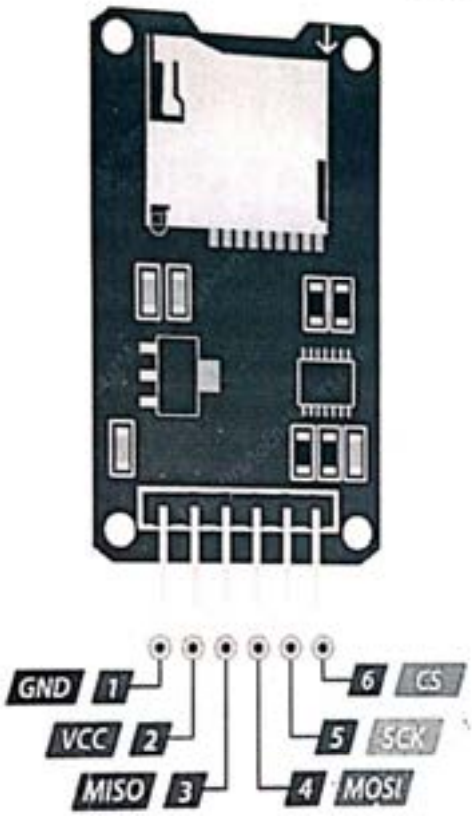

Figure 3.5 SD card pinout

SPECIFICATIONS

- VCC – 5V
- GND – GND
- MOSI – Master OUT Slave IN (Input)
- MISO – Master IN Slave OUT (Output)
- SCK – SPI Clock (Input)
- CS – Chip Select (Input)

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3.3 RECTIFIER CIRCUIT

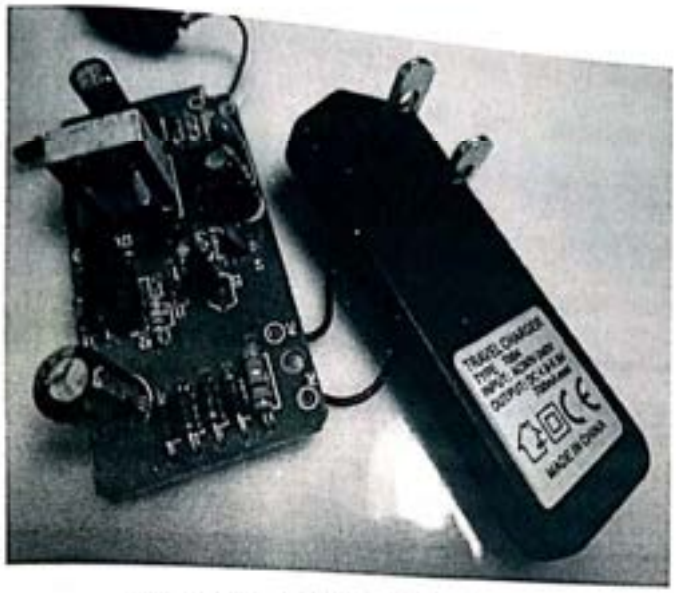

Figure 3.6 Rectifier Circuit

A rectifier circuit is shown in figure 3.6. A mobile battery charger circuit is a device that can automatically recharge a mobile phone's battery when the power in it gets low. Nowadays mobile phones have become an integral part of everyone's life and hence require frequent charging of battery owing to longer duration usage.

Battery chargers come as simple, trickle, timer based, intelligent, universal battery charger-analysers, fast, pulse, inductive, USB based, solar chargers and motion powered chargers. These battery chargers also vary depending on the applications like mobile phone charger, battery charger for vehicles, electric vehicle batteries chargers and charge stations.

In an AC-DC converter section, the transformer step-downs the available AC supply to 9V AC at 75 mA which is rectified by using a full wave rectifier, and then filtered by the capacitor. The 12V DC charging voltage is provided by the regulator and when the switch is pressed, the charger starts working and the power on LED glows to indicate the charger is 'on'.

The relay driver section consists of PNP transistors to energize the electromagnetic relay.

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3.4 TRANSFORMER

A transformer is a passive electrical device that transfers electrical energy between two or more circuits. A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits. Transformers are used for increasing or decreasing the alternating voltages in electric power applications, and for coupling the stages of signal processing circuits. A transformer diagram is shown in figure 3.7.

Figure 3.7 Transformer

A centre-tapped transformer also known as two phase three wire transformer is normally used for rectifier circuits. When a digital project has to work with AC mains a Transformer is used to step-down the voltage (in our case, to 24V or 12V) and then convert it to DC by using a rectifier circuit. In a centre-tapped transformer the peak inverse voltage is twice as in bridge rectifier hence this transformer is commonly used in full wave rectifier circuits.

12V-0-12V Centre Tapped Transformer Specifications

- Step-down Centre tapped Transformer
- Input Voltage: 220V AC at 50Hz
- Output Voltage: 24V, 12V or 0V
- Output Current: 1A
- Vertical mount type
- Low cost and small package

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3.5 RECTIFIER

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction.

The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, stacks of copper and selenium oxide plates, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. A rectifier diagram is shown in figure 3.8.

Figure 3.8 Rectifier

1N5402 is a power diode because of its high forward current and reverse voltage with a power dissipation of 6.25W.

Features

- Average forward current is 3A
- Forward Voltage drop is 1.2V
- Non-repetitive Peak current is 200A
- Peak Reverse current is 10uA.
- Repetitive reverse Voltage is 200V
- Maximum RMS Voltage is 140V
- Available in DO-201 Package

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3.6 AUDIO AMPLIFIER

An audio power amplifier (or power amp) is an electronic amplifier that low-power electronic audio signals such as the signal from radio receiver or electric guitar pickup to a level that is high enough for driving loudspeakers or headphones.

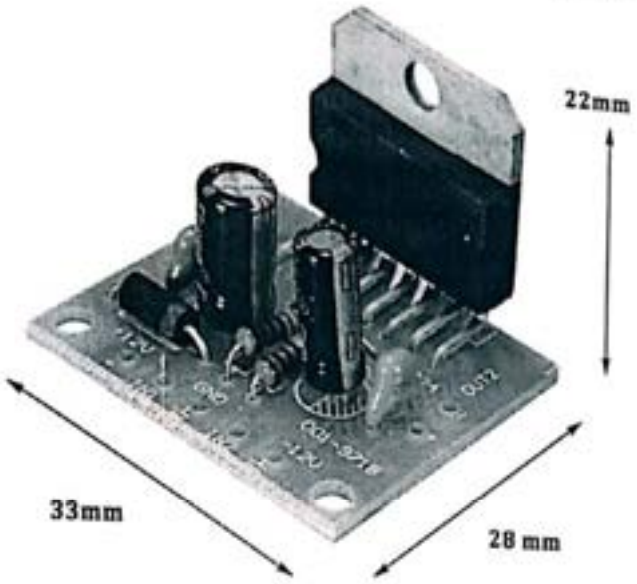

Figure 3.9 Audio amplifier

An audio amplifier is shown in figure 3.9. Audio power amplifiers are found in all manner of sound systems including sound reinforcement, public address and home audio systems and musical instrument amplifiers like guitar amplifiers. It is the final electronic stage in a typical audio playback chain before the signal is sent to the loudspeakers.

The TDA7297 – 30 +30W dual bridge amplifier Key Features Integrated circuit TDA7297 set microelectronics. Wide supply voltage range (6V - 18V) Minimum external components no SVR capacitor no bootstrap no Boucher cells internally fixed gain Short circuit protection Thermal overload protection

Features & details

- Best Quality Salon 7297 Single IC Board, Use extra bridge component for better sound output.
- Input sound: two channel stereo, Output two channel stereo, 12 Volt DC.

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3.7 SPEAKER

Speaker is a device that converts Analog audio signals into the equivalent air vibrations in order to make audible sound. When CRT monitors were the norm, speakers designed for computers were shielded to avoid magnetic interference with the CRT's magnetic coil. A speaker diagram is shown in figure 3.10.

Figure 3.10 Speaker

Our CD-YP 10" speakers are excellent choices 6-inch speakers. Their two-way design handles 250 watts max. power (40 Watts nominal) and feature Crispy Deals extremely strong and lightweight injected moulded polypropylene (IMPP) with Material composite cone woofer, for improved sensitivity and reduced distortion. These speakers are designed with a shallow mounting depth for easy install into a wide variety of vehicles. Speaker grilles are not included.

Features & details

- YP 8-inch Speaker 4 Ohm
- New multilayer Cloth matrix cone design for optimum sound reproduction and responsiveness
- Lightweight elastic polymer surround
- High Bass Performance Auditor

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3.8 PUSHBUTTON

Push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons (due to their physical nature) still require a spring to return to their un-pushed state. Terms for the "pushing" of a button include mashing, slapping, hitting, punching.

Figure 3.11 Push button

A Push Button is shown in figure 3.11. Push button is a type of switch which shorts or completes the circuit when it is pressed. It is used in many circuits to trigger the systems. A spring is placed inside it to take it back in initial or off position as soon as the button is released. It is usually made up of hard material like plastic or metal.

A Push Button is a type of switch work on a simple mechanism called "Push-to-make". Initially, it remains in off state or normally open state but when it is pressed, it allows the current to pass through it or we can say it makes the circuit when pressed. Normally their body is made up of plastic or metal in some types.

Push Button structure has four legs, two on one side and other two on another side. So, we can operate two lines of the circuit by single Push Button.

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CHAPTER 4

WORKING PRINCIPLE

4.1 BASIC OPERATION

A door bell, as we all know, is basically an electrical or electronic device used as an audible indicator.

Door bells are available plentifully in the market in different sizes, shapes and types, ranging from the most ordinary types to the highly sophisticated ones. The most basic ones may include bells in the form of buzzers which normally generate an ear-piercing, harsh buzzing sound, and the "dingdong" ones which are much more pleasant, though are usually only able to generate a fixed two-tone sound.

More interesting types may come with multi-musical outputs or may have an embedded piece of voice output making it very hi-tech. However, since wireless door bells can be expensive, we are here discussing the kind which do need wiring and are more commonly used. A simple calling bell circuit diagram is shown in figure 4.1.

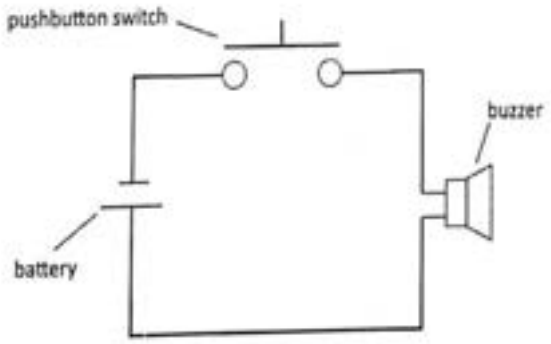

Figure 4.1 Simple calling bell circuit

Today, electronic doorbells are becoming more popular. Electronic doorbells don't have electromagnets or tone bars. When you press the button of an electronic doorbell, a special circuit is called an integrated circuit is triggered that in turn causes a recorded digital sound to play.

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4.2 PRINCIPLE OF OPERATION

This project is based on the Arduino Nano software. in the two-way doorbell working on the two-push button switches the switch connected in a one doorbell in the first switch is placed in first door and the second switch is placed in second door then the doorbell is placed in hall. This is considered an essential home appliance through which a visitor is able to make known his or her presence by pressing a button on the outside of the home. This has become an indispensable piece of equipment.

You can see that a door bell normally has two wires which needs mains supply voltage to operate, the bell switch also has two terminals and functions as a cut off system and stops the flow of electricity from its one terminal to the other when turned off and vice versa. Therefore, by simply connecting the shown components one after the other just as illustrated, your door bell can be wired quickly and easily.

It is important to note that the entire wiring technically doesn't have any polarity, and the inputs may be oriented any way round, however for safety concerns the phase should always go to the switch so that when power is switched off or when not in use, the appliance may be kept aloof from dangerous AC mains supply.

When you press a doorbell button, you complete an electrical circuit that allows household electricity to flow through the doorbell's internal electromagnet. The magnetic field generated by the electromagnet is then used to power a mechanism that creates the doorbell sound.

Doorbells are low-voltage devices. This means they require relatively little energy to operate. An important part of a doorbell mechanism is the transformer. The transformer converts regular 120 - Volt household current to the lower voltage (usually somewhere between 6 - 16 Volts) required by the doorbell. An electromagnet to move a magnetic piston to strike two tone bars. This makes that "ding dong" sound you've probably heard many times.

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4.3 PROPOSED SYSTEM

A doorbell is a signalling device typically placed near an entry door to a building. When a visitor presses a button the bell rings inside the building, alerting the occupant to the presence of the visitor. Today the traditional in most wired systems, a button on the outside next to the door, lock. One terminal of this button is wired to a terminal on a transformer. A doorbell transformer steps down the 120 - or 240 - Volt AC electrical power to a lower voltage, typically to 20 Volts it operates. A proposed system is shown in figure 4.2.

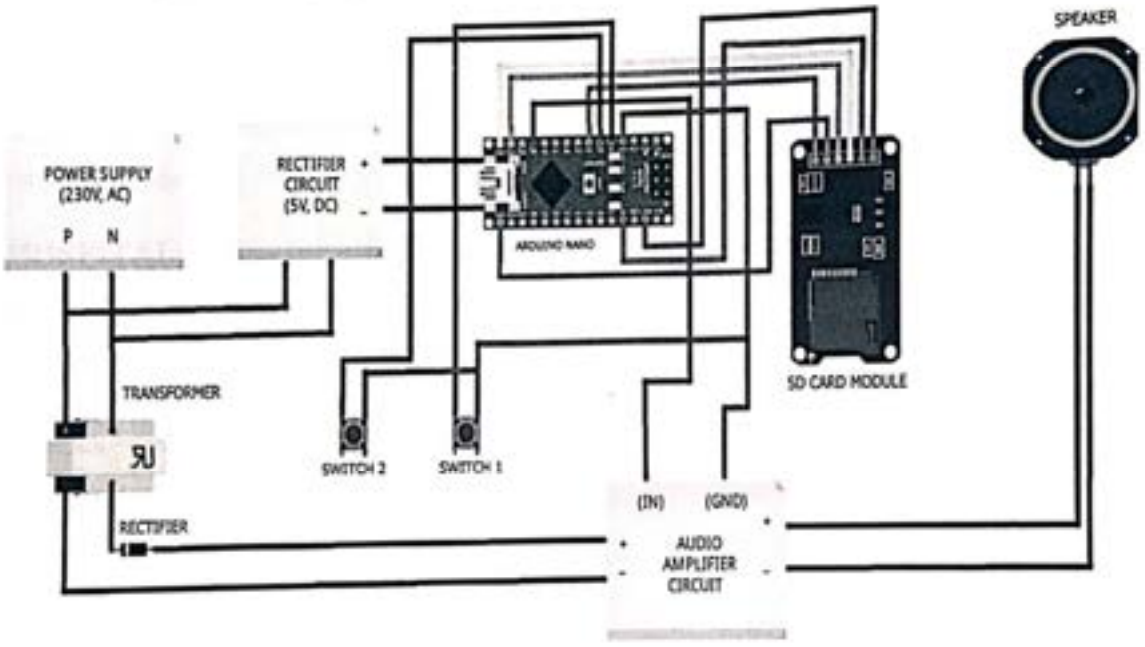

Figure 4.2 Proposed system

The simplest type of doorbell is the buzzer. In a buzzer doorbell, the electromagnet operates a self-interrupting circuit. When the button is pressed, the circuit closes and the electromagnet move a contact arm. When the contact arm moves, it interrupts the circuit and the electromagnet stops. When it stops, the contact arms fall back into position, completing the circuit and starting the process over again.

This cycle repeats quickly over and over again as long as the button of the doorbell is held down. The sound of the contact arm hitting the electromagnet multiple times every second creates the buzzing noise you hear as the doorbell.

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4.4 ADVANTAGES

- Reduce the cost
- Reduce the components
- Perfect output
- Low power conception
- Easy to install at any place

4.5 WHERE TO USE

HOME: Basically, in homes we are commonly use the ordinary calling bell system. In that systems we can't identify which door is knocking if more than one door is available in our home. By using the two-way calling bell system, we can easily identify that which door is knocked.

HOSPITAL: When came to the hospitals we can modify the two-way calling bell system as the patient monitoring system. During the emergency conditions we can identify the need of a patient without the help of others simply patient press the button the alarm will starts to ring.

INSTITUTIONS: As well as in the institutions also we can modify the two-way calling bell system for the office management purposes for particular mentioned calling usage.

HOTELS: The number of servants will be working in hotel so those all are name will be saved in this doorbell and the manager is don't need to call customer order he press the switch and the servant will be take order.

INN: This type of doorbell used for room service purpose in this inn. The all room are set one switch and bell is fixed in ground floor. So, any room service will be need at any room just press the switch and room service will be given.

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CHAPTER 5

RESULT AND DISCUSSION

The result of the project is that the voice module in the door bell is executed i.e., "DOOR ONE CALLING" And "DOOR TWO CALLING". The Two-way door bell system is activated when the push button is pressed by a user/visitor. The response time is very quick as planned. The test of result carried out on the various places and different conditions. So, the conclusion is our project "THE TWO IN ONE DOOR BELL SYSTEM" output is taken successfully as planned and it works perfectly at homes, hotels, offices, institutions, hospitals, etc., Hardware design of project is shown in figure 5.1.

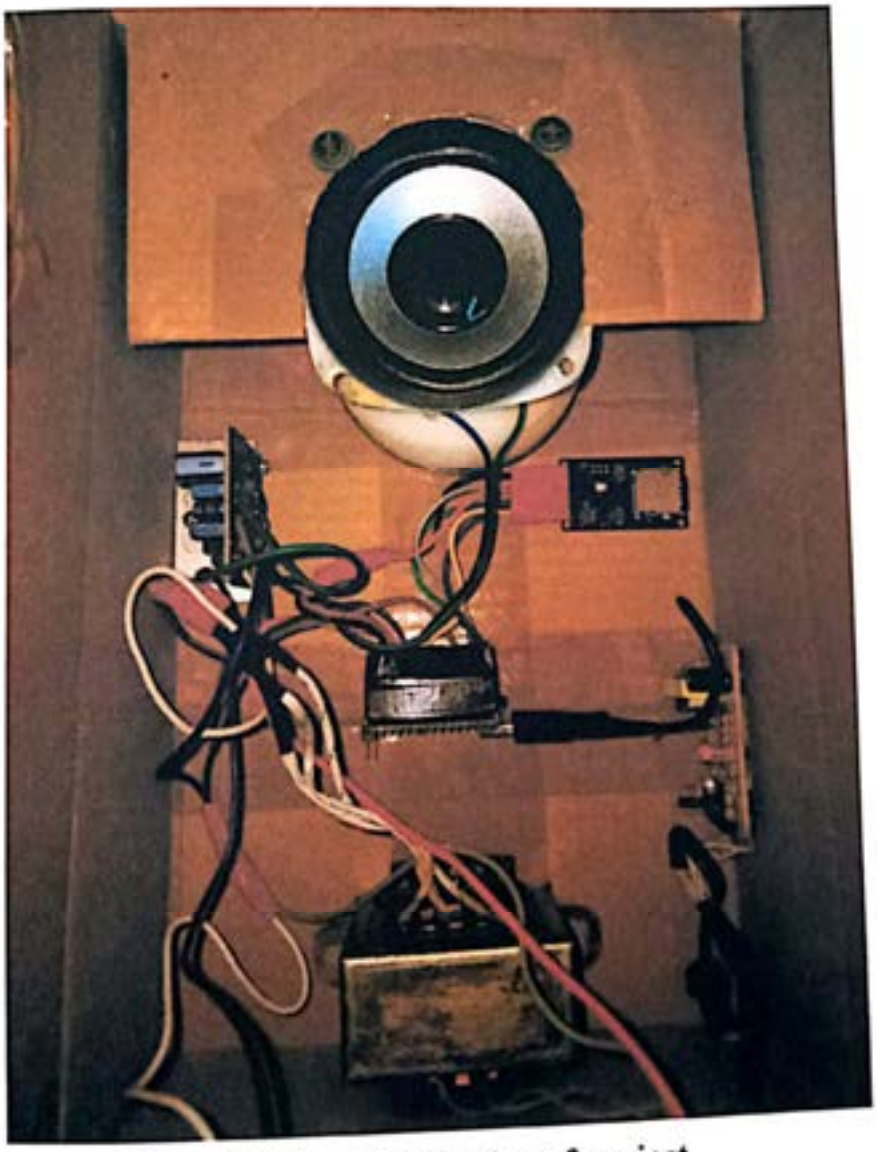

Figure 5.1 Hardware design of project

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CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Conclude from the project was that, in modern world everyone wants something new, something different so instead of using switch to ring the doorbell just an alarm is produced by Knocking the door which people feel more luxurious.

Heartily thanks our faculty and indebted to thanks all our friends who directly or indirectly helped us and acted as a driving force to successfully complete this project. Any errors, omissions and suggestions for the improvements of this project are most welcome.

6.2 FUTURE SCOPE

Purpose of this project is, here going to see some points regarding to purpose behind choosing this topic and what is the requirements of this type of project in our day to day life.

- Save time for searching door bell.
- Save electricity.
- Enhance security.
- Save manpower.

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REFERENCES

1. Braun, D., HP Inc, 2003. Electronic doorbell system. U.S. Patent Application 09/940,616.

2. Davis, G., 2014. Doorbell system, apparatus, and method. U.S. Patent Application 13/828,162.

3. Langer, P. and Cinzori, D.C., 2009. Apparatuses and methods for driving a doorbell system peripheral load at a higher current. U.S. Patent 7,477,134.

4. Scalisi, J.F., SkyBell Technologies Inc, 2015. Doorbell communication systems and methods. U.S. Patent 8,941,736.

5. Tylicki, S., Raper, W., Atkins, B. and Cornett, R., Desa IP LLC, 2007. MP3 doorbell chime system. U.S. Patent Application 11/155,753.

6. Yeh, J., Lucky Star Enterprise and Co Ltd, 2004. Monitor system with video and audio transmission actuated by doorbell actuator. U.S. Patent Application 10/284,328.

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MATERIAL CARRYING MACHINE

A MINI PROJECT REPORT

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

ELECTRICAL AND ELECTRONICS ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

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ABSTRACT

Line Following is one of the most important aspects of robotics. A Line Following Robot is an autonomous robot which is able to follow either a black line that is drawn on the surface consisting of a contrasting color. It is designed to move automatically and follow the line. The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of four sensor makes its movement precise and flexible. The robot is driven by DC gear motors to control the movement of the wheels. The Micro controller interface is used to perform and implement algorithms to control the speed of the motors, steering the robot to travel along the line smoothly.

It operates as programmed to follow a dark line on the white background and detects turns or deviations and modify the motor appropriately. In this system each back wheel has a dedicated motor while the front wheel is free to rotate. In this environment the robot functions as material carrier to deliver products from one place to another place.

This project aims to implement the algorithm and control the movement of the robot by proper tuning of the control parameters and thus achieve better performance. In addition the LCD interface is added in order to display the distance travelled by the robot. It can be used industrial automated equipment carriers, small household applications, tour guides in museums and other similar applications, etc.

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LIST OF ABBREVIATIONS

AC	-	Alternating Current
DC	-	Direct Current
IC	-	Integrated Circuit
IR	-	Infra Red
LED	-	Light Emitting Diode
MC	-	MicroController
AVR	-	Automatic Voltage Regulator
PU	-	Processing Unit

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Since the inception of computers, automation and robotic technologies have been utilized to create consumer products that increase life quality. An example of this is the automated robot vacuum cleaner, which has become increasingly common across the world. Although vacuum cleaning may seem like an extremely minor problem to be solved, one such brand of these products, the Roomba, has sold over 10 million units worldwide, which clearly shows that there is extremely high demand for such products.

The Following Robot Carrier aims to utilize such technology to solve another common issue: carrying heavy items. There are many issues associated with carrying heavy items, ranging from health concerns to simply being a nuisance. The Following Robot Carrier therefore aims to eliminate such problems by being a helpful robot that can carry almost any kind of item whilst following the user in an accurate and unobtrusive manner.

Although this robot would be useful for people of all ages, this project's main demographic is the elderly (65+) and those with physical disabilities. Since mid-1974, the population of those aged 65 or over has increased by 47% and now makes up nearly 18% of the population, while the number of those aged 75 or over has increased by 89% and makes up 8% of the population. Approximately one-third of independent adults aged 65 or over experience a fall, many of which occur because of instability caused by groceries. Citizens with physical disabilities make up roughly 9% of the population of England. The Following Robot Carrier would greatly increase the level of safety for those who want more independence from human care.

The final design must be able to operate in indoor and outdoor environments, as users may want to take it for trips to the supermarket. Hence, it requires a certain degree of robustness in its construction, so that components do not get damaged or knocked out of place by small falls or bumps in the road.

The average height of a mountable curb in the UK is four inches, and given that sometimes it is necessary to go across curbs, it is imperative that the robot can withstand a fall of such a height. It must also traverse small bumps and potholes in the road, meaning the robot has to withstand both large impacts and constant rattling. This can be resolved by using integrated circuits such as PCBs and sturdy materials. The robot should also be waterproof, as it may start raining during the user's trip, so all electrical components should be protected with a waterproof casing. This will also provide some protection toward humidity and moisture.

Many of these design aspects must first be tested out on the prototype, but because the prototype is of smaller size and will be built differently from the final product, tests for criteria such as robustness and its ability to handle falls cannot be carried out accurately. As the product's main demographic is expected to be senior citizens and those with physical impairments, the installation process needs to be as simple as possible. Ideally, the robot will work straight out of the box, as all hardware will be put together during the manufacturing process.

From a software standpoint, the final product must be as straightforward as possible to operate with all software already installed and optimized. To reduce the amount of confusion for those less adept with technology and software, there should only be one setting for the robot's operation, i.e. there will be no way to alter any settings or variables in the code. This includes the values that determine how far behind the user the robot should follow and turning speed.

During prototyping, there will be experimenting to find the optimal ways to build the robot such that no installation will be required after initial

manufacturing, as well as the optimal settings for the software. A prototype of the user worn device will also be built and optimized to be as comfortable and easy to set up as possible.

1.2 LITERATURE SURVEY

Wuet., et al., (2015) The authors described geometric calibration of industrial robot KUKA KR-270 and ensured the best robot positioning accuracy after geometric error compensation using Taguchi Meth

Nikdel., et al., 2014 To enhance the efficiency of the flexible joint robot and to fix the parameters of the controller, a Hybrid-Taguchi genetic algorithm (HTGA) was proposed.The authors used orthogonal arrays (OA) which speed up the convergence of the algorithm

Seoet., et al., (2013) The authors proposed kinematic parameters of stair climbing by body flip locomotion with caterpillar type main plate platform. To achieve maximum stair climbing stability, kinematic parameters such as caterpillar speed of rotation, platform height and platform length were optimized using Taguchi method.

Rout., et al., (2006) The concepts of interior and exterior orthogonal arrays were employed to recognize the noteworthy parameters and choose theoptimal tolerance variety.

1.3 OBJECTIVE OF THE PROJECT

The aim of this robot was to follow a black line and also it is a type of LF robot which is capable of doing different items that we mention the next parts. The Infra Red option has 2 major benefits over the light sensors solution. Firstly that the Infra Red Spectrum is a lot cleaner than the visual spectrum, there is a lot less potential for interference. The other advantage is that phototransistors will react much quicker than photo cells

1.4 ORGANIZATION OF THE CHAPTERS

- The Chapter 2 deals with components of proposed system
- The Chapter 3 explains the details of proposed systems.
- The Chapter 4 presents the conclusion.

CHAPTER 2

PROPOSED SYSTEM

2.1 INTRODUCTION

In these recent days, many line following robots have been designed and utilized. This line following robots normally consists of either four wheels, two wheels or single wheel. The line following robot was designed to follow a line that may be a physical spot on the floor. The sensor was mounted with the robot in order to communicate with microcontroller in sensing the line that had drawn by line tracer on a white surface or vice versa. The project is constructed using an Arduino Board (UNO) as a microcontroller, two servo motors, 12V DC supply , and robot frame. The block diagram of the system is shown in Figure. The purpose of the paper is to provide simpler robot's hardware architecture. The one-channel sensor module connects to the control module. VCC pin is connected to the 3.3V or 5V power supply, GND pin is connected to the GND, OUT pins are connected to the digital I/O pin. Pin number is based on the actual program code.

The main objectives of the study include

- To introduce robotic system.
- To work independent of human.
- To apply the useful C programming language systematically.
- To experiment on the compatibility of the working relation among the Arduino microcontroller and other components.
- To solve the complexity of hardware design construction.
- To reduce the man work.
- To save time and energy.
- To shift materials easily from one place to another place.

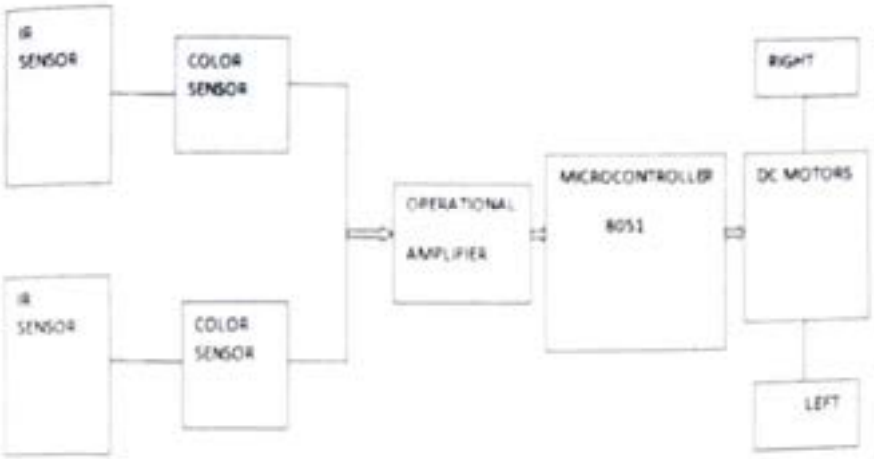

Figure 2.1 Block Diagram of System

2.2 CONCEPT DEVELOPMENT

The first step in concept development was to come up with a complete design for the hardware as shown in figure 2.1. Originally, the prototype was going to be the same size that the final product would be, but it quickly became apparent that a chassis of this size would be extremely expensive and not readily available. Thus a decision was made to buy a small robot chassis and focus on developing the other aspects of the robot more, such as designing the optimal circuit for the motors and how best to achieve the method for robot following the user. The chassis purchased allowed for a breadboard to be mounted vertically on top of the robot, allowing extra surface area for placing other components such as the camera, and also weights for testing weight-speed characteristics.

To determine which other components would be needed a circuit design was proposed. This was a H-bridge because this would allow current to flow in both directions through the motor, thus allowing the motors to turn backwards too. To construct this, diodes, BJT transistors and various resistors would have to be purchased. Calculations to determine the values of these components can be found in the appendix.

2.3HARDWARE DEVELOPMENT

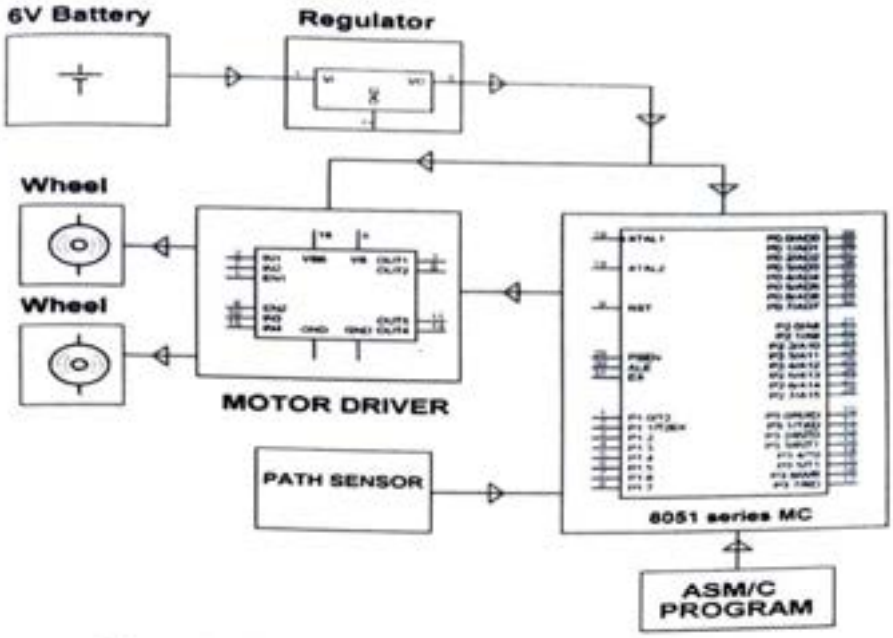

Figure 2.2 Hardware Development of Proposed System

H-bridge circuit for the front left motor. All other motors will have an identical circuit as shown in figure 2.2. When the wheel must turn forwards, Pin 8 will be at 3.3V, and Pin 10 at 0V. This causes Q1, Q2 and Q6 to go into saturation mode, and all others will be off. This induces a voltage across the motor, which draws up to 0.16A of current and turns the wheel runs. Normally Q1 and Q3 would not be included in an H-Bridge as the supply voltage would be 5V, and the voltage of 3.3V would be enough to drive Q2 and Q4 into saturation. However, the supply voltage for this robot is 7.5V, and so the resistors above Q1 and Q3 will draw voltage and allow these transistors to bring current to ground, reducing the effective voltage in Q2 and Q4. The diodes protect the motor by providing a current path for when one set of transistors is switched off and the others are switched on.

2.4 SOFTWARE DEVELOPMENT

Whilst the circuit was being designed, the software for the robot was being developed concurrently. C++ would have been a better language to use

for real time programs, as it compiles and optimises code before execution, as opposed to Python's real time compiling, but Python has much more resources relating to the project. In order for the Raspberry Pi to communicate with the camera, Open CV was downloaded. This is an online computer vision and machine-learning software library, with function libraries such as "PiCamera" that contain functions that retrieve data from the camera to the processor.

The main portion of the code is an infinite while loop. Inside this loop, the code constantly requests RGB data from the camera and introduces random Gaussian noise in order to cut out unpredictable high frequency noise. This data is then transferred to grey scale to compress the data to increase the efficiency of the processing. The "Canny edge detector" function in Open CV is then called to detect edges and recognize polygons. In real life, not many objects are of a square so if the user worn device is made to be a square, and the robot made to detect all objects with a height-width ratio between 0.8 and 1.2, the user can be easily isolated.

The code then determines the midpoint of the square and places it on a coordinate system. The robot turns left or right if the midpoint is to the right or left of the origin of the coordinate system respectively. Essentially, the robot is trying to move the midpoint of the square to the origin.

2.5 TESTING

Test Number	Angle (Degrees)	Result (Pass/Fail)
1	10	P
2	20	P
3	30	P
4	40	P
5	50	F
6	47	P

Table 2.1 Testing Result of the System

The above table2.1 shows various testing angle gives positive results. The overall result show that the test number 1 at angle of 10 Degree were been able rotate and its result as positive one likewise all the above testing angle were been positive except the 47 degree.

2.7 COMPARISON TABLE BETWEEN PROPOSED SYSTEM AND EXISTING SYSTEM

CONTENT	EXISITING SYSTEM	PROPOSED SYSTEM
Time to complete	71.4 seconds	47.6 seconds
Line tracking	Smooth	Smooth
Velocity	0.14 m/s	0.2m/s
Integrate circuit	Not present	Present
Efficiency	Low compare to proposed	High compare to existing
Cost	Low compare to proposed	High compare to existing
Testing result	Not Good	Good

Table 2.2 Comparison of Existing and Proposed System

The above table 2.2 shows the comparison of various parameter between the existing system and proposed system .The time taken to complete the task in the proposed system is much faster when compared to the existing system. The tracking system are smooth in both existing system and proposed system. Existing system is very complex because absence of integrate circuit and proposed system consist of integrated circuit so the system is very simple when compared to existing system.

Due to the presence of integrated circuit, the efficiency is better in proposed system whereas the existing system has the medium quality. While comparing to proposed system, the existing system has low efficiency and the proposed system has high efficiency. The testing result of existing system is not good while the proposed system has better testing result.

CHAPTER 3

HARDWARE DESCRIPTION

3.1. BASIC OPERATION

Capture line position with optical sensors mounted at front end of the robot. For this a combination of IR-LED and Photodiode called an optical sensor has been used. This make sensing process of high resolution and high robustness. Steer robot requires steering mechanism for tracking. Two motors governing wheel motion are used for achieving this task. On the detecting no black surface robot move in a circular motion until line is found.

Figure 3.1 Hardware of the Proposed System

A line follower consists of an infrared light sensor and an infrared LED as shown in figure 3.1. It works by illuminating a surface with infrared light; the sensor then picks up the reflected infrared radiation and, based on its intensity, determines the reflectivity of the surface in question. Light-colored surfaces will reflect more light than dark surfaces, resulting in their appearing brighter to the sensor. This allows the sensor to detect a dark line on a pale

surface, or a pale line on a dark surface. You can use a line follower to help your robot navigate along a marked path, or in any other application involving discerning the boundary between two high-contrast surfaces.

3.2 OPTICAL SENSOR

The robot uses photodiode sensors to sense the line; an array of four IR-LEDs (TX) and Photodiode sensors (Rx), facing the ground used in this setup. An analog signal is obtained in output, depends on the amount of light reflected back, which is provided to the comparator to produce 0s and 1s which are then fed to the Arduino. The sensors on the left named as L1, L2 and R1, R2 on the right side. Assumption should be considered that when a sensor is on the line it reads 0 and when it is off the line it reads 1. The Arduino correspondence to the algorithm given below decides the next movement, trying to position the robot such that all sensors read 0. With sensors, robots can react and respond to changes in their environment in ways that appear intelligent or life-like.

3.3 ARRANGEMENT OF SENSOR

An array of sensors arranged in a straight row pattern is bolted under the front of the robot. It locates the position of line below the robot. Distance between two adjacent sensors is about 1.5 cm. We can use any number of sensors. If we have low number, then our robot movement is not smooth and it may face problems during sharp turns. If higher number of sensors were, used robot movement will become smooth and reliable for sharp turns; it requires complex programming for micro-controller and requires more hardware, which is its disadvantage. Thus, optimum number of sensors required.

3.4 COMPARATOR

Comparator is a device, which compares two input voltages and gives output high or low. In circuit diagram it is normally represented by a triangle

having-Inverting (negative) Input, Non-Inverting (positive) Input (+), Vcc, Ground, Output.

3.5 PROCESSING UNIT

Processing system acts as the brain of robot, generating desired output for corresponding inputs, in which microcontrollers are used. There are several companies nowadays that manufacture microcontrollers, for example ATMEL corporation, Microchip, Intel, Motorola etc. We will be using ATmega32L microcontroller in our robot. It is known as AVR1.

3.6 MOTOR DRIVER

Motor driver is a current enhancing device; it can also be act as Switching Device. Thus after inserting motor driver among the motor and microcontroller. Motor driver taking the input signals from microcontroller and generate corresponding output for motor.

3.7 IC L298D

This is a motor driver IC that can drive two motor simultaneously. Supply voltage (VSS) is the voltage at which motor drive. Generally, 6V for dc motor and 6 to 12V for gear motor are used, depending upon the rating of the motor. Logical Supply Voltage deciding what value of input voltage should be considered as high or low .So if the logical supply voltage equals to +5V, then -0.3V to 1.5V will be considered as Input low voltage and 2.3V to 5V is taken into consider as Input High Voltage. The Enable 1 and Enable 2 are the input pin for the PWM led speed control for the motor L293D has 2 Channels .One channel is used for one motor.

3.8 DC MOTOR

Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. In general, motor operating

with the effect of conductor with current and the permanent magnetic field. The conductor with current usually producing magnetic field that will react with the magnetic field produces by the permanent magnet to make the motor rotate. There are generally three basic types of motor, DC motor, even servomotor and stepper motor, which are always being used in building a robot.

DC motors are most easy for controlling. One DC motor has two signals for its operation. Reversing the polarity of the power supply across it can change the direction required. Speed can be varied by varying the voltage across motor.

3.9 PROXIMITY SENSOR

The combination of IR- LED and Photodiode is used as the reflective optical sensor. It generate interrupt when the IR-beam is break to the photodiode. To create the IR break beam, IR LED is used with a low value resistor so that it shines very bright. The receiver is Photodiode which biases 'on' whenever the IR LED's light is detected. A sensor will be placed adjacent the IR link and turned on so as to generate a pulse to the Arduino. The Arduino LCD interface is used to show the covered distance digitally.

3.10 PERFOMANCE

The final robot must be able to carry luggage and follow the user without going off course. It will also need to avoid obstacles along the path, make its way around them automatically and find the user again. Therefore the robot must be able to vary its speed, approximately from standstill to a brisk walking pace. It is crucial for the robot to be fully automated and perform these tasks without user intervention otherwise the user may forget the robot and lose it.

The average walking speed of a younger pedestrian is 4.95 feet per second, and that of an average elderly pedestrian is 4.11 feet per second. Although the target demographic is the elderly, the robot must also be usable by the average human, and thus a speed of at least 4.95 feet per second must be able to be achieved under the same conditions as US Road's study. The robot

must also have sufficient power to make sure that these speeds can still be achieved whilst carrying a load. Given that the average human eats around 1.5 kilograms of food a day, the average weekly shop may weight around 10.5 kilograms. This is the weight that the robot should be able to carry and achieve its required speed.

The final robot would also have to have a certain surface area in order to accommodate the load without having to pile too many items on top of each other. The average surface area of a shopping trolley is 100cm x 50cm. Thus the robot must have a surface area of at least $0.5m^2$ as this would mean that any shopping that would be bought at the supermarket can also fit onto the robot.

For the prototype robot, the main focus is to optimize the "following" function. One other problem is how the user would approach the robot, as if it is programmed to always keep a certain distance from the user, the user would never be able to interact with and place grocery bags onto it. The prototype can be used to test the best methods of solving this problem.

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CHAPTER 4

CONCLUSION AND FUTURE SCOPE

4.1 CONCLUSION

In the allocated time, a fully functioning prototype was built that would follow the user using image processing techniques. Although a fully functioning product that could be the used in the real world was not constructed, a lot of valuable knowledge was gained and potential pitfalls were identified.

Unfortunately, such a robot is far from becoming a reality, as there are many problems with the operation of the robot in the real world, and the development of this technology has not yet reached a point where it can perform its tasks as desired. However, the group is hopeful that as more research is done and technology improves, such a product can be materialized and help millions of elderly and disabled people around the world be more independent.

4.2 FUTURE SCOPE

Although the prototype robot can follow its user, this is not enough for it to be a useful product for consumers. To be useful in real life situations, the robot must be able to navigate past moving and stationary obstacles. Therefore further work must be done to allow the robot to anticipate the trajectory of possible objects such as cars or walking humans who have not spotted the robot.

The robot must then be able to avoid or overcome these situations. This may be done either with more advanced image processing techniques using the camera or with other components such as ultrasonic sensors. A mobile application would then be developed for smart phones, which would allow the user to remotely start and control the robot. This helps the user to communicate with the robot.

REFERENCES

1. Alessandro De Luca, Bruno Siciliano. "Closed-Form Dynamic Model of Planar Multilink Lightweight Robots." IEEE, Transaction on Systems: Man and Cybernetics, Vol. 21, NO. 4 July/August, 1991.

2. Debopath .S and Md. Jinnah, "Digital RPM meter using Arduino,"Dept. Elect.Eng., Ah AhAhsanullah Univ. of Sci. & Tech., Dhaka, Bangladesh, 2012.

3. Frangois G. Pin and Hubert A. Vasseur, "Autonomous Trajectory Generation for Mobile Robots with Non-holonomic and Steering Angle Constraints," in Proceedings of the IEEE International Workshop on Intelligent Motion Control, Istanbul, Turkey, August 20-22, 1990.

4. Huosheng Hu. "Dynamic Planning and Real-Time Control for A Mobile Robot," Ph.D. Dissertation, University of Oxford, 1992.

5. Hyo-Sung Ahn, Kevin L. Moore, Yangquan Chen. Iterative Learning Control. London, Springer, February 5, 2007.

6. Johann Borenstein. "Control and Kinematic Design of Multidegree-of-Freedom Mobile Robots with Compliant Linkage," IEEE Transactions on Robotics and Automation, February 1995, Vol. 11, No. 1, pp. 21-35.

7. Komonya, S. Tachi, K. Tanie, "A Method for Autonomous Locomotion of Mobile Robots,"in Journal
of Robotics Society of Japan, vol. 2, pp.222-231, 1984.

8. Monk.S, Programming Arduino Getting Started with Sketches, New Delhi, India: Tata Macgrawhill, 2012.

9. Parsad.S, "Line Following Robot,"Dept. Elex. & Comm. Eng., Visvesvaraya TecTechnological University, Banglore, India, 2005.

10. Robert Miklosovic, Aaron Radke, and Zhiqiang Gao, "Discrete Implementation and Generalization of the Extended State Observer," in Proceedings of the 2006 American Control Conference, Minneapolis, Minnesota, USA, June 14-16, 2006

11. Shu-Wen Yu. "Enhanced Iterative Learning Control with Applications to A Wafer Scanner System." Ph.D. Dissertation, University of California, Berkeley. Spring, 2011.

12. Tanvir Ahmed, Khandakar Mahbubul Islam, Md. Faiz Ahmed, Rakib Hossain, and Md. Mahbubur Rahman. "Tree Based Localization Model for Line Following Robots-," International Journal of Multimedia and Ubiquitous Engineering, Vol.12, No.1 , pp. 17-34, Dec 2017.

SMART FARMING SYSTEM

A PROJECT REPORT

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ABSTRACT

Smart forming system is autonomous & sophisticated, which will aid in the growth of agriculture yield by applying hi-tech agriculture technique without human intervention. There are lot of new technology have the potential to create a impact on the green revolution. In droughty California nowadays utilizing smart irrigation system not only for the environment sustainability but also for the lower expense of water usage in the field.

In olden days farmers used to figure the ripeness of soil and influenced suspicious to develop which kind of yield .they don't think about the humidity, level of water & especially climate condition. Motor is connected with DOL starter it contains on /off push button to start and stop the motor, GSM control circuit is connected to the DOL starter for control the motor turn on/off operation through the GSM control. There are three lands for the irrigation purpose that timer is giving the input signals to solenoid valve for only the time which required irrigating the land and that moisture sensor checks the lands moisture level and gives the signal to the timer.

In our system the man work for irrigation is eliminated & loss of water during irrigation is avoided by our system, this system provide unimaginable benefit to farmer in the field without require huge man work. The smart farming system developed by our team is adaptive plants and crops irrigation. This purpose of our smart farming system are to provide a water delivering schedule to the crop to ensure all the crop having enough water for their healthy growth, to reduce the amount of water wasted in irrigation, this system able to make decision for the user when distribute water into field.

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LIST OF ABBREVIATIONS

AC	-	Alternating Current
DC	-	Direct Current
I/O	-	Input/Output
DOL	-	Direct On Line
GSM	-	Global System Module
SMS	-	Short Message Service
UART	-	Universal Asynchronous Receiver Transmitter
RAM	-	Random Access Memory
GND	-	GrouND
LED	-	Light Emitting Diode
MCCB	-	Molded Case Circuit Breaker
NO	-	Normally Open
NC	-	Normally Closed
PH	-	Potential Hydrogen
GCM	-	Global Climate Model
LDPE	-	Low Density Poly Ethylene
HDPE	-	High Density Poly Ethylene

CHAPTER 1

INTRODUCTION

1.1 IRRIGATION

Irrigation is defined as "Artificially supplying & systematically dividing of water for agriculture & horticulture in order to obtain higher or qualitatively better production"(After Eijkelkamp Agrisearch Equipment). Water is essential to plant growth & for millenniums. Successful farmers have used different methods to apply water to their crops. This artificial addition of water is called irrigation. Irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops (Cantor, 1967). Irrigation is a basic determinant of agriculture because its inadequacies are the most powerful constraints on the increase of agricultural production. In traditional agriculture, irrigation was recognized for its protective role of insurance against the vagaries of rainfall & drought. But now, adoption of high yielding varieties, chemical fertilization & multiple cropping highly used controlled irrigation for increasing productivity.

1.1.1 Importance of irrigation

In the next 35 to 45 years world food production will need to double to meet the demands of increased population. Ninety percent of this increased food production will have to come from existing lands & seventy percent of this increased food production will have to come from irrigated land. Without irrigation farming is very limited & if the rainfall decreases to less than 30cm, agriculture becomes impossible without irrigation (King, 1953). It increases crop yield. It protects from famine. It helps to cultivate superior crops with the water supply as per need of the crops. Ultimately it helps in economic development. Irrigation water improves water conditions in the soil, increases the water content of plant fibers, dissolves nutrients & makes them available to

plants. Irrigation affects temperature conditions by regulating the temperature of the surface layer of the soil & the ground layer of the air & also makes possible control of the growth & development of plants & improvement of the quality of the harvest. In fruit & berry crops that receive optimum quantities of moisture, the sugar content of the fruit increases & in oil crops the fat content in the seeds is greater. For rice & wheat) with supplementary nitrogen feeding), the protein content in the grain increases & for cotton the quality of the fiber is improved.

1.1.2 Present Status of Irrigation

In the middle of 20th century, the advent of diesel & electric motors led for the first time to system that could pump groundwater out of major aquifers faster than it was recharged. This can lead to permanent loss of aquifer capacity, decreased water quality, ground subsidence & other problems. The future of food production in such areas as the North China Plain, the Punjab & the Great Plains of US is threatened. At the global scale 27,88,000 sq. km. of agricultural land was equipped with irrigation at present, which was 19,31,000 sq. km. in 1980. About 70% of the area equipped for irrigation is located in Asia which was 68% in 1980. 9% of the area equipped for irrigation in Europe, which was 7% in 1980. In Africa it was 5% both in 2003 & 1980. In America the area equipped for irrigation was 15% in 2003 & 18% in 1980. In Oceania it was 1% in 2003 & 0.9% in 1980. The largest contiguous areas of high irrigation density are found in North India & Pakistan along the rivers Ganges & Indus, in the Hai He, Huang He & Yangtze basins in China, along the Nile River in Egypt & Sudan, in the Mississippi-Missouri river basin & in parts of California.

1.1.3 Types of Irrigation System

To supply water the entire field uniformly so that each plant would get sufficient amount of water, there are various types of irrigation techniques that

differ in how the water obtained from the source is distributed within the field. These are:

- Surface Irrigation: In this irrigation system water moves over & across the land by simple gravity flow in order to wet it & to infiltrate into the soil. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called flood irrigation when the irrigation results in flooding or near flooding of the cultivated land.

- Ditch Irrigation: This is the simplest & oldest irrigation system & it is still common in many parts of the world. The only technology essential is the manpower or machines to dig ditches or furrows between the rows of plants. Water is added to the ditches by means of gravity flow, pumps & siphons.

- Localized Irrigation: It is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, & applied as a small discharge.

- Drip Irrigation: This is also known as trickle irrigation. Water is delivered at or near the root zone of plants; drop by drop. This method can be the most water efficient method of irrigation shown in fig 1.1

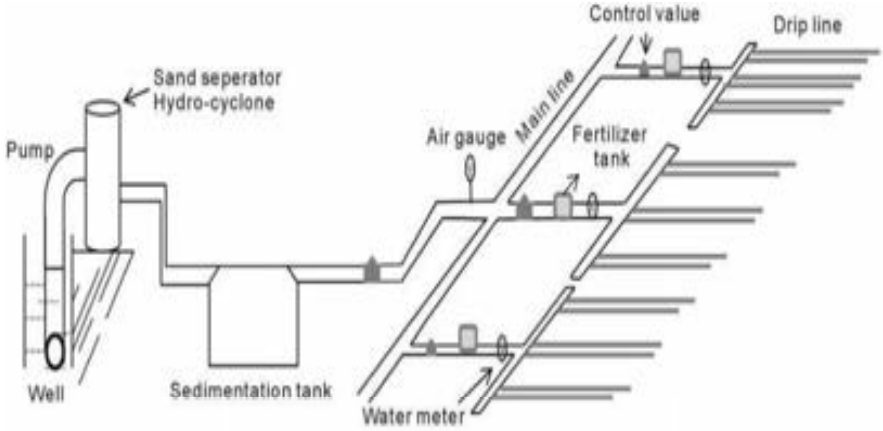


Figure 1.1 Drip Irrigation Systems

- Overhead Irrigation: This is the artificial application of water to crops from above. Central pivot systems, which are in wide use in areas of flat terrain, have sprinklers spaced along very long aluminum or steel pipes that extend in two directions from a central supply point. Sprinkler systems are another very common overhead irrigation system. In these systems, water is piped to a point within the area to be irrigated.

- Sub-Irrigation: This is also called as seepage irrigation used for many years in the fields where water table is high. This method artificially raises the water table by allowing the soil to be moistened from below the plants" root zone.

- Manual Irrigation: This system has low requirements for infrastructure & technical equipment but needs high labor inputs by using buckets or watering cans.

1.1.4 Canal Irrigation in India

Rain water is considered as one of the most ideal sources of irrigation if in case it is timely & adequately received. But rainfall in India varies in different regions. It is uncertain, uneven & prominently seasonal. Notwithstanding that long dry period in India also badly affects the agriculture. Irrigation in India, carried are on in three different ways according to their sources such as; by canals, by wells or tube wells, & by tanks.

Out of the total area under irrigation 40 percent are irrigated by canals, 40 percent by wells or tube wells & 12 percent by tanks. The rest 8 percent of land are irrigated by other methods. This system has low requirements for infrastructure & technical equipment but needs high labor inputs by using buckets or watering cans. It is uncertain, uneven & prominently seasonal. Notwithstanding that long dry period. three different ways according to their sources such as; by canals, by wells or tube wells, & by tanks.

1.2 LITERATURE SURVEY

Anjum Awasthi et al., (2013) The proposed system in this paper is designed by considering the requirement of a sugarcane crop for Indian climatic conditions. The WSN in agriculture is new technology for information acquisition and processing in sugarcane field. It is more advantageous than the traditional agriculture techniques. This work structured the precision agriculture monitoring system by wireless sensor nodes and base station to record the data of sensor nodes. This is low cost system where the recorded information is transmitted to remote location using a GSM network via a SMS. The farmer may use the received information to control the parameters. This kind of wireless detection and control improves the effectiveness and efficiency of resources used, which leads to the improved production. The drawback of system is its dependency on the GSM network.

Galande et al., (2013) The Microcontroller based atomized drip irrigation system using wireless technique proves to be a real time feedback control system which monitors and controls all the activities of drip irrigation system efficiently. The present proposal is a model to modernize the agriculture industries at a mass scale with optimum expenditure. Using this system, one can save manpower, water to improve production and ultimately profit. The developed irrigation automation system can be proposed to be used in several commercial agricultural productions since it is obtained in low cost and in reliable operation. This application of sensor-based site- Specific irrigation has some advantages such as preventing moisture stress of trees, diminishing of excessive water usage, ensuring of rapid growing weeds and derogating salification. If different kinds of sensors (that is, temperature, humidity, and etc.) are involved in such irrigation in future works, it can be said that an internet based remote control of irrigation automation will be possible. The developed system can also transfer fertilizer and the other agricultural chemicals (calcium, sodium, ammonium, zinc) to the field with adding new sensors and valves.

Muthunoori Naresh et al., (2014) Farmers used to figure the ripeness of soil and influenced suspicions to develop which to kind of yield. They didn't think about the humidity, level of water and especially climate condition which terrible a farmer increasingly The Internet of things (IOT) is remodeling the agribusiness empowering the agriculturists through the extensive range of strategies, for example, accuracy as well as practical farming to deal with challenges in the field. IOT modernization helps in assembly information on circumstances like climate, dampness, temperature and fruitfulness of soil, Crop web based examination empowers discovery of wild plant, level of water, bug location, creature interruption in to the field, trim development, horticulture. IOT utilize farmers to get related with his residence from wherever and at whatever point. Remote sensor structures are utilized for watching the homestead conditions and tinier scale controllers are utilized to control and mechanize the home shapes. To see remotely the conditions as picture and video, remote cameras have been used. IOT development can diminish the cost and update the productivity of standard developing.

Murtaza Hassan Ansari et al., (2014) This paper focuses on the effective irrigation and prevention of water wastage in uncontrolled irrigation. New irrigation electrical control technologies could improve irrigation efficiency, promoting water conservation and reducing the environmental impacts. The objectives of this project were to avoid wastage of water and increase irrigation efficiency by using a PLC based irrigation system with the help of soil moisture sensor, water level sensor, and GSM controller. It also improves the traditional irrigation system enabling the irrigation system to have high efficiency and low water usage. The existing irrigation system is tedious, time consuming and very wasteful in water usage. This PLC based sprinkler irrigation system gives the best feature than the traditional one.

Nina Gupta et al., (2017) This paper on "Smart Irrigation System" is develop to create an automated irrigation mechanism which turns the pumping motor ON and OFF on detecting the moisture content of the earth using the soil moisture sensor without the intervention of human. The benefit of employing

these techniques is to decrease human interference and it is quite feasible and affordable. This Smart irrigation system project is using an arduino micro-controller, that is programmed to collect the input signal according to moisture content of the soil and its output is given to the op-amp that will operate the pump.

Pawan Juare et al., (2016) Now you can see that India's population is reached beyond 1.2 billion and the population rate is increasing day by day so after 25-30 years there will be serious problem of food for everyone, so to solve this problem development of agriculture is very much important. Today, the farmers are suffering from the lack of resources rains and scarcity of water. Overall the main aim of this paper is to provide an automatic irrigation system thereby saving time, money & power of the farmer and solving the all issue. The traditional farming-land irrigation techniques require manual work and man powers are required. With the help of latest technology of irrigation the man power can be minimized. Whenever there is some changes in temperature and the humidity of the surroundings these sensors senses the variation in the temperature and humidity and gives an interrupt signal to the micro-controller from which we can monitories the overall system automatically .

Saleemmaleekh et al., (2013) With the advancement in technology, the world around us in every part of our life getting automated. The manual procedures are being replaced by these automated systems, since they are with energy efficient and consume less labor work. This paper proposes the advantages of having Wireless Sensor Network technology in Indian agricultural sector, which shows the path to the rural farmers to replace some of their traditional techniques. Here, multiple environmental data such as Humidity, Soil moisture, Soil pH etc. are collected by a set of wireless sensor nodes and applied as input to the Peripheral Interface Controller (PIC). The data is checked continuously by PIC controller and a set of control actions like Irrigation, Soil fertility check etc. are made if they exceed threshold level. After every activity, an evidence message is sent through SMS via GSM modem to the farmer. The module by module design and implementation of the system are given. The system

overcomes the limitations of traditional agricultural procedures by utilizing water resource efficiently and also reducing labor cost

Shena Deskhan et al., (2015) With the water requirements in irrigation being large, there is a need for a smart irrigation system that can save about 80% of the water. This prototype aims at saving time and avoiding problems like constant vigilance. It also helps in water conservation by automatically providing water to the plants/gardens depending on their water requirements. It can also prove to be efficient in Agricultural fields, Lawns & Parks. As technology is advancing, there is always a chance of reducing risks and making work simpler. Embedded and micro controller systems provide solutions for many problems. This application precisely controls water system for gardens by using a sensor micro controller system. It is achieved by installing sensors in the field to monitor the soil temperature and soil moisture which transmits the data to the microcontroller for estimation of water demands of plants.

Swarup et al., (2013) Smart sensors based monitoring system for agriculture have been used to increase the yield of plants by monitoring the environmental conditions (parameters) and thus providing the necessary information to the clients (farmers). The proposed system is mainly developed for the betterment of farmers. The use wireless sensor network over the wired one helps for deploying it in any type of environment for monitoring, making it flexible and robust. The use of FPGA element facilitates the system for re-configurability and re programmability according to different environmental conditions.

Udupa et al., (2015) The Arduino board and soil moisture sensor based irrigation system proves to be a real time response control system which monitors and wheel all the activities of irrigation system. The present system is a model to modernize the agriculture industries at a mass scale with optimum expenditure. An automated irrigation model is designed and Implemented this model considering low cost, reliability, and automatic

control. As the proposed model is automatically controlled it will help the farmers to properly irrigate their fields. The model always ensures the sufficient level of water in different fields avoiding the under-irrigation and over-irrigation

1.3 OBJECTIVE OF THE PROJECT

Our objective of making this project is for reducing the man power using during the irrigation and large amount of water is wasted in irrigation we use this system to reduce the man work and loss of water, we can start and stop the irrigation automatically.

1.4 ORGANIZATION OF THE CHAPTERS

- The Chapter 2 deals with the GSM remote controlled motor
- The Chapter 3 explains the details of proposed systems.
- The Chapter 4 explains the detail of result obtained from project.
- The Chapter 5 presents the conclusion.

CHAPTER 2

GSM REMOTE CONTROLLED MOTOR

2.1 INTRODUCTION

In everyday life, there must be some physical elements that need to be controlled in order for them to perform their expected behaviors. A control system therefore can be defined as a device, or set of devices, that manages, commands, directs or regulates the behavior of other devices or systems. Consequently, automatic controlling involves designing a control system to function with minimal or no human interference. Intelligent systems are being used in a wide range of fields including from medical sciences to financial sciences, education, law, and so on. Several of them are embedded in the design of everyday devices.

The messages are sent from the mobile set that contain commands in written form which are then processed accordingly to perform the required task. A microcontroller based system has been proposed for our project. There are several terminologies that are used extensively throughout this project report. GSM (Global System for Mobile Communications) It is a cellular communication standard SMS (Short Message Service): It is a service available on most digital mobile phones that permit the sending of short messages (also known as text messaging service). These SMS based control system can be used to enhance the individual's lifestyle, e.g. the motor is turned "ON" using SMS when the owner of the house goes out. Existing solutions for motor control when no one is available to either switch "ON" or "OFF" the sockets.

Mobile phones have become one of the most popular communication devices among most of the people around the world, and the Short Message Service (SMS) is popular among mobile phone users as a cheap and convenient method of communicating. Therefore, SMS technology is a common feature

with all mobile network service providers. Since the use of SMS technology is a cheap, convenient and flexible way of conveying data, researchers are trying to apply this technology in many different areas that are not covered by service providers at present.

2.2 OPERATING ENVIRONMENT

The control system will include two separate units: the cellular phone, and the control unit. There will therefore be two operating environments. The cellular phone will operate indoors and outdoors whereas the control unit will operate indoors within the temperature and humidity limits for proper operation of the hardware. Assuming that the control unit is powered and operating properly, the process of controlling a device connected to the interface will proceed through the following steps;

- The remote user sends text messages including commands to the receiver.
- GSM receiver receives messages sent from the user cell phone.
- GSM receiver decodes the sent message and sends the commands to the microcontroller.
- Microcontroller issues commands to the appliances and the devices connected will switch ON / OFF.

2.3 SHORT MESSAGE SERVICE

SMS stands for Short Message Service. It is a technology that enables the sending and receiving of message between mobile phones. SMS first appeared in Europe in 1992. It was included in the GSM (Global System for Mobile Communication) standards right at the beginning. Later it was ported to wireless technologies like CDMA and TDMA. The GSM and SMS standards were originally developed by ETSI. ETSI is the abbreviation for European Telecommunication Standard Institute. Now the 3GPP (Third Generation

Partnership Project) is responsible for the development and maintenance of the GSM and SMS standards. One SMS message can contain at most 140 bytes (1120 bits) of data, so one SMS message can contain up to 160 characters if 7-bit character encoding is used. (7-bit character encoding is suitable for encoding Latin characters like English alphabets.). 70 characters if 16-bit Unicode UCS2 character encoding is used. (SMS text messages containing non-Latin characters like Chinese character should use 16- 32bit character encoding.) Once the message is sent the message is received by SMSC, which must then get it to the appropriate mobile device. To do this the SMSC sends a SMS request to Home Location Register (HLR) to find the roaming customer. Once HLR receives the request, it responds to the SMSC with the subscriber's status:

- Inactive or active
- Where subscriber is roaming.

The system pages the device, and if it responds, the message gets delivered. The SMSC receives verification that the message was received by the end user, then categorizes the message as "sent" and will not attempt to send again. SMS provides a mechanism for transmitting short message to and from wireless devices. The service makes use of an SMSC, which acts as a store and forward system for short messages. One major advantage of SMS is that it is supported by 100% GSM mobile phones. Almost all subscription plans provided by wireless carriers include inexpensive SMS messaging service

2.3.1 SMS Through Worldwide

SMS is so successful all over the world. SMS messaging is now one of the most important revenue sources of wireless carriers. Some of the reasons are discussed below provided by wireless carriers include inexpensive SMS messaging service

1. SMS Message can be sent to an offline Mobile Phone.
2. SMS Messaging is less disturbing while you can still stay in touch.
3. SMS are supported by 100% GSM Mobile Phones and they can be exchanged between different wireless carriers
4. SMS Messages can be sent and read at any time.

2.4 ALGORITHM

1. Start
2. Microcontroller configuration
3. Interrupt Configuration
4. GSM module configuration
    a. UART initialization
    b. Baud rate negotiation
    c. Issue Disable command echo
    d. Set message type as TXT
    e. Delete all messages(if any)
5. Blink the LED for 5 times
    a. Read EEPROM for any saved number
6. Copy the saved number to microcontroller RAM
7. Begin infinity loop
8. Read if any message Received from GSM module
9. If "Pwd" received as message
    a. Blink led for 7 times
    b. Copy the phone number that sent the "nSTN" message to RAM of the microcontroller
    c. Also saved the number to the EEPROM of the microcontroller.
    d. Send Acknowledge msg to the phone number.
10. If command detected (perform its function)
    a. Turn on/off the Motor

2.5 SYSTEM FLOW DIAGRAM

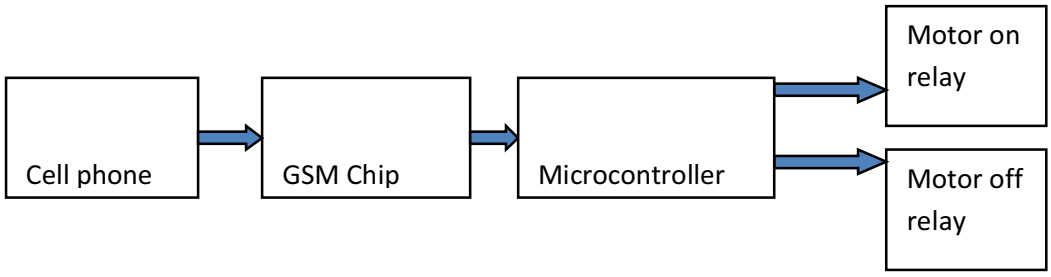


Figure 2.1 Block Diagram of GSM Motor Control

The block diagram shown in fig 2.1 different blocks used in the system the cell phone is used to sent the SMS from anywhere that the message is received through by GSM chip through the receiving antenna that helps to made communication with the controller that the controller is used to convert the message signal to binary signal based on the input command there is set of operation that controller makes decision according to the input command. The GSM Module provides a remote GSM mobile to control the system using the SMS. Based on input command the controller used to turn on the motor and also used to turn off the motor. The image of the GSM motor control is shown in the figure 2.2

Figure 2.2 GSM Module Motor Control Unit

2.6 PROBLEM STATEMENT

This project is an alternative way to overcome and extend the application of existing home control system. Generally, all appliances in our various homes should be switched OFF before embarking on any journey, either short or long distance to avoid electrical damages. This home appliance control system deals with controlling the electrical power point in various homes with a GSM mobile. The major problems faced is the hard purchase of the materials due to the fact that some of the materials used are not produced or hardly seen in or within the country. Due to the power failure in the country, the application of this home appliances control will not be that affective. Not everything that we had planned went smoothly during the project development span.

Also we had a limited amount of time for its completion so we were under a certain amount of pressure as well. We had to start from the research phase at the beginning andneeded to gain knowledge on all the devices and components that we had intended to usefor our project. Other phases of the project included coding, debugging, testing, documentation and implementation and it needed certain time for completion so we really had to manage the limited time available to us and work accordingly to finish the project within the scheduled time.

CHAPTER 3

PROPOSED SYSTEM

3.1 INTRODUCTION

This system is specific for a crop and hence its usage is limited. Proper scheduling of irrigation is critical for efficient water management in crop production, particularly under conditions of water scarcity. The effects of the applied amount of irrigation water, irrigation frequency and water use are particularly important. To improve water efficiency there must be a proper irrigation scheduling strategy.

Smart farming system is autonomous & sophisticated, which will aid in the growth of agriculture yield by applying hi-tech agriculture technique without human intervention. There are lot of new technology have the potential to create an impact on the green revolution. In olden days farmers used to figure the ripeness of soil and influenced suspicious to develop which kind of yield .they don't think about the humidity, level of water & especially climate condition.

In our system the man work for irrigation is eliminated & loss of water during irrigation is avoided by our system, this system provide unimaginable benefit to farmer in the field without require huge man work. The smart farming system developed by our team is adaptive plants and crops irrigation. this purpose of our smart farming system are to provide a water delivering schedule to the crop to ensure all the crop having enough water for their healthy growth, to reduce the amount of water wasted in irrigation, this system able to make decision for the user when distribute water into field. . In olden days farmers used to figure the ripeness of soil and influenced suspicious to develop which kind of yield .they don't think about the humidity

3.2 BLOCK DIAGRAM OF PROPOSED SYSTEM

The block diagram of the proposed system in the figure 3.1 and the system contain many blocks with the wide variety of ranges and it consists of three set of land for the irrigation system.

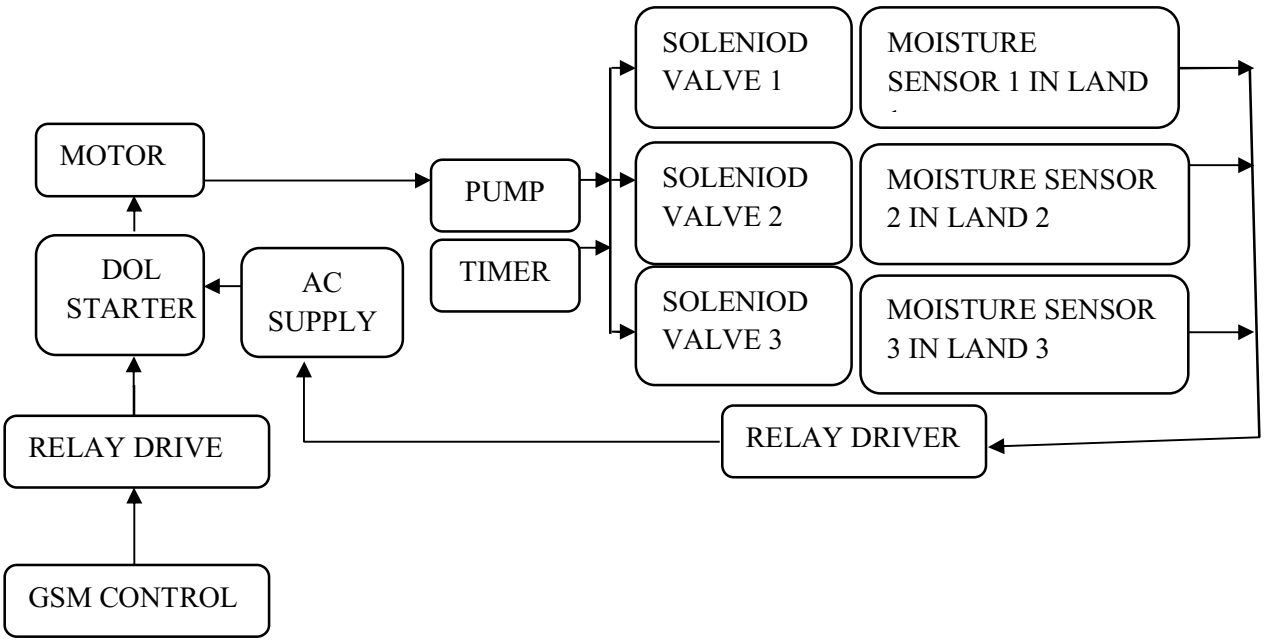


Figure 3.1 Block Diagram of Proposed System.

In this system motor is connected with DOL starter it contains on /off push button to start and stop the motor, GSM control circuit is connected to the DOL starter for control the motor turn on/off operation through the GSM control. There are three lands for the irrigation purpose that timer is giving the input signals to solenoid valve for only the time which required irrigating the land and that moisture sensor checks the lands moisture level and gives the signal to the timer.

In our system the man work for irrigation is eliminated & loss of water during irrigation is avoided by our system, this system provide unimaginable benefit to farmer in the field without require huge man work. The smart farming system developed by our team is adaptive plants and crops irrigation. this purpose of our smart farming system are to provide a water delivering schedule to the crop to ensure all the crop having enough water for their

healthy growth, to reduce the amount of water wasted in irrigation, this system able to make decision for the user when distribute water into field.

3.3 COMPONENTS IN THE SYSTEM

- Pump Motor
- Solenoid valve
- Timer
- Moisture Sensor
- 12V Rectifier unit
- Relay

3.3.1 Pump Motor

The pump definition is, it is a typical mechanical apparatus, and the main function of this device is to force a gas otherwise liquid to move ahead in a pipeline. These are also used for compressing gases otherwise fill air into tires. Pumps use mechanical energy to draw the liquid inside and to discharge them throughout the exit by pressurizing them. The energy sources of pumps mainly include wind power, manual operation, electricity & engines. The working principle of a pump is, it enhances the fluid's pressure to provide the driving strength which is necessary for flow. Usually, the pressure filter supply pump is a centrifugal type pump, and the working principle is that slurry penetrates the pump during the rotating impeller's eye which informs a circular motion

The common types of pumps are positive displacement pumps, and these pumps will make possible the movement of the fluids by catching a set quantity of volume within the released pipe & the volume being situated is stable during the process cycle of the pump. On the other hand, a Centrifugal pump uses a rotating impeller for creating a vacuum for moving liquids from one location to another location. These are normally rated with volumetric flow rate, horsepower, opening pressure within meters of the head, inlet suction in meters of the head. Here, the head can be simplified because the no of feet can

move up otherwise lesser a column of water at atmospheric force. From an early design end of observation, engineers frequently employ a quantity named the exact speed to recognize the most appropriate pump for an exact flow rate combination as well as the head.

Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps. water pumps help regulate the flow of water through a vehicle's cooling system; when the seal on these go bad, the whole pump must be replaced. Located within the home or business, pressure water pumps regulate the water pressure year round, controlling water flow. The picture of motor shown in fig 3.2

Figure 3.2 ½ HP Pump Motor

3.3.2 Solenoid Valve

A solenoid valve is an electromechanical device used for controlling liquid or gas flow. The solenoid valve is controlled by electrical current, which is run through a coil. When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open solenoid valve or close the valve. When

electrical current is removed from the coil, the valve will return to its de-energized state. In direct-acting solenoid valves, the plunger directly opens and closes an orifice inside the valve. In pilot-operated valves (also called the servo-type), the plunger opens and closes a pilot orifice. The inlet line pressure, which is led through the pilot orifice, opens and closes the valve seal. The most common solenoid valve has two ports: an inlet port and an outlet port. Advanced design may have three or more ports. Some designs utilize a manifold-type design shown in fig 3.3

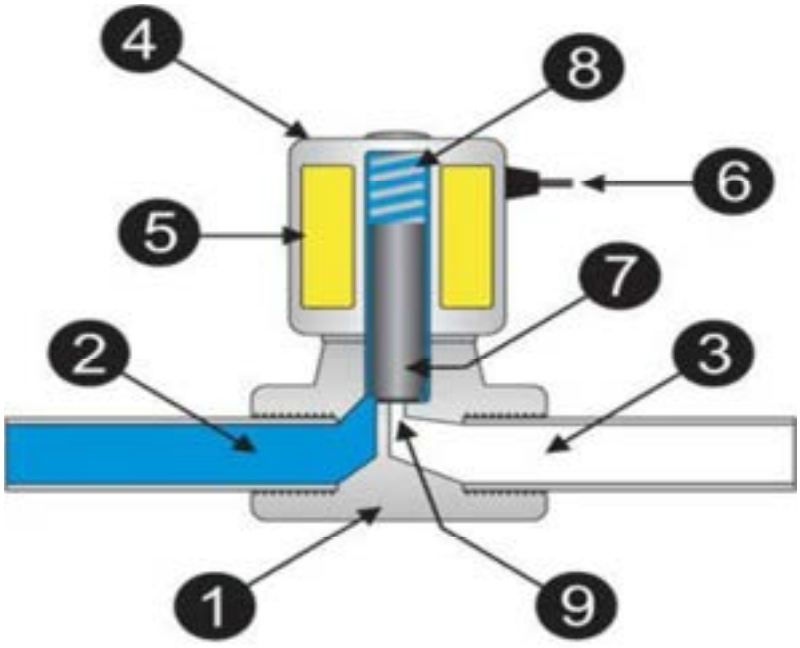


Figure 3.3 Solenoid Valve with Parts

Solenoid valves make automation of fluid and gas control possible. Modern solenoid valves offer fast operation, high reliability, long service life, and compact design. The media controlled by the solenoid valve enters the valve through the inlet port (Part 2 in the illustration above). The media must flow through the orifice (9) before continuing into the outlet port (3). The orifice is closed and opened by the plunger (7). The valve pictured above is a normally-closed solenoid valve. Normally-closed valves use a spring (8) which presses the plunger tip against the opening of the orifice. The sealing material at the tip of the plunger keeps the media from entering the orifice, until the

plunger is lifted up by an electromagnetic field created by the coil. The picture of solenoid valve shown in fig 3.4

Figure 3.4 Solenoid Valve

3.3.3 TIMER

Electronic Timers that have a wide set of applications. Used to measure time intervals, our Timers have modes that can be customized to suit your requirements. We believe in providing our customers the best experience by manufacturing products that help you make your tasks easier. And a variety of timers like Electronic Timer, Timer Switch, Programmable Timers and much more. Time delay relays are simple, reliable, and economical, and they help in controlling an event based on time. They are very important for use in industrial control logic circuits. Time Delay Relays have various applications including flashing light control (time on, time off), engine auto-start control, furnace safety purge control, motor soft-start delay control, and conveyor belt. Digital Timers play an important role in our day-to-day life and they play equally important part in the industries.

There have been many developments in the electronic industry, and Electronic Timer is one of them. Programmable Digital Timer has many uses like measurement, display as well as control in applications. Find out more about the features. These programmable timers are used to measure and control time intervals and the functions make them suitable for specific customer requirements and the timer is shown in figure 3.5

Figure 3.5 Timer

3.3.4 Moisture Sensor

The Moisture sensor is used to measure the water content (moisture) of soil. When the soil is having water shortage, the module output is at high level; else the output is at low level. This sensor reminds the user to water their plants and also monitors the moisture content of soil. It has been widely used in

agriculture, land irrigation and botanical gardening. Specifications of moisture sensor,

- Working Voltage:5V
- Working Current:<20mA
- Interface type: Analog
- Working Temperature:10°C~30°C

The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges.

The Soil Moisture Sensor is used to measure the loss of moisture over time due to evaporation and plant uptake, evaluate optimum soil moisture contents for various species of plants, monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments. These sensors normally used to check volumetric water content, and another group of sensors calculates a new property of moisture within soils named water potential. Generally, these sensors are named as soil water potential sensors which include gypsum blocks and densitometer. Pin descriptions of moisture sensor are,

- VCC pin is used for power
- A0 pin is an analog output
- D0 pin is a digital output
- GND pin is a Ground

This module also includes a potentiometer that will fix the threshold value, & the value can be evaluated by the comparator-LM393. The LED will

turn on/off based on the threshold value. The probe can be powered with an DC supply or batteries in the range of 3.5 to 20 volts. The output is a voltage in the range of 0 to 3V, so any multimeter can be used to measure the moisture level. desired moisture when to light up the LED and signal that the plant needs water. Adjust the potentiometer and see the point at which it starts to light. Measure the potentiometer current value and replace it with a fixed resistor. That the moisture sensor shown in fig 3.6

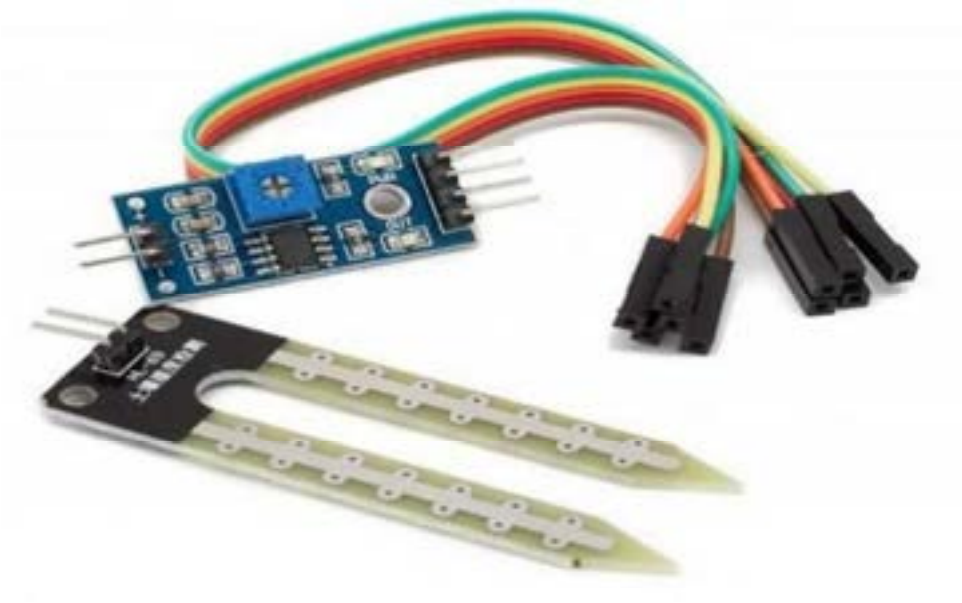


Figure 3.6 Moisture Sensor

3.3.5 Rectifier unit (12V)

Rectifiers let you convert from alternating current (AC) to direct current (DC). AC is current that switches between flowing backwards and forwards at regular intervals while DC flows in a single direction. They generally rely on a bridge rectifier or a rectifier diode. All rectifiers use P-N junctions, semiconductor devices that let electric current flow in only a single direction from the formation of p-type semiconductors with n-type semiconductors. The "p" side has an excess of holes (locations where there are no electrons) so it is positively charged. The "n" side is negatively charged with electrons in their outer shells .Many circuits with this technology are built with a bridge rectifier. Bridge rectifiers convert AC to DC using its system of diodes made of a

semiconductor material in either a half wave method that rectifiers one direction of the AC signal or a full wave method that rectifies both directions of the input AC.

Semiconductors are materials that let current flow because they're made of metals like gallium or metalloids like silicon that are contaminated with materials like phosphorous as a means of controlling current. You can use a bridge rectifier for different applications for a wide range of currents. Bridge rectifiers also have the advantage of outputting more voltage and power than other rectifiers. Despite these benefits, bridge rectifiers suffer from having to use four diodes with the extra diodes compared to other rectifiers, causing a voltage drop that decreases the output voltage.

These diodes take advantage of the p-n junction to convert AC to DC as a sort of electric "switch" that lets current flow in either the forward or reverse direction based on the p-n junction direction. Forward biased diodes let current continue to flow while reverse biased diodes block it. This is what causes silicon diodes to have a forward voltage of about 0.7 volts so that they only lets current flow if it's more than volts. For germanium diodes, the forward voltage is 0.3 volts. The anode terminal of a battery, electrode or other voltage source where oxidization occurs in a circuit, supplies the holes to the cathode of a diode in forming the p-n junction.

In contrast, the cathode of a voltage source, where reduction occurs, provides the electrons that are sent to the anode of the diode. An n-type semiconductor contains an excess of electrons arranged such that charge can flow freely through while still remaining controllable. They're generally produced from arsenic, phosphorous, antimony, bismuth and other elements that have five valence electrons. A p-type semiconductor, on the other hand, has a positive charge due to holes, and is made from gallium, boron, indium and other elements. The distribution of electrons and holes lets charge flow between p-type and n-type semiconductors, and, when connected together, the two create a P-N junction. Electrons from the n-type semiconductor rush over

to the p-type one in diodes that let current flow in a single direction. These diodes take advantage of the p-n junction to convert AC to DC as a sort of electric "switch" that lets current flow in either the forward or reverse direction based on the p-n junction direction. Forward biased diodes let current continue to flow while reverse biased diodes block it. This is what causes silicon diodes to have a forward voltage of about 0.7 volts so that they only let current flow if it's more than volts. The circuit diagram of 12 V rectifier units is shown in the fig 3.7

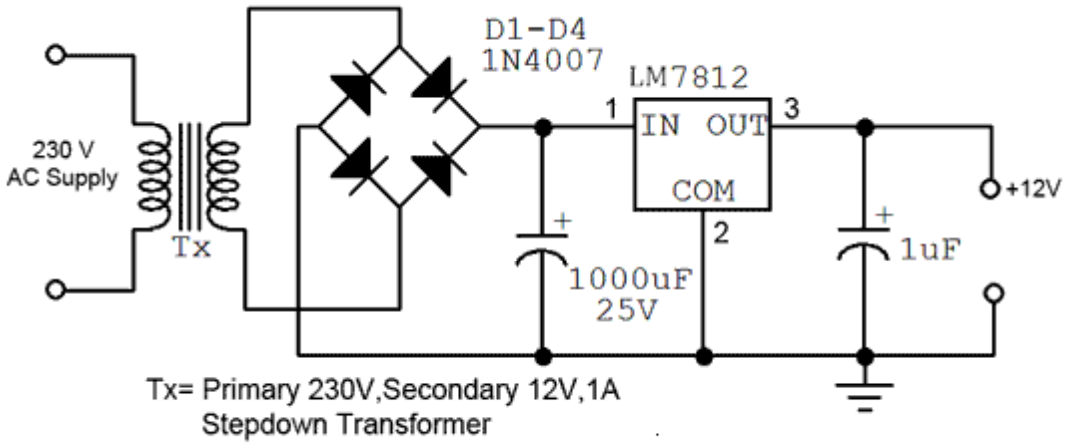


Figure 3.7 Circuit diagram of 12V Rectifier unit

3.3.6 DOL Starter

Different starting methods are employed for starting induction motors because Induction Motor draws more starting current during starting. To prevent damage to the windings due to the high starting current flow, we employ different types of starters. The simplest form of motor starter for the induction motor is the Direct on Line starter. The Direct On Line Motor Starter (DOL) consist a MCCB or Circuit Breaker, Contactor and an overload relay for protection. Electromagnetic contactor which can be opened by the thermal overload relay under fault conditions.

Typically, the contactor will be controlled by separate start and stop buttons, and an auxiliary contact on the contactor is used, across the start button, as a hold in contact. I.e. the contactor is electrically latched closed while the motor is operating. Different starting methods are employed for starting induction motors because Induction Motor draws more starting current during starting. To prevent damage to the windings due to the high starting current flow, we employ different types of starters. The electromagnet consists of a coil of wire placed on an iron core. When a current flow through the coil, the iron of the magnet becomes magnetized, attracting an iron bar called the armature. An interruption of the current flow through the coil of wire causes the armature to drop out due to the presence of an air gap in the magnetic circuit. The electromagnet consists of a coil of wire placed on an iron core. When a current flow through the coil, the iron of the magnet becomes magnetized, attracting an iron bar called the armature. An interruption of the current flow through the coil of wire causes the armature to drop out due to the presence of an air gap in the magnetic circuit. The line diagram of DOL Starter shown in fig 3.8

Line-voltage magnetic motor starters are electromechanical devices that provide a safe, convenient, and economical means of starting and stopping motors, and have the advantage of being controlled remotely. The great bulk of motor controllers sold are of this type. Contactors are mainly used to control machinery which uses electric motors. It consists of a coil which connects to a voltage source. Very often for Single phase Motors, 230V coils are used and for three phase motors, 415V coils are used. The contactor has three main NO contacts and lesser power rated contacts named as Auxiliary Contacts [NO and NC] used for the control circuit. A contact is conducting metal parts which completes or interrupt an electrical circuit.

- NO-normally open
- NC-normally closed

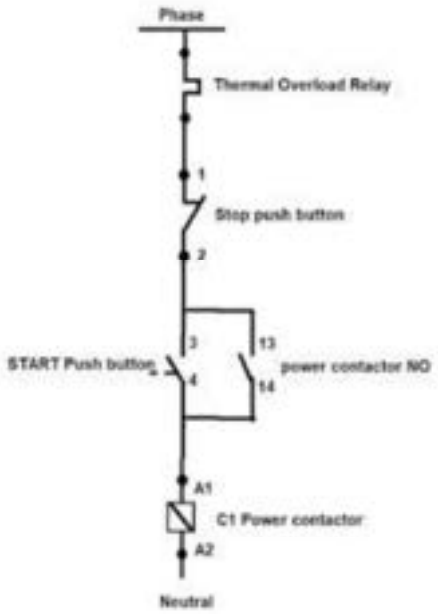


Figure 3.8 Line Diagram of DOL Starter

3.3.7 Relay

Relay is an electrically operated switch, that open and close, Relay control one electrical circuit by opening and closing contacts in another circuit, when the relay is not energized the contact is open. It consists of set of input terminal for a single or multiple control signals, and a set of contact terminals. The switch may have any number of contacts in multiple contact form. That relay contain 3 terminal normally open, normally closed and common terminal, the single channel relay shown in fig 3.8

Figure 3.9 Single Channel Relay

CHAPTER 4

RESULTS & ANALYSIS

4.1 INTRODUCTION

In this project we use different electronic components to control the irrigation in automatic. The main purpose of the automation is to reduce the man power during irrigation and waste of water during irrigation, list of components used in this systems are timer, moisture sensor, DOL starter, GSM controlled circuit and solenoid valve etc. The smart irrigation system was tested on a garden plant. The plant's water requirement is 600-800mm a day and temperature requirement of the soil ranges from 50℃ - 100℃. Moreover this system proves to be cost effective and proficient in conserving water and reducing its wastage.

4.2 PH VALUE FOR DIFFERENT SOILS

Soil PH is an indication of the acidity or alkalinity of soil and is measured in PH units. Soil PH is defined as the negative logarithm of the hydrogen ion concentration the PH scale varies from 0–14 with PH7 as neutral point. The desirable PH range for optimum plant growth varies among crops while some crops grow best in the 6-7 PH range; others grow slightly with the acidic conditions. Normally soil becomes acidic when basic element such as calcium, magnesium, sodium and potassium are replaced by hydrogen ion that the PH level of soils is shown in the table 4.1.

Rainfall contributes to a soil's acidity; water combines with the carbon dioxide to form a weak acid ionizes, the released hydrogen ions are replaces the calcium ions in the soil this net effect increase the soil acidity. The models are then developed to replicate the hydrological cycle, the climate influence by considering the variability in the climate parameters. Some soil PH affects the soil nutrition's and chemicals that soluble in soil water and nutrition available in plants.

Table 4.1 PH Value of Soil Types

S.no	Soil type	PH value	Best for the plant
1	Clay	5.5-7	Moisture loving perennials
2	Sandy	Near 7	Drought tolerant plants
3	Silty	6-6.5	Moisture loving plants
4	Loamy	5.5-6.5	All types of plants

4.3 IMPACT OF CLIMATIC CHANGE IN IRRIGATION

The natural processes in any watershed can be influenced by changes in climatic variables and have long term impact on economic and ecological processes In general, climate change is defined as "the difference between long-term mean values of a climate parameter or statistic, where the mean is taken over a specified interval of time, usually a number of decades". The hydrologic cycle is a part of the climate system; the interactions between the components in the system give rise to the system complexity and this system complexity has been modeled as a) empirical model, b) water balance model, c) conceptual lumped parameter model and d) process based distributed parameter models.

The models are then developed to replicate the hydrological cycle, the climate influence by considering the variability in the climate parameters. Intergovernmental Panel on Climate Change (IPCC) developed a global climate model (GCM) which forecast the future climate parameters. Incorporating the parameter values from GCM into hydrological cycle models will have the ability to visualize the impact of climate change on the system. The IPCC has stated that the average global surface temperature has increased by 0.45°C to 0.6°C and the average sea level has increased by 15 to 20 cm during last century. The variation of temperature according to their climate is shown in table 2.2.

Table 4.2 Variation in Temperature based on Climate

S.no	Climatic zone	Temperature ℃		
		min	Max	Avg
1	Winter	22	25	28
2	Summer	26	30	34
3	Monsoon	24	30	32
4	Post monsoon	23	26	28

4.4 AGRICULTURE IN CALIFORNIA

California agriculture's revenue occupies 12% of the total revenue of agriculture of United States. At the same time, the agriculture in California consumes 80% of water usage of the state, not including some other water activities such as groundwater extraction which may potentially increase this figure to a higher level. The drought in California has lasted for four years, which already causes huge economic loss to this market. Farmers have generally changed the types of crops which consume less water to maintain their business. If there is not an ultimate solution to increase the irrigation systems in California now, there is going to be a catastrophe on California's agriculture market. Water usage in California in shown in fig 4.1

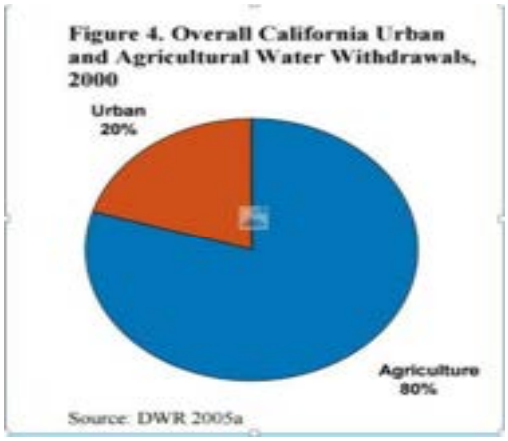


Figure 4.1 Water Usages in California

Developed this smart water irrigation system to save the water sustainability of the regional area, to maintain the crop fields environmental

friendly by preventing soil and earth from getting flooded or dried, and, most importantly, to save economic cost of water usages for the farmers and for the whole market. While several different environmental factors play a key role in agricultural productivity, this project focuses purely on the water consumption aspects of agriculture. The project is a scaled version, as much in size as in complexity, of what agricultural estates experience on a daily basis.

4.5 WATER ECONOMIZATION TECHNIQUES

With water being such a crucial focus of agriculture nowadays, several different water economization techniques and procedures have been put into practice already. Drip system irrigation is becoming more and more generalized and drought resistant crops are starting to replace too heavy water-consuming plants. However, following a study from the Pacific Institute, the method enabling the largest amount of water saving is through the installation of smart irrigation systems, irrigation as shown in the graph below in fig 4.2.

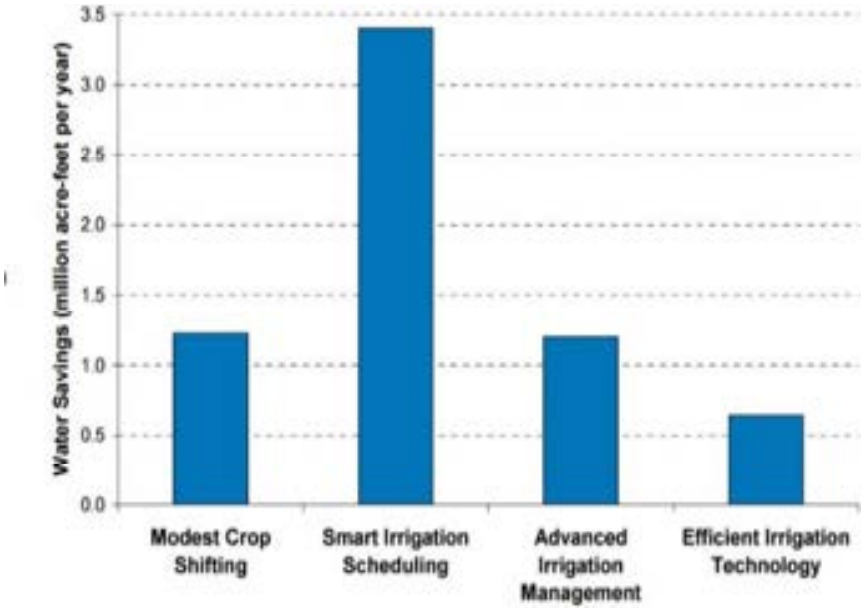


Figure 4.2 Water Economization Techniques

4.6 DEVELOPMENT AND SPREAD OF MICRO IRRIGATION

Experiments with micro – irrigation technology were first conducted in Germany in the 1860s where water was pumped through clay pipes for

irrigation. Research done by E.B. House at Colorado State University in 1913 concluded that the technology was too expensive to be used commercially and no further studies were done till the 1920s (CICR Report, 2011). Use of perforated pipes (Germany, 1920s) was one of the major breakthroughs in the industry.

However, current micro – irrigation technology relates to the work of Symcha Blass of Israel in the 1930s.He accidentally discovered the concept when a farmer drew his attention to a large tree that showed a much more rigorous growth than other trees in the area because it received water from a leaking faucet nearby. Based on this observation, he developed the first patented drip irrigation system and subsequently took major steps in the development of his idea with the advent of cheap plastics in 1950s after the World War II. The availability of low cost plastic pipe for water delivery lines helped popularize the use of drip irrigation systems.

From Israel the drip irrigation concept spread to Australia, North America and South Africa by the late 1960s and eventually throughout the world. The development of LDPE (Low density poly ethylene), HDPE (High density poly ethylene) and LLDPE (Low linear density poly ethylene) in 1977, suitable and economical material, resulted in the sudden growth of micro – irrigation industry, he developed the first patented drip irrigation system and subsequently took major steps in the development of his idea with the advent of cheap plastics in 1950s after the World War II. The availability of low cost plastic pipe for water delivery lines helped popularize the use of drip irrigation systems. The development of micro irrigation is essential for saving the water in irrigation system.

4.7 CONSUMBTION OF WATER IN IRRIGAATION

Plants will tend to be extracting water at higher rates during specific times of the day. Plants also need to have a certain quantity of water over several days and have a water application pattern alternating between highs and lows. Setting up all of these constraints is where the human interaction

with the cyber-physical system becomes crucial. That the graph shows ideal water consumption of plant during normal days in fig 4.3

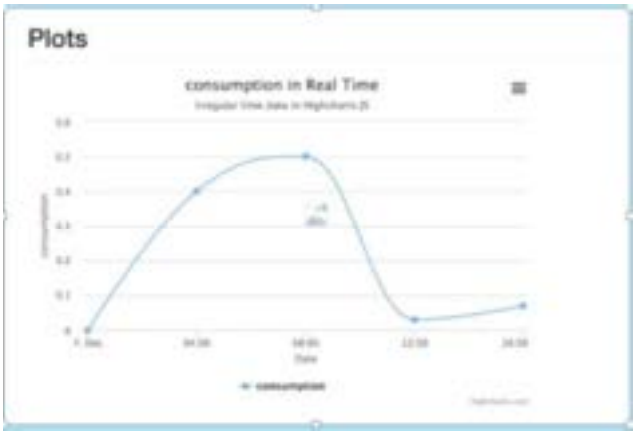


Figure 4.3 Consumption of Water during Normal Days

Each plant will require different values and parameters. One could say however that this can be too complex and time consuming for the user. Moreover, he could not know exactly what amount of water his plants need to grow optimally. Our system is trying to account for this by having adaptive constraints depending on the information sent back from the moisture sensor. When looking at the graph above, grass has a 3 day cyclic irrigation pattern, while impatiens' irrigation cycle is every 48 hours. Hence for each plant, the moisture from 72 (or 48 depending on the plant) hours ago will be compared to the present moisture. Plants also need to have a certain quantity of water over several days An example can be shown in the graph below in fig4.4.

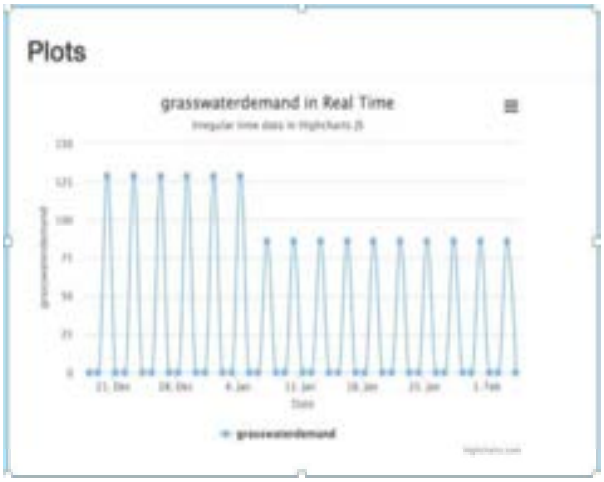


Figure 4.4 Grass Water Demand in Several Days

4.8 DETERMINING WATER REQUIREMENT

Water requirement for litchi crop (WR), is a function of surface area covered by plants, evaporation rate and infiltration capacity of soil. The irrigation water requirement for each plant is calculated first and thereafter for the whole plot of 1 ha based on plant population for the different seasons. The maximum discharge required during any one of the three seasons is adopted for design purposes. The irrigation water requirement is determined using average season wise pan evaporation data for the area. The average figure of 20 or 30 years is taken into account while doing the calculations. The daily water requirement for fully-grown plants can be calculated as under.

WR = A x B x C x D x E

Where: WR = Water requirement (l p d /plant)

A = Open Pan evaporation (mm/day)

B = Pan Factor (0.7); this may differ area wise

C = Spacing of plant (m2)

D = Crop factor (factor depends on plant growth-for fully grown plants = 1)

E = Wetted Area (0.3 for widely spaced crops) the total water requirement of the farm plot would be WR x No. of Plants.

There are several evidences to show that flower induction in litchi is promoted by water stress during the preceding autumn and winter. High moisture prior to floral initiation promotes vegetative growth and suppresses flowering. However, the desired response is only achieved if the water deficit is followed by cool weather. Drought cannot be used to induce flowering in tropical environments. It has also been observed that drought during actual flower development or anthesis reduces yields. Furthermore, shoot growth is more sensitive to drought than photosynthesis or fruit growth. Leaves cease to expand once leaf water potential falls below - 2.5 MPa, Mild water deficits after flowering shift resources in favor of the fruit, whereas severe drought sharply reduces yield and fruit quality. These observations must be kept in

mind while deciding irrigation schedules for litchi trees.

Young trees up to 3-4 years are irrigated frequently from October to June. The period from July to September receives sufficient rain to fulfill the water needs of the trees. If the rain during this period is scanty, the trees are irrigated at 15 days interval during October–November, at one month interval during December-February and at 7 or 10 interval during March–July. This schedule favors rapid vegetative growth and induces the trees to bear in the 4th or 5th year of planting. When the trees come into bearing, the irrigation schedule is changed. The bearing trees are seldom irrigated from November to March i.e. till flowering and fruit setting are over. Irrigation plays an important role in raising and stabilizing yield and maintaining quality of a crop like litchi, which is more precious than other fruit crops grown in tropical or subtropical climate.

Water relations are very important to the function of the litchi tree, as water is the greatest component of the tree by mass and almost all critical processes can be limited by inappropriate water status. The essential role of water, however, does not mean that the water is always limiting or is regulating variations in productivity. As regards litchi tree's water requirement it is believed that litchi is a hardy plant species able to tolerate drought fairly well during vegetative period. But once inflorescences have initiated and fruit setting is over, the best fruit yield and quality is achieved only when the trees are well watered. Similarly, younger plants (1-3 years old) are highly sensitive to drought. They require frequent irrigations particularly in hot summer months. Otherwise, mortality rate of younger plants is higher as compared to other fruit crops under neglected un-irrigated conditions.

Thereafter trees are irrigated at weekly intervals till harvesting of the crop in last week of May or early June. Thus, localities which have a consistently dry period from November to March are more congenial for litchi cultivation. This method uses the combined climatologically effect of temperature variations and aerodynamic variations seems to be more promising in deriving evapotranspiration.

4.8.1 Reference Evapotranspiration (ETo)

Table 4.3 shows the mean monthly ETo values of the study area. It increased steadily from 4.1 mm day-1 in January to a peak value of 6.6 mm day-1 in May and declined to 6.4 mm day-1 in June. This continued to a lowest value of 3.7 mm day-1 in December. 4

Table 4.3 Reference Evapotranspiration (ETo) Value

Month	ETo Mm day^{-1}
Jan	4.1
Feb	4.9
Mar	5.6
Apr	6.4
May	6.6
Jun	6.4
Jul	5.7
Aug	5.6
Sep	5.6
Oct	5.4
Nov	4.4
Dec	3.7

4.8.2 Crop Evapotranspiration (ETc)

The mean monthly ETc values for the dry season (October to June) in table 3 followed the same pattern as that of ETo. The highest value of ETc of 6.3 mm day-1 was obtained in May while the lowest of 3.5 mm day-1 was obtained December. Thus, localities which have a consistently dry period from November to March are more congenial for litchi cultivation. This method uses the combined climatologically effect of temperature variations and aerodynamic variations seems to be more promising in deriving evapotranspiration. Table 4.4 shows the mean monthly ETc values of the study area.

Table 4.4 Crop Evapotranspiration (ETo) Value

Month	ETo Mm day^{-1}
Jan	3.9
Feb	4.7
Mar	5.3
Apr	6.1
May	6.3
Jun	6.1
Jul	5.4
Aug	5.3
Sep	5.3
Oct	5.1
Nov	4.2
Dec	3.5

4.8.3 Water Requirement (WR)

Water is the greatest component of the tree by mass and almost all critical processes can be limited by inappropriate water status. The essential role of water, however, does not mean that the water is always limiting or is regulating variations in productivity. **Y**ounger plants (1-3 years old) are highly sensitive to drought. They require frequent irrigations particularly in hot summer months. Otherwise, mortality rate of younger plants is higher as compared to other fruit crops under neglected un-irrigated conditions.

Computed daily water requirements for amaranthus growth in Maiduguri metropolis are presented in tables 4.5 below for early, development and maturity growth stages respectively. In table 4, peak water requirements of 0.7 L day-1 were obtained in April, May and June and lowest of 0.4 L day-1 in December and January. This could be as a result of low temperatures in December and January compared to higher values in April, May and June.

Table 4.5 Water Requirement (WR) Value

Month	Water requirement $Lday^{-1}$
Jan	1.5
Feb	1.7
Mar	2.0
Apr	2.3
May	2.3
Jun	2.3
Jul	2.1
Aug	2.0
Sep	1.9
Oct	1.7
Nov	1.6
Dec	1.3

4.8.4 Irrigation Time

Irrigation times (Tirrig.) in tables 4.5 showed that irrigation times (Tirrig.) are inversely proportional to the application rates (ar). The longest irrigation times (Tirrig.) were 1.4, 3.7, and 3.9 h day-1in May while at 0.5 application rate (ar) while the shortest were 0.3, 0.7 and 0.9 h day-1 in December for early, development and maturity stages respectively. Hence, less water is saved in May than in December. Theoretical values of water requirements (WR) and irrigation timing (Tirrig) for irrigation.

In practical terms, the water requirement and irrigation time can be computed based on the dates the crop is planted. Dry season drip irrigation system as water saving measure and optimum yield. Results showed that evapotranspiration (ET), water requirement (WR) and irrigation time (Tirrig.) values were lowest in December and highest in May when compared to other values within the dry season.

Table 4.6 Irrigation Time (Tirrig.)Value

Month	Irrigation Time $Lday^{-1}$
Jan	1.2
Feb	1.4
Mar	1.6
Apr	1.8
May	1.8
Jun	1.8
Jul	1.7
Aug	1.7
Sep	1.5
Oct	1.3
Nov	1.2
Dec	1.0

4.9 SOIL HEAT FLUX

The soil is capable of absorbing, emitting, and storing energy. Some energy available for evapotranspiration could be used to heat the soil. Conversely, if the soil is warmer than the crop, the soil could provide some energy for evapotranspiration. The amount of energy entering or leaving the soil, called the soil heat flux, is denoted by the symbol G.

If the algebraic value of G is positive, the soil is absorbing energy. If G is less than zero, the soil is providing energy for evapotranspiration. The average daily amount of soil heat flux over a 10 to 30 day period is usually small. The value of G generally becomes more important for daily calculations and for long-term estimates. Wright (1982) presented the following method of computing the daily soil heat flux; some energy available for evapotranspiration could be used to heat the soil.

$$G = C_s (T_a - T_p)$$

Where: G = soil heat flux (lang/d)

C_s = an empirical specific heat coefficient for the soil (lang/°F/d)

Ta = average air temperature for the current day, (°F)

Tp = mean air temperature for the preceding three days (°F)

Wright (1982) used a value of 5 Langley's per degree Fahrenheit per day for C_s for an alfalfa crop at Kimberly, Idaho. The value of C_s varies for grass grown on other soils and in other locations. Unfortunately, other values of C_s are not readily available, and the value from Wright should be used as an initial approximation.

4.10 IRRIGATION SHEDULING

An important use of on-farm irrigation requirements is for irrigation scheduling. Irrigation scheduling is deciding when to irrigate and how much water to apply. Modern scheduling is based on the soil water balance for one or more points in the field. By estimating the future soil water content, irrigation can be applied before crop stress and after leaching would occur. Scheduling must involve forecasting to anticipate future water needs.

Several scheduling techniques and levels of sophistication can be applied to keep track of the amount of water in the crop root zone. A widely used method accounts for soil water similar to accounting for money in a checking account. The "checkbook" method depends on recording the soil water balance throughout the season. The date for future irrigations can be predicted if the average weekly water use rate is known.

In some locations crop water use information is made available via newspapers, radio broadcasts, or telephone call-in systems. Any scheduling program should use rainfall measured at the field site. Rainfall amounts measured at the farmstead or in town are not good enough for scheduling because the spatial variability for rainfall is quite large. The checkbook method is simple and easily applied, but is tedious when several fields are considered. Also, forecasting can make bookkeeping cumbersome. Irrigation scheduling can be fine tuned beyond the checkbook method using computers to calculate

crop water use, evaluate alternatives, and consider system characteristics.

The basic concept of the first developed computerized scheduling (Jensen, et al. 1971) is widely used today. Most computer programs use a soil water balance, for one or more points in the field, to determine when to irrigate. The initial soil water depletion at the start of an update period must be known from either soil water measurement or previous calculations. Soil water depletion during the update period is calculated daily using crop evapotranspiration, rainfall, and irrigation. The deficit at the end of the update period provides the predicted status of the soil water depletion. Anticipated depletion for the future is then predicted for the forecast period using the long-term average water use rate. Irrigations are scheduled when available soil water drops below the MAD, which is often assumed to be 50 percent of the available water for the crop root zone.

To include irrigation in the soil water balance, the net depth must be determined. The net depth depends upon the type of system. Usually sprinkler systems are operated to apply a known gross depth. Thus, the net depth is the product of the application efficiency and the gross depth. Surface systems are often operated to refill the crop root zone, or that amount minus some rainfall allowance. The rainfall allowance, room for rain, is generally from 0.5 to 1.0 inches for fine textured soils and is generally not used for sandy soils. For surface systems, the net depth is often known and the gross depth is calculated using the net depth and application efficiency.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage. Moreover in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence we require an automatic system that will precisely monitor and control the water requirements in the field. Installing Smart irrigation system saves time and ensures judicious usage of water.

Moreover this architecture uses timer which promises an increase in system life by reducing power consumption. Modernization of farming is straightforward, reasonable and operable. As relying upon these parameter esteems rancher can without much of a stretch choose which fungicides and pesticides are utilized for enhancing crop creation.

5.2 FUTURE SCOPE

- To provide protection from insect attack for better yield. Focused on the prevention of crops from insect attack which damages the crop leaves and root so it automatically affects the crop yield
- To observe other parameters for better yield.
- Climatic conditions also affect the growth of crops, like temperature increases the water requirement also increases so it can also be monitored
- A water meter can be installed to estimate the amount of water used for irrigation and thus giving a cost estimation.
- A solenoid valve can be used for varying the volume of water flow. Furthermore, Wireless sensors can also be used.

REFERENCES

[1] Rafael Muñoz-Carpena and Michael D. Dukes, Automatic Irrigation Based on Soil Moisture for Vegetable Crops, IFAS Extension, 2005.

[2] G. Vellidis , M. Tucker, C. Perry, C. Kvien, C. Bednarz, "A Real-Time Wireless Smart Sensor Array for Scheduling Irrigation", National Environmentally Sound Production Agriculture Laboratory (NESPAL), 2007.

[3] Constantinos Marios Angelopoulos, Sotiris Nikoletseas , Georgios Constantinos Theofanopoulos, A Smart System for Garden Watering using Wireless Sensor Networks, MobiWac ,October 31–November 4, 2011.

[4] R.suresh, S.Gopinath, K.Govindaraju, T.Devika, N.Suthanthira Vanitha, GSM based Automated Irrigation Control using Raingun Irrigation System, International Journal of Advanced Research in Computer and Communication Engineering ,Vol. 3, Issue 2, February 2014.

[5] International journal of engineering sciences & research technology (IJESRT) survey of smart irrigation system H. N. Kamalaskar* Dr. P. H. Zope, ISSN: 2277-9655

[6] Karan Kanasura, VishalZaveri, Sensor Based Automated Irrigation System With Iot: A Technical Review, Babu Madhav Institute of Technology, UkaTasadia University, Bardoli, and Gujarat, India.

[7] Rafael Muñoz-Carpena and Michael D. Dukes, Automatic Irrigation Based on Soil Moisture for Vegetable Crops, IFAS Extension, 2005.

[8] VeenaDivya K. Member IACSIT1, 2,3,4,5. A real time implementation of a GSM based automated irrigation control system using drip irrigation methology. Department of Instrumentation Technology, R. V. College of Engineering, Bengaluru, Karnata.2013; 4(5). ISSN: 2229-5518

[9] R. Suresh, S. Gopinath, K. Govindaraju, T. Devika, N. Suthanthira Vanitha, GSM based Automated Irrigation Control using Raingun Irrigation System, International Journal of Advanced Research in Computer and Communication Engineering ,Vol. 3, Issue 2, February 2014.

[10] Narayanamoorthy, A., Economic Viability of Drip Irrigation: An Empirical Analysis from Maharashtra, Indian Journal of Agricultural Economics, Vol.52, No.4, October-December, pp.728-739.

[11] INCID, Drip Irrigation in India. Indian National Committee on Irrigation and Drainage, New Delhi, 1994.

[12] Kulkarni, S. A. Looking Beyond Eight Sprinklers. National Conference on Micro-Irrigation. G. B. Pant University of Agriculture and Technology, Pantnagar, India, June 3-5, 2005.

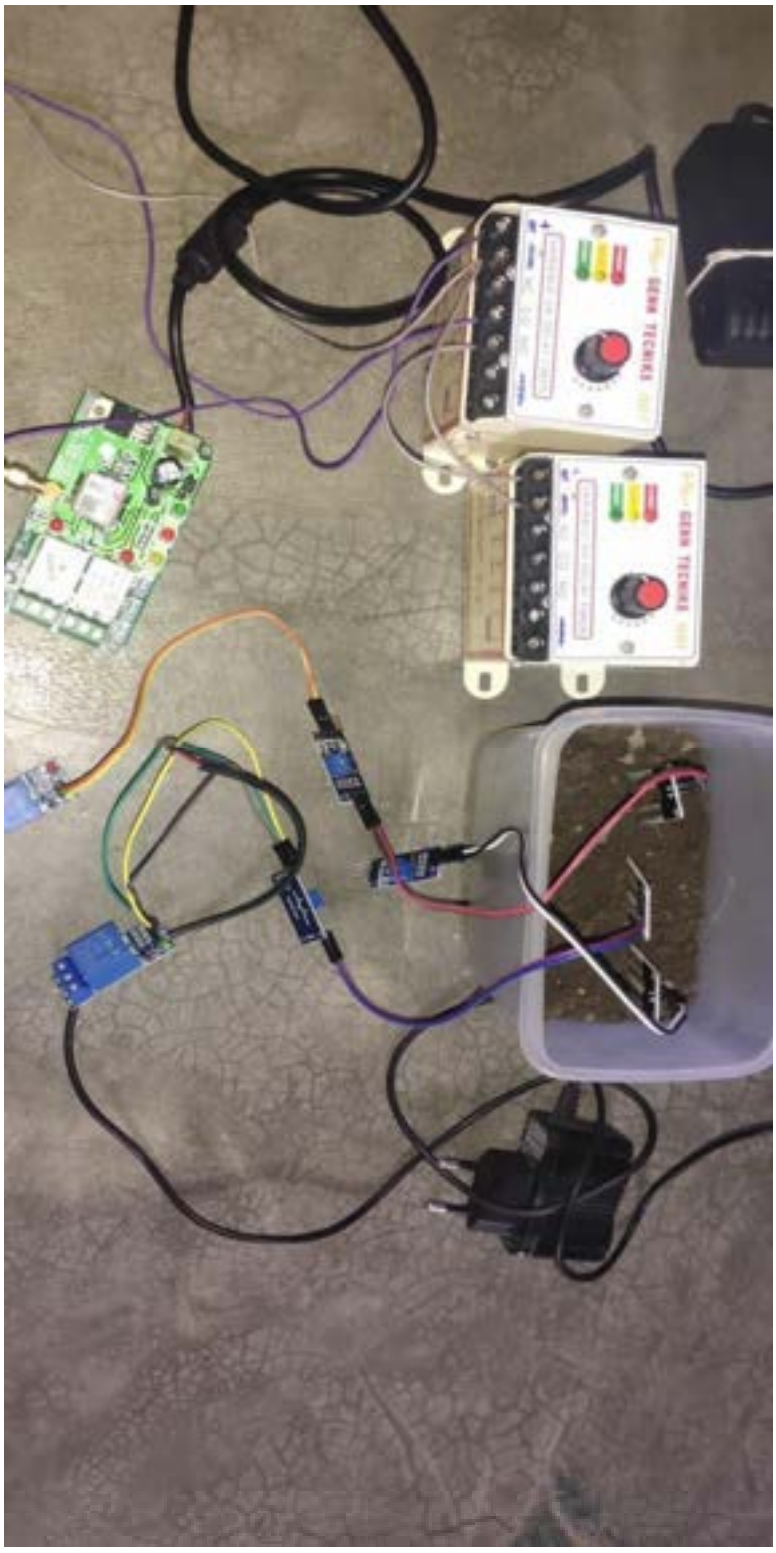
[13] Tahar Boutraa, Abdellah Akhkha, Abdulkhaliq Alshuaibi, Ragheid Atta, "Evaluation of the effectiveness of an automated irrigation system using wheat crops." Agriculture and Biology.

[14] Jia Wenjun and He Xinlin, "The Study of Influence on Water-Salt Transportation under Saline Drip Irrigation", ICAE, 27-29 May 2011.

[15] KoushikAnand, C. Jayakumar,MohanaMuthu, and Sridhar Amirneni, "Automatic Drip Irrigation System Using Fuzzy Logic and Mobile Technology," TIAR, 10-12 July 2015.

[16] Drashti Divani, Pallavi Patil, and Sunil K, "Automated Plant Watering System," ICCPEIC, 2021 April 2016

HARDWARD DESCRIPTION



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ENHANCE THE POWER QUALITY OF SOLAR CELL AND SAVONIUS ROTOR HYBRID SYSTEM

A MAIN PROJECT REPORT

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ABSTRACT

The growing energy demand reduced supply of conventional fuels, evidenced by petroleum crisis. Development of alternative energy sources that are cleaner are renewable and produce little environmental impact. Among the alternative sources, the electrical energy from hybrid system is currently regarded as a natural energy source that is more useful, since it is clean, abundant and distributed over the Earth. In spite of the phenomena of reflection and absorption of sunlight by the atmosphere, it is estimated that solar energy incident on the Earth's surface is on the order of ten thousand times greater than the world energy consumption. A great advantage of hybrid system is the reduction of carbon dioxide emissions. These methods are accurate, fast and reliable. Hybrid system has become increasingly important as a renewable source due to its advantages such as absence of fuel cost, low maintenance requirement and environmental friendliness. These methods vary in complexity, sensors required, convergence speed, cost and range of effectiveness. Hybrid Systems holds the most potential to meet our energy demands. solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. Similarly, Wind energy is capable of supplying large amounts of power but its presence is highly unpredictable as it can be here one moment and gone in another. The common inherent drawback of hybrid systems are their intermittent natures that make them unreliable. This configuration allows the sources to supply the load separately or simultaneously depending on the availability of the energy sources. These regulators support step up and step-down operations for each renewable energy sources.

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LIST OF ABBREVATIONS

VAWT	Vertical Axis Wind Turbine
LED	Light Emitting Diode
DC-DC	Direct Current – Direct Current
DC-AC	Direct Current – Alternating Current
RPM	Revolution Per Minute
LDR	Light Dependent Resistor
CT	Current Transformer
IG	Induction Generator

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services. Based on REN21's 2017 report, renewables contributed 19.3% to humans' global energy consumption and 24.5% to their generation of electricity in 2015 and 2016, respectively. This energy consumption is divided as 8.9% coming from traditional biomass, 4.2% as heat energy (modern biomass, geothermal and solar heat), 3.9% from hydroelectricity and the remaining 2.2% is electricity from wind, solar, geothermal, and other forms of biomass. Worldwide investments in renewable technologies amounted to more than US$286 billion in 2015. In 2017, worldwide investments in renewable energy amounted to US$279.8 billion with China accounting for US$126.6 billion or 45% of the global investments, the United States for US$40.5 billion and Europe for US$40.9 billion.

Globally there are an estimated 7.7 million jobs associated with the renewable energy industries, with solar photovoltaics being the largest renewable employer. Renewable energy systems are rapidly becoming more efficient and cheaper and their share of total energy consumption is increasing. As of 2019, more than two-thirds of worldwide newly installed electricity capacity was renewable. Growth in consumption of coal and oil could end by 2020 due to increased uptake of renewables and natural gas. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20

percent of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond. Some places and at least two countries, Iceland and Norway, generate all their electricity using renewable energy already, and many other countries have the set a goal to reach 100% renewable energy in the future. At least 47 nations around the world already have over 50 percent of electricity from renewable resources. Renewable energy resources exist over wide geographical areas, in contrast to fossil fuels, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency technologies is resulting in significant energy security, climate change mitigation, and economic benefits.

In international public opinion surveys there is strong support for promoting renewable sources such as solar power and wind power. While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas and developing countries, where energy is often crucial in human development. As most of renewable energy technologies provide electricity, renewable energy deployment is often applied in conjunction with further electrification, which has several benefits: electricity can be converted to heat (where necessary generating higher temperatures than fossil fuels), can be converted into mechanical energy with high efficiency, and is clean at the point of consumption. In addition, electrification with renewable energy is more efficient and therefore leads to significant reductions in primary energy requirements

Renewable energy resources and significant opportunities for energy efficiency exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency, and technological diversification of energy sources, would result in significant energy security and economic benefits. It would also reduce environmental pollution such as air pollution caused by burning of

fossil fuels and improve public health, reduce premature mortalities due to pollution and save associated health costs that amount to several hundred billion dollars annually only in the United States. Renewable energy sources, that derive their energy from the sun, either directly or indirectly, such as hydro and wind, are expected to be capable of supplying humanity energy for almost another 1 billion years, at which point the predicted increase in heat from the Sun is expected to make the surface of the earth too hot for liquid water to exist.

Climate change and global warming concerns, coupled with the continuing fall in the costs of some renewable energy equipment, such as wind turbines and solar panels, are driving increased use of renewables. New government spending, regulation and policies helped the industry weather the global financial crisis better than many other sectors. As of 2019, however, according to the International Renewable Energy Agency, renewables overall share in the energy mix (including power, heat and transport) needs to grow six times faster, in order to keep the rise in average global temperatures "well below" 2.0 °C (3.6 °F) during the present century, compared to pre-industrial levels.

As of 2011, small solar PV systems provide electricity to a few million households, and micro-hydro configured into mini-grids serves many more. Over 44 million households use biogas made in household-scale digesters for lighting and/or cooking, and more than 166 million households rely on a new generation of more-efficient biomass cookstoves. United Nations' Secretary-General Ban Ki-moon has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity.

At the national level, at least 30 nations around the world already have renewable energy contributing more than 20% of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond, and some 120 countries have various policy targets for longer-term shares

of renewable energy, including a 20% target of all electricity generated for the European Union by 2020.

Some countries have much higher long-term policy targets of up to 100% renewables. Outside Europe, a diverse group of 20 or more other countries target renewable energy shares in the 2020–2030 time frame that range from 10% to 50%Renewable energy often displaces conventional fuels in four areas: electricity generation, hot water/space heating, transportation, and rural (off-grid) energy services.

1.2 Wind Energy

In 2018, worldwide installed capacity of wind power was 564 GW. Air flow can be used to run wind turbines. Modern utility-scale wind turbines range from around 600 kW to 9 MW of rated power. The power available from the wind is a function of the cube of the wind speed, so as wind speed increases, power output increases up to the maximum output for the particular turbine.

Areas where winds are stronger and more constant, such as offshore and high-altitude sites, are preferred locations for wind farms. Typically, full load hours of wind turbines vary between 16 and 57 percent annually, but might be higher in particularly favourable offshore sites.

Wind-generated electricity met nearly 4% of global electricity demand in 2015, with nearly 63 GW of new wind power capacity installed. Wind energy was the leading source of new capacity in Europe, the US and Canada, and the second largest in China. In Denmark, wind energy met more than 40% of its electricity demand while Ireland, Portugal and Spain each met nearly 20%.

Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand, assuming all practical barriers needed were overcome.

This would require wind turbines to be installed over large areas, particularly in areas of higher wind resources, such as offshore. As offshore wind speeds average ~90% greater than that of land, so offshore resources can contribute substantially more energy than land-stationed turbines. Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand, assuming all practical barriers needed were overcome.

Figure 1.1 Wind Farm

1.3 Solar energy

In 2017, global installed solar capacity was 390 GW. Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, concentrated solar power (CSP), concentrator photovoltaics (CPV), solar architecture and artificial

photosynthesis . Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert, and distribute solar energy.

Passive solar techniques include orienting a building to the Sun, selecting materials with favourable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Active solar technologies encompass solar thermal energy, using solar collectors for heating, and solar power, converting sunlight into electricity either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

Figure 1.2 Solar Farm

A photovoltaic system converts light into electrical direct current (DC) by taking advantage of the photoelectric effect.[60] Solar PV has turned into a multi-billion, fast-growing industry, continues to improve its cost-effectiveness, and has the most potential of any renewable technologies together with CSP. Concentrated solar power (CSP) systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Commercial concentrated solar power

plants were first developed in the 1980s. CSP-Stirling has by far the highest efficiency among all solar energy technologies.

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous ,inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared".

Italy has the largest proportion of solar electricity in the world; in 2015, solar supplied 7.7% of electricity demand in Italy. In 2017, after another year of rapid growth, solar generated approximately 2% of global power, or 460 TWh.

1.4 LITERATURE SURVEY

Andrew mathewdominic [1].et al., The performance of the wind-solar hybrid system with balanced linear load at wind speed of 11 m/s. The corresponding rotor speed set point is at 99.6 rad/s, and its stator-frequency is 47.08 Hz. Since the power generated by the system is more than the required active power for the electrical loads. The battery is absorbing the power to maintain the frequency of the load voltage constant. The required battery capacity is determined by the energy needed to keep the circuit working during the peak load time. To determine whether the circuit will operate from the mains or from the battery, it's indicated by small led (green on main, red on battery, Blue battery at minimum level) by using control circuit.

Ahmed, N.A., Miyatake, M [2]. The prototype resulting from this project consists of one of the very first wind-solar energy street-lighting systems. The main

innovative feature is the full integration of VAWT Savonius rotor along the structure of the lamp-post. This solution allows the ex-potation of a considerable wind rotor frontal area and then has a wide potential of productivity, eventually also with grid ex- changing. Two Savonius rotor options have been designed and realized according to wind tunnel tests geometrical optimization and to the most appropriate nominal speed of rotation for security and efficiency.

A safety brake system has been designed and successfully tested during free rotor operation. It has been set-up a field test for the wind and solar energy microgeneration unit, based on a meteorological tower and a dedicated algorithm for the correlation of wind speed measurements. Such a detailed experimental apparatus is devoted to give the tools for a comprehensive study of the renewable energy system. Besides, the performance evaluation of wind solar devices, experimentation allows to test different control strategies e.g. related to LED switching.

Bakos, G.C., Tsagas, N.F [3], The proposed system is designed to be full autonomous through the whole year. The calculated energy production is 371.7 kWh while the annual consumption is 222.8 kWh. The remaining 148.9 kWh can be sold given that the system is connected to power grid. In the other hand if the system works stand- alone the produced power is enough for the autonomous operation, The lighting system of this application is most appropriate for lighting of low traffic roads According to recent research works the metal.

Borowy, B.S. et al. [4], Studied hybrid wind/solar systems using battery banks and developed an optimal model for designing such systems. The stand-alone system was designed to power a telecommunication station along the coast of China. The slope angle of the photovoltaic (PV) array was studied to find the optimal power-producing angle, as well as the optimal values of other variables such as the number

of wind turbines and battery capacity, The annualized cost of the system was minimized while meeting the specified loss of power supply probability (L.PSP). The model was solved using a genetic algorithm, and good complementarity between the two energy sources was reported studied an optimal sizing procedure for a similar system in Turkey.

Bouroussis.A et al. [5], Presented a hybrid system model that included fuel cell generation along with wind and solar power. The fuel cell system was used as a backup resource, where as the main energy sources were the solar and wind systems. Results demonstrate that the system is reliable and can supply high-quality power to the load, even in the absence of wind and sun. Also designed fuel cell systems hybridized with solar and wind energy which are well-suited to grid- independent applications.

Celik, A.N. et al. [6], Used a genetic algorithm to develop an optimal sizing method for a hybrid wind/solar system that optimizes its configurations with the use of battery banks. The optimal sizing method was then used to calculate optimal system configurations that achieve a given loss of power supply probability (LPSP) while at the same time minimizing the annualized cost of the system (ACS). The feasibility of meeting the energy demand of a seawater greenhouse in Oman using a hybrid wind/solar energy system was assessed by Mahmoudi et al by analysing hourly wind speed and solar radiation measurements.

Daniele Vitalil [7], Assessed the feasibility of providing power to and meeting the load requirements of a typical commercial building using a hybrid solar-wind energy system; different combinations of wind energy systems, photovoltaic panels with battery storage, and a diesel backup energy system were investigated. The feasibility of a grid-independent hybrid wind/solar system for a particular region of

Australia was studied by Shakya et al. This design featured a compressed hydrogen gas storage system.

Dihrab S.S. et al. [8], Assessed the long-term performance of a hybrid wind/solar power system for both standalone and grid-dependent applications by using a probabilistic approach to model the uncertain nature of the load and resources.

Elhadidy M.A. [9], Proposed a hybrid PV/wind system that would be used for grid-connected applications as a power source in three cities in Iraq. A simulation of the model was carried out on MATLAB, where the input parameters were determined by meteorological data from the three locations, as well as the sizes of the wind turbines and the PV arrays. Their results showed that their hybrid system would provide sufficient energy for villages in desert or rural areas.

1.5 ORGANIZATION OF THE PROJECT

Chapter 2: Deals with Existing System

Chapter 3: Deals with Proposed System and Hardware System

Chapter 4: Deals with simulation system

Chapter 5: Deals with Conclusion and Future Scope

Chapter 6: Deals with Appendixes and Reference

CHAPTER 2

EXISTING SYSTEM

2.1 ANALYSIS OF HYBRID POWER GENERATION USING SAVONIUS BLADE

Electricity is most needed for our day to day life There are two ways of electricity generation either by conventional energy resources or by non-conventional energy resources. Electrical energy demand increases in world so to fulfil demand we have to generate electrical energy. Nowadays electrical energy is generated by the conventional energy resources like coal, diesel, and nuclear etc The main drawback of these sources is that it produces waste like ash in coal power plant, nuclear waste in nuclear power plant and taking care of this wastage is very costly. And it also damages the nature. The nuclear waste is very harmful to human being also.

The conventional energy resources are depleting day by day. Soon it will be completely vanishes from the earth so we have to find another way to generate electricity. The new source should be reliable, pollution free and economical. The non-conventional energy resources should be good alternative energy resources for the conventional energy resources There are many non-conventional energy resources like geothermal, tidal, wind; solar etc. the tidal energy has drawbacks like it can only implemented on sea shores. While geothermal energy needs very lager step to extract heat from earth. Solar and wind are easily available in all condition.

The non-conventional energy resources like solar, wind can be good alternative source. Solar energy has drawback that it could not produce electrical energy in rainy and cloudy season so we need to overcome this drawback we can

use two energy resources so that any one of source fails other source will keep generating the electricity and in good weather condition we can use both sources combine.

2.1.1 WORKING PRINCIPLE

The kinetic energy of the wind is converted into rotational energy using vertical axis turbine. Rotational energy from the turbine is converted into electrical energy by the induction generator. The output of the generator is given to the inverter and store in a battery bank. The stored power is given to the ac load for using street light.

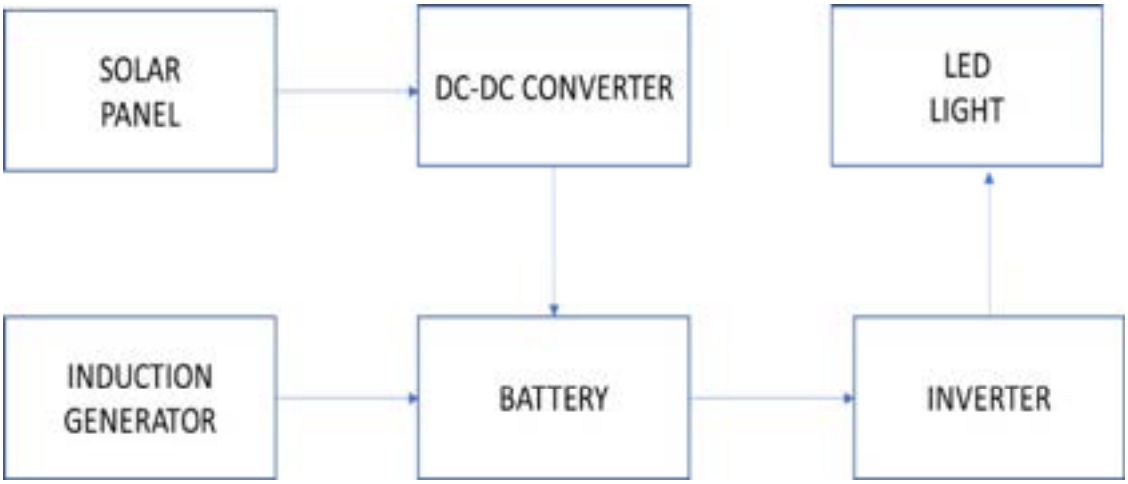


Figure 2.1 Block Diagram

2.2 Wind Turbine

Wind Turbine Wind is the continuous movement of atmospheric air masses and determined by its speed and orientation. This movement derives from the changes and the different values of the atmospheric pressure while these values are the result of the solar heating of different parts of the earth surface. Despite the fact that the atmospheric air moves horizontally and vertically as well, only its horizontal

movement is actually considered as wind. Wind energy is the conversion of a small percentage, about 0.2%, of the solar radiation that reaches the surface of the earth. The wind power around the globe is estimated in 3.6 10 MW while, according to valid estimation of the world meteorology organization, the percentage which is available for energy exploitations in various part of the world is only 19 and it is estimated around 0.60(175 1012KWH).

2.3 Wind Turbine Types

Wind turbines can rotate about cither a horizontal or a vertical axis, the former being both older and more common. They can also include blades, or be bladeless. Vertical designs produce less power and are less common. Horizontal Axis Wind Turbine Large three-bladed horizontal-axis wind turbines (HAWT) with the blades upwind of the tower produce the overwhelming majority of wind power in the world today. These turbines have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a yaw system. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator.

Some turbines use a different type of generator suited to slower rotational speed input. These don't need a gearbox, and are called direct-drive, meaning they couple the rotor directly to the generator with no gearbox in between. While permanent magnet direct-drive generators can he more costly due to the rare earth materials required, these gearless turbines are sometimes preferred over gearbox generators because they "eliminate the gear-speed increaser, which is susceptible to significant accumulated fatigue torque loading, related reliability issues, and maintenance costs. Most horizontal axis turbines have their rotors upwind of the

supporting tower. Downwind machines have been built, because they don't need an additional mechanism for keeping them in line with the wind.

In high winds, the blades can also be allowed to bend, which reduces their swept area and thus their wind resistance. Despite these advantages, upwind designs are preferred, because the change in loading from the wind as each blade passes behind the supporting tower can cause damage to the turbine.

2.4.1Vertical-axis Wind Turbines

Have the main rotor shaft arranged vertically. One advantage of this arrangement is that the turbine does not need to be pointed into the wind to be effective, which is an advantage on a site where the wind direction is highly variable. The key disadvantages include the relatively low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power coefficient, the 360-degree rotation of the aerofoil within the wind flow during each cycle and hence the highly dynamic loading on the blade. The pulsating torque generated by some rotor designs on the drive train, and the difficulty of modelling the wind flow accurately and hence the challenges of analysing and designing the rotor prior to fabricating a prototype.

When a turbine is mounted on a rooftop the building generally redirects wind over the roof and this can double the wind speed at the turbine. If the height of a rooftop mounted turbine tower is approximately 50% of the building height it is near the optimum for maximum wind energy and minimum wind turbulence. While wind speeds within the built environment are generally much lower than at exposed rural sites, noise may be a concern and an existing structure may not adequately resist the additional stress. It is also an advantage when the turbine is integrated into a building because it is inherently less steerable. Also, the generator and gearbox can be placed

near the ground, using a direct drive from the rotor assembly to the ground-based gearbox.

2.4.2 Vertical Axis Wind Turbine (VAWT)

Vertical axis wind turbine are different from traditional wind turbines in that their main axis is perpendicular to the ground, Their configuration make them ideal for both rural and urban settings and other the owner an opportunity to offset the rising cost of electricity and to preserve the environment.

VAWTS are not affected by the direction of the wind which is useful in areas where the wind changes direction frequently or quickly. VAWTS are batter able to harvest turbulent air flow fount around building and other obstacles.

2.5 Savonius Turbine

Savonius is a type of VAWT, which uses a rotor was introduced by finnish engineer S.J .Savonius in 1922. Savonius turbines are one of the simplest turbines. aerodynamically, they are drag-type devices. Each cup or drum catches the wind and so turns the shaft, bringing the opposing cup or drum into a flow of the wind.

Table 2.1 Descriptions of Savonius Blade

S.NO	DESCRIPTION	DIMENTIONS
1	Length	1000mm
2	Width	163.10mm
3	Wind chord	163mm
4	Wind width	76.72mm

2.5.1 Principles of Savonius Rotor Wind Turbine

Savonius wind turbines are a type of vertical-axis wind turbine(VAWT), used for converting the force of the wind into torque on a rotating shaft. The turbine consists of a number of aero foils, usually but not always vertically mounted on a rotating shaft or framework, either ground stationed or tethered in airborne systems. Because of the curvature, the scoops experience less drag when moving against the wind than when moving with the wind.

The differential drag causes the Savonius turbine to spin. Because they are drag-type devices, Savonius turbines extract much less of the wind's power than other similarly-sized lift-type turbines. The Savonius turbine is one of the simplest turbines Aerodynamically, it is a drag-type device, consisting of two or three scoops. Looking down on the rotor from above, a two-scoop machine would look like an "S shape in cross section.

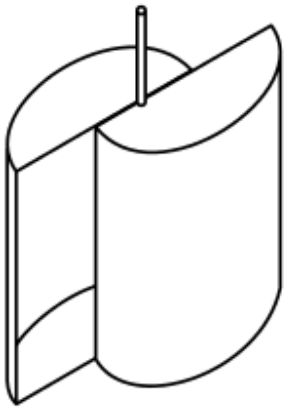


Figure 2.2 savonius blade

Much of the swept area of a Savonius rotor may be near the ground, if it has a small mount without an extended post, making the overall energy extraction less effective due to the lower wind speeds found at lower heights. Power available in

the wind =0.5*air density*swept area*wind velocity*generator efficiency*gearbox bearing efficiency*coefficient of performance

The equation for wind power p =0.5*p*A*Cp*V*Ng *Nb

where,

p = Air density in kg/m3

A=Rotor swept area (m2)

Cp= Coefficient of performance

V=wind velocity (m/s)

Ng=generator efficiency

Nb= gear box bearing efficiency

2.5.2 Solar Panel

Photovoltaic solar panels absorb sun light as a source of energy to generate

electricity. A photovoltaic(PV) module is a packaged, connected assembly of

Figure 2.3 Solar Panel

typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

The most common application of solar energy collection outside agriculture is solar water heating systems.. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells must be connected electrically in series, one to another. Module electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability.

The secondary voltage of the PT is generally 110 V. In an ideal potential transformer or voltage transformer, when rated burden gets connected across the secondary; the ratio of primary and secondary voltages of transformer is equal to the turns ratio and furthermore, the two terminal voltages are in precise phase opposite to each other. But in actual transformer, there must be an error in the voltage ratio as well as in the phase angle between primary and secondary voltages.

2.5.4 Efficiency

Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. There are a few commercially available solar modules that exceed efficiency of 24%.

Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range (specifically, ultraviolet, infrared, and low or diffused light). Hence, much of the incident sunlight energy is wasted by solar modules, and they can give far higher efficiencies if illuminated with monochromatic light.

Therefore, another design concept is to split the light into six to eight different wavelength ranges that will produce a different colour of light, and direct the beams onto different cells tuned to those ranges This has been projected to be capable of raising efficiency by 50%. A single solar module can produce only a limited amount of power, most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism. Efficiencies of solar panel can be calculated by MPP (maximum power point) value of solar panels

Solar inverters convert the DC power to AC power by performing MPPT process solar inverter samples the output Power (1-V curve) from the solar cell and applies the proper resistance (load) to solar cells to obtain maximum power.

MPP (Maximum power point) of the solar panel consists of MPP voltage (V mpp) and MPP current (I mpp) it is a capacity of the solar panel and the higher value can make higher MPP.

2.5.5 Limitations

Pollution and Energy in Production Solar panel has been a well-known method of generating clean, emission free electricity. However, it produces only direct current electricity (DC), which is not what normal appliances use. Solar photovoltaic systems (solar PV systems) are often made of solar PV panels (modules) and inverter (changing DC to AC).

Solar PV panels are mainly made of solar photovoltaic cells, which has no fundamental difference to the material for making computer chips. The process of producing solar PV cells (computer chips) is energy intensive and involves highly poisonous and environmental toxic chemicals There are few solar PV

manufacturing plants around the world producing PV modules with energy produced from PV.

There is no silver bullet in electricity or energy demand and bill management, because customers (sites) have different specific situations, eg different comfort/convenience needs, different electricity tariffs, or different usage patterns. Electricity tariff may have a few elements, such as daily access and metering charge, energy charge (based on kWh, MWh) or peak demand charge (eg a price for the highest 30min energy consumption in a month). Overall, energy investment is largely an economical decision and it is better to make investment decisions based on systematical evaluation of options in operational improvement, energy efficiency, onsite generation and energy storage.

2.5.6 Applications

- Photovoltaic power stations
- Rooftop solar PV systems
- Standalone PV systems
- Solar hybrid power systems
- Concentrated photovoltaic
- Solar planes
- Solar-pumped
- lasers Solar panels on space crafts and space stations.

2.6 Induction Generator

An induction generator or asynchronous generator is a type of alternator current to electrical generator that uses the principles of induction motors produce power. Induction generators operate by mechanically turning their rotors faster than synchronous speed.

A regular AC induction motor usually can be used as a generator, without any internal modifications. Induction generators are useful in applications such as mini hydro power plants, wind turbines, or in reducing high-pressure gas streams to lower pressure, because they can recover energy with relatively simple controls. An induction generator usually draws its excitation power from an electrical grid.

Because of this, induction generators cannot usually black start a deenergized distribution system. Sometimes, however, they are self-excited by using phase correcting capacitors.

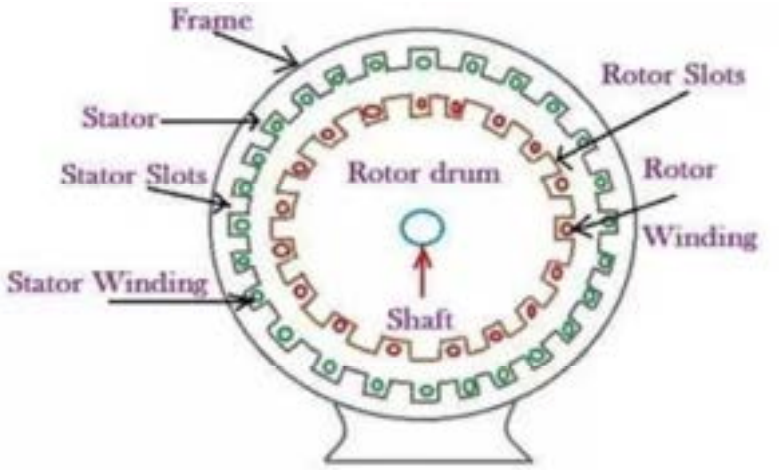


Figure 2.4 Structure Of Induction Generator

2.6.1 Principle of Operation

An induction generator produces electrical power when its rotor is turned faster than the synchronous speed. For a typical four pole motor (two pairs of poles on stator) operating on a 60 Hz electrical grid, the synchronous speed is 1800 rotations per minute (rpm). The same four-pole motor operating on a 50 Hz grid will have a synchronous speed of 1500 RPM. The motor normally turns slightly slower

than the synchronous speed: the difference between synchronous and operating speed is called slip and is usually expressed as per cent of the synchronous speed. For example a motor operating at 1450 RPM that has a synchronous speed of 1500 RPM is running at a slip of +3.3%.An induction generator or asynchronous generator is a type of alternating current (AC) electrical generator that the principles induction motors to produce power.

Induction generators operate by mechanically turning their rotors faster than synchronous speed. In normal motor operation, the stator flux rotation is faster than the rotor rotation. This causes the stator flux to induce rotor currents, which create a rotor flux with magnetic polarity opposite to stator. In this way, the rotor is dragged along behind stator flux, with the currents in the rotor induced at the slip frequency, In generator operation, a prime mover (turbine or engine) drives the rotor above the synchronous speed(negative slip).The stator flux still induces currents in the rotor, but since the opposing rotor flux is now cutting the stator coils, an active current is produced in stator coils and the motor now operates as a generator, sending power back to the electrical grid. An induction machine requires an externally-supplied armature current.

Because the rotor field always lags behind the stator field, the induction machine always consumes reactive power, regardless of whether it is operating as a generator or a motor. The induction machine will operate as an induction generator and will start producing a generating torque, This generating torque is opposite to the direction of the rotation of the rotor. In an equivalent circuit of an induction motor, the mechanical shaft load has been replaced by a resistor of the value given below.

The torque-speed characteristics of a three phase induction machine for all ranges of speed is shown below In an Induction generator, the slip (s) is negative

and therefore, the load resistance Re is also negative. This shows that the load resistance does not absorb the power, but starts acting as a source of power

An induction machine can be started by charging the capacitors, with a LA source, while the generator is tuning typically at or above generating speeds. Once the DC source is removed the capacitors will provide the magnetization current An induction machine that has recently been operating may a spontaneously produce voltage and current due to residual magnetism left in the core. Active power delivered to the line is proportional to slip above the synchronous speed.

A source of excitation current for magnetizing flux (reactive power) for the stator is still required, to induce rotor current. This can be supplied from the electrical grid or, once it starts producing power, from the generator itself.

Full rated power of the generator is reached at very small slip values (motor dependent, typically 3%). At synchronous speed of 1800 rpm, generator will produce no power. When the driving speed is increased to 1860 rpm, full output power is produced. If the prime mover is unable to produce enough power to fully drive the generator, speed will remain somewhere between 1800 and 1860 rpm range.

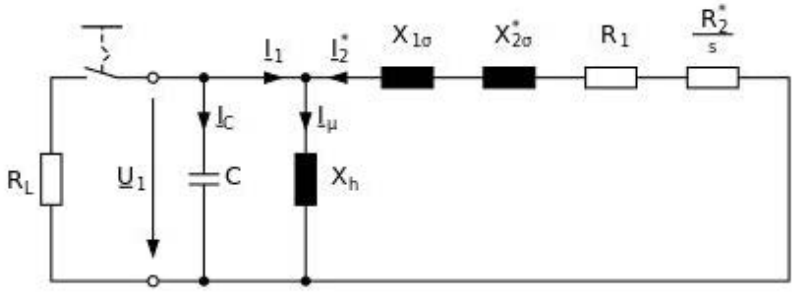


Figure 2.6 Equivalent Circuit of Induction Generator

2.6.2 Required Capacitance

A capacitor bank must supply reactive power to the motor when used in standalone mode. The reactive power supplied should be equal or greater than the reactive power that the machine normally draws when operating as a motor.

2.6.3 Torque vs Speed

The basic fundamental of induction generators is the conversion between mechanical energy to electrical energy. This requires an external torque applied to the rotor to turn it faster than the synchronous speed. However, indefinitely increasing torque doesn't lead to an indefinite increase in power generation. The rotating magnetic field torque excited from the armature works to counter the motion of the rotor and prevent over speed because of induced motion in the opposite direction. As the speed of the motor increases the counter torque reaches a max value of torque (breakdown torque) that if can operate until before the operating conditions become unstable. Ideally, induction generators work best in the stable region between the no load condition and maximum torque region.

In practice and without taking this notion into account, many users unsuccessfully apply these principles to the actual deployment. In almost every case, under the same active grid voltage, the power that the generator produces is greater than the power it consumes when it is at the motor, fully loaded state, its rated power Sometimes the differences are in multiple folds. A higher power will lead to a higher.For prolonged operation, and implied in its guarantee, each motor has a maximum pass-through current This amperage value, the current density, is derived from the maximum pass-through current property of the internal copper magnet and the combined configuration of their connections. Torque-speed curve shown in figure 2.7

The unit to examine the internal setting of the copper wires, a division of the wattage of its rated power by its rated voltage can give users some senses of its value (W/V-A, where W is its rated power in wats, Vs ts rated voltage, and A is the amperage value). Therefore, claims of making a unit generate more power than it's rated should be more closely examined.

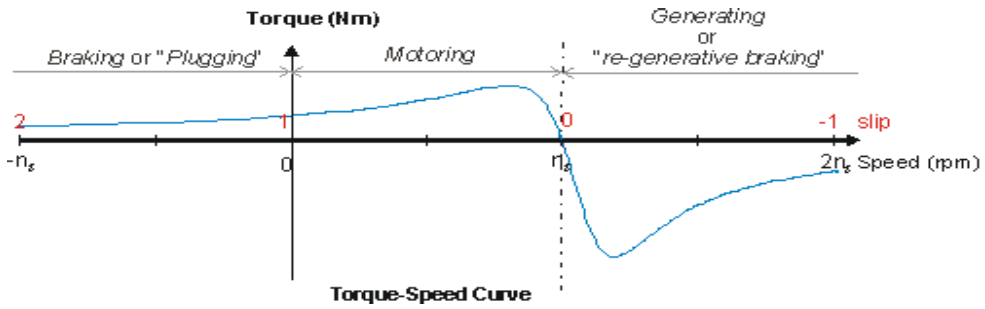


Figure 2.7 Torque-Speed Curve

2.6.4 Grid and Stand-Alone Connections

In induction generators, the reactive power required to establish the air gap magnetic flux is provided by a capacitor bank connected to the machine in case of stand-alone system and in case of grid connection it draws reactive power from the grid to maintain its air gap flux.

For a grid-connected system, frequency and voltage at the machine will be dictated by the electric grid, since it is very small compared to the whole system. For standalone systems, frequency and voltage are complex function of machine parameters, capacitance used for excitation, and load value and type Induction generators are often used in wind turbines and some micro hydro installations due to their ability to produce useful power at varying rotor speeds. Typical connection of standalone generator. Induction generators are mechanically and electrically simpler than other generator types. They are also more rugged, requiring no brushes.

Limitation

An induction generator connected to a capacitor system can generate sufficient reactive power to operate on its own. When the load current exceeds the capability of the generator to supply both magnetization reactive power and load power the generator will immediately cease to produce power The load must be removed and the induction generator restarted with cither a DC source, or if present, residual.

Induction generators are particularly suitable for wind generating stations as in this case speed is always a variable factor. Unlike synchronous motors, induction generators are load-dependent and cannot be used alone for grid frequency control. If the load also absorbs reactive power, capacitor bank must be increased in size to compensate. Prime mover speed should be used to generate frequency of 50HZ.

2.6.5 Induction Generator Working Theory

Just like a DC Machine, a same induction machine can be used as an induction motor as well as an induction generator, without any internal modifications. Induction generators are also called as asynchronous generators. Before starting to explain how an induction (asynchronous) generator works, I assume that you know the working principle of an induction motor. In an induction motor, the rotor rotates because of Slip (ie. relative velocity between the rotating magnetic field and the rotor).Rotor tries to catch up the synchronously rotating field of the stator be succeeds. If rotor catches up the synchronous speed, the relative velocity will be zero.

Induction generators are particularly suitable for wind generating stations as in this case speed is always a variable factor. Unlike synchronous motors, induction generators are load-dependent and cannot be used alone for grid frequency control.

2.6.6 Induction Generators Work

AC supply is connected to the stator terminals of an induction machine. Rotating magnetic field produced in the stator pulls the rotor to behind it (the machine is acting as a motor). Now, if the rotor is accelerated to the synchronous speed by means or a pa mover, the slip will be zero and hence the net torque will be zero. The rotor current will become zero when the rotor is running at synchronous speed

If the rotor is made to rotate at a speed more than the synchronous speed, the slip becomes negative. A rotor current is generated in the opposite direction, due to the rotor conductors cutting stator magnetic field.

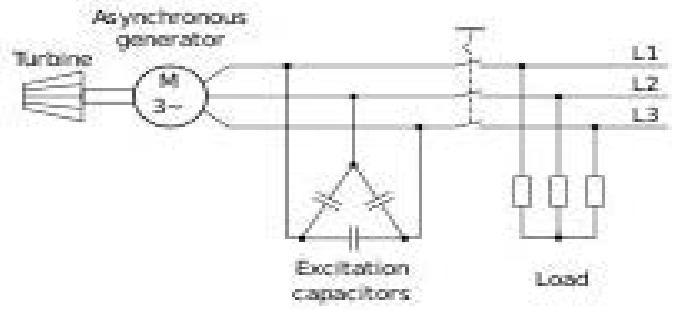


Figure 2.8 Asynchronous Generator.

This generated rotor current produces a rotating magnetic field in the rotor which pushes (forces in opposite way) onto the stator field. This causes a stator voltage which pushes current flowing out of the stator winding against the applied voltage. Thus, the machine is now working as an Induction generator is not a self-excited machine. Now, if the rotor is accelerated to the synchronous speed by means or a pa mover, the slip will be zero and hence the net torque will be zero. The rotor current will become zero when the rotor is running at synchronous speed.

2.6.7 Self-Excited Induction Generator

It is clear that an induction machine needs reactive power for excitation, regardless whether it is operating as a generator or a motor. When an induction generator is connected to a grid, it takes reactive power from the grid. But what if we want to use an induction generator to supply a load without using an external.A capacitor bank can be connected across the stator terminals to supply reactive power lo the machine as well as to the load. When the rotor is rotated at an enough speed, a small voltage is generated across the stator terminals due to residual magnetism. Due to this small generated voltage, capacitor current is produced which provides further reactive power for magnetization.

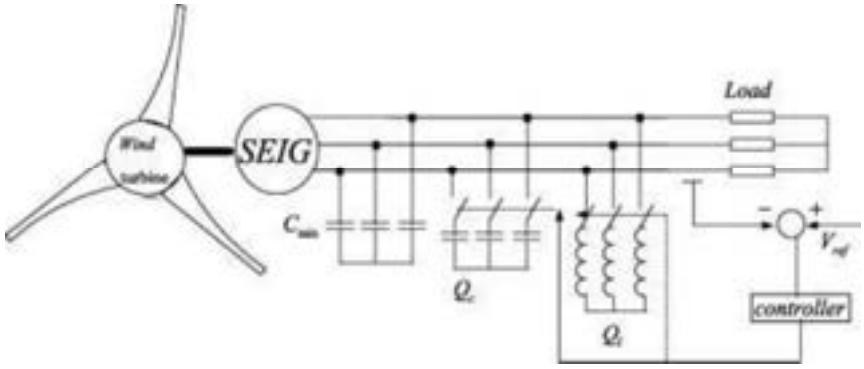


Figure 2.9 Self Excited Induction Generator

2.7 Gear

Two important concepts in gearing are pitch surface and pitch angle The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis. The most familiar kinds of bevel gears have pitch angles of less than 90 degrees and therefore are cone-shaped.

The Bevel gear This type of bevel gear is called external because the gear teeth point outward. The pitch surfaces of meshed

Bevel gears that have pitch angles of greater than ninety degrees have teeth that point inward and are called internal bevel gears. Bevel gears that have pitch angles of exactly 90 degrees have teeth that point outward parallel with the axis and resemble the points on a crown. That's why this type of bevel gear is called a crown gear.

Figure 2.10 Bevel gear

2.7.1 Types

Bevel gears are classified in different types according to geometry

Straight bevel gears:

Straight bevel gears have conical pitch surface and teeth are straight and tapering towards apex.

Spiral bevel gears:

Spiral bevel gears have curved teeth at an angle allowing tooth contact to be gradual and smooth.

Hypoid bevel gears:

Hypoid bevel gears are similar to spiral bevel but the pitch surfaces are hyperbolic and not conical. Pinion can be offset above, or below, the gear centre thus allowing larger pinion diameter, and longer life and smoother mesh, with additional ratios in a limiting case of making the bevel surface parallel with the axis of rotation, this configuration resembles a worm drive Hypoid gears were widely used in automobile rear axles.

Zerol bevel gears:

Zerol bevel gears are very similar to a bevel gear only exception is teeth are curved: the ends of each tooth are coplanar with the axis, but the middle of each tooth is swept circumferentially round the gear. Zerol bevel gears can be thought of as spiral bevel gears, which also have curved teeth, but with a spiral angle of zero, so the ends of the teeth align with the axis.

2.7.2 Applications

The bevel gear has many diverse applications such as locomotives, marine applications, automobiles, printing presses, cooling towers, power plants, steel plants, railway track inspection machines, etc. For examples, see the following articles on:

Bevel gears are used in differential drives, which can transmit power to two axles spinning at different speeds, such as those on a cornering automobile. Bevel gears are used as the main mechanism for a hand drill As the handle of the drill is turned

in a vertical direction, the bevel gears change the rotation of the chuck to a horizontal rotation.

The gears in a bevel gear planer permit minor adjustment during assembly and allow for some displacement due to deflection under operating loads without concentrating the load on the end of the tooth.

Spiral bevel gears are important components on rotor craft drive systems. These components are required to operate at high speeds, high loads, and for a large number of load cycles.

In this application, spiral bevel gears are used to redirect the shaft from the horizontal gas turbine engine to the vertical rotor. Bevel gears are also used as speed reducers.

2.7.3Advantages

By increasing or decreasing the ratio of teeth between the drive and driven wheels one may change the ratio of rotations between the two, meaning that the rotational drive and torque of the second wheel can be changed in relation to the first, with speed increasing and torque decreasing, or speed decreasing and torque increasing This gear makes it possible to change the operating angle. Differing of the number of teeth (effectively diameter) on each wheel allows mechanical advantage to be changed.

2.8Component of Hybrid Power System

1. Charge controller
2. Battery bank
3. Connected load

4. DC-AC Inverter

5. DC-DC Converter

6. Connecting wires

7. switch Instead of a grid-lied solar inverter, can use a standard power inverter or off- grid solar inverter to power for AC appliances.

2.8.1 Charge Controller

A charge controller determines how mush current should be injected into the batteries for its most optimum performance. As it determines the efficiency of the entire solar system as well as the operating life of the batteries, it is a critical component. The charge controller protects the battery bank from over charging.

2.8.2 Battery Bank

There may be periods when there is no sunlight. Evening, nights and cloudy days such as situations beyond our control. In order to provide electricity during these period, excess energy, during energy is stored in these battery banks and is used to power loads whenever required.

2.8.3 Connected Load

Load ensures that the electrical circuit is complete and the electricity can flow through .

2.8.4 Switch

A switch is an electrical component that can make or break an electrical circuit, interrupting the current or diverting it from one conductor to another.

The mechanism of a switch removes or restores the conducting path in a circuit when it is operated.

2.8.5 DC-AC Inverter

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process. Circuitry that performs the opposite function, converting AC to DC is called a rectifier.

Inverter is an electronic device or circuitry that changes direct current (DC) to alternating current The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry.

Static inverters do not use moving parts in the conversion process. A typical power inverter device or circuit requires a relatively stable DC power source capable of supplying enough current for the intended power demands of the system. The input voltage depends on the design and purpose of the inverter.

An inverter can produce asquare wave, modified sine wave, pulsed sine wave, pulse width modulated wave (PWM) or sine wave depending on circuit design There are two basic designs for producing household plug-in voltage from a lower voltage DC source Circuitry that performs the opposite function, converting AC to DC, is called a rectifier.

2.7 Battery

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal When a battery is connected to an external electric load, a redox reaction converts high energy reactants to lower energy products, and the free energy difference is delivered to the external circuit as electrical energy. Historically the term battery specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

Primary batteries are used once and discarded, the electrode materials are irreversibly changed during discharge Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary batteries can be discharged and recharged multiple times using an applied electric current, the original composition of the electrodes can be restored by reverse current Examples include the lead acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smartphones Battery used here is 12v 35Ah lead acid battery. Lead acid batteries are one of the most popular types of batteries in electronics. Although slightly lower in energy density than lithium metal, lead acid is safe, the provide certain precautions are met when charging and discharging This have many advantages over other conventional types of batteries, the lead acid battery is the optimum choice for a solar assisted bicycle. Battery is rated in ampere hours and this is called the battery capacity.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead

acid batteries or lithium-ion batteries in vehicles, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges.

Batteries convert chemical energy directly to electrical energy. In many cases, the electrical released is the difference in the cohesive or bond energies of the metals, oxides, or molecules undergoing the electrochemical reaction. For instance, energy can be stored in Zn or Li, which are high-energy metals because they are not stabilized by d-electron bonding, unlike transition metals. Batteries are designed such that the energetically favourable redox reaction can occur only if electrons move through the external part of the circuit.

A battery consists of some number of voltaic cells. Each cell consists of two half cells connected in series by a conductive electrolyte containing metal. One half cell which anions (negatively charged ions) migrate the other half cell includes electrolyte and the positive electrode, to which cations (positively charged ions) migrate. Cations are reduced (electrons are added) at the cathode while metal atoms are oxidized (electrons are removed) at the anode.

Some cells use different electrolytes for each half cell then a separator is used to prevent mixing of the electrolytes while allowing ions to flow between half-cells to complete the electrical circuit.

The lead acid cell technology is the most efficient and practical choice for the desired application. The battery chosen for this project was a high capacity lead acid battery pack designed specifically for vehicles. To choose battery bank size per the load requirement so that it should fulfil the requirement of load for calculating the battery bank size need to find following data.

1. Find total daily use in watt-hours (wh).

2. Find total back up time of the battery.

2.8.6 DC-DC Converter

DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply(SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination.

To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

Switching converters (such as buck converters) provide much greater power efficiency as DC-to-DC converters than linear regulators, which are simpler circuits that lower voltages by dissipating power as heat, but do not step up output current.

Buck converters can be highly efficient (often higher than 90%), making them useful for tasks such as converting a computer's main (bulk) supply voltage (often 12 V) down to lower voltages needed by USB, DRAM and the CPU(1.8 V or less).

Theory of operation

The basic operation of the buck converter has the current in an inductor controlled by two switches (usually a transistor and a diode). In the idealised converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off, and

the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle.

2.9 ADVANTAGES

1. Absence of moving parts.

2. Long effective life and high reliability.

3. Having a vertical axis, the Savonius turbine continues to work effectively even if the wind changes direction.

4. It works well even at low wind speeds

5. It greatly reducing the initial setup cost

2.9.1 Problem Overview

The results are taken on the basis that 100 vehicles travelled at voltage speed of 70km/hr at average wind speed of 4.5m/s for the duration of 2hrs.The electric power generated from designed wind turbine is approximately 140 watts hr.

CHAPTER 3
PROPOSED SYSTEM AND HARDWARE DESCRIPTION

3.1 BLOCK DIAGRAM

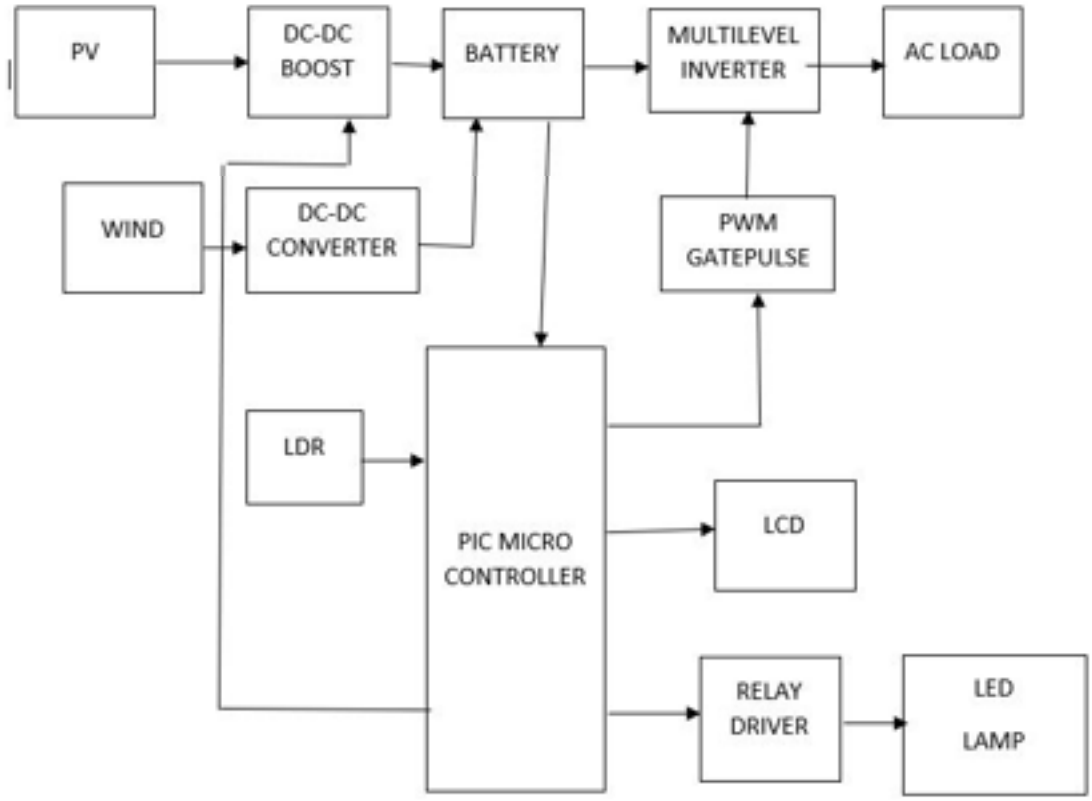


Figure 3.1 Block Diagram

3.2 WORKING PRINCIPLE

The kinetic energy of the wind is converted into rotational energy using vertical axis turbine. Rotational energy from the turbine is converted into electrical energy by the induction generator. The output of the generator is given to the inverter and store in a battery bank. The stored power is given to the ac load for using street light.

3.3 PHOTOVOLTAIC CELL:

Conversion of light energy in electrical energy is based on a phenomenon called photovoltaic effect. When semiconductor materials are exposed to light, the some of the photons of light ray are absorbed by the semiconductor crystal which causes a significant number of free electrons in the crystal. This is the basic reason for producing electricity due to photovoltaic effect. Photovoltaic cell is the basic unit of the system where the photovoltaic effect is utilised to produce electricity from light energy. Silicon is the most widely used semiconductor material for constructing the photovoltaic cell. The silicon atom has four valence electrons. In a solid crystal, each silicon atom shares each of its four valence electrons with another nearest silicon atom hence creating covalent bonds between them. In this way, silicon crystal gets a tetrahedral lattice structure. While light ray strikes on any materials some portion of the light is reflected, some portion is transmitted through the materials and rest is absorbed by the materials.

The same thing happens when light falls on a silicon crystal. If the intensity of incident light is high enough, sufficient numbers of photons are absorbed by the crystal and these photons, in turn, excite some of the electrons of covalent bonds. These excited electrons then get sufficient energy to migrate from valence band to conduction band. As the energy level of these electrons is in the conduction band, they leave from the covalent bond leaving a hole in the bond behind each removed electron.

These are called free electrons move randomly inside the crystal structure of the silicon. These free electrons and holes have a vital role in creating electricity in photovoltaic cell. These electrons and holes are hence called light-generated electrons and holes respectively. These light generated electrons and holes cannot

produce electricity in the silicon crystal alone. There should be some additional mechanism to do that.

3.4 REGULATOR 7805

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

All voltage sources cannot able to give fixed output due to fluctuations in the circuit. For getting constant and steady output, the voltage regulators are implemented. The integrated circuits which are used for the regulation of voltage are termed as voltage regulator ICs. Here, we can discuss about IC 7805.The voltage regulator IC 7805 is actually a member of 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply. This regulator IC also adds a provision for a heat sink. The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.

The purposes of coupling the components to the IC7805 are explained below. C_1- It is the bypass capacitor, used to bypass very small extent spikes to the earth. C_2 and C_3- They are the filter capacitors. C_2 is used to make the slow changes in the input voltage given to the circuit to the steady form. C_3 is used to make the slow changes in the output voltage from the regulator in the circuit to the steady form.

When the value of these capacitors increases, stabilization is enlarged. But these capacitors single-handedly are unable to filter the very minute changes in the input and output voltages. C_4- like C_1, it is also a bypass capacitor, used to bypass very small extent spikes to the ground or earth. This is done without influencing other components.

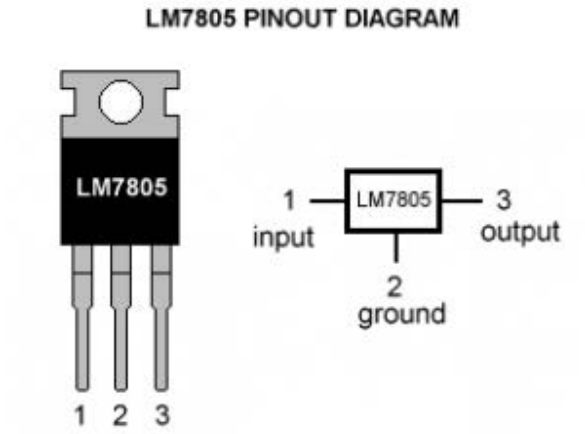


Figure 3.5 Regulated Power Supply Circuit

The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.

Applications of Voltage Regulator 7805 IC

- Current regulator
- Regulated dual supply
- Building circuits for Phone charger, UPS power supply circuits, portable CD player etc.,
- Fixed output regulator

  Adjustable output regulator etc.

3.5 RELAY DRIVER:

Figure 3.3 Relay Driver

A relay driver circuit is a circuit which can drive, or operate, a relay so that it can function appropriately in a circuit. The driven relay can then operate as a switch in the circuit which can open or close, according to the needs of the circuit and its operation. In this project, we will build a relay driver for both DC and AC relays. Since DC and AC voltages operate differently, to build relay drivers for them requires slightly different setup. We will also go over a generic relay driver which can operate from either AC or DC voltage and operate both AC and DC relays. All the circuits are relatively simple to understand.

3.6 POWER SUPPLY

A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

3.6.1 Power Supply Unit Block

All digital circuits work only with low DC voltage. A power supply unit is required to provide the appropriate voltage supply. This unit consists of transformer, rectifier, filter and a regulator. AC voltage typically of 230Vrms is connected to a transformer which steps that AC voltage down to the desired AC voltage level. A

diode rectifier then provides a full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variations. Regulator circuit can use this DC input to provide DC voltage that not only has much less ripple voltage but also remains in the same DC value, even when the DC voltage varies, or the load connected to the output DC voltage changes. The required DC supply is obtained from the available AC supply after rectification, filtration and regulation. Block diagram of power supply unit is shown in Figure 5.1

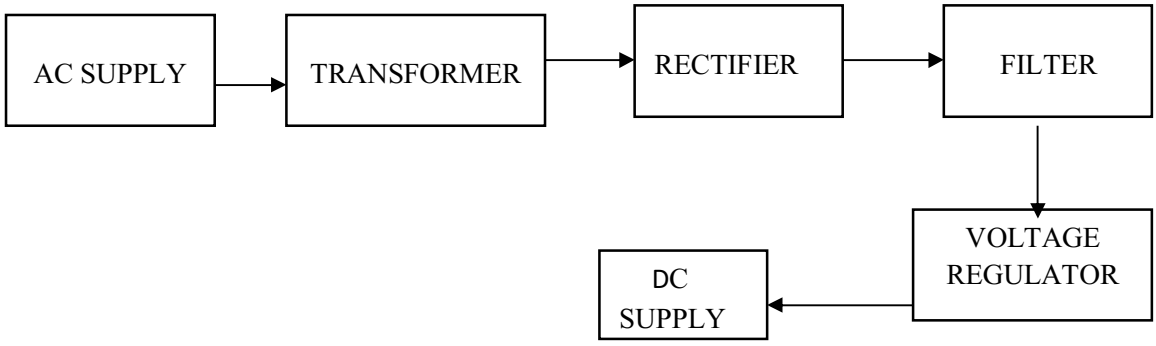


Figure 5.1 Power Supply Block Diagram

The main components used in the power supply unit are Transformer, Rectifier, Filter and Regulator. The 230V AC supply is converted into 9V AC supply through the transformer. The output of the transformer has the same frequency as in the input AC power. This AC power is converted into DC power through diodes. Here the bridge diode is used to convert AC supply to the DC power supply. This converted DC power supply has the ripple content and for normal operation of the circuit, the ripple content of the DC power supply should be as low as possible. Because the ripple content of the power supply will reduce the life of the circuit. So to reduce the ripple content of the DC power supply, the large value

of capacitance filter is used.This filtered output will not be the regulated voltage. For this purpose IC7805 regulator IC is used in the circuit.

3.7 TRANSFORMER

Transformer is a device used either for stepping-up or stepping-down the AC supply voltage with a corresponding decreases or increases in the current. Here, a transformer is used for stepping-down the voltage so as to get a voltage that can be regulated to get a constant 5V.

3.8 RECTIFIER

A rectifier is a device like semiconductor, capable of converting sinusoidal input waveform units into a unidirectional waveform, with a nonzero average component.

3.8.1 FILTERS

Capacitors are used as filters in the power supply unit. The action of the system depends upon the fact, that the capacitors stores energy during the conduction period and delivers this energy to the load during the inverse or non-conducting period. In this way, time during which the current passes through the load is prolonged and ripple is considerably reduced.

3.8.2 VOLTAGE REGULATOR

The LM78XX is three terminal regulator available with several fixed output voltages making them useful in a wide range of applications. IC7805 is a fixed voltage regulators used in this circuit .Circuit diagram of such power supply is as shown in Figure 3.5

This is a very useful device, indeed. With it, we can easily multiply or divide voltage and current in AC circuits. Indeed, the transformer has made long-distance transmission of electric power a practical reality, as AC voltage can be "stepped up" and current "stepped down" for reduced wire resistance power losses

along power lines connecting generating stations with loads. At either end (both the generator and at the loads), voltage levels are reduced by transformers for safer operation and less expensive equipment. A transformer that increases voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a step-up transformer. Conversely, a transformer designed to do just the opposite is called a step-down transformer.

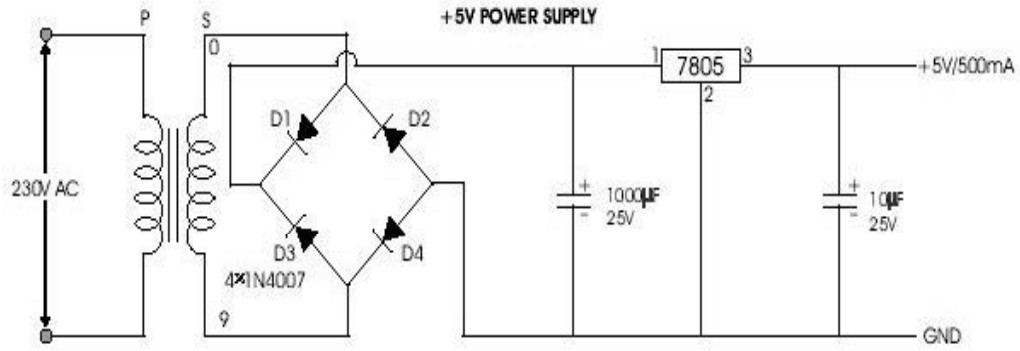


Figure 3.5 Five Volts Power Supply

This is a step-down transformer, as evidenced by the high turn count of the primary winding and the low turn count of the secondary. As a step-down unit, this transformer converts high-voltage, low-current power into low-voltage, high-current power. The larger-gauge wire used in the secondary winding is necessary due to the increase in current.

The primary winding, which doesn't have to conduct as much current, may be made of smaller-gauge wire. A transformer that increases voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a step-up transformer.. A transformer that increases voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a

step-up transformer. Conversely, a transformer designed to do just the opposite is called a step-down transformer.

3.8.3 POTENTIAL TRANSFORMER THEORY

A voltage transformer theory or potential transformer theory is just like a theory of general purpose step down transformer. Primary of this transformer is connected across the phase and ground. Just like the transformer used for stepping down purpose, potential transformer i.e. PT has lower turns winding at its secondary. The system voltage is applied across the terminals of primary winding of that transformer, and then proportionate secondary voltage appears across the secondary terminals of the PT.

The secondary voltage of the PT is generally 110 V. In an ideal potential transformer or voltage transformer, when rated burden gets connected across the secondary; the ratio of primary and secondary voltages of transformer is equal to the turns ratio and furthermore, the two terminal voltages are in precise phase opposite to each other. But in actual transformer, there must be an error in the voltage ratio as well as in the phase angle between primary and secondary voltages.

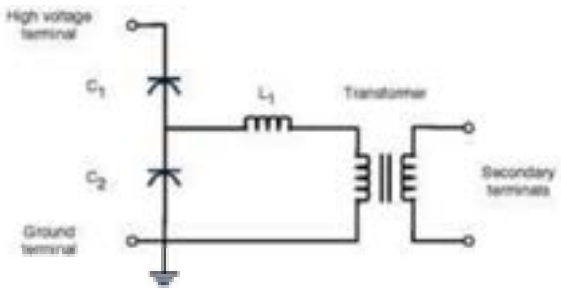


Figure 3.4. Potential Transformer

Potential transformers (PT) (also called voltage transformers (VT)) are a parallel connected type of instrument transformer. They are designed to present negligible load to the supply being measured and have an accurate voltage ratio and phase relationship to enable accurate secondary connected metering. PT has lower turns winding at its secondary. The system voltage is applied across the terminals of primary winding of that transformer, and then proportionate secondary voltage appears across the secondary terminals of the PT.

3.8.4 CURRENT TRANSFORMER

A current transformer (CT) is used for measurement of alternating electric currents. Current transformers, together with voltage (or potential) transformers (VT or PT), are known as instrument transformers. When current in a circuit is too high to apply directly to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. A current transformer isolates the measuring instruments from what may be very high voltage in the monitored circuit. Current transformers are commonly used in metering and protective relays in the electrical power industry.

Like any other transformer, a current transformer has a primary winding, a magnetic core and a secondary winding. The alternating current in the primary produces an alternating magnetic field in the core, which then induces an alternating current in the secondary winding circuit. An essential objective of current transformer design is to ensure the primary and secondary circuits are efficiently coupled, so the secondary current is linearly proportional to the primary current.

The most common design of CT consists of a length of wire wrapped many times around a silicon steel ring passed 'around' the circuit being measured. The

CT's primary circuit therefore consists of a single 'turn' of conductor, with a secondary of many tens or hundreds of turns. The primary winding may be a permanent part of the current transformer, with a heavy copper bar to carry current through the magnetic core. Window-type current transformers (aka zero sequence current transformers, or ZSCT) are also common, which can have circuit cables run through the middle of an opening in the core to provide a single-turn primary winding. When conductors passing through a CT are not centered in the circular (or oval) opening, slight inaccuracies may occur.

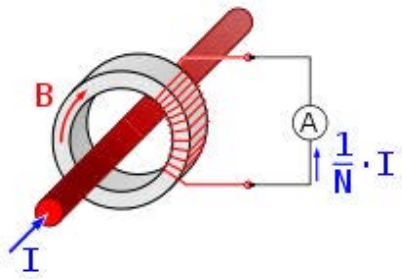


Figure 3.7.Current Transformer

Shapes and sizes can vary depending on the end user or switchgear manufacturer. Typical examples of low-voltage single ratio metering current transformers are either ring type or plastic molded case. High-voltage current transformers are mounted on porcelain insulators to isolate them from ground. Some CT configurations slip around the bushing of a high-voltage transformer or circuit breaker, which automatically centers the conductor inside the CT window.

Current transformers can be mounted on the low voltage or high voltage leads of a power transformer; sometimes a section of bus bar is arranged to be easily removed for exchange of current transformers Many digital clamp meters utilize a current transformer for measuring alternating current (AC).Current transformers are used extensively for measuring current and monitoring the operation of the power

grid. Along with voltage leads, revenue-grade CTs drive the electrical utility's watt-hour meter on virtually every building with three-phase service and single-phase services greater than 200 ampere.

The CT is typically described by its current ratio from primary to secondary. Often, multiple CTs are installed as a "stack" for various uses. For example, protection devices and revenue metering may use separate CTs to provide isolation between metering and protection circuits, and allows current transformers with different characteristics (accuracy, overload performance) to be used for the devices.

The primary circuit is largely unaffected by the insertion of the CT. The rated secondary current is commonly standardized at 1 or 5 amperes. For example, a 4000:5 CT secondary winding will supply an output current of 5 amperes when the primary winding current is 4000 amperes. The secondary winding can be single or multi-ratio, with five taps being common for multi-ratio CTs.The load, or burden, of the CT should be a low resistance. If the voltage time integral area is higher than the core's design rating, the core goes into saturation toward the end of each cycle, distorting the waveform and affecting accuracy.

3.8.5 Accuracy of CT

- Burden
- Burden class/saturation class
- Rating factor
- Load
- External electromagnetic fields
- Temperature and
- Physical configuration.

- The selected tap, for multi-ratio CTs
- Phase change

For the IEC standard, accuracy classes for various types of measurement are set out in IEC 61869-1, Classes 0.1, 0.2s, 0.2, 0.5, 0.5s, 1 and 3. The class designation is an approximate measure of the CT's accuracy. The ratio (primary to secondary current) error of a Class 1 CT is 1% at rated current; the ratio error of a Class 0.5 CT is 0.5% or less. Errors in phase are also important especially in power measuring circuits, and each class has an allowable maximum phase error for a specified load impedance.

Current transformers used for protective relaying also have accuracy requirements at overload currents in excess of the normal rating to ensure accurate performance of relays during system faults. A CT with a rating of 2.5L400 specifies with an output from its secondary winding of 20 times its rated secondary current (usually 5 A × 20 = 100 A) and 400 V (IZ drop) its output accuracy will be within 2.5 percent.

3.9 APPLICATIONS

Current transformers are used for protection, measurement and control in high-voltage electrical substations and the electrical grid. Current transformers may be installed inside switchgear or in apparatus bushings, but very often free-standing outdoor current transformers are used. In a switchyard, live tank current transformers have a substantial part of their enclosure energized at the line voltage and must be mounted on insulators. Dead tank current transformers isolate the measured circuit from the enclosure. Live tank CTs are useful because the primary conductor is short, which gives better stability and a higher short-circuit current rating.

The primary of the winding can be evenly distributed around the magnetic core, which gives better performance for overloads and transients. Since the major insulation of a live-tank current transformer is not exposed to the heat of the primary conductors, insulation life and thermal stability is improved. A high-voltage current transformer may contain several cores, each with a secondary winding, for different purposes (such as metering circuits, control, or protection).A neutral current transformer is used as earth fault protection to measure any fault current flowing through the neutral line from the wye neutral point of a transformer.

CHAPTER 4

SIMULATION SYSTEM

4.1 SOFTWARE TESTING DESCRIPTION

4.1.1 Introduction

MATLAB is a technical computing environment for high-performance numeric computation and visualization, produced by The Math's Works Inc. It includes a number of subject specific toolboxes as well as a dynamic system simulation package, Simulink.

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java .you can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing.

It integrates computation, visualization, and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics

- Application development, including Graphical User Interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non interactive language such as C or Fortran.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

4.2 A SHORT INTRODUCTION TO MATLAB

To execute Mat lab in a UNIX environment, at the prompt, type Mat lab and return. If MATLAB is successfully executed, a small pop up window will appear with the Mat lab logo. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment. In the UNIX window, an introductory message will stream by and the Mat lab prompt will appear.

To enter commands in Mat lab, simply type them in. Beware that Mat lab is case sensitive; this tutorial contains Mat lab code. Each line of Mat lab code starts with the prompt. When you cut a segment of code from this tutorial, do not cut the prompt.

Power system simulation involves modeling power generation equipment, planning the integration of power plants onto the electric grid, and performing generator control system parameter estimation. To enter commands in Mat lab, simply type them in. Beware that Mat lab is case sensitive; this tutorial contains Mat lab code. Each line of Mat lab code starts with the prompt. matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non interactive language such as C or Fortran.

Critical power system simulation and optimization tasks include:

- Simulating performance against grid code and ensuring production goals are met
- Automating control system parameter estimation to meet regulatory requirements
- Performing EMT simulation and harmonic analysis to identify and mitigate power quality issues.

Structures

MATLAB has structure data types. Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. In addition, MATLAB supports dynamic field names (field look-ups by name, field manipulations, etc.).

Unfortunately, MATLAB JIT does not support MATLAB structures; therefore just a simple bundling of various variables into a structure will come at a cost.Functions when creating a MATLAB function, the name of the file should

match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores.

Function handles

MATLAB supports elements of lambda calculus by introducing function handles or function references, which are implemented either in .m files or anonymous/nested functions.

4.2.1 Mat lab Advantages

- Mat lab is an interpreted language from numerical computation.
- It allows one to perform numerical calculations, and visualize the results without the need for complicated and time consuming programming.

Mat lab allows its users to accurately solve problems, produce graphics easily and produce code efficiently

4.3 SIMULATION DIAGRAM

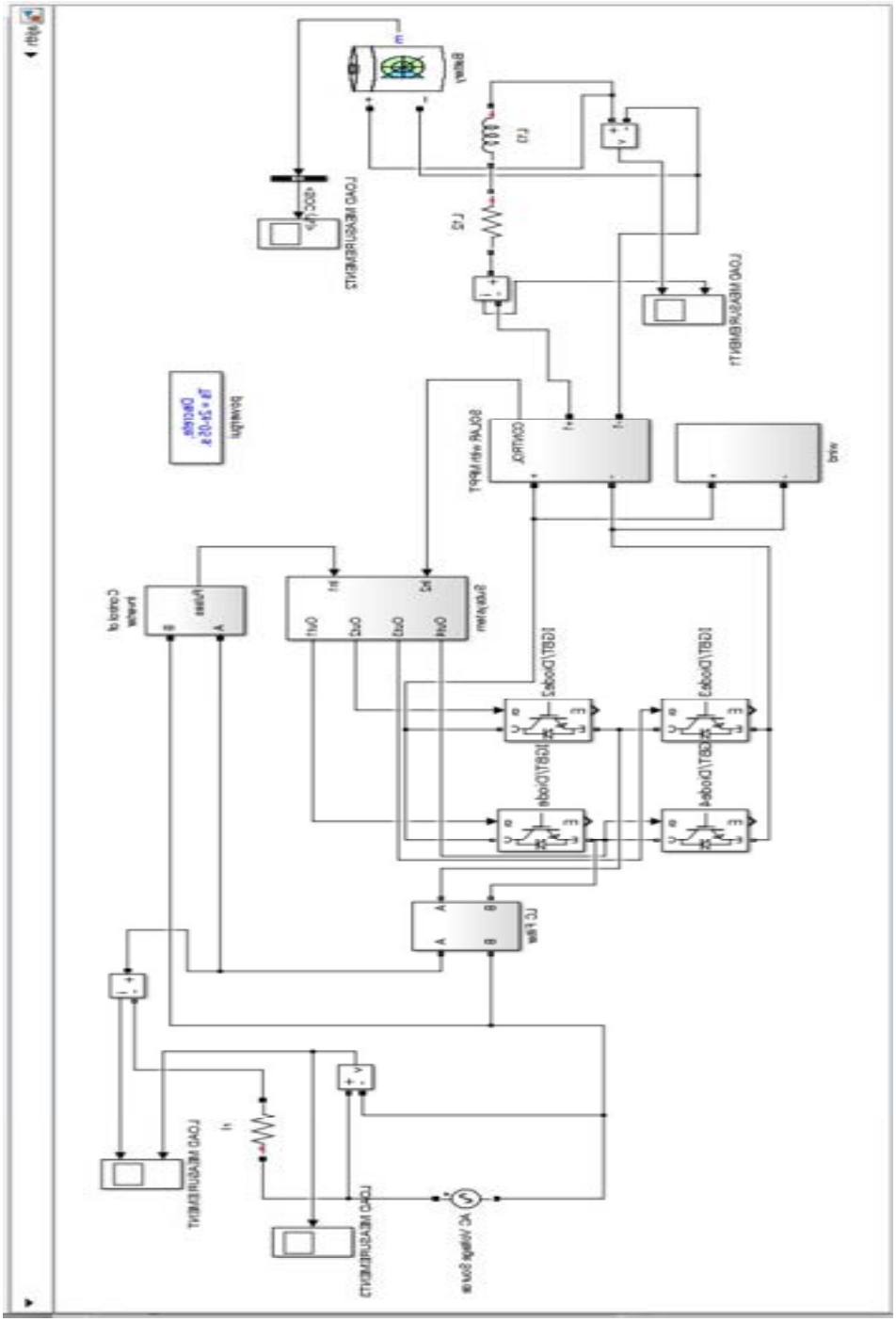


Figure 4.1 Simulation Block

4.4 SOLAR OUTPUT

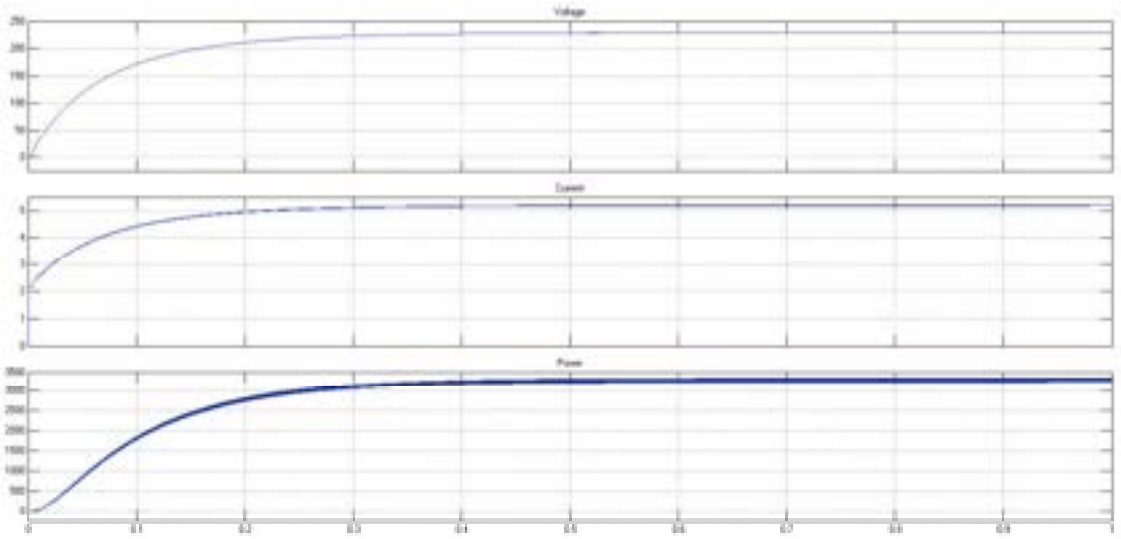


Figure 4.2 Solar Output

We get source from solar power, when the load voltages of the given input to the converter are shown in the figure 4.2. The characteristics of proposed solar power. The output of solar is 12 V.

Time in (hr)	Intensity level (W/m^2)	Voltage in volts	Current in amps	Power in watts
9-10.30	10	3	3	10
10.30-12.00	20	7	3	20
12.00-4.00	31	8	3	25

Table 4.1 Calculation Of Solar Output

The number of series connected cells is 12 and open-circuit voltage is 18 is used to generate the maximum voltage of 20V.

4.5 WIND GENERATOR OUTPUT

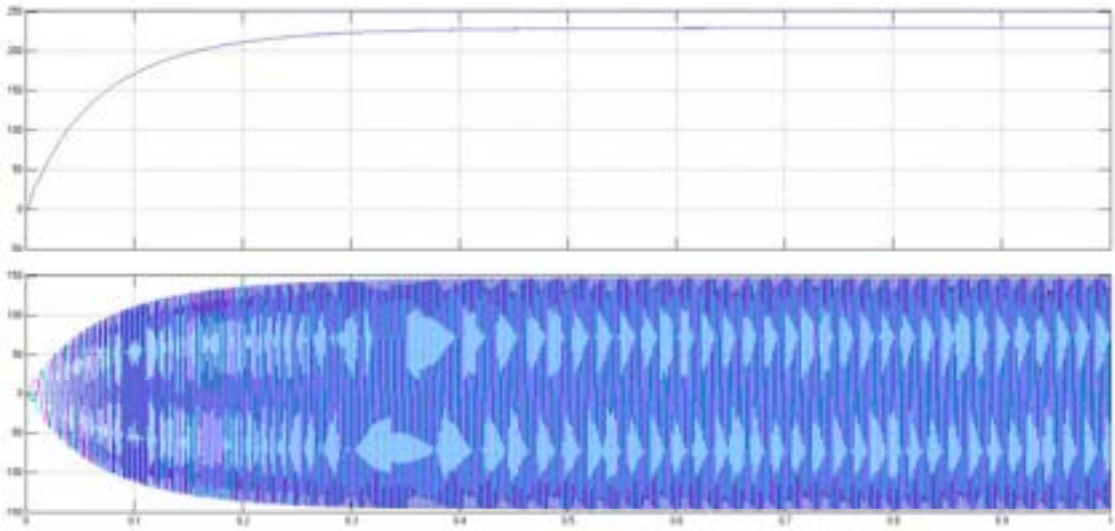
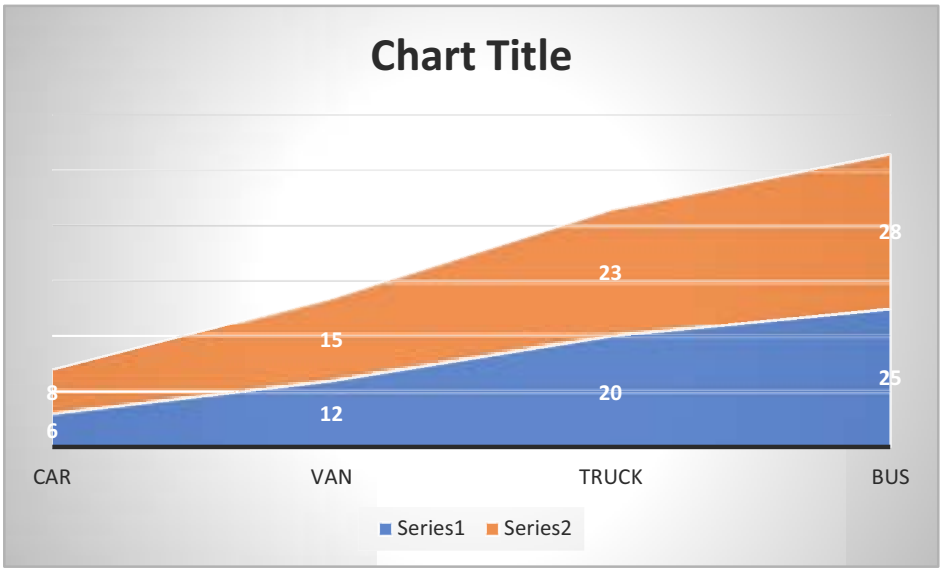


Figure 4.3 Wind Generator Output

For10 m/s velocity of wind speed the vertical axis wind generator generates power of 144 watts and at speed 15 m/s it generates 147 watts. When the wind speed increases the generating power also increased.

Table 4.2 Calculation Of Wind Output

S.No	Vehicles	Wind Speed(M/S)	Power Generation
1	Car	6	8v
2	Van	12	15v
3	Truck	20	23v
4	Bus	25	28v



4.6 INVERTER OUTPUT

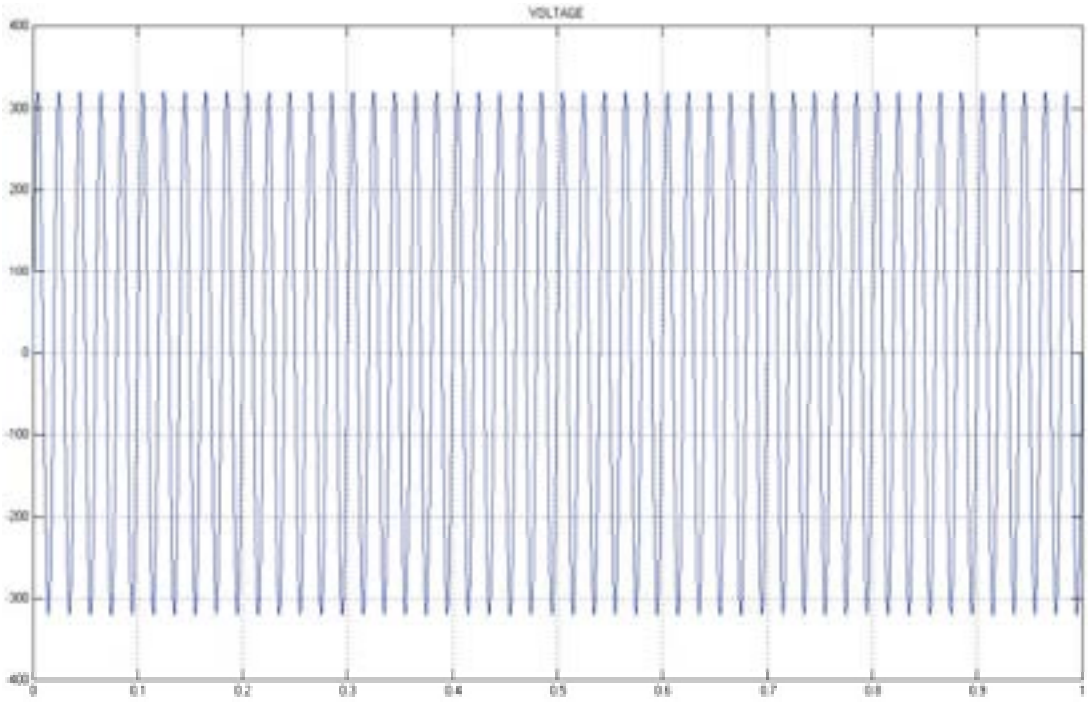
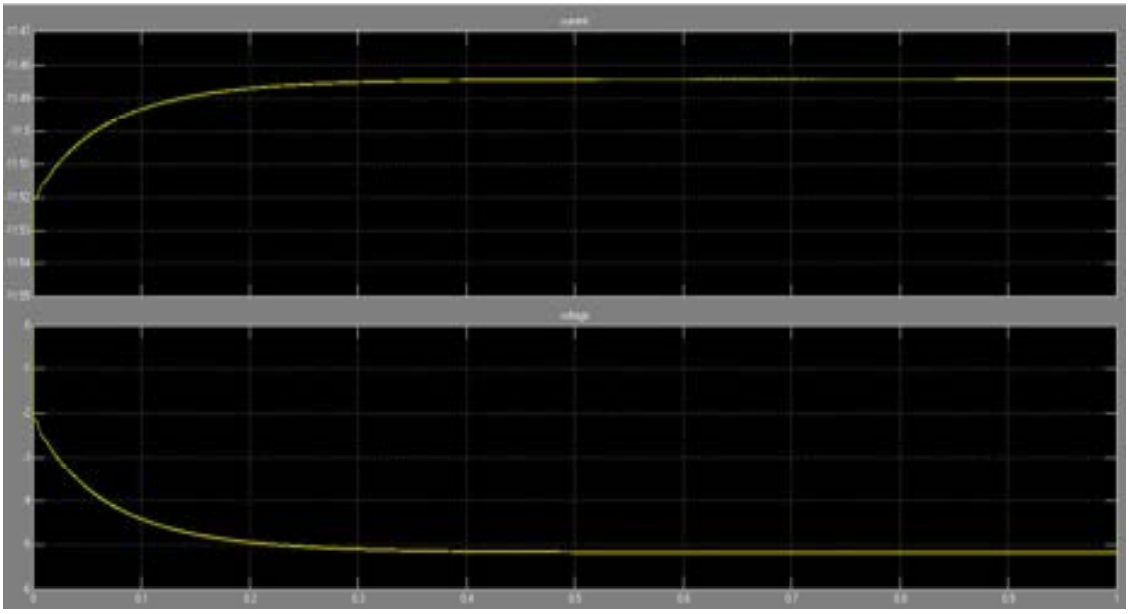


Figure 4.4 Inverter Output

The inverter circuit that changes direct current to alternating current from the photovoltaic panel.

4.7 BATTERY OUTPUT



Power	Time required for charging (hours)
For 6 W	14 hrs.
For 10 W	8.4 hrs.
For 20 W	4.2 hrs.

Inorder to charge the 24V ,4A lithium ion battery , it takes 7 hours to fully charged. Usable capacity 300 AH and depth of discharge 100%

CHAPTER 5

HARDWARE DISCRIPTION

5.1 CONVERTER

DC to DC power converter which steps down voltage from its put to its output. It is a class of switched-mode power supply typically containing at Just two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination with inductors) are normally added to such a converter's output and input.

5.2 MULTILEVEL INVERTER

Multilevel inverter is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). It can be capable of supplying enough current for the intended power of the systems. Specifications of multilevel inverter is 12Volt.Multilevel inverter is an electronic device or circuitry that changes direct current (DC) to alternating current. The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The Multilevel inverter does not produce any power; the power is provided by the DC source. A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry.

5.3 LDR SENSOR

A Light Dependent Resistor (LDR) is also called a photoresistor cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistor whose resistance value decreases when the intensity of light decreases. The

optoelectronic devices is mostly used in light varying sensor circuit, and light and dark activated switching circuits. Some of its applications include camera light meters, street lights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks.

5.4 MOSFET

The MOSFET is a metal oxide silicon field effect transistor. It is a semiconductor device which is widely used for switching and amplifying electronic signals in the electronic devices. The MOSFET is having three terminal devices such as source, drain and gate. The MOSFET is the most common semiconductor devices in digital and analog circuits and the most common power devices.

5.5 BATTERY

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize. The lithium ions are small enough to be able to move through a micro-permeable separator between the anode and cathode. In part because of lithium's small size (third only to hydrogen and helium), Li-ion batteries are capable of having a very high voltage and charge storage per unit mass and unit volume.

5.6 Operation

In the above given circuit both the input of solar PV panel and savonius hybrid system has given to the converter section it boost the input voltage to the required level and the power has stored in the lithium ion battery the stored energy used for LED street light. The remaining generating current used of other residential lightings.

5.7 CIRCUIT DIAGRAM

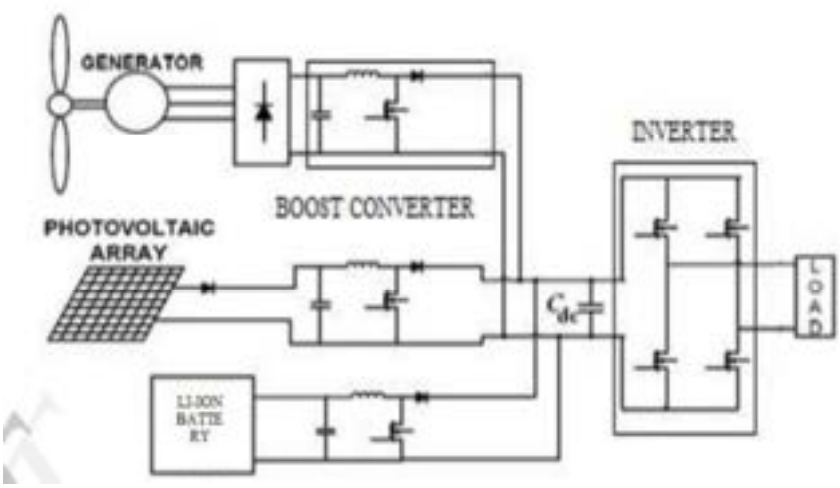


Figure 5.1Hardware Circuit

5.8 IMAGE OF HARDWARE

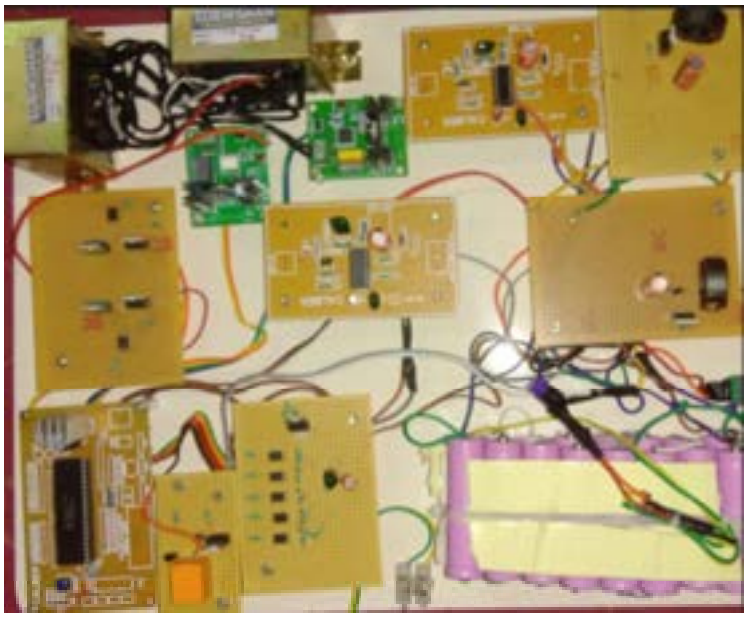


Figure 5.2 Image Of Hardware

CHAPTER 6
CONCLUSION&FUTURE SCOPE

6.1 CONCLUSION

This hybrid power generation project is to use both solar and wind energy obtained in the national highways and applicable for powering street light. The integration of both the solar power generation and the wind power generation will helps us to increase efficiency of the overall system with the improved consistency of power generation, the implemented power flow and reduced pollution. The wind and solar system are complementary. The greater output can be obtained from the wind turbine during the air flow periods and during the day time the solar panels would produce their peak outputs. The generating power can be stored by a storage device and hybrid system decreases the cost of instalment and operation.

6.2 SCOPE FOR FUTURE WORK

Hybrid generation is the combination of solar and wind energy. By using induction generator and solar panels, the maximum output power can be achieved. But, if the ordinary solar panels are replaced by the adaptive solar panel will possible to increase the efficiency.

APPENDIX

REFERENCES

[1] Andrew Mathew Dominic M.R., Solar and Wind Hybrid power generation system for Street lights at Highways, Volume 3, Issue 3, March 2014.

[2] Ahmed, NA. Miyatake, M. and Al-Othman, A.K. "Power Fluctuations Suppression Of Stand-Alone Hybrid Generation Combining Solar Photovoltaic Wind Turbine And Fuel Cell Systems, Energy Conversion and Management, Vol 49, pp. 2711, 2008.

[3] Bakos, G.C and Tsagas, NF Technoeconomic Assessment Of A Hybrid Solar Wind Installation For Electrical Energy Saving", Energy and Buildings, Vol. 35, No. 2. pp 139-45, 2003.

[4] Borowy, B.S. and Salameh 2.M. "Methodology For Optimally Sizing The Combination Of A Battery Bank And PV Array In A Wind/PV Hybrid System", IEEE Trans. Energy Conver, Vol. 11, No. 2, pp. 367-73, 1996.

[5] Bouroussis. A, lasonGeorgaris, Frangiskos, Topalıs.R. Outdoor lighting using renewable energy sources, September 22-24, 2006.

[6] Celik. AN. "Techno-Economic Analysis Of Autonomous PV-Wind Hybrid Energy Systems Using Different Sizing Methods", Energy Conversion And Management, Vol. 44, pp. 1951-1968, 2003.

[7] Daniele Vitalil and Sergio Montelpare, An innovative wind-solar hybrid street light development and early testing of a prototype, 15 July 2013; accepted 18 March 2014.

[8] Dihrab S.S. And Sopian, K. "Electricity generation of hybrid PV/wind systems in Iraq", Renewable Energy, Vol. 35, pp. 1303-1307, 2010.

[9] Elhadidy M.A., and Shaahid, S.M. "Promoting applications of hybrid (wind + photovoltaic diesel + battery) power systems in hot regions, Renewable Energy, Vol. 29, No. 4. pp. 517-528, 2004.

[10] Y.M. Chen, Y.C Liu, S.C Hung, C.S. Cheng, Multi-Input Inverter for Grid-Connected Hybrid PV/Wind Power System, IEEE Transactions on Power Electronics, VOL. 22, May 2007.

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SMART CLASS BASED ON FINGER PRINT ATTENDANCE SYSTEM AND SMART TV

A MAIN PROJECT REPORT

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in

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PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

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ABSTRACT

Fingerprint attendance system aim to automate the attendance procedure of an educational institution using biometric technology. The system of recording student attendance using fingerprint identification that allows student to monitor student attendance to class is a true electronically by using biometric recognition (visual biometric). It can reduce the presence of fraudulent student who are now mostly done by the students and system can also reduce problems such the presence of missing paper and easily damaged. In this project work, attendance is mark after student biometric identification. For student identification a fingerprint recognition-based identification system is used. Finger print features are the best and fastest method for biometric identification. It will be more secure to use and unique for every person don't change in one's lifetime. Identifying individual from a set of enrolled fingerprints is a time taking process. The proposed system has been implemented using C# programming by using Arduino. A smart learning setting not solely permits student to access digital resources and engage in learning system any place and anytime. Smart class is a digital initiative which is rapidly transforming the way teacher teach and student learn. Smart class as a modernized method of education in Indian education, Which provide quality education to student by using smart class. Without use of CPU, processor or computer required only a pen drive is plugged to smart TV. Smart TV we are used for Bluetooth, wi-fi connection, casting, audio system and network connection.

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LIST OF ABBREVATIONS

CPU	Central Processing Unit
TV	Television
GSM	Global System for Mobile communication
SIM	Subscriber Identification Module
LCD	Liquid Crystal Display
Wi-Fi	Wireless Fidelity
RFID	Radio –Frequency Identification
SMS	Short Message Service

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Classroom is a space for teaching and learning a general classroom usually has a blackboard, a lecture, tables and chairs. In this project, we study about the Smart classroom has an additional feature which includes the fingerprint attendance system and the Smart TV. To make a classroom activity more efficient, education institutes have been continuously developing electronic products, such as micro phone, projector, video camera and computer into classroom during the last few decades. The next step for education institutes to enhance the functionality of classroom. Conventional attendance system followed in an educational system where the teacher calls out the name of each student and marks the attendance cause time wastage during lecture time. This becomes more and more severe especially in the current scenario where number of students in a class is very large. Managing the attendance data such a large group is also very difficult. Another disadvantage of present system is the chance of the student to mark fake attendance. Fingerprint based device are being used in corporate environments. These devices use computers to store and verify fingerprints. It can be ported to academic environments with modifications. The entitled student attendance monitoring system is to update student attendance automatically and sent the HOD of the corresponding department. It will display the class faculty lecturing the classroom and sent the alert message to the corresponding faculty member.

The student entering a classroom places his finger on the biometric sensor. The digital output from sensor received by Arduino controller compares with digital data various students registered if mismatch occurs it gives invalid finger else the data is stored when all the students thumb is received then we switch a button on biometric system. Fingerprint is one of the most unique parts of the human body that distinguishes one person from others and is easily accessed. This uniqueness is supported by technology that can automatically identify or recognize a person called fingerprint sensor. It enables the usage of effective system to improve it.

For the mentioned reason, we need a method to be able to recognize each user in a different fingerprint sensor. The purpose of this research is to build fingerprint sensor system for fingerprint data management to be centralized so identification can be done in each Fingerprint Sensor. The result of this research shows that by using Arduino and Raspberry Pi, data processing can be centralized so that fingerprint identification can be done in each fingerprint sensor with 98.5 % success rate of centralized server recording. Human beings have something unique that only belongs to them. This gives the idea of making the uniqueness of humanity as identity. Fingerprint is different to each of people, even for the twin. This makes fingerprints be appropriate used for biometrics technology. Another advantage of fingerprints is its practicality and durability.

Biometric fingerprint is a technology with physical characteristics of fingerprints. This type of biometrics is popularly used because it has a good performance and uniqueness. Moreover, fingerprints are permanent in one's lifetime, quite immune to aging and biological changes. Biometric technology has great potential in various technical fields such as network security, public security, and financial industry systems. Currently, the most developed technology is fingerprint recognition by using fingerprint sensor. Fingerprint sensor is a sensor used to detect fingerprint using optical system, where the detection is done by reading the contours (high level of the surface) fingerprint and static electricity body. The match rate of False Acceptance Rate (FAR) is up to <0.001% and the match rate limit of the Average Rejection Rate (FRR) is up to <1% [2]. However, the fingerprint sensor can only identify the user's fingerprint registered in the sensor. Therefore, we need a method that makes fingerprint recognition using a fingerprint sensor to be centralized. With the Arduino and Raspberry Pi, supporting data can be centralized to identify the users fingerprint entirely and can perform fingerprint recognition in different fingerprint sensors. Using Web Socket makes it possible to provide a variety of interactions between browsers and websites.

In, two-way continuous conversations can be made between browsers and servers. Continuous conversation is done by the GSM module which communicates with the respective subscriber identification module (SIM) and the output is displayed by using the LCD display. The display is more significant than any other displays in it forever

Smart classroom using teaching TV an easy to setup smart class with smart TV or an Android projector preloaded with digital contents. No CPU and Processor or computer required only a pen drive is plugged to the smart TV. Very easy to train and enable teachers for regular usage due to natural comfort with TVs. Get usage data with auto sync of reports to a central dashboard with no manual dependence. Smart TV we are used for Bluetooth, casting, audio system, network connection. Smart classroom is a digital initiative, which rapidly transforming the way teachers teach and students learn. Scenario which provides quality education to students by helping them in better concept formation, concept elaboration, improvement in reading and academic achievement. Technology befitted us in every aspects of our life right from communication to education.

1.2 LITERATURE SURVEY

AmiraSaleh, et al. [1] analyzed about the "fingerprint Recognition," Computer and systems engineering .Fingerprint Recognition is one of the research hot- spots in Biometric. It refers to the automated method of verifying a match between two human fingerprints. It is essentially a challenging pattern recognition problem where two competing error rates: The False Accept Rate (FAR) and the False Reject Rate (FRR) need to be minimized. Advancement of computing capabilities led to the development of Automated Fingerprint Authentication Systems (AFIS) and this led to extensive research especially in the last two decades. In this paper, we attempt to give a comprehensive scoping of the fingerprint recognition problem and address its major design and implementation issues as well as give an insight into its prospects.

Anil K. Jain, et al. [2] discussed about the "Filter bank Based Fingerprint Matching," IEEE Transactions on Image Processing. Pattern recognition aims to classify data (patterns) based on a priori knowledge or on statistical information extracted from the patterns. Under fingerprint recognition we have chosen the Fingerprint Matching as the research work. Most automatic systems for fingerprint comparison are based on minutiae matching. Minutiae are essentially terminations and bifurcations of the ridge lines that constitute a fingerprint pattern of our desired pattern that can be modified.

A minutia extraction approach has been presented using the midpoint ridge contours. The technique conferred in this paper is based on the extraction of minutiae from the thinned, binaries and segmented version of a fingerprint image. This paper describes fingerprint matching by using occurrences of minutiae points which enhances the performance of the matching algorithm. The quality of the proposed algorithm is that it can be associated with any algorithm as a part of pattern matching.

Chikkerur, et al. [3] discussed about the "A Systematic approach for feature extraction in fingerprint images". Fingerprint image enhancement and feature extraction are the most important stages in fingerprint verification. The robustness of the system depends entirely upon its ability to enhance bad quality images and reliably extract minutiae from it. In this paper we propose two original algorithms for the extraction of global and local features in fingerprint images. A global feature extraction and enhancement algorithm based on Fourier analysis that is simultaneously able to extract local ridge orientation, ridge frequency and ridge quality measure is proposed. A novel algorithm for minutiae features extraction and post processing based on chain coded contour following is also presented.

Davide Maltoni, et al. [4] analyzed about the "Handbook of Fingerprint Recognition," Springer Publishing Company. With their proven distinctiveness and stability over time, fingerprints continue to be the most widely used anatomical characteristic in systems that automatically recognize a person's identity. This markedly enhanced second edition provides in-depth coverage of the recent advances and practices in fingerprint recognition. Readers will find comprehensive and authoritative coverage of all the major concepts, topics, and systems and security issues associated with fingerprint recognition systems. Written with the same formula that made the success of the first edition, this unique professional reference includes state-of-the-art techniques in fingerprint matching, and covers developments in sensor technology, performance evaluation, international standards, and system security. Readers will find comprehensive and authoritative coverage.

Ishpreet Singh Virk, et al. [5] analyzed about the "Fingerprint Image Enhancement and Minutiae Matching in Fingerprint Verification", Journal of Computing Technologies. Fingerprint image enhancement and minutiae matching are two key steps in an automatic fingerprint identification system. In this paper, we develop a fingerprint image enhancement algorithm based on orientation fields; According to the principles of Jain matching algorithm, we also introduce ideas along the following three aspects: introduction of ridge information into the minutiae matching process in a simple but effective way, which solves the problem of reference point pair selection with low computational cost; use of a variable sized bounding box to make our algorithm more robust to non-linear deformation between fingerprint images; use of a simpler alignment method in our algorithm. . Readers will find comprehensive and authoritative coverage of all the major concepts, topics, and systems and security issues associated with fingerprint recognition systems. Written with the same formula that made the success of the first edition, this unique professional reference includes state-of-the-art techniques in fingerprint matching, and covers developments in sensor technology, performance evaluation, international standards, and system security.

Jain.A, et al. [6] discussed about the "An identity authentication system using fingerprints". Fingerprint verification is an important biometric technique for personal identification. We describe the design and implementation of a prototype automatic identity-authenticated that uses fingerprints to authenticate the identity of an individual. We have developed an improved minutiae-extraction algorithm that is faster and more accurate than our earlier algorithm. An alignment-based minutia-matching algorithm has been proposed. A minutia extraction approach has been presented using the midpoint ridge contours. The technique conferred in this paper is based on the extraction of minutiae from the thinned, binaries and segmented version of a fingerprint image.

This paper describes fingerprint matching by using occurrences of minutiae points which enhances the performance of the matching algorithm. This markedly enhanced second edition provides in-depth coverage of the recent advances and practices in fingerprint recognition.

Jianwei Yang, et al. [7] discussed about the "A Modified Gabon Design method for fingerprint image enhancement". Fingerprint image enhancement is an essential preprocessing step in fingerprint recognition applications. In this paper, we propose a novel filter design method for fingerprint image enhancement, primarily inspired from the traditional Gabor filter (TGF). The previous fingerprint image enhancement methods based on TGF banks have some drawbacks in their image-dependent parameter selection strategy, which leads to artifacts in some cases. Its parameter selection scheme is image independent.

The remarkable advantages of our MGF over the TGF consist in preserving fingerprint image structure and achieving image enhancement consistency. Experimental results indicate that the proposed MGF enhancement algorithm can reduce the FRR of a fingerprint matched by approximately 2% at a FAR of 0.01% approximately.

Kanagalakshmi.K, et al. [8] described about the" Frequency Domain Enhancement Algorithm Based on Log –Gabor Filter in FFT Domain," Global Journal of Computer Science and Technology. DJ Academy for Managerial Excellence, Coimbatore, Tamil Nadu, India Abstract-Minutiae extraction is one of the most important steps for an Automatic Identification and Authentication Systems. Minutiae are the local fingerprint patterns mostly in the form often mentions and bifurcations. True minutiae are needed for further process. Those true minutiae are extracted only from a good quality and better enhanced image. To achieve this, we propose a frequency domain enhancement algorithm based on the Log-Gabor Filtering.

Kenneth Nilsson, et al. [9] described about the "Localization of corresponding points in fingerprints by complex filtering," Pattern Recognition. For the alignment of two fingerprints certain landmark points are needed. These should be automatically extracted with low misidentification rate. As landmarks we suggest the prominent symmetry points (singular points, SPs) in the fingerprints. We identify an SP by its symmetry properties. SPs are extracted from the complex orientation field estimated from the global structure of the fingerprint, i.e. the overall pattern of the ridges and valleys. Complex filters, applied to the orientation field in multiple resolution scales, are used to detect the symmetry and the type of symmetry. Experimental results are reported.

LifengSha, et al. [10] described about the "Improved Finger code For Filter Bank-Based Fingerprint Matching,'' Department of Information Engineering. Finger Code has been shown to be an effective representation to capture both the local and global information in a fingerprint. However, the performance of finger the reference point detection process, and the AAD features cannot fully extract the discriminating information in fingerprints. In this paper, we first propose a new rotation-invariant reference point location method, and then combine the direction features with the AAD features to form an oriented finger code. To address this issue, we develop an improved version of the TGF, called the modified Gabor filter (MGF).

Mustafa Salah Khalefa, et al. [11] discussed about the "Fingerprint Image Enhancement by Develop Mehtre Technique," Advanced Computing. Fingerprint identification is one of the most reliable biometrics technologies. There are many applications of fingerprint recognition such as voting, ecommerce, bank, virtual banks and military. Fingerprint image enhancement is an essential preprocessing step in extract minutiae from the input fingerprint images. In this paper, we propose an image enhancement method by developing Mehtre method for directional image. The enhancement is done by added the Block Filtering, Histogram Equalization and High-Pass Filtering. We have evaluated the performance of the enhancement image method by tested it with 100 fingerprint images. Experimental results show the enhancement method improves the recognition more accuracy.

Neeraj Singla, et al. [12] analyzed the "Biometric fingerprint identification using artificial neural network," International Journal of Advanced Research in Computer Science & Technology (IJARCST). Fingerprint authentication belongs to one of the oldest biometric systems. This paper defines a new approach for fingerprint recognition. In this paper only termination points of minutiae are used for authentication. This system matches only the fingerprint image with database image when there is 100 % match or more than 90 %.Finally, the neural network approach is applied for measurement of neural network performance. The false accept rate and false reject rate are also defined.

Raymond Thai, et al. [13] described about the "Fingerprint Image Enhancement and Minutiae Extraction, the School of Computer Science and Software Engineering, the University of Western Australia, 2003. The fingerprint of an individual is unique and remains unchanged over a lifetime. A fingerprint is formed from an impression of the pattern of ridges on a finger. A ridge is defined as a single curved segment, and a valley is the region between two adjacent. The minutiae, which are the local discontinuities in the ridge flow pattern, provide the features that are used for identification. Details such as the type, orientation, and location of minutiae are considered when performing minutiae extraction.

Tico, et al. [14] described about the "Wavelet domain features for fingerprint recognition". A fingerprint recognition approach based on features extracted from the wavelet transform of the discrete image is presented. The efficiency of the method is proven by the high recognition rates achieved using the k-nearest neighbor (k-NN) classifier. The method requires lower computational effort than most of the fingerprint recognition methods proposed to date.

Yang.J.C, et al. [15] explains about the "Fingerprint Verification Based on Invariant Moment Features and Nonlinear BPNN," International Journal of Control, Automation. A fingerprint verification system based on a set of invariant moment features and a nonlinear Back Propagation Neural Network (BPNN) verifier is proposed. An image-based method with invariant moment features for fingerprint verification is used to overcome the demerits of traditional minutiae-based methods and other image-based methods. The proposed system contains two stages: an off-line stage for template processing and an on-line stage for testing with input fingerprints. The system preprocesses fingerprints and reliably detects a unique reference point to determine a Region-of-Interest (ROI). The experimental results show that the proposed method with BPNN matching has a higher matching accuracy, while the method with absolute distance has a faster matching speed. Comparison results with other famous methods also show that the proposed method out performs them in verification accuracy.

1.3 OBJECTIVES

- To maintain a proper record of attendance based on unique identification of fingerprint
- To make secured attendance system
- To make a digital initiative to the learning system
- To enhance the functionality of the classroom

1.3ORGANIZATIONS OF THE PROJECT

Chapter 2 Discuss with the conventional method

Chapter 3 Deals with the proposed system

Chapter 4 Deals with the hardware description

Chapter 5 Deals with the software description

Chapter 6 Deals with the conclusion and future scope

CHAPTER 2

CONVENTIONAL AND EXISTING SYSTEM

2.1 RFID SYSTEM

The website is a social networking site that records, various information about each action performed by its members or its users, the website can also generate relevant ones that each member can be connected. One of the most popular attendance systems using technology is RFID. This technique is a very popular wireless identification technique for monitoring attendance. So, this system can save time than manually charging absent and more appropriate attendance allocation of score. Explain that automated information systems play a role in the growth, progress, and modernization of daily work processes, and with attendance performance graphs delineate consistency with student attendance.

Research says that one of the attendance systems of students based on the radio frequency technology is Radio Frequency Identification (RFID) which aims to monitor student progress. Also, RFID-based attendance could make the whole process simple, provide a well-structured report and can analyze student attendance pattern and time management so that resource allocation in the organization can be maximally utilized. RFID technology focuses on scalability and security and explained that employee discipline and staff performance could improve on an integrated RFID attendance system with database.

Fig 2.1 RFID system

This research aims to build a system which facilitates the administration of attendance and the attendance of logging employees effectively and efficiently, using the descriptive scheme method, interviews, and analysis of documents related to the attendance employees. So that it can build a RFID- based attendance system, which can help facilitate the attendance logging so that it can provide an assessment of the performance of the employees of the company for the progress of the company. This research was conducted because of earlier studies more discussion about the benefits of RFID.

2.1.1 CHALLENGES IN RFID

RFID systems can be easily disrupted

Since RFID systems make use of the electromagnetic spectrum (like Wi- Fi networks or cell phones), they are relatively easy to jam using energy at the right frequency. Although this would only be an inconvenience for consumers in stores (longer waits at the checkout), it could be disastrous in other environments where RFID is increasingly used, like hospitals or in the military in the field. Also, active RFID tags (those that use a battery to increase the range of the system) can be repeatedly interrogated to wear the battery down, disrupting the system.

RFID Reader Collision

Reader collision occurs when the signals from two or more readers overlap. The tag is unable to respond to simultaneous queries. Systems must be carefully set up to avoid this problem; many systems use an anti-collision protocol. Anti-collision protocols enable the tags to take turns in transmitting to a reader.

RFID Tag Collision

Tag collision occurs when many tags are present in a small area; but since the read time is very fast, it is easier for vendors to develop systems that ensure that tags respond one at a time. It can be easy to accidentally switch to yhe other tags easily and hence the involved methods of tag collision and its details and end up with false entry of data or in handwritten briefings. This error might not end up only with false information but also create problem in payroll system. Reporting the data can be time taking and expensive.

Reporting and checking the data can be time taking and expensive. In addition to tracking when employees work, organizations also need to keep tabs on when employees are not working with Performance Management Software in United Arab Emirates.

2.2 MANUAL SYSTEM

All organizations use attendance management to record their employees initial and final work timings. Some organizations also save comprehensive records of attendance issues such as who calls in sick and who arrives late. Manual time and attendance management systems totally rely on highly skilled persons but the problem being that humans are not perfect. It can be easy to accidentally switch details and end up with false entry of data or in handwritten briefings. This error might not end up only with false information but also create problem in payroll system. Reporting and checking data can be time taking and expensive. In addition to tracking when employees always work. This error might not end up only with false information but also create problem in payroll system. Reporting and checking the data can be time taking and expensive. In addition to tracking when employees work, organizations also need to keep tabs on when employees are not working with Performance Management Software in United Arab Emirates.

2.2.1 CHALLENGES IN MANUAL SYSTEM

It takes more physical and mental effort to keep track of paper documents, to find information and to keep details correct. After these unintentional mistakes, corrections are needed. Often a manual transaction must be completely recreated rather than just updated. With these manual or partly automated systems information often must be written down or entered more than once. All this massive confusion and blunders handle with student's attendance system. So it requires us to modify all these traditional systems and also it's in effectiveness. Many manual systems help in many actions but it has some of its poor performances in its activities. The manual works are too heavy and unpleasant for both the communities so that it requires some new modern technologies for everyone to improve all their smartness. It also has the benefit of reduction in the manual works all over.

Poor manual systems of time and attendance management can lead to many problems such as:

- Inconsistency in data entry and generate errors
- system is fully dependent on skilled individuals
- Time consuming and costly to produce reports
- Entry of false information
- Lack of security
- Duplication of data entry

There is a reason to be considered before you automate time and attendance management, and these are those good processes must already be in working condition. Putting a new automated system in most cases won't successfully implement where one hasn't existed before. The most effective way to get a positive result from new automated attendance management software is where a good manual time and attendance management system already exists, and new system automates these. It is also financially benefited to implement automated time and attendance management software that is too simple, easy to use and understand and requires no amount of external manual work. Data entry is inconsistent.

2.3 FACE RECOGNITION

Face recognition contains taking many images or pictures of the face and extracting the unique facial features as well as distances from or between the nose, ears, mouth, eyes and cheeks. Iris and retinal recognition examining the unique features of the iris is entailed in iris recognition. The colored section between the white region of the eye and the pupil is the iris. To control the size of the pupil is its primary purpose. The trabecular meshwork is included in the unique features of the iris and as well as other physiological properties that is freckles, furrows, rings, and the corona. It has many advantages as well as distances from or between the nose, ears, mouth, eyes and cheeks. Face recognition contains taking many images or pictures of the face and extracting the image. Examining pattern of blood vessels in the retina that is located at the back of the

eye is involved in retinal recognition. At the juncture of the optic nerve is focused on the scanner.

Fig 2.2 face recognition

2.3.1 CHALLENGES IN FACE RECOGNITION

To establish a subject's identity based on facial characteristics is the ability of face recognition. Various techniques from different research fields are required in automated face recognition such as

- computer vision
- machine learning
- pattern recognition
- Image processing.

From a number of subjects, face images are enrolled into the system as gallery data in a typical face recognition system, and using a one-to-one or one- to- many schemes, the test subject's face image (probe image) is matched to the gallery data. The one-to-many and one-to-one matching are called identification and verification respectively. To interact with each other, face recognition is one of the fundamental methods used by human beings. For the purpose of automatic person recognition, with still and video images, techniques for automatic face recognition have been developed over the past three decades. This system is very helpful in all the ways of recognition of biometric system.

This has a disadvantage that the face recognition will not be as same as every day. It depends on the lighting, weather, climate and other natural aspects.

2.4 PROJECTOR

Nowadays classrooms have changed intensely with the advent of new technology. All the new technology equipment's are used to improve the teaching and learning process more prolonged and interactive. Today, most of the teachers and learners desire to use multimedia projectors in their classrooms. There are several advantages that tend to make multimedia projector as the centerpiece of the classroom's advance enhancement technology to take classes in an effective way. Hereafter student's no longer need to crowd around the Laptop or desktop computer monitor to view any multimedia presentations.

- Easier Note Taking
- A better interactive learning experience
- Greater Teaching Versatility
- New ways to learn
- Better Use of Class Time

Multimedia projector visualized classrooms helps to arrange highly organized notes for taking a class. Teachers can use bulleted multimedia PowerPoint presentations and visualize it by using projectors. Taking classes by using projectors can lead to avoid almost all the teaching method problems in the past. Through multimedia visualizing projectors students can able to learn some new experience in the digitized world. They have a chance to use Google Earth for geography for looking some places in maps, using interactive school plans to learn some additional knowledge such as foreign language, clarify doubts easily by communicating face to face interaction and streaming videos to explore some information regarding their lessons.

By using projectors, teacher can use videos, slides and image examples to clarify all the doubts to the students in their subjects. It makes a sense of realizing the reality in the classroom for the student's community. The projector can also be used to display

the web content to access all the information on the individual computer. By using projectors, teachers can use less time repeating the same concept once again rather than rewriting all the information. A projector is a powerful tool to take all lessons more easily and helps to prepare all notes prior to the classes.

2.4.1 CHALLENGES IN PROJECTOR

- A dark room is very often required to use a projector.
- Installation Cost can be more in some cases as it depends upon how you get it installed.
- Most of the projectors need a separate audio system.
- Casting cannot be done.
- Internet cannot be accessed.

Fig 2.3 projector in classroom

CHAPTER 3

PROPOSED SYSTEM

3.1 INTRODUCTION

Fingerprint attendance system aim to automate the attendance procedure of an educational institution using biometric technology. The system of recording student attendance using fingerprint identification that allows student to monitor student attendance to class is a true electronically by using biometric recognition (visual biometric). It can reduce the presence of fraudulent student who are now mostly done by the students and system can also reduce problems such the presence of missing paper and easily damaged. In this project work, attendance is mark after student biometric identification. The fingerprint of an individual is unique and remains unchanged over a lifetime. It will be more secure to use and unique for every person don't change in one's lifetime. Identifying individual from a set of enrolled fingerprints is a time taking process. The proposed system has been implemented using C# programming by using Arduino.

A smart learning setting not solely permits student to access digital resources and engage in learning system any place and anytime. Smart class is a digital initiative which is rapidly transforming the way teacher teach and student learn. Today, most of the teachers and learners desire to use multimedia projectors in their classrooms. There are several advantages that tend to make multimedia projector as the centerpiece of the classroom's advance enhancement technology to take classes in an effective way. Hereafter student's no longer need to crowd around the Laptop or desktop computer monitor to view any multimedia presentations.

It is also financially benefited to implement automated time and attendance management software that is too simple, easy to use and understand and requires no amount of external manual work. Smart class is a digital initiative which is rapidly transforming the way teacher teach and student learn. Today, most of the teachers and learners desire to use projectors in their classrooms.

3.2 WORKING OF PROPOSED SYSTEM

Fingerprint module and Arduino UNO are used to take and keep the attendance. The system consists of fingerprint acquisition module and a GSM modem. Fingerprint acquisition module is used for capturing the fingerprint using finger print scanner and pre-treatment. GSM modem is used to send the attendance of the students to their parents in the form of SMS. After capturing the fingerprint by the fingerprint scanner, system matches this captured data with the data stored in the memory chip. If it is matched attendance is marked of that student and the ID number of that student is display on the LCD screen.

When the attendance of a student is marked enrollment number of that student is display on the LCD screen. In this system, there are three main parts: enrolling, searching and displaying the attendance. This simple device starts with the connection of Arduino and fingerprint sensor to the LCD Display and the GSM for enrolling and displaying. In searching phase, when the user presses the fingerprint sensor, it reads the user's fingerprint and related user's information are display on the LCD Display depending on the instruction written in. For this system, scanning time, date, username and ID number are displayed on the LCD display and sends the presence of the students to the GSM device. The main purpose of the microcontroller is to enroll and search the fingerprint. In enrolling, this controller read the template from the fingerprint sensor and enrolls the ID number. This display the ID number on serial monitor.

And then, this controller checks the fingerprint with the stored template in the searching process. An optical fingerprint sensor is used in this system. This sensor read the fingerprint pattern. The scan image is converted as template and saved in memory. GSM is the Global System for Mobile Communications. SMS is a bidirectional service for short alphanumeric (up to 160 bytes) messages. For point-to-point SMS, messages can also be stored in the SIM card for later retrieval. After that, weekly attendance is sends to the parent's mobile through GSM modem. An optical fingerprint sensor is used in this system. This sensor read the fingerprint pattern. This controller checks the fingerprint with the stored template in the searching process.

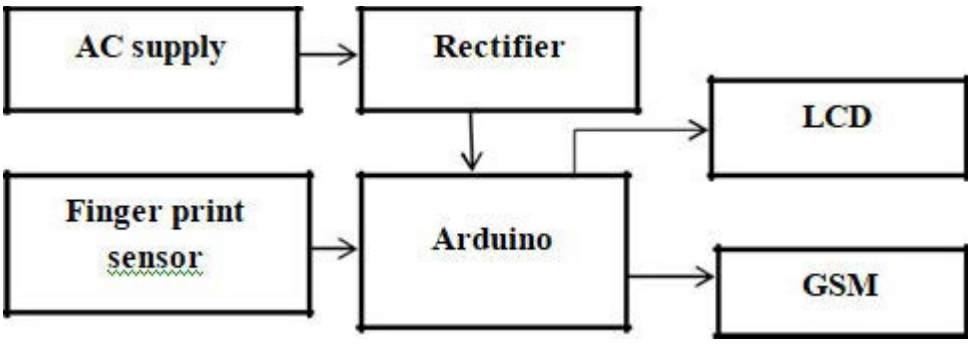

Fig.3.1 Block diagram of supply system

Smart TVs have the features of online interactive media, Internet TV, demand streaming media, and home networking and access the traditional broadcasting media that traditional television sets and set-top boxes offer. These devices allow viewers to search and view videos, movies, photos and other content on the Web, on a local cable TV channel, on a satellite TV channel, or on a local storage drive. Bluetooth is a wireless technology standard for exchanging data over short mouse or keyboard via the TV. Bluetooth technology uses 2.4GHz frequency thus proximity to Wi-Fi access points, routers or microwave ovens might interfere with Bluetooth audio streaming. The term HDMI means High- Definition Multimedia Interface which is used for the digitally delivering of uncompressed audio and video data between devices through the single cable. It is also used to connect the various devices such as AV receivers, DVD players, DVR, Blu-ray disc players to the ports. HEVC is critical and has content to new Ultra HD displays. USB means Universal Serial Bus is used to watch the movie or play music from the flash disk or external drives. Smart TV includes several applications such as YouTube, Amazon, Netflix and other apps can be downloaded from the play store or marketplace.

3.3 BLOCK DIAGRAM OF PROPOSED SYSTEM

Fingerprint based device are being used in corporate environments. These devices use computers to store and verify fingerprints. The entitled student attendance monitoring system is to update student attendance automatically and sent the HOD of the department.

It will display the class faculty lecturing the classroom and sent the alert message to the corresponding faculty member. The student entering a classroom places his finger on the biometric sensor. The digital output from sensor received by Arduino controller compares with digital data various students registered if mismatch occurs it gives invalid finger else the data is stored when all the students thumb is received then we switch a button on biometric system.

Up/Down counter or bidirectional counter are capable of counting in either the up direction or the down direction through any given count sequences. The counting from zero and increasing or incrementing to some preset value. In binary or BCD down counter, the count decreases by one for each external clock pulse from some preset value. Both synchronous and asynchronous counters are capable of counting "up" or counting "down" but in some cases "universal" type counter that can count in both directions either up or down depending on the state of their input control pin and these are known as bidirectional counters.

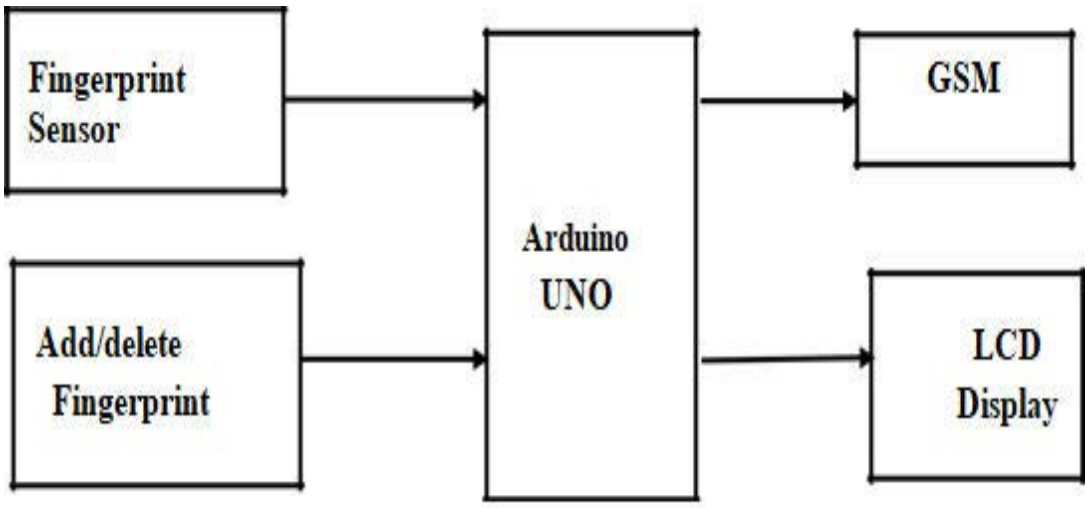

Fig 3.2 Block diagram of proposed system

CHAPTER 4

HARDWARE DESCRIPTION

4.1 FINGER PRINT SENSOR

Fingerprint processing includes two parts fingerprint enrollment and fingerprint matching. When enrolling user needs to the finger two times. The system will process the two-time finger images, generate a template of the processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with specific library. For 1:1 matching, system will compare the live finger with specific template designated in the module; for 1: N matching, or searching, system will search the whole finger library for matching finger. In both circumstances, system will return matching result, success or failure.

Fig 4.1 fingerprint sensor module

4.2 GSM

GSM means Global System for Mobile Communication used to interact with the Subscriber Identification Module (SIM). The project GSM and biometric based attendance system using Arduino is about enrolling attendance using fingerprint and broadcasting message to the registered mobile number using GSM module. This project takes as an input the fingerprint of a student that can be modified academically.

If the fingerprint matches it authenticates the user. This not only improves the accuracy of the system but also eliminates the proxy as the student himself/ herself must be present for the lectures for marking the attendance.

The system takes the attendance of students using biometric access and hence provides authenticity, accuracy and confidentiality. The register based conventional attendance system for the students in our educational institution is laborious, time consuming and kind of boring task for the educators. An intelligent system based on fingerprint scanner have been designed and implemented that supplanted the traditional mundane attendance system. A Graphical user interface application in the host computer helps the faculty to manage the device. He can perform tasks like enrolling the students fingerprint and the device is portable which means it can be taken to the classroom. Faculty can authorize and select the batch from a menu. In the first class, students must register their finger print by selecting roll number and placing their finger.

Fig 4.2 GSM SIM 800 module

4.3 LCD

Fingerprint sensor based biometric attendance system using Arduino. Simply, it will be interfacing fingerprint sensor with Arduino, LCD display to design the desired project. In this project, fingerprint module and Arduino is to take and keep attendance data and records. Biometric attendance system is commonly used system to mark the presence in office, schools and colleges.

The schools and colleges display the time record and every function happening via push button. The LED is used for power indication. First, the user needs to enroll fingerprints of the user with the help of push buttons. To do this, user need to press enroll key and then LCD asks for entering ID for the fingerprint to save it in memory by ID name. So now user needs to enter ID by using UP/DOWN keys. After selecting ID, user needs to press OK key.

Now LCD will ask to place finger over the fingerprint module. Now user needs to place his finger over the fingerprint module and then the module takes finger image. Now the LCD will say to remove finger from fingerprint module and ask to place finger again. Now user needs to put his finger again and a module takes an image and converts it into templates and stores it by selected ID into the fingerprint module's memory. Now the user will be registered, and he/she can feed attendance by putting their finger over fingerprint module. Now if the user wants to remove or delete any of the stored ID or fingerprint, then he/she needs to press DEL key. Once delete key is pressed LCD will ask to select ID that need to be deleted. Now users need to select ID and press OK key. Now fingerprint has been deleted successfully. LCD, in the system which will be built, serves to display the circumstances that occur within the system. When Arduino sends fingerprint extraction result to the server, the extraction data will be matched

Fig 4.3 LCD display

4.4 ARDUINO

Arduino is a software company, project, and user community that designs and manufactures computer open-source hardware, open-source (no license is required as there is no need of the access by an authorized individuals and easy to access)

It is also software and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on Arduino programming language which is controlled by a set of C/C++ functions.

The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The board can operate on an external supply of 6 to 20 volts.

Fig4.4 Arduino UNO module

If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts**.**

The main purpose of the microcontroller is to enroll and search the fingerprint. In enrolling, this controller read the template from the fingerprint sensor and enrolls the ID number. This display the ID number on serial monitor. And then, this controller checks the fingerprint with the stored template in the searching process. If the fingerprint is correct, the display valued are shown in excel. Otherwise, the controller doesn't give any output. ID number and name is displayed into Excel including the scanning time and date. LCD, in the system which will be built, serves to display the circumstances. When Arduino sends fingerprint extraction result to the server, the extraction data be matched.

The controller checks whether the fingerprint is present or not. When the fingerprint is detected and compared this template with the stored value in EEPROM.

If this is matched, ID number and name is displayed into Excel including the scanning time and date. LCD, in the system which will be built, serves to display the circumstances that occur within the system. When Arduino sends fingerprint extraction result to the server, the extraction data will be matched then the server will send 'return' to Arduino and Arduino will give command to LCD to show that command succeed. After all the hardware has been installed, attendance system design has been integrated, then the user's fingerprint will be sent from Arduino fingerprint sensor data via Local Area Network (LAN) to Raspberry server as designed in general architecture.

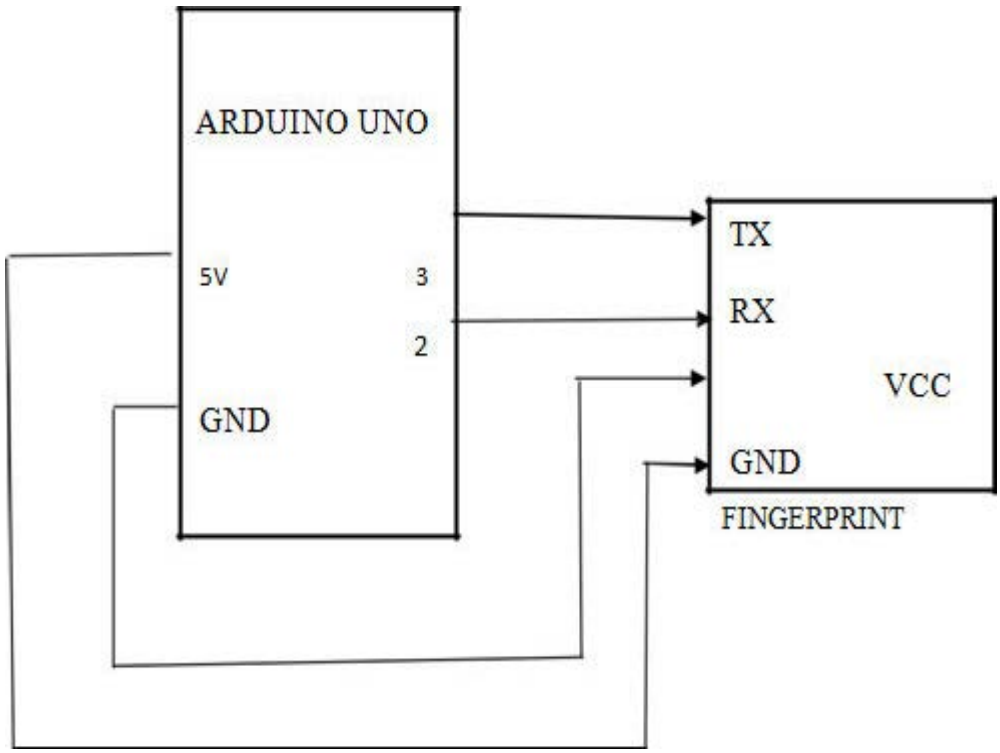

Fig 4.5 Block of Arduino UNO

4.5 FINGERPRINT MATCHING

Research Methodology The identification of fingerprints for the attendance system using Arduino and Raspberry Pi which is built on this research consisted of several stages. The first stage is done with the initialization of finger print sensor,

Arduino, Ethernet Shield and Raspberry Pi. The next stage is Fingerprint Sensor. This stage the Fingerprint Sensor will take the user's fingerprint extraction thrice in one time. Fingerprint data collection will be converted into hexadecimal form which will then send fingerprint extraction result to Arduino. Then Arduino will forward the results of fingerprint extraction to the server via Ethernet Shield. The stored data will be displayed. When Arduino sends fingerprint extraction result to the server, the extraction data will have matched them.

4.6 UPDOWN COUNTER

An up-counter counts events in increasing order. A down counter counts events in decreasing order. An up down counter is a combination of an up counter and down counter. It can count in directions, increasing as well as decreasing. By creating an array of Booleans large enough to hold one flag for each fingerprint and initialize all of them to false. As each fingerprint is scanned and can check its ID in the array. If it is false set it to true and increment the counter. If it is true, then set it to false and decrement the counter.

Fig 4.6 up down counter

4.7 SMART TV

- Bluetooth
- Casting
- Wi-Fi
- Projector
- Pen drive

4.7.1 BLUETOOTH

Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distance using short wavelength UHF radio waves in the industrial, scientific and medical radio bands from 2.4 to 2.485 GHz, and building personal area networks. Most smart TVs,if not all, have the Bluetooth option. The smart remotes on all smart TVs function via Bluetooth. Some older smart TVs may not have the option to transmit audio via Bluetooth. It helps to connect each electronic devices to share any type of files in it.

4.7.2 CASTING

Cast video from Chrome cast-enabled apps to your TV. Casting to your TV is a simple way to enjoy your favorite apps optimized for the big screen. You can even use your mobile device or tablet as a remote and control everything from playback to volume. Before you begin casting, Connect your mobile device, tablet, or computer to a Wi-Fi network .The mobile device, tablet or computer you are using to cast must be on the same Wi-Fi network as your Chrome cast or TV with Chrome cast built in. Note: To allow guests to cast without being on your Wi-Fi network, please read How to set up guest mode. It must be running the latest version of the Chrome cast-enabled app. Cast from Chrome cast-enabled apps to your TV.

Make sure the mobile device, tablet or computer are using to cast is on the same Wi-Fi network as your Chrome cast or TV with Chrome cast built in. Open a Chrome cast-enabled app. Tap the Cast button Inactive cast extension. The Cast button isn't located in the same place on all Chrome cast-enabled apps. Tap the device you'd like to cast to. When you're connected, the Cast button will turn color, letting you know you're connected. It can now cast videos, movies and TV shows directly to your TV. To stop casting, tap the Cast button and then Disconnect. Cast from Chrome cast-enabled apps from iOS devices running iOS 13Find new content to cast there's a lot of great content to enjoy from your favorite Chrome cast-enabled apps and we don't want you to miss a single great tune or podcast. It can also see a list of all Chrome cast-enabled apps and available content.

For more information on developing for Chrome cast, please visit our Chrome cast Developer Help Center. If your home has two or more isolated networks available, your Android device may auto-switch between networks depending on signal strength. This could affect whether you see the Cast button in your applications. To avoid auto-switching, android users can go to device Wi-Fi settings and Forget 'Network B' to ensure that the Android device is connected to the same 'Network A' as the Chrome cast or TV with Chrome cast built-in. If you're having trouble with a Chrome cast-enabled app, please try our Chrome cast.

Fig 4.7 smart television

4.7.3 Wi-Fi

Wi-Fi is a family of wireless networking technologies, based on the IEEE 802.11 family of standards, which are commonly used for local area networking of devices and Internet access. Wi-Fi is a trademark of the non- profit Wi-Fi Alliance, which restricts the use of the term Wi-Fi Certified to products that successfully complete interoperability certification testing. Devices that can use Wi-Fi technologies include desktops and laptops, smart phones and tablets, smart TVs, printers, digital audio players, digital cameras, cars and drone. Compatible hardware Personal computers, gaming consoles,

Smart Devices, televisions, printers, mobile phones. Wi-Fi uses multiple parts are designed to interwork seamlessly with its wired sibling Ethernet. It can access internet without the basic wire medium. It makes the contactless transfer of data from one system to another.

Compatible devices can network through a wireless access point to each other as well as to wired devices and the Internet. The different versions of Wi- Fi are specified with the different radio technologies determining radio bands, and the maximum ranges, and speeds that may be achieved. Wi-Fi most. Commonly uses the 2.4 gigahertz (120 mm) UHF and 5 gigahertz (60 mm) SHF ISM radio bands; these bands are subdivided into multiple channels. Channels can be shared between networks but only one transmitter can locally transmit on a channel at any moment in time. Wi-Fi's wavebands have relatively high absorption and work best for line-of- sight use.

Many common obstructions such as walls, pillars, home appliances etc. may greatly reduce range, but this also helps minimize interference between different networks in crowded environments. An access point often has a range of about 20-meter (66 feet) indoors while some modern access points claim up to a 150- meter(490-feet) range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves, or as large as many square kilometers using many overlapping access points with roaming permitted between them. . Devices that can use Wi-Fi technologies include desktops and laptops, smart phones and tablets, smart TVs, printers, digital audio players, digital cameras, cars and drone. Compatible hardware Personal computers, gaming consoles, Smart Devices, televisions, printers, mobile phones.

Over time the speed and spectral efficiency of Wi-Fi has increased. At close range, some versions of Wi-Fi, running on suitable hardware, can achieve speeds of over 1 Gbit/s. Wi-Fi is potentially more vulnerable to attack than wired networks because anyone within range of a network with a wireless network interface controller can attempt access. To connect to a Wi-Fi network, a user typically needs the network name and a password. The password is used to encrypt Wi-Fi packets to block eavesdroppers. Wi-Fi Protected Access (WPA) is intended to protect information moving across Wi-Fi networks and includes versions for personal and enterprise networks. Developing security features of WPA have included stronger protections and new security practice. Wi-Fi is a trademark of the non- profit Wi-Fi Alliance, which restricts the use of the term Wi-Fi Certified to products that successfully complete testing.

4.7.4 PROJECTOR

A USB flash drive is a data storage device that includes flash memory with an integrated USB interface. It is typically removable, rewritable and much smaller than an optical disc. Most weigh less than 30 g. Since first appearing on the market in late 2000, as with virtually all other computer memory devices, storage capacities have risen while prices have dropped. As with anywhere from 8 to 256 gigabytes were frequently sold, while 512 GB and 1 terabyte units were less frequent, and 2 TB flash drives were the largest available in terms of storage capacity.

With anywhere from 8 to 256 gigabytes were frequently sold, while 512 GB and 1 terabyte units were less frequent. USB flash drives are often used for storage; data back-up and transfer of computer files. Compared with floppy disks or CDs, they are smaller, faster, have significantly more capacity, and are more durable due to a lack of moving parts. Additionally, they are immune to electromagnetic interference and are unharmed by surface scratches.

Most desktop and laptop computers were supplied with floppy disk drives in addition to USB ports, but floppy disk drives. 3.5-inch floppy disc flash drives use the USB mass storage device class standard, supported natively by modern operating systems such as Windows, Linux, macOS and other Unix-like systems, as well as many BIOS boot ROMs. USB drives with USB 2.0 support can store more data and transfer faster than much larger optical disc drives like CD-RW or DVD-RW drives and can be read by many other systems such as the Xbox One, PlayStation 4, DVD players, automobile entertainment systems, and in a number of handheld devices such as smart phones and tablet computers, though the electronically similar SD card is better suited for those device.

4.7.5 PEN DRIVE

Pen drive is storage device and for the process transmission of the data from the computer system or from the other storage devices. The process of preventing the virus attack to the pen drive is a big deal. The data stored in the pen drive can be of different format such as text format, video and audio format any format can be saved. The advantages of using such USB pen drives and flash drives are mainly because the power consumption and overhead features. USB flash drives are often used for storage, data back-up and transfering of computer files.

Compared with floppy disks or CDs, they are smaller, faster, have significantly more capacity, and are more durable due to a lack of moving parts. Additionally, they are immune to electromagnetic interference (unlike floppy disks), and are unharmed by surface scratches (unlike CDs). Until about 2005, most desktop and laptop computers were supplied with floppy disk drives in addition to USB ports, but floppy disk drives became obsolete after widespread adoption of USB ports and the larger USB drive capacity compared to the "1.44 megabyte" (1440 kilobyte) 3.5-inch floppy disk.

CHAPTER 5

SOFTWARE DESCRIPTION

5.1 SOFTWARE REQUIREMENT:

5.1.1 EMBEDDED C:

Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems. So, in this article, we will see some of the Basics of Embedded C Program and the Programming Structure of Embedded C.

5.1.2 EMBEDDED SYSTEM:

An Embedded System can be best described as a system which has both the hardware and software and is designed to do a specific task. A good example for an Embedded System, which many households have, is a Washing Machine. We use washing machines almost daily but wouldn't get the idea that it is an embedded system consisting of a Processor (and other hardware as well) and software.

Embedded Systems can not only be stand-alone devices like Washing Machines but also be a part of a much larger system. An example for this is a Car. A modern day Car has several individual embedded systems that perform their specific tasks with the aim of making a smooth and safe. Some of the embedded systems in a Car are Anti-lock Braking System (ABS), Temperature Monitoring System, Automatic Climate Control, Tyre Pressure Monitoring System, Engine Oil Level Monitor, etc. Here embedded software is used as the programming software which can be modulated as per the enrollment of the finger print.

5.2 PROGRAMMING IN EMBEDDED SYSTEM:

As mentioned earlier, Embedded Systems consists of both Hardware and Software.

If we consider a simple Embedded System, the main Hardware Module is the Processor. The Processor is the heart of the Embedded System and it can be anything like a Microprocessor, Microcontroller, DSP, CPLD (Complex Programmable Logic Device) and FPGA (Field Programmable Gated Array).All these devices have one thing in common: they are programmable i.e. we can write a program (which is the software part of the Embedded System) to define how the device actually works.

Embedded Software or Program allows Hardware to monitor external events (Inputs) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may have to directly manipulate the internal architecture of the Embedded Hardware (usually the processor) such as Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc.

5.2.1 PROGRAM

```
#include <LiquidCrystal.h>
 // initialize the library with the numbers of the interface pins
LiquidCrystal lcd(4, 5, 6, 7, 8, 9);
 #include <Adafruit_Fingerprint.h>
 int getFingerprintIDez(),p1,p2,p3,p4,pa=0;
 const int buttonPin1 = 10;
 const int buttonPin2 = 11;
 const int buttonPin3 = 12;
 const int buttonPin4 = 13;
 int b1 = 1,b2 = 1,b3 = 1,b4 = 1;
 Adafruit_Fingerprint finger = Adafruit_Fingerprint(&Serial1);
 void doorOpen()
{
  lcd.clear();
  lcd.print("WELOME");
```

```
if((finger.fingerID==0)&&(p1==1))
 {
 Serial.println("id 1");//i enroled ID no 1 as Nidhi'sfingerprint, so used
 this line to display corresponding name
 p1=1;
 lcd.clear();
   lcd.setCursor(0, 0);
 lcd.print("id 1 repeated try");
 delay(2000);
 }

 if((finger.fingerID==0)&&(p1==0))
 {
 Serial.println("id 1");//i enroled ID no 1 as Nidhi'sfingerprint, so used
 this line to display corresponding name
 p1=1;
 lcd.clear();
   lcd.setCursor(0, 0);
 lcd.print("id 1");
 delay(2000);
 vot();
 }

if((finger.fingerID==1)&&(p2==1))
 {
   Serial.println("id 2");// i enroled ID no 1 as Cinla's fingerprint, so
   used this line to display corresponding name
```

```
  lcd.clear();
    lcd.setCursor(0, 0);
  lcd.print("id 2 repeated try");
  delay(3000);
                          // more number of user can be add hear
  }

  if((finger.fingerID==1)&&(p2==0))
  {
    Serial.println("id 2");// i enroled ID no 1 as Cinla's fingerprint, so
    used this line to display corresponding name
  lcd.clear();
    lcd.setCursor(0, 0);
  lcd.print("id 2");
  delay(2000);
  p2=1;
    vot();
                        // more number of user can be add hear
  }


if((finger.fingerID==2)&&(p3==1))
  {
    Serial.println("id 3");// i enroled ID no 1 as Cinla's fingerprint, so
    used this line to display corresponding name
  lcd.clear();
    lcd.setCursor(0, 0);
```

```
  lcd.print("id 3 repeated try");
  delay(3000);
                          // more number of user can be add hear
  }

if((finger.fingerID==2)&&(p3==0))
  {
    Serial.println("id 3");// i enroled ID no 1 as Cinla's fingerprint, so
    used this line to display corresponding name
  lcd.clear();
    lcd.setCursor(0, 0);
  lcd.print("id 3");
  delay(2000);
  p3=1;
    vot();
                          // more number of user can be add hear
  }
if((finger.fingerID==3)&&(p4==1))
  {
    Serial.println("id 4");// i enroled ID no 1 as Cinla's fingerprint, so
    used this line to display corresponding name
  lcd.clear();
    lcd.setCursor(0, 0);
  lcd.print("id 4 repeated try");
  delay(3000);
                           // more number of user can be add hear
  }
```

```
if((finger.fingerID==3)&&(p4==0))
  {
    Serial.println("id 4");// i enroled ID no 1 as Cinla's fingerprint, so
    used this line to display corresponding name
  lcd.clear();
    lcd.setCursor(0, 0);
  lcd.print("id 4");
  delay(2000);
  p4=1;
   vot();
                          // more number of user can be add hear
  }
 }

finger.fingerID=0;
delay(3000);
  Serial.println("No valid finger found,waiting for valid finger...");
  lcd.print("No valid finger");
  lcd.setCursor(0, 0);
  lcd.print("on the sensor");
}

void setup()
{
pinMode(buttonPin1, INPUT);
pinMode(buttonPin2, INPUT);
pinMode(buttonPin3, INPUT);
```

```
pinMode(buttonPin4, INPUT);
  lcd.begin(16, 2);
  Serial.begin(38400);
  Serial.println("fingertest");
  finger.begin(57600);

  if (finger.verifyPassword())
  {
    Serial.println("Found fingerprint sensor!");
  } else {
    Serial.println("Did not find fingerprint sensor :(");
    lcd.print("Sensor not Found");
    while (1);
  }
  Serial.println("No valid finger found,waiting for valid finger...");
  lcd.print("No valid finger");
  lcd.setCursor(0, 1);
  lcd.print("on the sensor");
  }

  void loop()                     // run over and over again
{
  Serial.println("No valid finger found,waiting for valid finger...");
  lcd.setCursor(0, 0);
  lcd.print("No valid finger");
  lcd.setCursor(0, 1);
  lcd.print("on the sensor");
```

```
      if(getFingerprintIDez()>=0)
  {
        doorOpen();
  }
}
uint8_t getFingerprintID()
{
  uint8_t p = finger.getImage();
  switch (p)
  {
    case FINGERPRINT_OK:
      Serial.println("Image taken");
      break;
    case FINGERPRINT_NOFINGER:
      Serial.println("No finger detected");
      return p;
    case FINGERPRINT_PACKETRECIEVEERR:
      Serial.println("Communication error");
      return p;
    case FINGERPRINT_IMAGEFAIL:
      Serial.println("Imaging error");
      return p;
        default:
      Serial.println("Unknown error");
      return p;
  }
```

```
// OK success!


p = finger.image2Tz();
switch (p)
{
  case FINGERPRINT_OK:
    Serial.println("Image converted");
    break;
  case FINGERPRINT_IMAGEMESS:
    Serial.println("Image too messy");
    return p;
  case FINGERPRINT_PACKETRECIEVEERR:
    Serial.println("Communication error");
    return p;
  case FINGERPRINT_FEATUREFAIL:
    Serial.println("Could not find fingerprint features");
    return p;
  case FINGERPRINT_INVALIDIMAGE:
    Serial.println("Could not find fingerprint features");
    return p;
  default:
    Serial.println("Unknown error");
    return p;
}


// OK converted!
p = finger.fingerFastSearch();
```

```
  if (p == FINGERPRINT_OK)
  {
    Serial.println("Found a print match!");
  } else if (p == FINGERPRINT_PACKETRECIEVEERR) {
    Serial.println("Communication error");
    return p;
  } else if (p == FINGERPRINT_NOTFOUND) {
    Serial.println("Did not find a match");
    return p;
  } else {
    Serial.println("Unknown error");
    return p;
  }

  // found a match!
  Serial.print("Found ID #"); Serial.print(finger.fingerID);
  Serial.print(" with confidence of "); Serial.println(finger.confidence);
}

// returns -1 if failed, otherwise returns ID #
int getFingerprintIDez() {
  uint8_t p = finger.getImage();
  if (p != FINGERPRINT_OK)  return -1;

  p = finger.image2Tz();
  if (p != FINGERPRINT_OK)  return -1;
```

```
  p = finger.fingerFastSearch();
  if (p != FINGERPRINT_OK)  return -1;


  // found a match!
  Serial.print("Found ID #"); Serial.print(finger.fingerID);
  Serial.print(" with confidence of "); Serial.println(finger.confidence);
  return finger.fingerID;
}
```

5.2.2 DIFFERENCE BETWEEN C AND EMBEDDED C

There is actually not much difference between C and Embedded C apart from few extensions and the operating environment. Both C and Embedded C are ISO Standards that have almost same syntax, data types, functions, etc. Embedded C is basically an extension to the Standard C Programming Language with additional features like Addressing I/O, multiple memory addressing and fixed-point arithmetic, etc. C Programming Language is generally used for developing desktop applications whereas Embedded C is used in the development of Microcontroller based applications.

5.2.3 EMBEDDED SYSTEM AND ITS REAL TIME APPLICATIONS

The World is filled with Embedded Systems. The development of Microcontroller has paved path for several Embedded System application and they play a significant role (and will continue to play in the future as well) in our modern day life in one way or the other. Starting from consumer electronics like Digital Cameras, DVD Players to high end and advanced systems like Flight Controllers and Missile Guidance Systems, embedded systems are omnipresent and became an important part of our life. Another important concept we are hearing these days is Real – Time Systems. The way we live our life has been significantly improved with the utilization of Embedded Systems and they will continue to be an integral part of our lives even tomorrow.

Some Other Real Time Applications of Embedded Systems

- Latest Smart TVs
- GPS Navigation Systems
- Almost all Modern Day Smart Phones
- Missile Guidance Systems

5.3 FEATURES:

- Built in Libraries for RS232 serial I/O library, I/O, I2C, discrete I/O and precision delays.
- Integrates with MPLAB and other simulators/emulators for source level debugging.
- Standard Hex file and debug files ensure compatibility with all programmers.

CHAPTER 6

CONCLUSION

6.1 CONCLUSION AND RESULT

The proposed system scanned the fingerprints placed on the device sensor and compared them against those stored in the database successfully. The performance of the system was acceptable and would be considered for full implementation especially because of its short execution time and reports generation. This system takes the attendance of the student and sends this attendance to their parent's mobile through GSM. Attendance system could not only speed up the process taking attendance but also reduce the error rate and produce faster verification process of authenticating student attendance. This system calculates the attendance of students and sends alert message for the absence students to relevant guardians' mobile phone. This system can also store the data of students for long time.

6.2 HARDWARE SPECIFICATIONS

S.NO	COMPONENTS	QUANTITY	RATINGS
1	Finger print sensor	1	R305
2	GSM	1	SIM 800
3	LCD display	1	2*16
4	Arduino	1	Arduino UNO
5	Counter	1	Bidirectional

6.3 HARDWARE BUDGET

S.NO	HARDWARE	BUDGET
1	FINGER PRINT SENSOR	4,000
2	GSM	1,800
3	LCD Display	400
4	Arduino	800
5	Counter	4,000
6	Smart TV	18,000
	Fitting and transportation charges	1,000
	Total amount	30,000

REFERENCE

1. Anne-mie. A, G.Sponselee, Ben Schoutten and Don G.Bouwhuis,Member,ISG, January 2008 "Effective Use of Smart Home Technology to Increase Well-Being"

2. Coutaz. J,Crowley. J, Dobson. S, Garlan. D, "Context is key" –Commun, ACM, vol 48, March(2005)

3. Dermosoniadis. V, Philippopoulos. P, Georgopoulos. C, "Smart Homes: a user perspective", 19th International Symposium on Human Factors in Telecommunication, Berlin, 2003.

4. Euzenat. J, Pierson. J, "RamparanyF.Gestiondynamique de contexte pour informatique diffuse" - Tours – France - RFIA 2006.

5. Hall. R.S., Cervantes. H, "An OSGi Implementation and Experience Report", Proceedings of the IEEE Consumer Communications and Networking Conference, January 2004.

6. Launay. P, "Deploiement d'un bus à messages sur un réseau à grandeechelle", Master thesis, Grenoble- France, 2000 June.

7. Lee. K, "IEEE 1451: A Standard in Support of Smart Transducer Networking IEEE Instrumentation and Measurement," Technology conference Baltimore, MD USA, May 1-4, 2000.

8. Rey.G, Coutaz.J, Le Contexteur,"Capture et distribution Dynamiqued'InformationsContextuelles" GrenobleFrance, ACM Publication, 2004.

9. TorilLaberg, Haakon Aspelund and Hilde Thygesen, ISBN-82 8081-057-9, "Smart Home Technology-Planning and management in municipal services (2018). International Journal of Intellectual Advancements and Research in Engineering Computations.

10. . VicentRicquebourg, David Menga, David Durand, Bruno Marhic, Laurent Delahoche, Christophe Loge "The Smart Home Concept, our immediate future".

11. Wang X.H., Zhang D.Q., Pung H.K., "Ontology Based Context Modeling and Reasoning using OWL" Workshop on CoMoRea 2004, Orlando, Florida USA, March 2004.

12. Wang X.H., Zhang D.Q., Pung H.K., "Ontology Based Context Modeling and Reasoning using OWL" Workshop on CoMoRea 2004, Orlando, Florida USA, March 2004.

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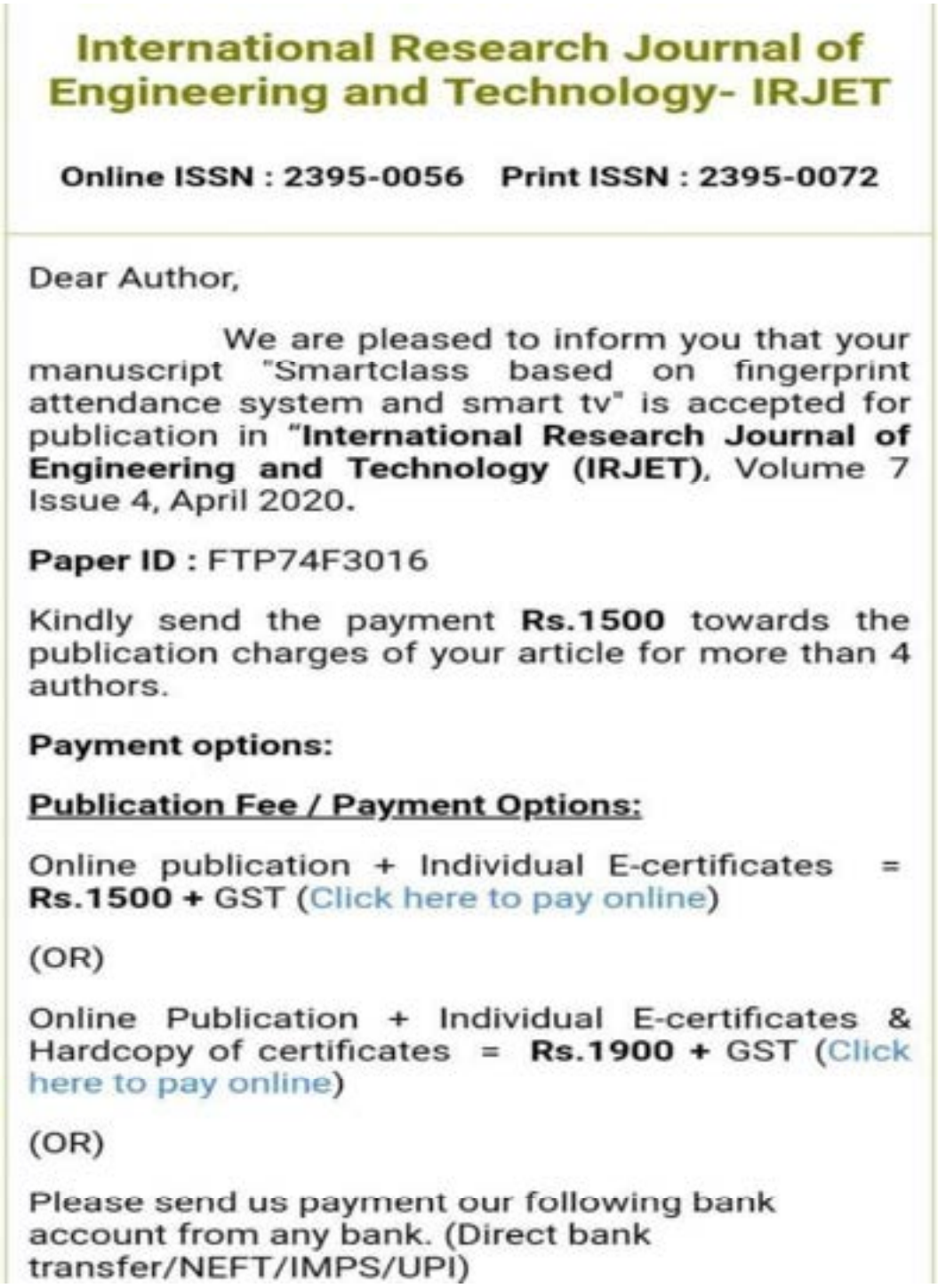

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EXPERIMENTAL AND THEORITICAL INVESTIGATION OF CI ENGINE CHARACTERISTICS FUELLED WITH TYRE OIL AND DIESEL BLENDS

PROJECT WORK (PHASE – I) REPORT

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BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

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ABSTRACT

Day by day increase in fossil fuels demand and price will be lead to search for alternative energy. This makes us to do project in finding alternate energy. Today scenarios there are so many alternate fuels are under research. Today's problem is to dispose waste tyre by without affecting the environment will be the biggest challenge. To overcome this challenge in this project we focused on converting the waste tyre into useful fuel by using pyrolysis process.

Initially, the tyre oil was purchased it contains impurities which lead to affect the engine characteristics. By removing dust and moisture content will improve engine characteristics. The raw oil was heated in the container will remove moisture content.

Then basic fuel properties like calorific value, density, viscosity, flash and fire point, etc.. of tyre oil was tested as per ASTM standard and compared with diesel are in this report. The test result shows the fuel properties are nearer to diesel fuel.

So, the tyre oil doped with diesel will be used as alternate fuel for Compression ignition engine. It motivated us to conduct experimental & theoretical investigation of engine characteristics fuelled with tyre oil in Phase II.

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LIST OF ABBREVIATIONS AND SYMBOLS

SYMBOLS AND UNITS

m^3	-	Meter cube
%	-	Percentage
Kg	-	Kilograms
M	-	Mass
C	-	Celsius
F	-	Fahrenheit
MPa	-	Mega pascal
MJ	-	Mega joule
W	-	Watts
K	-	Kelvin
T	-	Metric ton

ABBREVIATIONS

PVC	-	Polyvinyl Chloride
VCR	-	variable compression engine
P^H	-	power of hydrogen
ICE	-	internal combustion engines
CR	-	compression ratio
POME	-	palm oil methyl ester
IT	-	injection timing
IC	-	Internal Combustion
LPG	-	Liquefied Petroleum Gas
CNG	-	Compressed Natural Gas
PAHs	-	Polycyclic Aromatic Hydrocarbons
IV		Iodine value
ANN	-	Artificial Neural Network

CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

A large part of the energy consumed in the world is derived from fossil fuels such as petroleum, coal and natural gas. But, these petroleum based non-renewable resources will come to an end in the short run. Therefore, the investigations for renewable and sustainable alternative energy sources which can provide the necessary energy demand of the world has gained attention all over the world due to hazard of depletion of fuels, high price of petroleum and environmental concerns such as air pollution and global warming In the last decades, research interests on the internal combustion engines (ICE) have been explored in the area of alternate fuels, which are renewable, locally available, environment friendly .Beside these fuel researches the operating conditions of engines have gained very importance by researchers and manufacturers. Improvement internal combustion engines by optimizing the all operating conditions have been one of the primary study subjects through researchers.

To be able to increase the efficiency of an engine all effects of engine parameters should be known. Thus, many researchers have investigated the effects of these parameters mostly using variable compression engine (VCR) .The diesel engines are very fuel efficient and thus provide fuel economy. The operational simplicity of diesel engines makes diesel engines more preferable in the transportation sector and agricultural and forestry machinery. The extinction risk of fossil fuel and high cost of the petroleum causes to increase of effort in the means of alternative fuel development. After the oil crisis of the 1970s, investigation efforts on the field of the internal combustion engines have been extended in the area of alternative fuels, which are available locally, biodegradable, less toxic, environment friendly renewable, compared to fossil fuels.

Also, beside fuel researches many scientists have been working on engine parameters such as compression ratio and injection timing. These main parameters of engines effect directly performance and emission characteristics of ICE. Thus, many researchers have investigated the effects of these parameters mostly using variable compression engine (VCR).

Jindal et al. reported a study which investigates the effects of the engine design parameters such as compression ratio (CR) and fuel injection pressure on the performance of the engine.

The author studied the subject with some critical performance criterias such as brake thermal efficiency, specific fuel consumption, and emissions of carbon monoxide, carbon dioxide, hydrocarbons, nitrogen oxides and smoke opacity with Jatropha methyl ester as fuel.

Depnath et al. presented a study that investigates the variable compression ratio diesel engine when the engine is fueled with palm oil methyl ester thermodynamically. The effect of compression ratio (CR) and injection timing (IT) on energy and energy potential of a palm oil methly ester (POME) was found by them. The test were performed in a single cylinder, direct injection, water cooled variable compression ratio diesel engine at a constant peed of 1500 rpm under a full load.

Amarnath and Prabhakaran , reported a study which is related with the thermal performance and emissions of a variable compression ratio diesel engine fueled with karanja biodiesel and optimized the parameters based on experimental datas.

Al Dawody and Bhatti, investigated the emission, performance and the combustion, characteristics of a diesel engine fueled with soybean biodiesel-diesel blends experimentally and computationally.

In this study, a theoretical calculation were evaluated based on ideal diesel cycle by using parameters of compression ratio, ratio of specific heats, and cut-off ratio in order to optimize the operational conditions of a diesel engine. Theoretical calculations in this study shows the effects of engine operating parameters which is important to have guess before performing time consuming and costly experiments.

1.2 INTERNAL COMBUSTION ENGINES

Internal combustion engines are most commonly used for mobile propulsion in vehicles and portable machinery. In mobile equipment, internal combustion is advantageous since it can provide high power-to-weight ratios together with excellent fuel energy density. Generally using fossil fuel (mainly petroleum), these engines have appeared in transport in almost all vehicles (automobiles, trucks, motorcycles, boats, and in a wide variety of aircraft and locomotives).Diesel engines are found in virtually all heavy duty applications such as trucks, ships, locomotives, power generation, and stationary power. Where very high power-to-weight ratios are required, internal combustion engines appear in the form of gas turbines. These applications include jet aircraft, helicopters, large ships and electric generators.

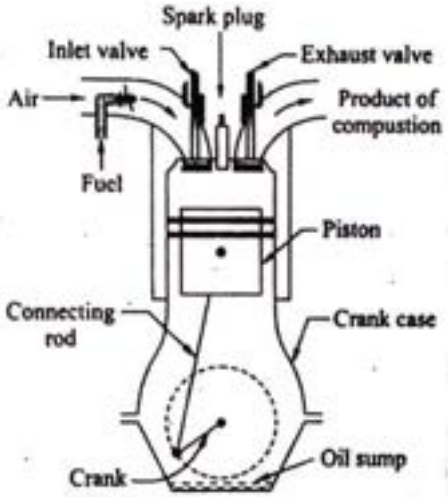

Figure 1.1 Internal combustion engines

Gasoline ignition systems generally rely on a combination of a lead-acid battery and an induction coil to provide a high-voltage electric spark to ignite the air-fuel mix in the engine's cylinder. This battery is recharged during operation using electricity –generating device such as a generator driven by the engine. Gasoline engines take in a mixture of air and gasoline and compress it to not more than 12.8 bar (1.28 MPa), then use a spark plug to ignite the mixture when it is compressed by the piston head in each cylinder. These gasoline internal combustion engines are much easier to start in cold weather than diesel engines; they can still have cold weather starting problems under extreme conditions.

Diesel and Homogeneous Charge Compression Ignition engines (HCCI), rely solely on the heat and pressure created by the engine in its compression process for ignition. Diesel engines take in air only, and shortly before peak compression, spray a small quantity of diesel fuel into the cylinder via a fuel injector that allows the fuel to instantly ignite. HCCI type engines take in both air and fuel, but continue to rely on an un-aided auto-combustion process, due to higher pressures and heat. [3]Light duty diesel engines with indirect injection in automobiles and light trucks employ glow plugs that preheat the combustion chamber just before starting to reduce no-start conditions in cold weather.

All internal combustion engines depend on combustion of a chemical fuel, typically with oxygen from the air[4]. The combustion process typically results in the production of a great quantity of heat, as well as the production of steam and carbon dioxide and other chemicals at very high temperature; the temperature reached is determined by the chemical makeup of the fuel and oxidizers, as well as by the compression and other factors.

1.3 BACKGROUND OF PYROLYSIS PRODUCTS FROM WASTE TYRES.

Municipal and industrial solid waste proper management is a major challenge Faced by society today due to health, environmental and economic aspects Involved.

In casting processes 70% of wastes generated are composed by sand The global foundry industry generated about 100 million tons of foundry Sand in 2011. Data from Brazilian Casting Association (ABIFA) indicated that 2.7 million tons of cast metals were produced in Brazil in 2014. Thus, during The year of 2014, the Brazilian casting industry generated approximately 3Million tons of waste foundry sand (WFS) which has been identified as the Most important problem in foundries.

Pyrolysis is an alternative method for the polymeric resin removal which Covers the CS surface. According to Kumar and Singh the most attractive Technique of chemical feedstock recycling is pyrolysis and the thermal Cracking or thermal pyrolysis involves the

polymeric materials degradation by Heating in the oxygen absence. The CS can be used as a support in fluidized Bed reactors. The kinetic parameters and mechanisms from polymeric resin [(C29H24N205)n] thermal decomposition were studied by PeronеI. Only 1% of CS is composed by polymeric resin (organic fraction), which would Make it technically unfeasible for the pyrolysis process.

Through co-pyrolysis With waste tyres, the energy that is already being provided is used. Therefore, The co-pyrolysis becomes attractive. The continually growing global automobile industry unavoidably results in Also steadily increasing amounts of end-of-life or waste tyres. It is estimated that about 1.5 billion waste tyres are produced annually worldwide. Until recently, the majority of these scrap tires were land filled; it is reported that about 4 billion waste tyres are currently in landfill sand stockpiles worldwide. Worn tyres, like other rubber products, do not readily decompose, so their disposal involves many problems and much energy and time.

Tyre pyrolysis is advantageous due to its products which can be obtained and also its lower emissions. According to Rombal do et al. rubber pyrolysis is one of the most reasonable alternatives in terms of environmental protection. Tyres have a higher calorific value than coal and biomass, ranging between 28 and 40 MJ.kg-1. Thus, they become an interesting alternative for thermochemical process (pyrolysis, combustion and gasification) due to its high calorific value property.

Tyre main components (styrene-butadiene, natural rubber and polybutadiene) degradation temperatures were studied by Williams and Besler. The styrene-butadiene is degraded at high temperature (723 K), natural rubber at lower temperatures (between 573 and 673 K), and finally the polybutadiene in two different temperature ranges (between 643 and 823 K).

Oil generated from tyre pyrolysis process can be used as fuel, or as a sourceof fine chemicals . This oil is dark brown/black colored, with mediumviscosity and a sulphurous /aromatic odor. It is chemically very complex, containing more than 100 identified compounds. The pyrolytic oil composition from waste tyres consists in both short and long chain carbon molecules, as well as single and multiple ring structures. Dai et al. reported oil

composition from tyres pyrolysis in a circulating fluidized bed: 26.77 wt% alkanes, 42.09 wt% aromatics, 26.64 wt% non-hydrocarbons and 4.05 wt% as asphalt. Conesa et al. reported a 39.5 wt% aliphatic fraction, 19.1 wt% aromatic fraction, 21.3 wt% hetero-atom fraction and 20.1 wt% polar fraction for oils produced from a laboratory scale fluidized bed reactor at 973 K. Kyari et al. pyrolyzed a seven-different-brands mixture of tyres in a fixed bed reactor and analyzed the oil produced by gas chromatographic/mass spectrometric (GC/MS). The tyre pyrolysis oil consisted in a single ring and polycyclic aromatic compounds and their alkylated derivatives, containing mainly alkylated benzenes, alkylated naphthalenes, alkanes, and alkenes, with compounds such as limonene, ethylbenzene, toluene accounting for the molecules majority. There were also significant concentrations of naphthalene and methyl, dimethyl and trim ethyl naph thalenes. Higher molecular weight compounds included phenanthrene and pyrene.

1.4 UPGRADING OF WASTE TYRE PYROLYSIS OIL TO BE USED IN DIESEL ENGINE.

The increasing industrialization and motorization of the world led to a steep rise in demand of petroleum products. Petroleum based fuels are stored fuels in the earth. There are limited reserves of these stored fuels and they are irreplaceable. These finite resources of petroleum are highly concentrated in certain regions of the world have given rise to uncertainty in its supply and price and are impacting growing economies like Bangladesh.

By the year 2100, the world population is expected to be in excess of 12 billion and it is estimated that the demand for energy will be increased by five times from what it is now. Also it is estimated that petroleum reserve of the world will be nearly exhausted by (2040)recent future. This makes it difficult for government to subsidize petroleum products in future. Around the world, there are initiatives to replace gasoline and diesel fuel due to the impact of fossil fuel crisis and hike in oil price. Millions of dollars are being invested in the search for alternative fuels. On the other hand, the disposal of waste tyres from automotive vehicles is becoming more and more complex.

Many attempts have been made by different researchers to find out alternative fuels for IC (Internal Combustion) engines. Many alternative fuels like biodiesel, LPG (Liquefied

Petroleum Gas), CNG (Compressed Natural Gas) and alcohols are being used nowadays by different vehicles. In this context pyrolysis of scrap tyres can be used effectively to produce oil, thereby solving the problem of waste tyre disposal .

The second author of the present paper developed and operating a fixed-bed fire-tube heating tire wastes pilot scale pyrolysis plant at RUET. In the present study, firstly upgrading experiments of product liquids obtained from the pilot plant have been conducted by fractional distillation, oxidative desulfurization and de-colorization. In the second phase of the investigations, obtained fractionates were characterized by analysing fuel properties, elemental analysis and FT-IR techniques and compared with conventional diesel fuel.

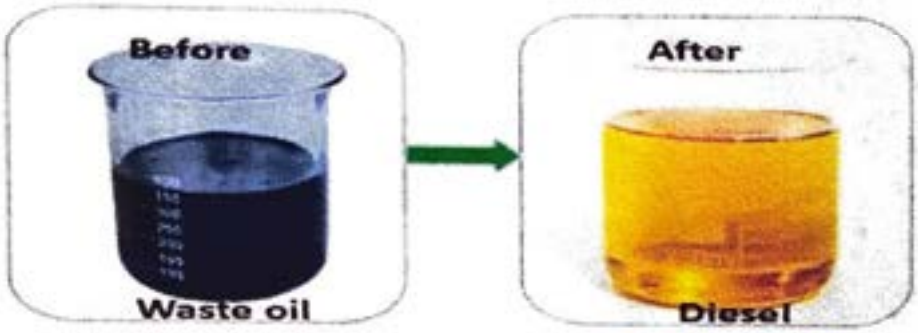

Figure 1.2 Upgrading of waste tyre pyrolysis oil to be used in diesel engine.

1.5 DIFFICULTIES WITH THE WASTE TYRES

Tyres are made of vulcanized rubbers (with styrene butadiene (SBR), natural rubber (NR) and poly butadiene (BR), carbon black, steel, textile cord and little amount of other additives [Table 1.1]. The toughness and resistance of the over material to biological removal make their removal and reprocessing difficult.

Table 1.1 Components of Tyre

Component	Proportion (%)
Natural Rubber	45
Synthetic Polymer	4
Carbon Black	22
Oil	6
Chemicals	4
Steel Wire	16.5
Others	2.5

1.6 MARKET SECTORS FOR SCRAP TYRES

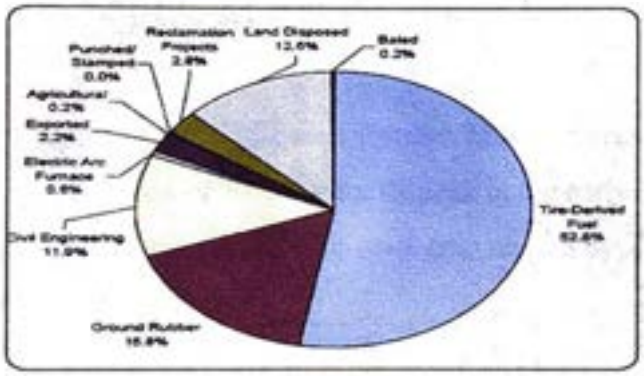

Figure.1.3. U.S. Scrap tyre Disposition (Source: Scrap Tire Markets in the United States 9thBiennial Report)

Figure.1.3 shows that 52.8% tire derived fuel obtained from pyrolysis of scrap tyres. For the India following opportunities can find.

1.6.1 THROUGH PYROLYSIS

- Tyre-derived fuels (TFDs) have demanded as only end-market as fuels for power cement kilns, paper mills and utility boilers.

- High-grade char that can replace carbon blacks, a vital ingredient in rubber products.

- The global demand for carbon blacks will grow to almost 4.3%annually through 2013, according to a Free donia report.

- Tyres contain steel wires and the amount range of 10% to 15% of the total tyre wastage.

- Valuable steel wires are pressed and sold to steel and scrap dealers.

- Non-Condensable gases arise during the pyrolysis process used as fuel.

1.6.2 THE TYRE-DERIVED AGGREGATE

According to a report by the US-based Rubber Manufacturers Association (RMA), this sector occupied a market share of 10% during Its peak in the early 1990s. It currently still shows stability, especially with the Demand in civil engineering applications, such as road sub grades and walls and Bridge backfills.

1.6.3 RECYCLING THROUGH GRINDING

Crumb is used in sports and play surfaces, brake linings, landscaping mulch, carpet underlay, absorbents for wastes and shoe soles.

Figure 1.4 Recycling through grinding

1.6.4 RECYCLING THROUGH DE-VULCANIZATION

Treating vulcanized rubber with heat or chemicals can produce de-vulcanized rubber, which can be used to replace part of the virgin material in automotive and cycle tyres, conveyor belts and footwear.

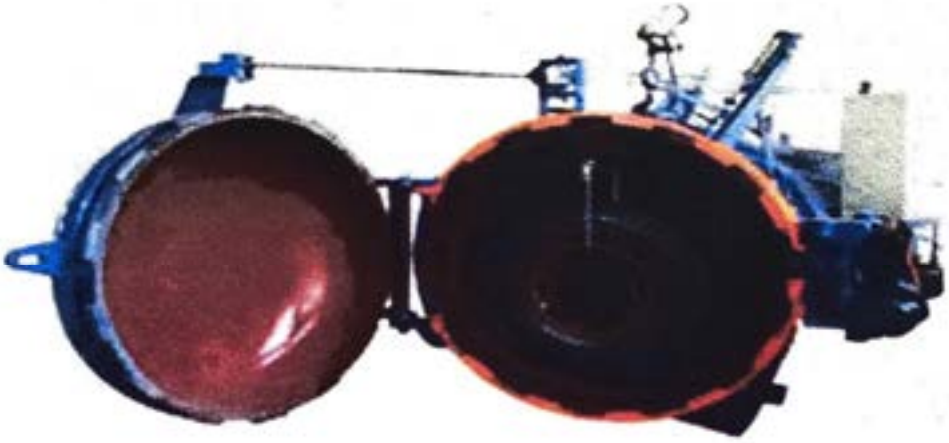

Figure 1.5 Recycling through de-vulcanization

1.6.5 RECYCLING THROUGH MICROWAVE TECHNOLOGY

Advance Molecular Agitation Technology (AMAT) has developed a prototype using microwave technology. This breaks the tyres into their original components. The steel is of grade a quality and can therefore be sold for recovery; the carbon and oil are also reusable. The amount of emissions produced is minimal.

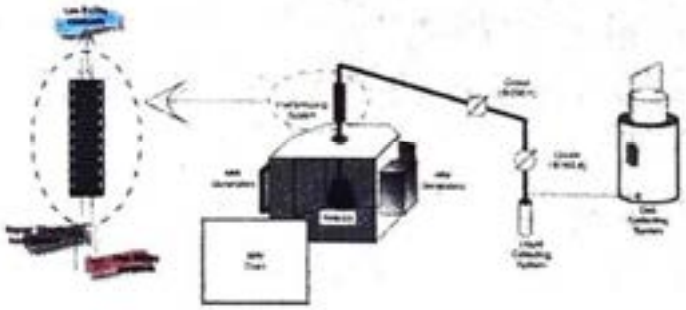

Figure 1.6 Recycling through microwave technology

1.7 USES OF WASTE TYRES

- Boat and dock fenders
- Under road surfaces
- Sports tracks
- Weights on silage sheeting on farms
- Crash barriers at motor racing circuits
- Children's play surfaces and furniture
- Protection for young plants and trees
- Compost heap containers
- Roof tiles
- Noise control products
- Structural support for earth walls
- Motorway embankments
- Artificial reefs and coastal defences

1.8 PYROLYSIS

It is most widely used option for scrap tyre recycling in all countries (Figure.1.1). Tyre pyrolysis is the thermal breakdown in the absence of oxygen is presently getting renewed attention. Various products are obtained during the tyre pyrolysis process such as: liquid residue (45- 50 wt %), steel; wire (10-15%), Solid char (30-35 wt %), and gases (5- 15 wt %) (fig.5). In the pyrolysis process non–condensable organics like H2, H2S, CO, CO2, CH4, C2H4, C3H6 etc are also present which gives the gaseous fraction. The little bit part of gas can be used as fuel inthe pyrolysis process.

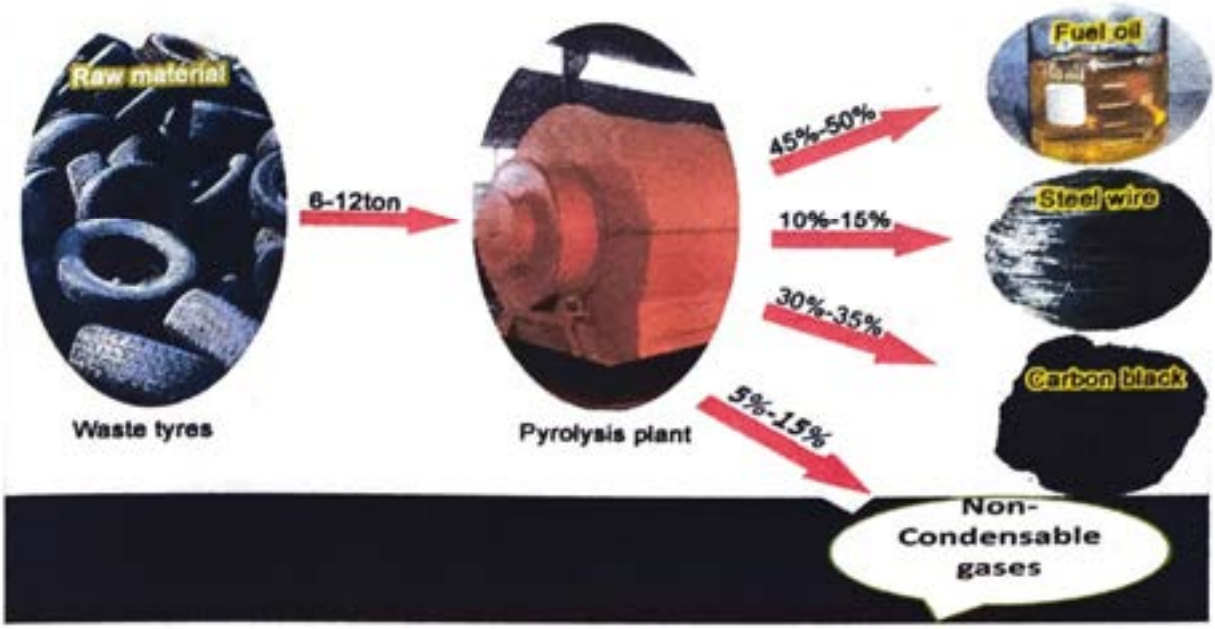

Figure 1.7. Pyrolysis process.

1.8.1 TYPES OF PYROLYSIS

- Vacuum pyrolysis
- Flash vacuum pyrolysis
- Fluidized bed pyrolysis
- Fast pyrolysis
- Based on residence type

1.9 FUTURE SCOPE AND CHALLENGES

- Optimization of the process to achieve an economical and eco-friendly method.
- Easy and more economical methods for removal of ash content from pyrolyzed carbon black for their wide applications.
- Different catalysts or modification of the catalysts can be used to obtain more yields of the oil products.
- Doping nano additives with the fuel blends will lead to reduce in emissions.

1.10 PYROLYSIS OIL APPLICATIONS

Interesting applications for pyrolysis oil include **Heat & Power, Automotive fuels** and **Bio refineries**. At the moment these are in varying stages of development, with only Heat & Power having been demonstrated at a commercial scale. The long-term vision is to focus more on the bio refinery concept where pyrolysis oil is (one of the) raw materials for bio based chemicals and automotive fuels. Recently bio refining of pyrolysis oil has gained an increasing amount of attention around the world. BTG-BTL is involved in the oil production and heat and power applications while its parent company BTG Biomass Technology Group is dedicated to the research and development of higher value added pyrolysis oil applications.

Current focus for pyrolysis oil application is on small or large scale (co-) combustion in natural gas, coal or heating oil fired boilers, furnaces and turbines. These systems are usually found in power plants where electricity, heat and steam are produced. Boilers, furnaces and turbines are also found at large industrial companies to supply their demand for electricity, heat and steam.

1.11 PYROLYSIS PRODUCTS.

Pyrolysis is a process of chemically decomposing organic materials at elevated temperatures in the absence of oxygen. The process typically occurs at temperatures above 430°C (800°F) and under pressure. It simultaneously involves the change of physical phase and chemical composition, and is an irreversible process

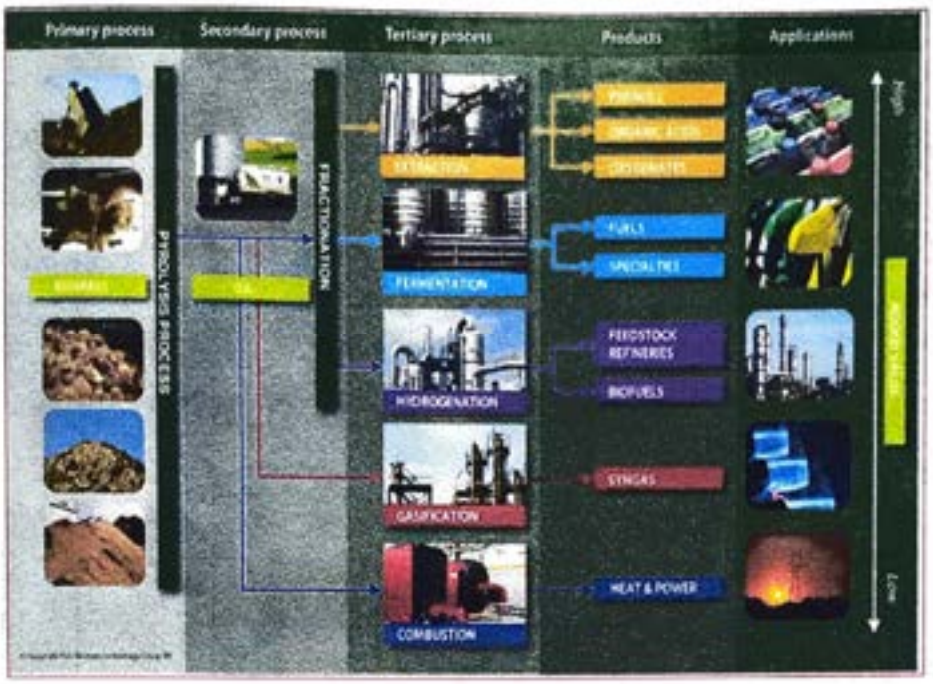

Figure 1.8. Pyrolysis process flow and application.

1.11.1 PYROLYSIS GAS

The approximate yield of gas from waste tyre pyrolysis is about 10-30% by weight and it increases with increasing pyrolysis temperature. The pyrolysis derived gas has a calorific value of approximately 30-40MJ N/m-3 and can be sufficient to provide the energy required for a small scale process plant. The carbon oxide components (COx) are mostly derived from the oxygenated organic compounds in tyres, such as stearic acid and extender oils. H2S is a product of the sulphur links vulcanized rubber structure decomposition and its concentration is low. C4 and >C4 gases are the most predominant products and these result from the depolymerisation of styrene-butadiene-rubber (SBR), usually the main constituent of automotive tyres . Table II shows the gaseous constituents produced during the pyrolysis of tyres. The components of the gas obtained from tyre pyrolysis at 400, 500, 600 and 700°C is shown by Figure1.4. The gaseous product mixture is made of shorter aliphatic chains than SBR due to rubber cracking and subsequent reactions to form lighter gases.

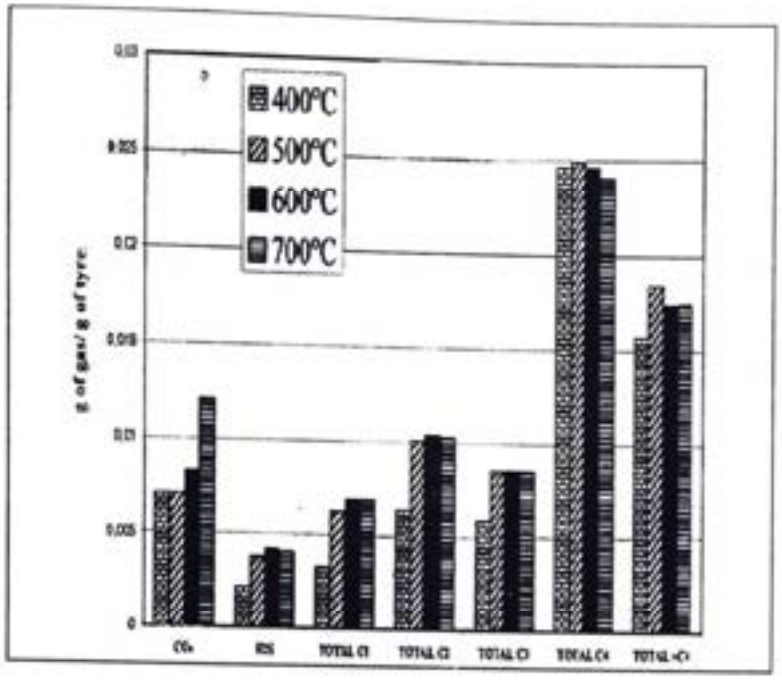

Figure1.9 Gaseous products distribution with temperature.

1.11.2 PYROLYSIS OIL

There is need for greener fuel alternatives due to fossil fuel depletion, increasing oil prices and emission challenges. Tyre pyrolysis liquids production pathways with their wide range of potential applications are as shown in figure.1.5.

The waste tyre pyrolytic liquid is an oily organic compound, dark brown in colour and with a strong acrid smell. This oil should be handled carefully as it reacts easily with human skin, leaving permanent yellowish brown marks and an acrid smell for a few days, and this is difficult to remove by detergents. The tyre derived oil is composed mainly of alkylated benzenes, naphthalenes, phenanthrenes, n-alkanes from C11 to C24, and alkenes from C8 to C15, with small quantities of nitrogen, sulphur and oxygenated compounds . The pyrolysis oil has a high calorific value of about 44 MJ/kg compared to that of waste tyres, 33 MJ/kg. The calorific value of the oil is also higher than that of bituminous coal, 28 MJ/kg and wood charcoal, 30 MJ/kg . Pyrolytic oils can be used as liquid fuels for industrial furnaces, power plants and boilers. The oil has a relatively low ash content and residual carbon.

1.11.3 ACTIVATED CARBON.

Activated carbon from pyrolytic char can be used for water purification and air purification, as well as in batteries and fuel cells[12]. Pyrolytic char has a calorific value comparable to high-grade coal and may therefore be used as fuel either in pulverized or briquetted form. The application of pyrolytic char as low grade carbon black for the manufacturing of thermoplastics and a low cost adsorbents for the treatment of industrial effluents has also been suggested . The potential of the tyre carbon black product as possible

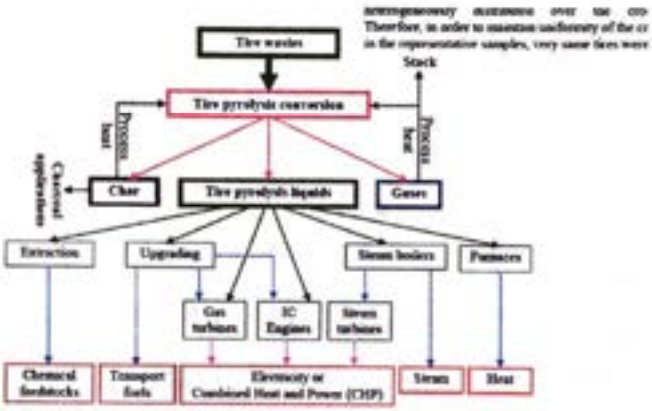

Figure.1.10. Tyre pyrolysis conversion and products applications.

Table 1.2 pyrolysis gas constituents.

S.NO	Component	Chemical formula
1	Carbon monoxide	CO
2	Carbon dioxide	CO2
3	Hydrogen sulphide	H2S
4	Methane	CH4
5	Ethane	C2H6
6	Ethene	C2H4
7	Propane	C3H8
8	Propene	C2H6
9	Butane	C4H10
10	Butene	C4H8
11	Butadiene	C4H6
12	Pentane	C5H12
13	Pantene	C5H10
14	Hexane	C5H14
15	Hexene	C6H12

Adsorbents for various pollutants has been assessed and found to be successful, thus stimulating a huge research interest. Active carbon can be used to adsorb phenols, basic dyes, metals, p-chlorophenols, butane and natural gas. The production, characterization and uses of carbon black as printing inks bases and recycled tyre fillers have been studied .

To enhance the commercial value of waste tyre pyrolytic carbon black and increase its potential application as activated carbon, further treatment such as chemical activation is required. This allows both pyrolysis and activation to be integrated into a single, relatively lower temperature process in the absence of oxygen. Demineralization of carbon black with acid (sulphuric and hydrochloric acid) followed by activation at high temperature, normally 900oC, in a furnace is common.

Commercial activation of carbon black is usually conducted at temperatures above 800oC in a mixture of steam and carbon dioxide. There is general agreement that steam is a more reactive agent than carbon dioxide Activation increases the surface area while decreasing the concentration of contaminants or non-carbon material. Table IV shows the characteristics of acid treated and activated carbon black. Steam-activated carbon black present greater capacities for the adsorption of small and medium size species such as phenol and methylene blue, while carbon dioxide-activated adsorb larger molecular size compounds such as textile dye Procion Red more effectively . Carbon black characteristics are influenced by the nature of activation and process temperature to a lesser extent.

1.11.4 STEEL WIRES

The pyrolysis derived steel wire marketing depends on the cleanliness, quantity, and packaging of the product. The cleanliness of recovered is measured by the degree of rubber contamination. Steel with less than 10% rubber is considered acceptable in the market . Thermal processing of scrap tyres can be used to recover steel with minimum or zero rubber contamination. The quality is also influenced by the pyrolytic process. For a batch process, the separation of steel and carbon black from pyrolytic oil is fairly simple. This is complex for continuous pyrolysis, gasification and liquefaction process where tyres are usually ground into chips. In addition, the recycling of the recovered steel in the manufacturing of steel products is hindered by the burning of residual sulphur. The waste tyre market is influenced

by the business cycle. During off peak, the processors may give away the steel for free or pay markets for collection. Bailing is difficult for steel recovered from shredded tyres. The added cost of transportation and storage reduces the income from this waste stream[10]. However, this may be cheaper than paying a tipping fee for disposal.

1.12. INTRODUCTION TO ANN

The performance of a CI engine for various proportions of blends, for various compression ratios and at different injection timings and pressures are usually desired by engine manufacturers and engineers. This can be obtained either by conducting comprehensive tests or by modelling the engine operation. Testing the engine under all possible operating conditions and fuel cases are both time consuming and expensive. On the other hand developing an accurate model for the operation of a CI engine fuelled with blends of biodiesel is too difficult due to the complex nature of the processes involved. So, as an alternative, engine performance and exhaust emissions can be modelled using Artificial Neural Networks (ANNs) [1]. The predictive ability of an ANN results from the training on experimental data and then validation by independent data. An ANN model can accommodate multiple input variables to predict multiple output variables.

The prediction by a well-trained ANN is normally much faster than the conventional simulation programs or mathematical models as no lengthy iterative calculations are needed to solve differential equations using numerical methods but the selection of an appropriate neural network topology is important in terms of model accuracy and model simplicity[5]. In addition, it is possible to add or remove input and output variables in the ANN if it is needed. And it was

investigated the engine performance and emissions characteristics of two different petroleum diesel-fuels, biodiesels (from soybean oil and yellow grease) using Artificial Neural Networks where 20% blends with No. 2 diesel fuel were used as experimental results. In this study, the average molecular weight, net heat of combustion, specific gravity, kinematic viscosity, C/H ratio and cetane number of each fuel were used as the input layer,

while outputs were the brake specific fuel-consumption, exhaust temperature, and exhaust emissions. The back-propagation learning algorithm with three different variants, single layer, and logistic sigmoid transfer function were used in the network. The network yielded R2 values of 0.99 for both training and test data. The mean % errors were smaller than 4.2 and 5.5 for the training and test data respectively.

1.13. EXPERIMENTAL INVESTIGATION

The engine used in the present study was a Kirloskar make single cylinder four stroke water cooled CI engine. The detailed specification of the engine is shown . The schematic diagram of the experimental set up is shown in Figure 1. The experimental set up consists of engine, dynamometer, load cell and temperature sensors *etc.* shows the photographic view of setup. Eddy current-dynamometer was used for engine loading. A fuel consumption meter, DP transmitter, Range 0-500 mm wc, was used for measuring the specific fuel consumptions of the engine. A quartz (piezoelectric) Kistler makes transducer was used to determine the engine cylinder combustion gas pressure sensor mounted on the cylinder head. The signals from charging amplifier were fed to the data acquisition system where the engine control module converted the signals into digital data.

The in-cylinder pressure data in terms of pressure crank angle history was obtained from the Legion Brothers database. The maximum resolution of the pressure sensor was 1°CA. The cylinder pressure signal was passed through an amplifier to give outputs of 0-10volts for the calibrated pressure range of 0-100 bar. Real time data acquisition was done with the help of Engine test Express V5.76 which was Lab view based software package developed by Legion Brothers. The rated frequency of the data acquisition system was 37 kHz and the sampling time used was 60 seconds. This time duration was selected to ensure that the data is representative. All the signals collected from the test rig needed to be converted from an original analogue form to a digital form. This was achieved by using an Analogue to Digital Converter (ADC) interface between the transducers and the computer. The CED 1401 power ADC is able to record waveforms data, digital (event) data and marker information. It can also generate waveform and digital outputs simultaneously for realtime, multi-tasking experimental system using its own processor, clocks and memory under the

control of the host computer. The Analogue to Digital Converter (ADC) has 8 channels, 500 MHz bandwidth and 4Gs/s sampling rate. Exhaust gas analyzer of AVL make (AVL DiGas 444) was used for measuring the emissions of HC, CO and NOx from the engine. A Smoke meter, model 437C, made by AVL Gurgaon, was used for measuring the smoke emission from engine. Exhaust gas emissions recorded were: unburned hydrocarbons (UBHC) in parts per million (ppm hex), and oxides of nitrogen (NOx) in ppm vol. and CO in % vol. by using gas analyser [2]. Opacity of the smoke in the exhaust was measured in % by using smoke meter. For exhaust gas temperature measurement, Chrome-Alumel K-Type thermocouples with stainless steel wire were implanted close to the engine exhaust manifold.

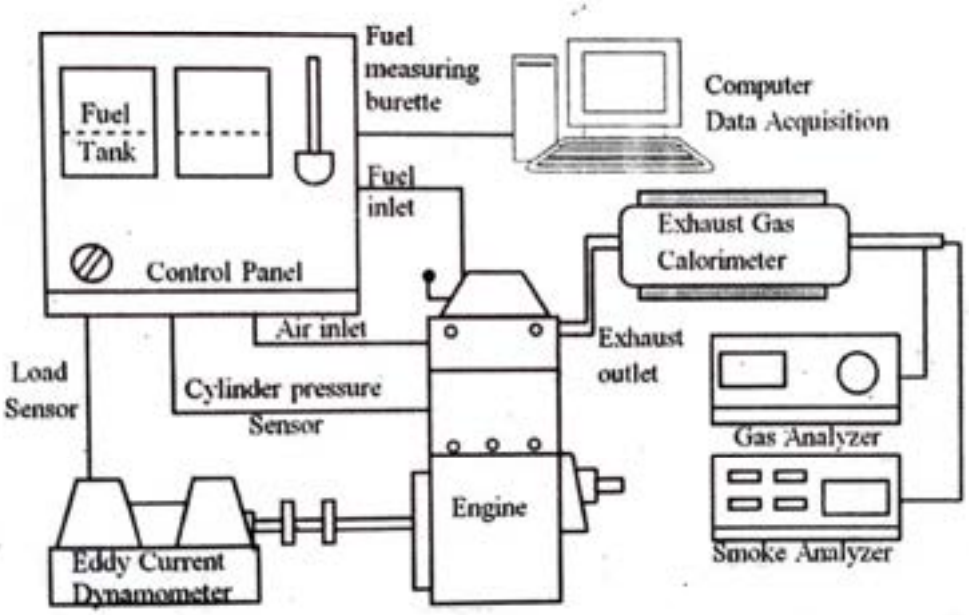

Figure 1.11 Experimental setup

1.14. ARTIFICIAL NEURAL NETWORKS

ANNs are logic programming technique developed by imitating the operation of the human brain to perform functions such as learning, remembering, deciding, and inference, without receiving any aid. ANNs have various important features, such as learning from data, generalization, working with an infinite number of variables, etc. Artificial neural cells are the smallest units that form the basis of the operation of ANNs just like a biological neuron which receives inputs from other sources, combines them in some way, performs generally a

non-linear operation on the result, and then outputs the final result. The artificial neural cells consist of mainly five elements namely; inputs, weights, summation functions, activation functions and outputs.

ANN has three main layers namely; input, hidden and output layers. The inputs are data from the external source. The processing elements, called neurons, in the input layer transfers data from the external source to the hidden layer. The weights are the values of connections between cells. The outputs are produced using data from neurons in the input and hidden layers, and the bias, summation and activation functions. In the output layer, the output of network is produced by processing data from hidden layer and sent to external source. The summation function is a function which calculates the net input of the cell. The summation function used in this study is given in Equation The activation function provides a curvilinear relation between the input and output layers. It also determines the output of the cell by processing the net input to the cell. The selection of an appropriate activation function significantly affects network performance. Commonly used activation functions are the threshold function, step activation function, sigmoid function, and hyperbolic tangent function. The type of activation function depends on the type of neural network to be designed. A sigmoid function is widely used for the transfer function. Logistic transfer function of the ANN model in this study is given in Equation

The significant advantages of artificial neural networks are learning ability and the use of different learning algorithms. The most important factor which determines its success in practice, after the selection of ANN architecture, is the learning algorithm. In order to obtain the output values closest to the numerical values, the best learning algorithm.

A most sought-after algorithm is the back-propagation algorithm, which has different variants. Back-propagation training algorithms such as conjugate gradient, quasi-Newton, and Levenberg–Marquardt (LM) use standard numerical optimization techniques. ANN with back-propagation algorithm learns by changing the weights which are stored as knowledge. The algorithm uses the second-order derivatives of the cost function so that a better convergence behavior can be obtained. To get the best prediction by the network, several architectures were evaluated and trained using the experimental data. The back-propagation algorithm was utilized in training of all ANN models. In the training stage, to obtain the output precisely, the number of neurons in the hidden layer was increased step by step . As a

result of conducted trials, best learning algorithms for most of the parameters was found to be the Levenberge Marquardt learning algorithm. The best ANN architecture built for prediction of UBHC is shown

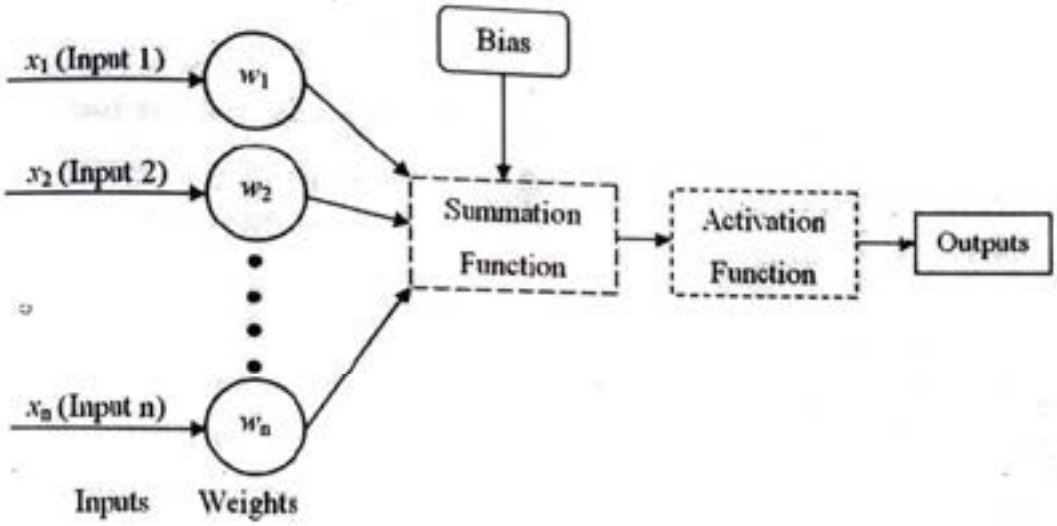

Figure 1.12 Structure of ANN

CHAPTER2
LITRERATURE REVIEW

2.1 LITERATURE REVIEWS.

Tyre Pyrolysis Oil is one of the product of pyrolysis of tyres. For the past 20 years it is being used as a fuel. Researchers have successfully blended TPO with diesel to run CI engines. Researchers have also characterized the fuel to understand the constituents present in it. Their research and findings are listed below.

The performance of a CI engine for various proportions of blends, for various compression ratios and at different injection timings and pressures are usually desired by engine manufacturers and engineers. This can be obtained either by conducting comprehensive tests or by modeling the engine operation. Testing the engine under all possible operating conditions and fuel cases are both time consuming and expensive. On the other hand developing an accurate model for the operation of a CI engine fuelled with blends of biodiesel is too difficult due to the complex nature of the processes involved. So, as an alternative, engine performance and exhaust emissions can be modeled using Artificial Neural Networks (ANNs). The predictive ability of an ANN results from the training on experimental data and then validation by independent data. An ANN model can accommodate multiple input variables to predict multiple output variables. The prediction by a well-trained ANN is normally much faster than the conventional simulation programs or mathematical models as no lengthy iterative calculations are needed to solve differential equations using numerical methods but the selection of an appropriate neural network topology is important in terms of model accuracy and model simplicity. In addition, it is possible to add or remove input and output variables in the ANN if it is needed.

Anant Garg et. al. overviewed application of ANN in the field of engine. It is concluded that using ANN engine development time could be reduced.

Çay et al. used artificial neural network (ANN) modeling to predict the brake specific fuel consumption, effective power and average effective pressure and exhaust gas temperature of the methanol engine. It was found that the R2 values were close to 1 for both training and

testing data. RMS values were smaller than 0.015 and mean errors were smaller than 3.8% for the testing data.

Canakci et al. investigated the engine performance and emissions characteristics of two different petroleum diesel-fuels (No. 1 and No. 2), biodiesels (from soybean oil and yellow grease) using Artificial Neural Networks where 20% blends with No. 2 diesel fuel were used as experimental results. In this study, the average molecular weight, net heat of combustion, specific gravity, kinematic viscosity, C/H ratio and cetane number of each fuel were used as the input layer, while outputs were the brake specific fuel-consumption, exhaust temperature, and exhaust emissions. The back-propagation learning algorithm with three different variants, single layer, and logistic sigmoid transfer function were used in the network. The network yielded R2 values of 0.99 for both training and test data. The mean % errors were smaller than 4.2 and 5.5 for the training and test data respectively.

Canakci et al. used ANN to model performance parameters and emissions of a biodiesel engine using waste cooking oil. Engine speed and percentage of blend were taken as the input variables and brake power, torque, specific fuel consumption and exhaust emissions as the outputs. It was observed that the regression values for most of the parameters were close to unity.

Ghobadian et al. developed an artificial neural network model of a diesel engine using waste cooking biodiesel fuel with standard Back-Propagation algorithm. The developed model predicted the engine performance and exhaust emissions quite well with correlation coefficient (R) 0.9487, 0.999, 0.929 and 0.999 for the engine torque, SFC, CO and HC emissions, respectively. The predicted MSE (Mean Square Error) was between the desired outputs as measured values and the simulated values were obtained as 0.0004 by the model.

Hidayet Qhuz et. al. develops ANN technique to apply on automotive sector to minimise cost, cost and workforce waste. It was found that artificial intelligence model is an appropriate model to estimate the performance of the engine.

Ismail et al. reported an artificial neural network model programmed for a light-duty diesel engine. Engine operating parameters viz., engine speed, output torque, fuel mass flow rate and biodiesel fuel types and blends, were used as the input parameters in the model. The results indicated that back-propagation feed-forward neural network, combination of tansig/purelin transfer functions, trainlm training algorithm were the optimum configuration to predict the correlations..

Jitendra Panchbhai et. al. deals with the ANN moelling to predict and optimize the performance of Diesel engine. The study showed that ANN can be used as alternative modelling technique. The alternative fuel used in this study was Cotton seed oil.

Jatindre Kumar studied the application of Artificial Neural Network for the prediction of properties of Diesel – Biodiesel blends. A traditional statistical technique of linear regression (principle of least squares) was used to find the various properties of biodiesel blends. Also various neural networks are used to predict these properties. Then the results of linear regression model and ANN model are compared fort the validation.

K. Prasad Rao at. al. aims to study the optimization of performance parameters to improve diesel engine efficiency. Taguchi method had been used to multiple objectives of the optimization problem into a single objective function. A confirmatory test showed satisfactory result by ANN in MATLAB.

Hafner et. al. uses ANN for Diesel engine control design.

Wong et al. evaluated optimal biodiesel ratio that could achieve the goals of fewer emissions, reasonable fuel economy and wide engine operating range. Different advanced machine learning techniques, namely ELM (extreme learning machine), LS-SVM (least-squares support vector machine) and RBFNN (radial-basis function neural network), were used to create engine models based on experimental data.

Wong et al. proposed a new biodiesel engine modeling and optimization framework based on extreme learning machine to achieve the goal of fewer emissions, low fuel cost and wide engine operating range. Logarithmic transformation of dependent variables was used to alleviate the problems of data scarcity and data exponentiality simultaneously. With the K-

ELM engine model, cuckoo search (CS) was then employed to determine the optimal biodiesel ratio. The evaluation result showed that K-ELM can achieve comparable performance to LS-SVM, resulting in a reliable prediction result for optimization. It also showed that the optimization results based on CS was effective. In the present work, experimental investigations of the performance and emissions of the diesel engine were conducted for different proportions of blends of Polanga with diesel at different injection pressures for full load condition. Using data from experimental results, ANN models have been developed for the performance parameters and emissions characteristics. In the model, blends of Polanga with diesel, different injection pressures are taken as input parameters and brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature, CO, NOx, smoke and UBHC emissions are taken as output parameters.

K. Xu. et. al. finds application of neural networks in forecasting engine systems reliability. The paper presents a comparative study of the predictive performances of neural network time series models for forecasting failures and reliability in engine systems.

T. Hariprasad et. al. deals with ANN modelling for the prediction of exhaust emission of Diesel engine. In this work feed forward neural network was used. The alternative fuel used was methyl esters of fish oil blended with Diesel. It was found that FFNN predicted values were very close to experimental values with very minimum percentage of error.

Srinath Pai et. al. focused on the prediction of the exhaust emission, carried out for neural networks to define how input affects the output using biodiesel blends. The result showed that ANN can be efficiently used to predict the emission from the engine with about 10 % error.

Sahoo et al. evaluated comparative performance and emission characteristics of jatropha, karanja and polanga based biodiesel as fuel in a tractor engine. They observed that brake specific fuel consumption for all the biodiesel blends with diesel increased with blends and decreased with speed. The study however lacks the effect of injection pressure on engine performance

usaf et al. conducted experiments in a diesel engine fuelled with a combination of both ompressed natural gas and diesel fuel. ANN modeling was used to predict brake power, orque, brake specific fuel consumption and engine emissions. A good correlation between redicted and the experimental values was observed.

.1.1. TPO AS A FUEL IN IC ENGINES

Williams studied the compounds present in TPO along with its combustion in a eramic lined furnace. Their investigation revealed that TPO has PAH in high concentrations. They found high SO2 and NOx emissions. To avoid PAH, they proposed combustion under excess oxygen conditions. Sharma and Murugan created an oxygen rich environment by blending TPO with an oxygenated fuel i.e Jatropha Methyl Ester. They reported NOx and SO2 emissions comparable to that of diesel when used in an IC engine. S. Murugan et al found that TPO when blended with diesel showed anomalous combustion and performance characteristics. They reported that TPO when blended with diesel in ratio of 30 - 40 % by volume, gives better combustion and performance than all other blends.

Ramaswamy, in their research work tested that CI engines can run upto 90% distilled TPO blend, above which the engine fails becomes dysfunctional[13]. They carried out $<200^0$c distillation which the kerosene range. Findings of their research showed higher smoke, HC emissions but lower NOx emissions compared to that of diesel when used to run a DI diesel engine.

The disposal of used tires from automotive vehicles becomes inexhaustible. Though many disposal methods are available to dispose of the waste automobile tires, still the problem persists. Pyrolysis of a substance offers value added products such as pyrolysis oil, pyrolysis gas, and char. It is also reported that TPO has properties similar to those of diesel fuel. One common way of disposal for these waste tires is land filling. It was surveyed that tires are bulky, and 75% of the space a tire occupies is void, so the land filling of waste tires has several difficulties

Studies carried out on aromatic fuel have shown that they give lower performance and higher emission compared to that of diesel fuel. They are low cetane fuel with longer ignition

delay. In a special case, when aromatic compounds are connected with long chain alkanes, have good cetane numbers compared to other aromatic compounds . Pioneering work carried out by Kidoguchi et al provide effect of cetane number and aromatic content of a fuel on combustion and emission characteristics of an IC engine. They have reported that:

- Keeping aromatic content constant, decreasing the cetane number increases NOx
- emissions and decreases particulate emissions. With increase in aromatic content both NOx and particulate emission increases.

Other surveys included patent search on lubricating oil and distillation products of crude oil. The present work relates TPO distillation products with that of distillation products of crude oil. From these surveys it was concluded that many have worked on characteristics on TPO and it being used as a fuel[17]. But the focus has not been on studying the combustion process and also on improving TPO as a source from which valuable products can be derived.

CHAPTER 3
WORK METHODOLOGY

3.1 STAGES OF WASTE TYRE OIL IN TO DIESEL BLEND

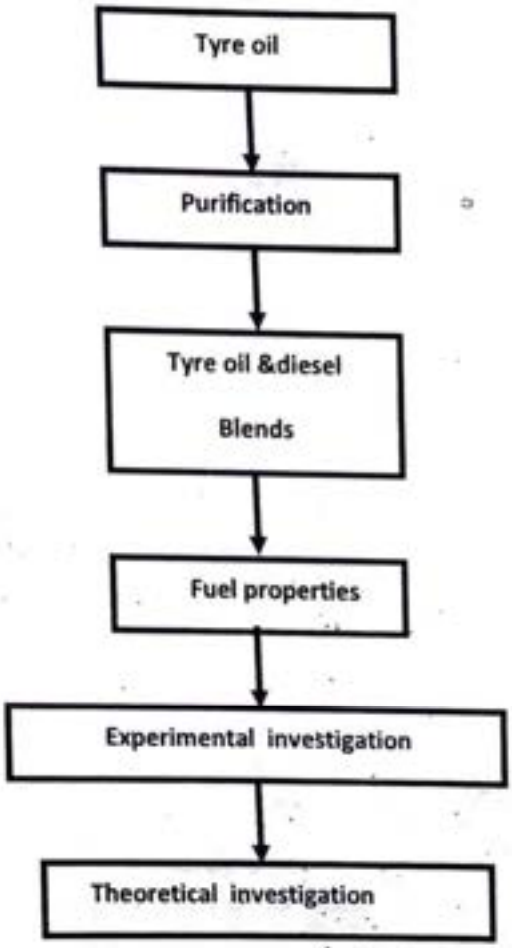

Figure no. 3.1 stages of waste tyre oil in to diesel blend.

3.2 Engineering Neural Networks

The application of software engineering principles to the development of neural networks has received little attention, except in the work of and indirectly in The aim of this paper is to provide some of the methods required to address the problems in neural network

development presented above, and to allow the development of neural networks for specific problems to be incorporated into traditional, planned, software engineering projects. In the literature the process of developing neural networks has typically started with requirements and then moved to implementation, often leaving design choices implicit. However, making these design choices explicit has a number of advantages[16]. we present an approach which aims to enumerate the set of design choices and can be used to observe correlations between particular choices and resulting development outcomes. By recording design choices, repeatability is possible because all of the information required to repeat the development is documented.

3.3 The Process of Developing Neural Networks

Predicting and Repeating Development is an excellent reason for recording relevant problem information. By defining the datasets and testing and training strategy in the problem specification phase we can prevent the neural network creation phase from consuming an unbounded and unplanned amount of resources. Another major problem facing neural network development is the unpredictable nature of current practice with regard to the creation of a specific neural network[18]. The current approach can be characterised as an unguided iterative approach
along the lines of:

1. Choose a problem representation, create an associated data set and set performance requirements.
2. Train a neural network while varying the associated parameters to achieve the given performance requirements.
3. If the performance requirements are met, stop. Otherwise try again.

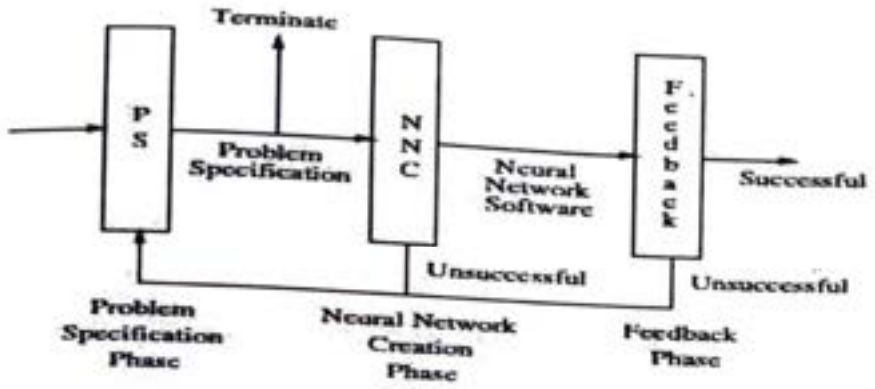

Figure 3.1. Neural Network Development.

3.4.The Problem Specification Phase

The first phase is problem specification where the problem (as determined by the associated data) is thoroughly defined, as are analysis techniques and precision and accuracy requirements. Problem specification is performed by the user, developer and problem domain expert/client. A majority of this information is used in the next phase of development but some is used to index and characterise the problem for later use as part of a historical record for future development and planning, to allow for repeatability[14]. There are three main scenarios concerning the specification of neural network development requirements. Firstly, where the client requires that, for some aspect of the system, a neural network is used. In this case, the neural network is a component of a larger system and the accuracy and precision constraints of the neural network are explicitly given by the client. Secondly, where the client requires some functionality which has associated performance requirements which can be satisfied by using a neural network. This is similar to the first case except that the client has no explicit requirement for using a neural network but the developer determines that a neural network could be an appropriate technology to satisfy the clients requirements and users needs.

3.5. The Neural Network Creation Phase

where the neural network software is created by combining the collections specified in the problem specification document and the generic neural network technology. As part of this phase, a specification of the generic neural network technology is needed[11]. Such a specification addresses the second part of the previously identified requirements problem. Three desirable properties of a neural network specification are formal verification. validation methods, and easy implementation and prototype creation.

3.6. The Feedback Phase.

The third and final phase, feedback, is where the client and user evaluate the performance of the neural network. Depending on the capabilities of the development organisation, Alternative methods can be implemented for evaluation purposes[6]. Alternative methods provide a sanity check for the neural network solution that has been developed. These activities establish whether the performance of the neural network is better than available alternatives. The resulting problem specification, project plan, neural network formal model used for development, and the feedback from the user and evaluation of the neural network are placed in the historical record for repeatability and planning (an aspect of predictability) purposes.

3.7. Phases of Development

The aim of the problem specification phase is to specify the problem, analyse the quality of the problem data and specify performance requirements. These activities are supported by a problem specification document template. The template includes sections for data analysis, data representation, and methods for data preparation as well as specifying the performance requirements. The performance requirements stipulate the desired precision and accuracy of the specific neural network software for it to be considered successful. Without these requirements, determining when the neural network creation phase has concluded is problematic and can lead to excessive expenditure of development resources.

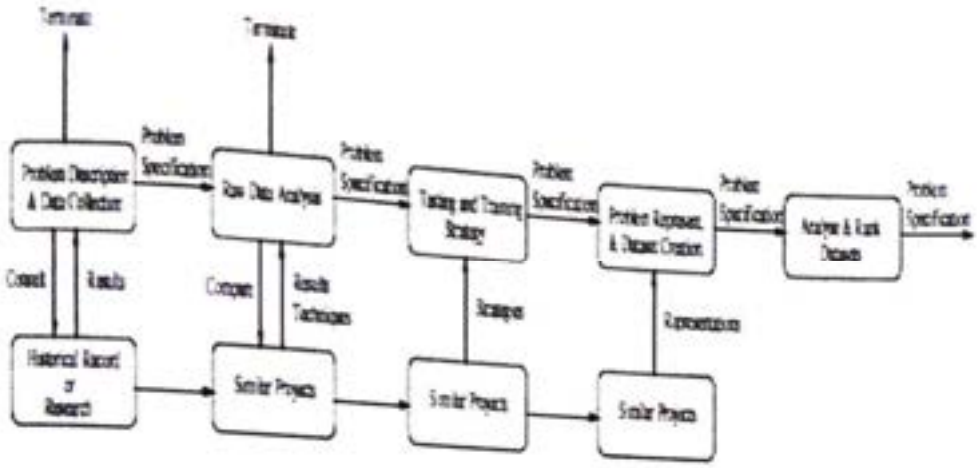

Figure 3.2 Problem specification phase

3.8. Neural Network Specification

The hardest single part of building a system is deciding what to build. Sallis et. al. estimate that approximately 53% of all problems in software development result from poor requirements. Schach et. al. report results from a variety of projects, conducted over the last 25 years, which describe the rapid increase in cost for correcting faults originating from poor requirements as software development progresses[8]. Indeed, there is universal agreement that poor requirements are a significant cause of problems later in the software development process. Given the pivotal role of the generic neural network software we require that the associated requirements are less problematic. One form that requirements can be stated in is a formal model.

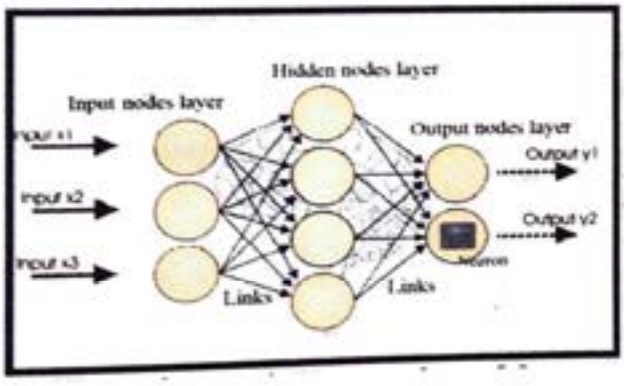

Figure 3.3 Model of basic network

1.Every network has a sequence of input nodes which can receive stimulus (in the form of values) from the environment, ie. values from outside the network. In the schema we denote input nodes by input nodes (an injective sequence of nodeids).

2. Every network has a sequence of output nodes which transmit values from the network to the environment. In the schema we denote output nodes by output nodes(an injective sequence of nereids).

3. Each node in a network has an identifier called a nodded. This allows the specification to define neural networks without knowledge of the node. It also means that we can create networks with a variety of nodes so long as they have a common interface. In this way we can create a heterogeneous network of nodes. That is, a network must be able to have a mixture of nodes with different transfer functions.

4. Every network contains a function, connections, which defines the connectivity of nodes in the network. The connections store the weights which connect nodes together.

5. In all networks, each node has a sequence (ordered set) of source nodes which supply executory or inhibitory values. In order to be able to apply an inverse mapping of the sources (ie. a sinks function) we use an injective sequence.

Factorial designs are good preliminary experiments, A type of factorial design, known as the fractional factorial design, are often used to find the "vital few" significant factors out of a large group of potential factors. This is also known as a screening experiment also used to determine curvature of the response.

3.9. Verification & Validation Methods.

The production of prototype implementations is potentially a very convincing way to explore the behaviour of a specification with its eventual user, and it is in that combination that we suggest formal specification and prototyping offer the most synergy.

Verifying neural network models is through constructing prototype implementations. Prototyping of the formal model allows for the specified properties and the resulting behaviour to be observed[9]. Confidence in the implementation of the prototype and the model is gained by running appropriate test cases and comparing the results with what is expected. There are two issues that must be addressed when validating formal models using a prototype. Firstly, the prototype must be a faithful representation of the model to allow the relevant parties to test the requirements through the prototype. Secondly, the final delivered system must be a correct implementation of the model and behave in the same way as the prototype. Without this it is possible to fail to meet the expectations of the user for the system. The use of prototypes to gain confidence in the correctness of formal models has been previously proposed for software and hardware development. Messenger and Preece advocate the use of formal specifications to verify and validate knowledge-based systems . The relevance here, is that, neural networks and knowledge-based systems are similar techniques, both used to solve complex, poorly understood problems which are derived from data. Meseguer and Preece use successively more detailed models, starting with a conceptual model then a formal specification and finally an implemented knowledge-based system.

3.10. ANN in Predicting Engine Emission and Performance

One of the most important factors that affect the viability of an automobile fuel is its suitability in terms of engine performance and exhaust emissions as discussed in the previous section. However, conducting actual experiments with automobile engines not only requires considerable amounts of fuel, heavy equipment and skilled personnel, but it is also very time

consuming and costly. Therefore, the use of ANN modelling techniques in predicting performance parameters of internal combustion engines has gained in popularity over the last few decades. Combustion related performance using various types of fuels including diesel, gasoline, natural gas, ethanol and biodiesel have successfully been modelled using ANN. developed an ANN model to predict the brake specific fuel consumption, effective power and average effective pressure and exhaust gas temperature of the methanol engine. A four-cylinder, four-stroke test engine was operated at different engine speeds and torques to obtain model training and testing data[7]. After training, this study found an ANN prediction accuracy with $R2$ values close to 1 for both training and testing data. RMS values less than 0.015 and mean errors less than 3.8% for the testing data were reported. This study concluded that the ANN model is a powerful technique for predicting performance parameters of internal combustion engines.

CHAPTER 4
RESULT & DISCUSSION

The physical properties of the waste tyre oil is been found and their results are been discussed below.

4.1 PHYSICAL PROPERTIES ANALYSIS OF WASTE TYRE OIL

The fuel properties of the tyre oil was analysed as per ASTM standard and presented in this report.

4.1.1. DENSITY

Density is a measurement that compares the amount of matter an object has to is volume. an object with much matter in certain volume has high density. The densities of waste tyre oil were found as per the ASTM D792 slightly higher than that of the commercial diesel because of high mass fraction. The density of the tyre oil obtained at 40-70°C, are 911 kg/m^3 and conventional diesel fuel is 831 kg/m^3.

Figure 4.1 Hydrometer

4.1.2. VISCOSITY

Viscosity of a fluid is a measure of its resistance to deformation at a given rate. For liquids, it corresponds to the informal concept of thickness. The viscosity of waste tyre oil as per the ASTM 3941 was lower than that of the diesel (13 cSt) Centistokes and the diesel is (18cSt). Because thickness of the oil is slightly high.

Viscosity affects injector, lubrication and fuel atomization. Fuels with low viscosity may not provide sufficient lubrication for the precision fit of fuel injection pumps or injector plungers resulting in leakage or increased wear. Fuels which do not meet viscosity requirements can lead to performance complaints. Fuel atomization is also affected by fuel viscosity. Diesel fuels with high viscosity tend to form larger droplets on injection which can cause poor combustion and increased exhaust smoke and emissions.

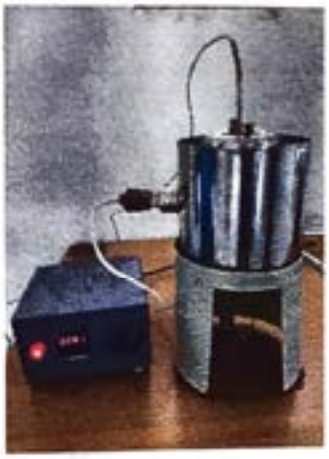

Figure4.2 Redwood viscometer

4.1.3 FLASH POINT

The flash point is the lowest temperature at which vapours above a volatile combustible substance ignite in air when exposed to flame.

The temperature is an indirect measure of volatility and serves as an indication of the fire hazards associated with storage and application of the fuel. The flash point of the tire- as per the ASTM D92 obtained at 60-80°C, which is higher than the conventional diesel because vapour pressure is high and the diesel flash point is 50-70^{0}C.

Figure 4.3 Pensky martens flash point apparatus.

4.1.4 FIRE POINT

The fire point of a fuel is the lowest temperature at which the vapour of that fuel will continue to burn for at least 5 seconds after ignition by an open flame of standard dimension. The fire point of the waste tyre oils are 70°C, conventional diesel fuel is 50 to 70°C, which is greater than tyre oil. It was measured by as per the ASTM D93

Figure 4.4 Fire point test apparatus (ASTM D93)

4.1.5. POUR POINT

The pour of the liquid is the temperature below which the liquid losses its flow characteristics . The pour point of the tire-derived liquids is comparatively low compared to the automotive diesel fuel but the laboratory experience of that it is problematic while lower than -20°C. as per the ASTM D97 (-29.25)

Figure 4.5 Cloud and pour point apparatus

4.1.6 COLOR

The color of fractionated oil is automatically change by air oxidation. Because it has contain unsaturated group more than diesel fuel.

4.1.7 VOLATILITY

A high vapour pressure (which often indicates a low flash point) can also cause cavitation's and gas pockets in the fuel pipes. These can be avoided by using an elevated pressure in the fuel handling system. The volatility of the oil as per the ASTM D1837 obtained at 40-70°C, conventional oil are 27.70, wt% at atmospheric temperature and pressure. It should be noted that some companies demand the use of fuels with a flash point higher than 60°C. and volatility of diesel is 18.70 wt%.

Figure 4.6 NOACK-VOLATILITY-TESTING-Apparatus

4.1.8 WATER CONTENT

Water and sediment may cause shortened filter life or plugged fuel filters which can in turn lead to fuel starvation in the engine.

In addition, water can have negative impact on fuel corrosion and on microbial growth which is found to be slight value for the tyre oil. The water content of the oil obtained at 40-70°C are 0.003wt% and the diesel is 40-70^{0}C are 0.0005wt%.

Figure 4.7 Moisture analyser (coulometric type)

4.1.9. CALORIFIC VALUE

The calorific value of the tyre oil as per the ASTM D3173-II is 42-44 MJ/kg. The calorific value is high and comparable with that of a diesel fuel oil, indicating the potential for the use of tyre derived oils as fuel. Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals that occur naturally in coal, crude oil and gasoline. PAHs also are present in products made from fossil fuels.

Some of the PAH have been shown to be carcinogenic and/or mutagenic. PAHs also can be released into the air during the incomplete burning of fossil fuels[15]. The less efficient the burning process, the more PAHs is given off but studies have shown that combustion of tyre oil with excess air results in negligible emissions of PAH. Since diesel engine always operate lean with combustion efficiency of 98% there may be less emission of PAH. It is shows the concentration of the main PAH in the tyre pyrolysis oil compared to the diesel fuel and is found to be 24% by mass for tyre oil almost double the value of diesel.

Figure 4.8 Bomb calorimeter apparatus.

CHAPTER 5

FUTURE SCOPE AND CONCLUSION

5.1 FUTURE SCOPE

- Experimental and theoretical investigation on engine characteristics to be carried out.
- Characteristics analysis of the fuel to be done.
- Fuel blends will be doped with nano additives and investigate the fuel properties and engine characteristics.

5.2 CONCLUSION

Based on the literature collected the following conclusion are drawn, the tyre oil blended with diesel will be the best alternative fuel for CI engine, ANN technique will be the best theoretical tool to compare with experimental value.

Based on the above discussion the properties of waste tyre oil are

- The densities of waste tyre oil were found as per the ASTM D792 40-70°C, are 911 kg/m^3.
- The viscosity of waste tyre oil as per the ASTM 3941 was 13 cst.
- The fire point of the waste tyre oils are 70°C, as per the ASTM obtained at 60-80°C
- The fire point of the waste tyre oils are 70°C. It was measured by as per the ASTM D93
- The pour of the liquid is -20°C. as per the ASTM D97 (-29.25).
- The color of fractionated oil is automatically change by air oxidation.
- The volatility of the oil as per the ASTM D1837 obtained at 40-70°C.

REFERENCES

[1] Anant Garg, Parag Dewan, Mukesh Saxena, "Artificial Neural netwrok based methodologies for optimization of engine operations", International Journal Scientific and Engineering Reseach, Vol. 3, Issue 5, (2012), pp. 1-5.

[2] Çay Y., Korkmaz I., Çiçek A., and Kara F. Prediction of engine performance and exhaust emissions for gasoline and methanol using artificial neural network. Energy 50(2013) pp.177–186.

[3] Canakci M. and J.V. Gerpen. Comparison of engine performance and emissions for petroleum diesel fuel, yellow-grease biodiesel and soybean-oil biodiesel. Transactions of the ASAE 46(4)(2003)pp937–944.

[4] Canakci M., Ozsezen A.N., Arcaklioglu E., and Erdil A. Prediction of performance and exhaust emissions of a diesel engine fuelled with biodiesel produced from waste frying palm oil. Expert Systems with Applications 36(2009)pp 9268–9280.

[5] Ghobadian B., Rahimi H., Nikbakht A.M., Najafi G., and Yusaf T.F. Diesel engine performance and exhaust emission analysis using waste cooking biodiesel fuel with an artificial neural network. Renewable Energy 34(4)(2009).pp976–982.

[6] Hidayet Oğuz, Ismail Sarıtas, and Hakan Emre Baydan, "Prediction of diesel engine performance using biofuels with artificial neural network", Expert Systems with Applications 37.9 (2010), pp 6579-6586.

[7] Ismail H.M., Kiat N.H., Queck C.W., and Gan S. Artificial neural networks modelling of engine-out responses for a light-duty diesel engine fuelled with biodiesel blends. Applied Energy 92(2012) pp 769–777.

[8] Jitendra S. Pachbhai, Prof. M. M. Deshmukh, Ravindra R. Dhanfule, "Application of ANN to optimize the performance of CT engine fuelled with cotton seed oil", International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 6, (2014), pp. 351-358.

[9] Jatinder Kumar, Ajay Bansal, "Application of Artificial neural netwrok to predict properties of Diesel-Biodiesel Blends", Kathmandu University Journal of Science, Engineering and Technology, Vol. 6, No. II, (2010), pp. 98-103.

[10] K. Prasada Rao, R. Umamaheshwara Rao, S. Ravibabu, Dr. V. Rambabu, "Optimiztion of performance parameters of Diesel engine using biofuels", International Journal of Thermal Technologies, Vol. 3, No. 3, (2013), pp. 85-91.

[11] M. Hafner, M. Schu¨ ler, O. Nelles, R. Iserman, "Fast neural networks for Diesel engine control design", Control Eng. Pract. 8 (2000), pp. 1211–1221.

[12] R. Joskić, D. Margeta, K. Bionda, Oxidative desulfurization of model diesel fuel with hydrogen peroxide, Original scientific paper, GOMABN Vol. 53, Issue 1 (2014) 11-18.

[13] Srinath Pai , Krishnaprasad , Dr. Abdul Sharief , Dr. Shiva kumar , Dr. Shreeprakash B., "Emission Analysis of a Diesel Engine Using ANN – A Review", National Conference on Advances in Mechanical Engineering Science,(2007) pp. 123-129.

[14] Sahoo P.K, Das L.M, Babu M.K.G., Arora P., Singh V.P., Kumar N.R., and Varyani T.S. Comparative evaluation of performance and emission characteristics of jatropha, karanja and polanga based biodiesel as fuel in a tractor engine. *Fuel* 88(2009)pp 1698–1707.

[15] T. Hariprasad, K. Hema Chandra Reddy, and M. Muralidhar Rao, "Performance and exhaust emissions analysis of a diesel engine using methyl esters of fish oil with artificial neural network aid", International journal of engineering and technology 2.1 (2010), 23.

[16] Wong K.I., Wong P.K., Cheung C.S., Vong C.M. Modeling and optimization of biodiesel engine performance using advanced machine learning methods. Energy 55(2013)pp 519–528.

[17] Wong P.K., Wong K.I., Vong C.M., and Cheung C.S. Modeling and optimization of biodiesel engine performance using kernel-based extreme learning machine and cuckoo search. Renewable Energy 74(2015)pp640–64.

[18] Yusaf T.F., Buttsworth D.R., Saleh K.H., Yousif B. F. CNG-diesel engine performance and exhaust emission analysis with the aid of artificial neural network. Applied Energy 87(2010)pp1661–1669.

ANALYSIS OF MECHANICAL PROPERTIES FOR THE ALUMINIUM BASED COMPOSITE

PROJECT WORK PHASE -1 REPORT

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ABSTRACT

In the current automotive sector utilization of suitable material to make the parts are complicated one. While considering with the factors like weight, cost and mechanical properties, composite material are suggested as the suitable material for the automotive sector. Because, of their low weight to high strength ratio and improvised mechanical properties it is done by the addition of composite material was prepared with AI7475 as base material and silicon carbide particle are blended with base material. In this work such a type of silicon carbide as reinforcement. To analyse the quality of the composite material different weight percentage of silicon carbide such as 10%, 20% and 30% are added with the base material and the composite were prepared by stir casting process. To prove the characteristics of the composite material tensile test and micro hardness test were to be conducted. Finally the suitable composite will to be suggested for the parts in the automotive sector.

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CHAPTER 1
INTRODUCTION

In the present work Al (7475) alloy is taken as base material and then it is reinforced with aluminum (7475) and silicon carbide (sic). The prepared aluminum metal matrix composite samples are in the ratio of Al (7475) and the fabrication method used for sample preparation in stir casting process. After preparation of suitable sample certain tests are performed to analyse various mechanical properties like tensile strength , compressive strength shear strength, impact strength and hardness. After that microstructure of the sample in also observed under microscope . At last a comparison is made between the mechanical properties of base aluminium and the prepared aluminium metal matrix composites.

1.1 COMPOSITE MATERIALS:

Composite are materials in which two phases are combined, usually with strong interfaces between the base metal and reinforcement. They usually consist of a continuous phase called the matrix and discontinuous phase in the form of fibers, whiskers or particles called the reinforcement.. Composite materials are gaining wide spread acceptance due to their characteristics of (MMCs) is due to the relation of structure to properties such as specific stiffness or specific strength. Composites materials are high-stiffness and high strength, low density, high temperature stability, high electrical and thermal conductivity, adjustable coefficient of thermal expansion, corrosion resistance, improved wear resistance etc. the matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material.

1.2 Objectives for Development:

The reinforcement of light metals opens up the possibility of application of these materials in areas where weight reduction has first priority. The precondition here is the improvement of the component properties. The development objectives for light metal composite materials are:

- Increase in yield strength and tensile strength at room temperature and above while maintaining the minimum ductility or rather toughness
- Increase in creep resistance at higher temperatures compared to conventional alloys
- Increase in fatigue strength, especially at higher temperatures
- Improvement of thermal shock resistance
- Improvement of corrosion resistance
- Increase in Young's modulus
- Reduction of thermal elongation

1.3 Application of MMC:

Metal Matrix Composite (MMC) is rapidly becoming prime candidates as structural materials in engineering as well as in electronic application. Aluminium (Al) and Copper (Cu) reinforced by SiC is used in various industries due to its excellent thermo-physical properties such as low coefficient of thermal expansion (CTE), high thermal conductivity and improved mechanical properties such as higher specific strength, better wear esistance and specific modulus.

1.4 MATERIAL CHARACTERISTICS OF COMPOSITIES:

ALUMINIUM (Al):

Aluminium / Aluminum alloys have high electrical conductivity and strong corrosion resistance **characteristics**. These **alloys** are good low-temperature **alloys**. They gain strength when exposed to subzero temperatures and lose strength when exposed to high temperatures.

ZINC (Zn):

Zinc is a bluish-silver, lustrous metal that tarnishes in moist air, producing a layer of carbonate. It is somewhat brittle at room temperature but malleable above 100 °C. It is a fair conductor of electricity, and burns in air with a bright bluish-green flame producing white clouds of the oxide.

MAGNESIUM (Mg):

Magnesium is a silvery-white, low density, reasonably strong metal that tarnishes in air to form a thin oxide coating. **Magnesium** and its alloys have very good corrosion resistance and good high temperature mechanical properties. The metal reacts with water to produce hydrogen gas.

Atomic weight: 24.305

SILICON (Si):

Silicon is a hard, relatively inert metalloid and in crystalline form is very brittle with a marked metallic luster. **Silicon** occurs mainly in nature as the oxide and as silicates. The solid form of **silicon** does not react with oxygen, water and most acids.

Classification: Silicon is a metalloid

Atomic weight: 28.0855

CHROMOIUM (Cr):

Chromium is a lustrous, brittle, hard metal. Its colour is silver-gray and it can be highly polished. It does not tarnish in air, when heated it borns and forms the green chromic oxide. **Chromium** is unstable in oxygen, it immediately produces a thin oxide layer that is impermeable to oxygen and protects the metal below.

CHAPTER 2

LITERATURE REVIEW

Analysis of stir cast aluminium silicon carbide metal matrix composite:

Sijo MT , K R Jayadevan

Scientists are continuously trying to improve various properties of engineering materials. This led to new category of materials called composite materials; they are composed of a combination of distinctly different two or more micro or macro constituents that differ in the form of composition and it is insoluble in each other. Composite materials have a continuous, phase called the matrix; and a dispersed, non-continuous, phase called the reinforcement. The reinforcing phase material may be in the form of fibers, particles, or flakes. The matrix phase materials are generally continuous. In a composite, each material retains its original properties but when composited it yields superior properties which cannot be obtained separately [1]. Such types of material are developed to satisfy proper mechanical properties which cannot be derived from conventional materials. And also composites meet the requirements of specific design and function, along with the desired properties.

Characterization of silicon carbide reinforced aluminum matrix composites:

Md. Habibur Rahman, H. M. Mamun Al Rashed

Metallic matrix composites are combinations of two or more different metals, intermatallic compounds or second phases in which dispersed phases are embedded within the metallic matrix. They are produced by controlling the morphologies of the constituents to achieve optimum combination of properties. Properties of the composites depend on the AMCs materials than unreinforced materials such as- greater strength and high specific modulus, improved stiffness, light weight, low thermal expansion coefficient, high thermal conductivity, tailored electrical properties, increased wear resistance and improved damping capabilities. Reinforcing constituents can be incorporated within the matrix in the form of particles, short fibers, continuous fibers or mono filaments. Now it is used in aerospace, thermal management areas, industrial products, automotive applications such as engine piston, brake disc etc. AMCs can be manufactured by liquid state processing (stir casting, infiltration, squeeze casting etc.), semisolid processing and powder metallurgical route.

Usually non metallic and ceramic particles like silicon carbide (SiC), alumina (Al2O3), boron carbide (B4C), graphite etc. are used as reinforcements in AMCs.

Development of Aluminium Based Silicon Carbide Particulate Metal Matrix Composite for Spur Gear:

P.B. Pawar, Abhay, A. Utpat,

Aluminium alloy materials or simply composites are combinations of materials. They are made up of combining two or more materials in such a way that the resulting materials have certain design properties or improved properties. Aluminium Silicon carbide alloy composite materials are widely used for a many number of applications like engineering structures, industry Al-SiC composites can be more easily produced by the stir casting technique due to its good cast ability and relatively adding some surface active elements (magnesium and lithium) into the matrix, increasing the liquid temperature and stirring of molten matrix alloy for an adequate time period during incorporation. Study of wear properties of Al-SiC composite was carried out by Singla et al. [2009] He found that wear rate decreases linearly with increasing SiC content.

Micro structural aspects of Aluminium Silicon Carbide Metal Matrix Composite:

C.Neelima Devi, N.Selavaraj, V.Mahesh,

Materials must have combinations of properties for specific uses since present day products of modern technological origins operate in environment that are special or extreme like very high temperature (of order of 2500 K), cryogenic condition, vacuum (as in space), high hydrostatic pressure (as in deep sea). The conventional material may not always be capable of meeting the demand of such environments. Hence new materials being created for meeting these performance requirements and Aluminium alloy materials from one class of such materials developed. Aluminium silicon carbide alloy composite materials are widely used for a many number of applications like engineering structures, aerospace and marine application, automotive bumpers, sporting goods and so on. As Aluminium alloy are expected from these materials. They are the materials to be used for sophisticated applications like aircraft and space applications should have higher performance, efficiency and reliability. Materials have to be of light-weight for many applications so that the resulting products can be efficient and cost effective.

Aluminium matrix hybrid composites:

Michael Oluwastosin Bodurin, Kenneth kanayo Alaneme,

MMCs are fast replacing conventional metallic alloys in so many applications as their use have been extended from predominantly aerospace and automobile to defence, marine sports and recreation industries [6]. MMCs are basically metallic alloys reinforced with mostly ceramic materials. The common metallic alloys utilized are alloys of light metals (Al.Mg and Ti) however, other metallic alloys like zinc (Zn), cop-per (Cu) and stainless steel have been used for producing aluminium matrix composites (AMCs) area variable in literatures [4,5,11]. However, high cost and limited supply of conventional ceramic reinforcing materials especially in developing countries has remain a major problem associated with the development of discontinuously rein-forced aluminium matrix composites (DRAMCs) [12]. Other challenges facing DRAMCs that are reported to be of interest to researchers are inferior ductility, low fracture toughness and inability to predict the corrosion behaviour of AMCs.

Review on Effect of Silicon Carbide (SiC) on Stir Cast Aluminium Metal Matrix Composite:

Jayashree P.K, Gowri Shankar M.C, Achulta Kini, Vijay sharma.S

Aluminum based matrix composites remain the most explored metal matrix material for the development of MMCs. When these composites reinforced with silicon carbide (SiCp) particles have up to 20% improvement in yield strength, lower coefficient of thermal expansion , higher modulus of elasticity and more wear resistance than the corresponding non-reinforced matrix alloy systems Among all materials, composite materials have the potential to replace widely used steel and aluminum, and many times with better performance. In AMCs one of the constituent is aluminium alloy, is termed as matrix phase. The other constituent is embedded in this aluminium / aluminium alloy matrix and serves as the coefficient of thermal expansion of copper matrix is about four times that of the tungsten fibres. Consequently, it has been assumed that the high dislocation density in SiC-reinforced aluminium alloy matrix composite was also caused by the difference between the thermal expansion coefficients. The coefficient of thermal expansion of aluminium alloy is about ten times that of SiC .The enhanced strength could be accounted for by a high dislocation density.

Surface Modification of SiC Reinforcements & Its Effects on Mechanical Properties of Aluminium Based MMC:

Mohan Vnarotti, Shrishali P, B R. Sridhar, K.Venkateswarlu

Metal matrix composites are the engineered materials produced by mixture of two or more unlike materials, at least one of which is basically a metal. Different manufacturing processes for producing Metal matrix composites have been developed. In the present study liquid metallurgy process is adopted. Liquid metallurgy [1,2] process is the most economical method among spray deposition [3], powder metallurgy [4], liquid metal infiltration [5] and squeeze casting particles [7]. An extensive research work has been carried on improving wettability. Particles try to float on the surface of the melt, though larger specific density of the SiC particles than the A356 alloy due to high surface tension and poor wetting between the particles and the melt. Zhou et al. suggested a mechanical force by stirring process cannot solve this wetting process [9]. This may be due to gas layers formed on the surface of the particle.

Aluminium Metal Matrix Composites – A Review:

Magibalan.S, Senthil kumar.P, Vignesh.P, Prabu.M, Balan.A.V, Shivasankaran.N,

Metal-matrix composites (MMCs) are engineered combinations of two or more materials (one of which is a metal) where tailored properties are achieved by systematic combinations of different constituents. Conventional monolithic materials have limitations in respect to achievable combinations of strength, stiffness and density .Engineered. MMCs consisting of continuous or discontinuous fibres, whiskers, or particles in a metal achieve combinations of very high specific strength and specific modulus. From the last few years in much industrial application the important parameter in material selection is specific strength, weight and cost. Here we discussed the review paper relevant to this. Before going the review section we must know the difference between the composite and MMC. The composite defined as the made of several part or element but only combined different material not a non-metal whereas the non-metal is mixed with material this called MMC.

Synthesis and characterization of aluminium-silicon-silicon carbide composite:

J P Pathak, J K Singh & S mohan

Aluminium-silicon-silicon carbide composite was prepared by mechanical mixing (300 rpm) of silicon carbide powder (-300 mesh) in solidifying solid-liquid slurry of hypoeutectic, eutectic and hypereutectic compositions of aluminium-silicon alloy. Requisite amount of hot (300°C) silicon carbide powder was charged into agitating metallic melt of aluminium-silicon matrix alloy and mixing continued while dropping the temperature of the system. The mixing period was 3-4 min during which temperature of the system dropped to Silicon carbide occurred in the grain boundry regions associated with silicon and fragmented dendrites together with eutectic mixture. Strength, hardness and wear resistance of composite increased with increase of silicon carbide content. Coefficient of friction of composite having higher amount of silicon carbide was always lower than the composite with lower amount of silicon carbide, whether the tests were conducted in lubrication, semi-dry and dry sliding conditions.

Development of aluminium based silicon carbide particulate metal matrix composite:

Manoj Singla , D. Deepak Dwivedi , Lakhvir Singh, Vikas Chawla

Metal matrix composite (MMC) is engineered combination of the metal (matrix) and hard particle/ceramic (Reinforced) to get tailored properties. MMC's are either in use or prototyping for the space shuttle, commercial airlines, electroic substrates, bicycle, automobiles, golf clubs, and a variety of other applications.

Like all composites, aluminium-matrix composites are not a single material buta family of material whose stiffness, strength, density, thermal and electrical and electrical properties can be tailored. The matrix alloy, reinforced material, volume and shape of the reinforced, location of the matrix reinforced and fabrication method can all be varied to achive required properties. The aim involved in design metal matrix composite materials is to be combine the desirable attributes of metal matrix produces a material mechanical.

CHAPTER 3

MATERIALS USED IN STIR CASTING

3.1 Aluminium (7475):

Aluminium / aluminium alloys have high electrical conductivity and strong corrosion resistance characteristics. These alloys are good low-temperature alloys . They gain strength when exposed to sub zero temperatures and lose strength when exposed to high temperatures. Aluminium alloys are sensitive to high temperatures ranging between 200 and 250°C (392 and 482°F).The following datasheet provides an overview of Aluminium / Aluminium 7475 alloy.

3.2 Chemical composition:

The chemical composition Aluminium / Aluminium 7475 alloy is outlined in the following table.

Table 3.2 Chemical Composition

Element	Content(%)
Aluminium, Al	90.3
Zinc, Zn	5.7
Magnesium, Mg	2.3
Silicon, Si	1.50
Chromoium, Cr	0.22

Aluminum Alloy 7475, derived from Aluminum 7075, provides excellent toughness for a broad variety of applications. This alloy offers several metalworking options that include machining, forming, and heat treating. For machining, Aluminum Alloy 7475 functions best in the annealed condition and should be used with oil-based lubricants. It is also most easily formed in the annealed condition, as its hardened state results in spring-back.

Alloy 7475 also works well for conventional cold working. Operations such as spinning are possible if the alloy is warmed to 250°F.

The chemical composition of Aluminum Alloy 7475 falls within the following parameters:

- Cu 1.2-1.9%
- Mn .06%
- Mg 1.9-2.6%
- Fe .12%
- Si .10%
- Zn 5.2-6.2%
- Cr .18-.25%
- Ti .06%

This alloy is typically available in flat rolled products, and it is widely used for applications that require high strength, including planes and other aerospace assemblies.

3.3 Physical Properties:

The following table shows the physical properties of Aluminium / Aluminium 7475 alloy.

Table 3.3 Physical Properties

Properties	Metric	Imperial
Density	2.6-2.8 g/cm³	10152-11603ksi
Melting point	546°c	1015°F

Aluminum is silvery-white in color. It melts at 1220.576 Fahrenheit and boils at 4472.33. Aluminum has an atomic weight of 26.98154, and an atomic radius of 143.1 pm. It is one of the most ductile and malleable metals. Aluminum is non-magnetic.

- Melting point: 660 °C (for AL 99,99 acc. to composition / alloying higher resp. lower)
- Boiling point: 2500 °C (acc. to composition / alloying higher resp. lower)
- Density: 2,70 g/cm³
- Relative atomic mass 26,98
- Oxidation number: 3

- Atomic radius: 143,1 pm
- Ionic radius: 57 pm (+3)
- Electrical conductivity: 36 m/Ohm·mm²

3.4 Mechanical Properties:

The mechanical properties of Aluminium / Aluminium 7475 alloy are displayed in the following table.

Table 3.4 Mechanical Properties

Properties	Metric	Imperial
Elastic modulus	70-80 Gpa	10152-11603 ksi
Poisson's ratio	0.33	0.33

It can also be cast to a high tolerance. Alloying, cold working and heat-treating can all be utilized to tailor the **properties of aluminium**. The tensile **strength** of pure **aluminium** is around 90 Mpa but this can be increased to over 690 Mpa for some heat-treatable **alloys**

3.5 Thermal properties:

The thermal properties of aliminium / aluminium 7475 alloy are given in the following table.

Table 3.5 Thermal Properties

Properties		Condition	
		T (°C)	Treatment
Thermal Conductivity	177 (W/m-k)	25	0

Aluminium / Aluminum alloys have high electrical **conductivity** and strong corrosion **resistance** characteristics. These **alloys** are good low-temperature **alloys**. They gain **strength** when exposed to sub zero temperatures and lose **strength** when exposed to high temperatures.

3.6 REINFORCEMENT MATRIX:

3.6.1 Silicon carbide (Sic):

Silicon carbide is also known as carborundum, is a semiconductor containing silicon and carbide. It occurs in nature as the extremely rare mineral moissanite. Synthetic Sic powder has been mass-produced since 1893 for use as an abrasive. Grains of silicon carbide can be bonded together by sintering to form very hard ceramics that are widely used in application requiring high endurance, such as car brakes, car clutches and ceramic plates in bulletproof vests. Electronic application of silicon carbide such as light emitting diodes (LEDs) and detectors in early radios were first demonstrated around 1907. SiC is used in semiconductor electronics devices that operate at high temperature or high voltages, or both. Large single crystals of silicon carbide can be grown by the lely method and they can be cut into gems known as synthetic moissanite.

3.6.2 Key silicon carbide properties:

- Low density
- High strength
- Low thermal expansion
- High thermal conductivity
- High hardness
- Excellent thermal shock resistance
- High elastic modulus
- Superior chemical inertness

3.6.3 Silicon carbide typical uses:

- Fixed and moving turbine components
- Suction box covers
- Seals, bearings
- Ball valve parts

- Hot gas flow liners
- Heat exchangers
- Semiconductor process equipment

3.6.4 Silicon carbide engineering properties:

Table 3.6.4 Silicon carbide engineering properties

Mechanical	SI/Metric (Imperial)	SI/Metric	(Imperial)
Density	Gm/cc (lb/ft³)	3.1	(193.5)
Porosity	% (%)	0	(0)
Color	-	Black	-
Flexural strength	Mpa (lb/in²×10³)	550	(80)
Elastic Modulus	Gpa (lb/in²×10^6)	410	(59.5)
Shear modulus	Gpa (lb/in²×10^6)	-	-
Bulk modulus	Gpa (lb/in²×10^6)	-	-
Poission's ratio	-	0.14	(0.14)
Compressive strength	Mpa (lb/in²×10^6)	3900	(566)
Hardness	Kg/mm2	2800	-
Maximum use temperature (no load)	°C(°F)	1650	(3000)
Thermal			
Thermal Conductivity	W/m*K (BTU*in/ft²*hr*F)	120	(830)
Coefficient of thermal expansion	10°/°c (10°/°F)	4.0	(2.2)
Specific heat	J/Kg*°K (Btu/lb*°F)	750	(0.18)
Electrical			
Dielectric strength	Ac-kv/mm (volts/mil0	-	semiconductor
Loss Tangent	-	-	-
Volume resistivity	Ohm*cm	10³-10^6	Dopant dependent

CHAPTER 4

WORKING FOR STIR CASTING PROCESS

4.1 Stir casting process:

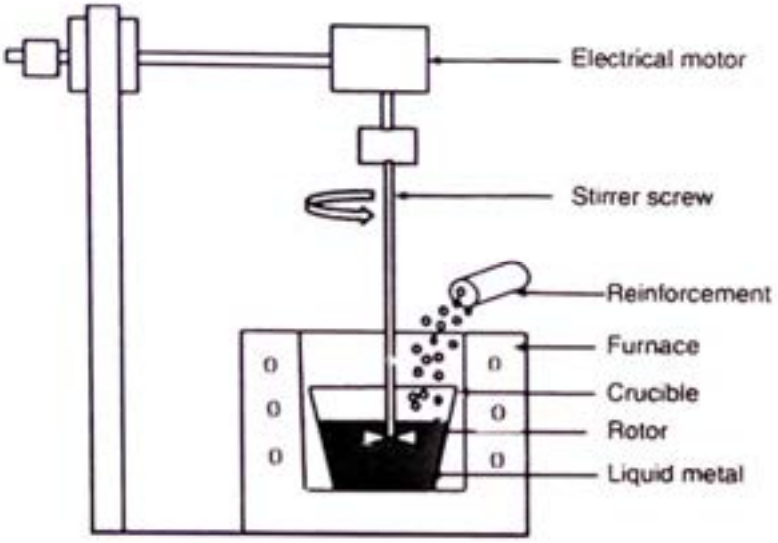

Figure 4.1 Stir casting process

Stir casting process setup is shown in Figure 1. In a stir casting process, the reinforcing phases (usually in powder form) are distributed into molten aluminium by mechanical stirring. Prior mechanical stirring, the surfaces of both must be properly cleaned in order to minimize the reaction between these two. Introducing reinforcement particles to the stirred molten matrix sometimes will entrap not only the particles but also other impurities such as metal oxide and slag, which is formed on the surface of the melt. During pouring, air envelopes may form between particles, which can alter the interface properties between particles and the melt, and also retarding the wettability between them. A major concern associated with the stir casting process is the segregation of reinforcing particles which is caused by the surfacing or settling of reinforcement particles during melting and casting process. To prevent settling of particles a motor driven agitator is used. Aluminium silicon carbide metal matrix composite will reach a state called mushy state before solidification. Once the mushy state is reached the reinforcement particles remain in its position during solidification. The final distribution of the particles in the solid depends on material properties and process parameters such as the wetting condition of the particles with the melt, strength of mixing, relative density, and rate of solidification. The distribution of the

particles in the molten matrix also depends on the geometry of the mechanical stirrer, stirring parameters, placement of the mechanical stirrer in the melt, melting temperature, and the characteristics of the particles added. To create and maintain a good distribution of the reinforcement material in molten matrix a vortex method is used. In this method, after the matrix material is melted, it is stirred vigorously to form a vortex at the surface of the melt, and the reinforcement material is then introduced at the side of the vortex. The stirring is continued for a few minutes before the slurry is cast.

An interesting recent development in stir casting is a two-step mixing process. In this process, the matrix material is first heated above its liquidus temperature. Then it is cooled down to a temperature between the liquidus and solidus points and kept in a semi-solid state. At this stage, the preheated reinforcement particles are added and mixed. The slurry is again heated to liquid state and mixed thoroughly. The results indicate that the two-step mixing process is quite successful to obtain a uniform dispersion of reinforcement in the matrix. An increasing trend for hardness and impact strength with increase in weight percentage of SiC has been observed [6]. For preheating the reinforcement particles, different researchers have used varying temperature and time (10000C for 1.5h in air [7], 11000C for 1-3h [8], 8500C for 8h [9]). Preheating of reinforcement particles prevents the reaction between matrix and reinforcement. Further, preheating of SiC particles assists in removing surface impurities, and altering the surface composition due to formation of SiO2 layer on the surface.

4.2 SCOPE OF WORK:

The proposed work is to evolve a development process for the best mix of the alloying elements for AlSiC for deriving optimal mechanical properties for a given hardness and impact strength the material.

4.3 METHODOLOGY:

With the use of experimental set-up we can analyze the data in a real time environment or verify the actual results obtained by other methods. This method is simpler to visualize and understand but is more challenging in terms of manipulation of the input data for finding the sensitivity associated with the output.

Also, it is time consuming and expensive to build a prototype and later engage the testing equipment for this purpose. For our case, the physical experimentation has been carried out under specified input conditions at the foundry; the details of which are given below.

4.4 EXPERIMENTAL SET UP USED IN STIR CASTING OPERATION:

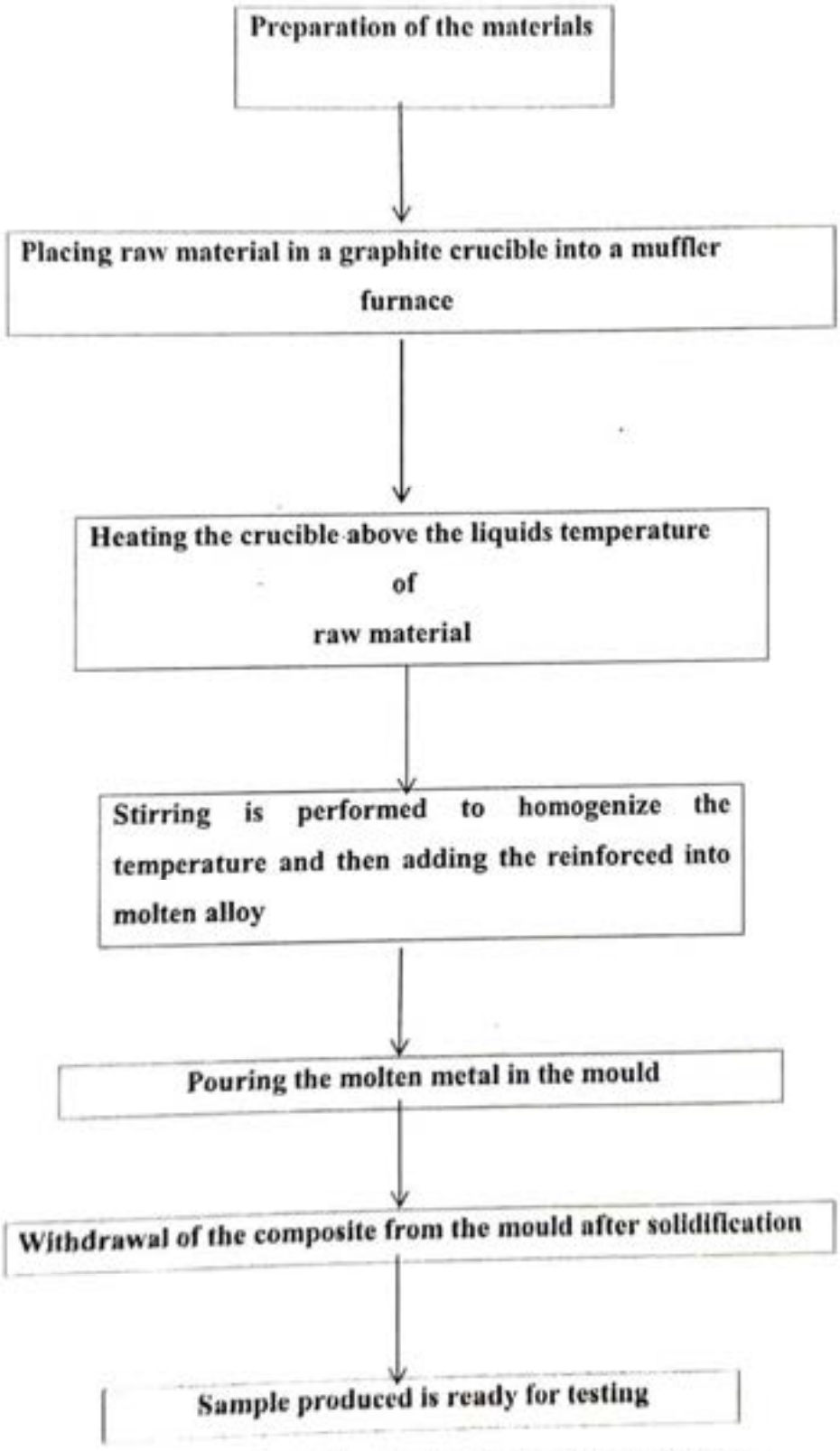

Figure 4.4 Flowchart showing steps involved in stir casting

4.5 EXPERIMENTAL PROCEDURES:

Aluminium Alloy was melted in a crucible by heating it in a muffle furnace at 800 C for three to four hours. The silicon carbide particles were preheated at 1000 C for one to three hours to make their surfaces oxidized. The furnace was first raised above the liquid us temperature of Aluminium near about 750 C to melt the alloy completely and was cooled down just below the liquid us to keep slurry in Semi solid state.

Automatic stirring was carried out with the help of radial drilling machine for about 10 minutes at stirring rate of 290 RPM. At this stage, the preheated SiC particles were added manually to the vortex. In the final mixing process the furnace temperature was controlled within 700+ 10 C. After stirring process the mixture was pour in the other mould to get desired shape.

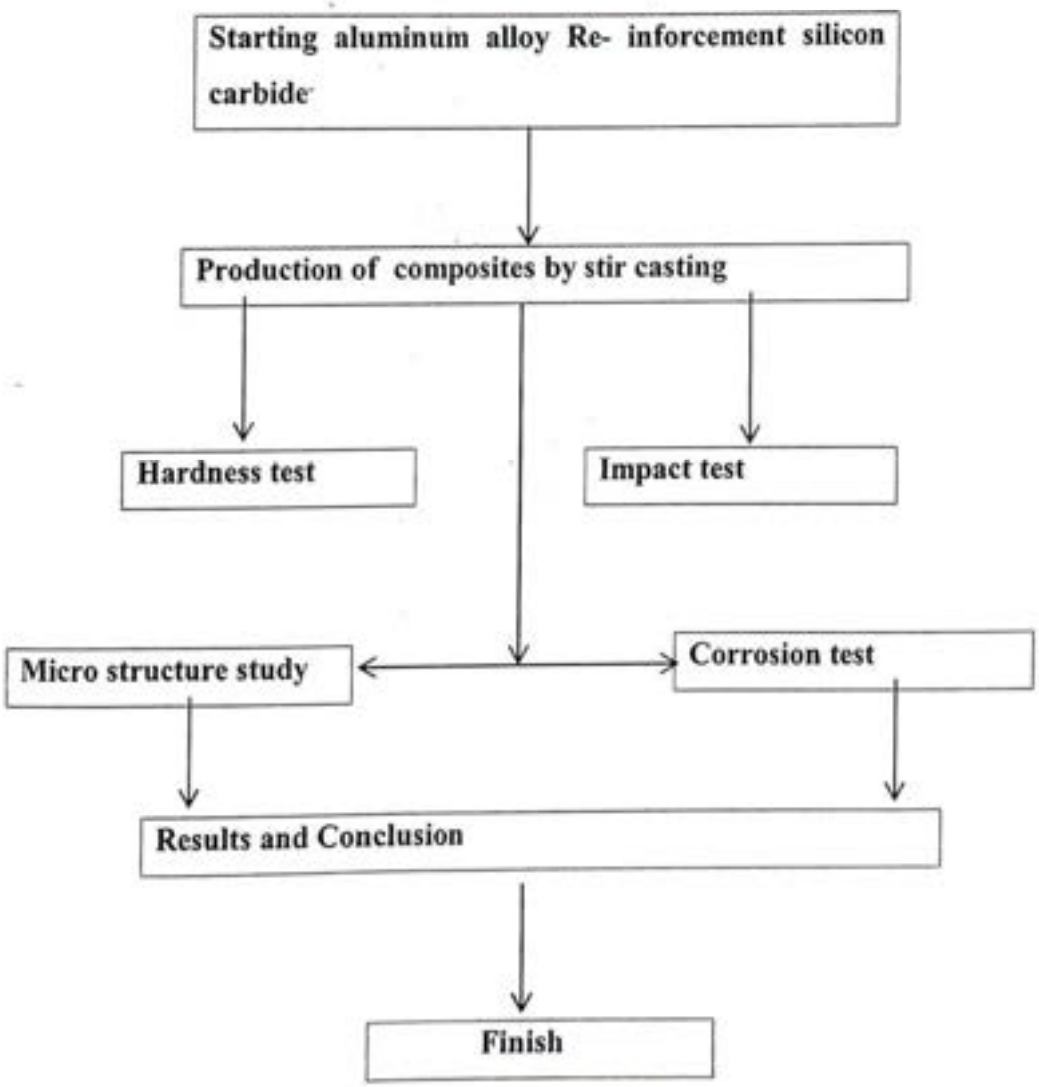

Figure 4.5 Flowchart experimental techniques follow

4.6 Steps for Experimental methodology:

Step 1: Preparation of sand mould

Green sand or Molding sand as it is popularly known is used with binding material to form the drag or the cores of the mold .

Step2: Preparation of Specimen of various

Compositions. The alloying element proportionately by weight in the ratio of 5%, 10%,15%, 20%, 25%, 30%. The percentage of alloying element to be used is determined by literature and history for development of this work.

Step 3: Machining of specimen for test

For Charpy/ Izod Impact test, the material needs to be sized as a square section with a notch as specified by the relevant IS standard.

Step 4: Checking Hardness over Hardness testing machine

Brinell Hardness Test is to be carried out over 'Llyod' Testing machine

Step 5: Checking Impact Strength using 'Charpy Impact testing machine'

Test for Impact Strength is to be carried out using the setup specified for I zod Impact Test.

4.7 Hardness:

Hardness is the resistance of a material to localized deformation. The term can apply to deformation from indentation, scratching, cutting or bending. measurements are widely used for the quality control of materials.

4.8 Impact Strength:

The impact toughness of a material can be determined with a Charpy or I zod test. For the test the specimen is broken by a single overload event due to the impact of the pendulum. A stop pointer issued to record how far the pendulum swings back after fracturing the specimen. The impact toughness of a metal is determined by measuring the energy absorbed in the fracture specimen.

4.9 Microstructure:

Metallographic samples were sectioned from the cylindrical cast bars. A 0.5 % HF solution was used to etch the samples wherever required.

4.10 Corrosion:

Corrosion is an irreversible interfacial reaction of a material (metal, ceramic, and polymer environment which results in consumption of then material or in dissolution into the material of a component of the environment high-strength.

CHAPTER 5

SCOPE OF FUTURE WORK

1. This can future be extended by varying the weight % of SiC and by varying the composition of AlSiC metal matrix composites.
2. Heat treatment with different reinforcing material will be done.
3. To evaluate the mechanical properties various tests will be performed.
4. From results of different combinations properties will be compared for better solutions.
5. The best combination will be implemented in any of the mechanical applications.

CHAPTER 6
ADVANTAGES AND APPLICATION

6.1 Advantages:

- The material properties of aluminium silicon carbide metal matrix composites make it a good solution for large size products.
- Aluminium silicon carbide metal matrix materials are good for contributing to weight reduction and provide excellent damping for high speed and precise equipment motion applications like robot parts.

6.2 Applications:

Aluminium silicon carbide metal matrix composites are used in various fields like aerospace, aircraft, underwater, automobile, substrate in electronics, golf clubs, turbine blades, brake pads etc.

CONCLUSION

From the above chapters and literature review's it is concluded that,

- Composite of base material Al 7475 with SiC of different combination (10%, 20%, 30%) Can be prepared.
- The composites have to be prepared by stir casting process.
- To identify the suitable composite for automotive sector tensile test, micro hardness test, impact test has to be carried out.
- In future, the above points are considered and a suitable composite is suggested for automotive sector.

References:

1. Sijo MT , K R Jayadevan , "Analysis of stir cast aluminium silicon carbide metal matrix composite: A comprehensive review" , International conference on emerging trends in engineering, science and technology (ICETEST – 2015)
2. Md. Habibur Rahman, H. M. Mamun Al Rashed, " Characterization of silicon carbide reinforced aluminium matrix composites", 10th International conference on mechanical engineering, (ICME - 2013)
3. P.B.Pawar, Abhay A. Utpat, "Development of aluminium based silicon carbide particulate metal matrix composite for spur gear", 3rd International conference on material processing and characterization (ICMPC 2014)
4. C.Neelima Devi, N.Selavaraj, V.Mahesh, "Micro structural aspects of aluminium silicon carbide metal matrix composite", Int. Journal of applied sciences andengineering research,, Vol, 1,No,2, 2012
5. Michael Oluwastosin Bodurin, Kenneth kanayo Alaneme, Lesley Heath Chown," Aluminium matrix hybrid composites: a review of reinforcement philosophies: mechanical, corrosion and tribological characteristics, School of chemical and metallurgical engineering, DST-NRF Centre of excellent in strong material.
6. Jayashree P.K, Gowri Shankar M.C, Achulta Kini, Vijay sharma.S, and Raviraj Shetty, "Review on effect of silicon carbide (SiC) on stir cast aluminium metal matrix composites", "Department of mechanical & manufacturing engineering", Accept 05 Agust 2013, available online 15 august, Vol, No, 3(August 2013
7. Mohan Vnarotti, Shrishali P, B R. Sridhar, K.Venkateswarlu, " Surface modification of SiC reinforcement & its effect on mechanical properties of aluminium based MMC". ITER- India (IPR) Gandhinagar Gujarat, 382 010, india.
8. Magibalan.S, Senthil kumar.P, Vignesh.P, Prabu.M, Balan.A.V, Shivasankaran.N, " Aluminium metal matrix composites – A review", Assistant professor, department of mechanical engineering.

9. J P Pathak, J K Singh & S Mohan, "Synthesis and characterization of aluminium-silicon-silicon carbide composite", "Centre of advance study, department of metallurgical engineering, institute of technology, banaras hindu university, Varanasi 221 005, India.

10. Manoj Singla, D. Deepak Dwivedi, Lakhvir Singh, Vikas Chawla, "Development of alumminium based silicon carbide particulate metal matrix composite", " Journal of minerals & material charaterizaton & engineering Vol, 8, No.6, pp 455-467, 2009.

FABRICATION AND CHARACTERISATION OF ALUMINIUM METAL MATRIX COMPOSITE REINFORCED WITH GGBS

PROJECT WORK (PHASE I) REPORT

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ABSTRACT

Aluminum metal matrix composites (AMCs) are now gaining their usage in aerospace and automotive industries. Among many AMCs, Aluminum 6061 metal matrix composite with Ground Granulated Blast Furnace (GGBS) slag is a novel composite. This composite is widely used in automotive industries due to high wear resistance, high strength to low weight ratio, elevated temperature toughness and high stiffness. The fabrication of metal matrix composites Al6061/GGBS MMCs containing four different weight percentages (3%, 6%, 9%, 12%) of GGBS have been fabricated by using a liquid state (stir casting) method. In this project work, the aluminum metal matrix composites were characterized by scanning electron microscopy (SEM) to verify the uniform distribution of GGBS particles in Al 6061. The X-ray diffraction and EDAX analysis is also planned to conduct the %composites of the different AMCs for conforming the reinforcement present in the AMCs. Additionally, tensile and hardness testing is also to conduct the performance of the different composite of reinforcement in AMCs.

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ABBREVIATIONS

MMC -Metal Matrix Composite

PMC-Polymer matrix composite

CMC-Ceramic Matrix Composite

AMC-Aluminium Metal Matrix Composite

SS-Stainless Steel

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The ability of the human understanding is highly reflected by the materials technology. The materials being developed from Paleolithic age till today makes us to understand the evolution of the materials technology. The symbolic Delhi Iron Pillar, Dhar Iron pillar and many historical monuments are some of the evidences that show the importance of materials.

The composites are the class of materials whose application stared from 1940's by the introduction of E- Glass / Phenolic Random structures. Their advancement is tremendous such that the composites of Graphite/ polyamides find application in space shuttle, where the cost reduction, weight reduction and increase in the payload capacity are some of the essential requirements. In 1960's focus was given on the fabrication, study of properties and mechanical behaviour of the composite materials. The need and demand for high strength, Light weight SS materials in the field of Aerospace, Automobile, Defense, Marine and construction sectors paved the way for replacement of Monolithic materials to composite materials. The composite materials are superior in their strength and modulus with low specific gravity when compared to their monolithic counterparts.

Extensive studies about the nature of materials with their structure- property relationship, helps in developing composite materials with improved mechanical, physical and Degradation properties. Continuous advancements in the field of composite materials make us to understand that they are the futuristic materials for diversified applications.

Metal Matrix Composites (MMCs) are the modern superior materials possessing the properties of lightweight, good wear resistance, high specific strength and a low thermal coefficient. These composite materials are extensively used in defense and automotive, aerospace, industries. MMC composed by Al6061 as metallic base material called matrix which is reinforced with B4C and graphite a hard ceramic reinforcement. The main aim of

this chapter is to provide the background information about the proposed study from an extensive literature survey. This literature review has helpful through information a planning and understanding of present work has been achieved. Selection of materials, their modern day applications, brief information about the processes involved in fabrication of metal matrix composites, recent advancements in processing and machining, evolution and efficient employment of different optimization technique have been deal with in this chapter.

1.2 COMPOSITES

The composites constitute a major proportion in the category of engineering materials where application ranges from day-to-day products to products for complex applications, such that they conquer the market. There is a steady and substantial growth of composite materials. Several combinations of the matrix and the reinforcements are possible.

Though the composites are light weight materials, the current challenge is to make them cost-effective. Many innovative manufacturing methods resulted in the production of composites in more economic manner with short manufacturing lead time. But the manufacturing technique is not only the solution for making cost-effective composites. The Integration of Designing, Tooling, Materials selection, Quality control and manufacturing management technique should be done to give a better cost-effective composite, with achievement of concurrent engineering.

The application of composites in many applications other than Automobile, Aerospace, Marine, Defense and construction sectors offer much large business opportunities because of the sheer size of transportation industry.

The other applications include the use of fibre reinforced plastics (FRPs) in the kitchen shelves, wind turbine blades, fuel cylinder, explosive impact resistant applications, beams of highways, paper making rollers, chemical storage tanks, and Drive staffs. In Defense applications, the lightweight composites are used in Bullet-proof vests and Jackets, light-weight arm ours, etc. Kevlar is one such material which is widely used in this application. But the cost of procurement of Kevlar is high since it has to withstand many attacks, which are either natural (or) man-made. So the focus has been shifted to introduce-natural fibers which can replace same percentage of Kevlar. The composites are tailored to

be earthquake resistant where it absorbs vibrations and shocks through tailored micro-structures. The concrete foam is used to strengthen the existing structures and repair the damage of the civil structures caused by seismic activities. The properties of the composites can be varied over a broad range of values by the designer, where both material selection and structural design are involved. The selection of suitable reinforcement decides the characteristics of the final finish product, which suits for particular application.

The selection of materials also depends upon various factors such as geometry of the components, working life time requirements, number of components to be produced, saving in the assembly, material handling and transportation costs and the optimal usage of the resources available. In sure case, best results can be achieved by combination of both composite and traditional materials.

1.2.1 Definition - Composite

Composites are the class of materials where two or more materials are mixed / bonded on a macroscopic scale according to a particular application. The composite material comprises of Matrix – continuous phase and reinforcement- discontinuous phase. The reinforcement (Fibres, particles, fillers, flakes) are embedded on the Matrix (Metals, Polymers and ceramics), which holds the reinforcements for the overall improvement of mechanical property. If the new combination is designed in well- structured manner, the products of the composites will be better than the individual properties of Matrix and reinforcements. The composites are different from the alloys. In alloys there should be a presence of minimum one metal, which will be homogeneous mixture of metals and (or) non- metals on a microscopic scale. The Vander -walls force of attraction will be very high in case of Alloys. Also, the distribution of alloying elements is uniform throughout the structure because the solid phases are in intimate contact with each other. So the alloys can be much standard sizes and shapes (Ingots and Bars).

But the distribution of the reinforcements is not uniform in the Matrix. The Vander-walls force of attraction is also not very strong in the case of composites. Due to these, the composites don't have uniform property throughout the component. Also, the density of composites varies from area to another.

1.2.2 Characteristics of the Composites

The composites comprises of 2 phases – a discontinuous phase call reinforcement embedded in a cent / Matrix phase. The reinforcement may be one (or) more in number which is usually stronger and harder than the Matrix part.

The composites property is highly dependent on the properties of Matrix and reinforcement materials. The distribution of reinforcement and the interaction of the reinforce with the Matrix phase decide the property of the composite as a whole. The geometry of reinforcements (Size, shape, orientation and distribution) also influences the properties of the composite to major extent.

The reinforcements shape may be spherical / cylindrical if the aspect ratio is i.e., (l / d) Else the shape of the reinforcement may be rectangular cross- section platelets. The volume fraction of the reinforcement is correlated with the interfacial area, that determines the extent of bonding between the Matrix and reinforcements phase. The addition of reinforcements to the Matrix phase is expressed in terms of either volume fraction (or) mass fraction which determines the overall properties of the composites.

The mixing of reinforcements with the matrix is the uncontrollable parameter, while fabricating the composite. The process parameters should be well - defined while performing casting techniques, where the isotropy of the composite as a whole should not get deviated. There are different types of metal matrix composites on the basis of reinforcement in MMC such as

(fig A) particle reinforcement;
(fig B) short fiber reinforcement;
(fig C) continuous fiber reinforcement;
(fig D) laminate reinforcement.

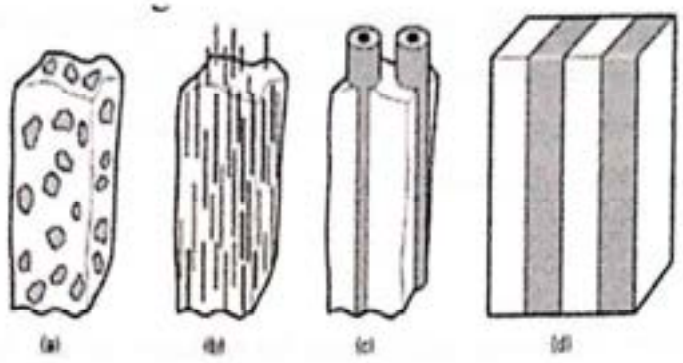


Figure 1.1 Types of MMC

1.3 Classification of Composites

Composite materials can be classified in different ways. Classification based on the geometry of reinforcement is convenient to express the properties and performance of the composites. The two broad classifications of composites are (1) Particulate composites (2) Fibrous composites.

1.3.1 Particulate Composites

The reinforcement is of particle nature. The shape of the reinforcement could be spherical, cubic, cylindrical (or) some irregular shape. But the particulate composite are in general equiaxed structures. These particulates are not that much effective in improving the Fracture Resistance. But the improvement in the stiffness is observed with particulates. Particulates modify the mechanical, thermal, Degradational, Machining and electrical properties of the overall composite. The selection of suitable particulate to a particular application is highly essential. Care should be taken to avoid shrinkage (or) Volumetric distortion when the composite are subjected to exposure in various environments.

1.3.2 Fibrous Composites

The fiber has the aspect Ratio (l/d) greater than 1. The dimensions and orientation of the fibrous reinforcement determine the overall property of the composites. The fracture resistance of the Matrix phase is much improved with the addition of fibrous reinforcement phase, since the crack growth which is normal to the reinforcement is discouraged (or) the propagation of cracks gets stopped as the fibrous act carrier to the crack propagation. In case, of Brittle Matrix phases, the fibrous reinforcements are recommended. The Man- made

fibrous are engineered to suit a particular application. The natural fibrous properties differ from place to place i.e., no uniformly in properly throughout the world. A pole vault made of bamboos from different regions may not have the uniform properties. So the importance of Man- made fibrous reinforced composites substitutes the pole vault made of natural bamboos.

The fibrous take the load from the Matrix phase and protect the Matrix phase against environment and during handling and transportation. The transfer of load from the Matrix to fibrous is much more critical than the load transfer from Matrix to particulate.

The composite are classified into class I and class II depending upon the interaction of the Matrix with reinforcement phase. Class I composite are the ones where the interaction between Matrix and reinforcement is formed to be very weak. Classes II composite have a strong interaction between Matrix and reinforcement phase.

1.3.3 Natural Composites

Natural composites exist in both animals and plants. Wood is a composite – it is ade rom long cellulose fibres (a polymer) held together by a much weaker substance caled lignin. Cellulose is also found in cotton, but without the lignin to bind it together it is much weaker. The two weak substances – lignin and cellulose – together form a much stronger one.

The bone in your body is also a composite. It is made from a hard but brittle material called hydroxyapatite (which is mainly calcium phosphate) and a soft and flexible material called collagen (which is a protein). Collagen is also found in hair and finger nails. On its own it would not be much use in the skeleton but it can combine with hydroxyapatite to give bone the properties that are needed to support the body.

1.3.4 Early composites

People have been making composites for many thousands of years. One early example is mud bricks. Mud can be dried out into a brick shape to give a building material. It is strong if you try to squash it (it has good compressive strength) but it breaks quite easily if you try to bend it (it has poor tensile strength). Straw seems very strong if you try to stretch it, but you can crumple it up easily. By mixing mud and straw together it is possible

to make bricks that are resistant to both squeezing and tearing and make excellent building blocks.

The composites are generally classified based on matrix and reinforcing material, and it is presented as a tree diagram

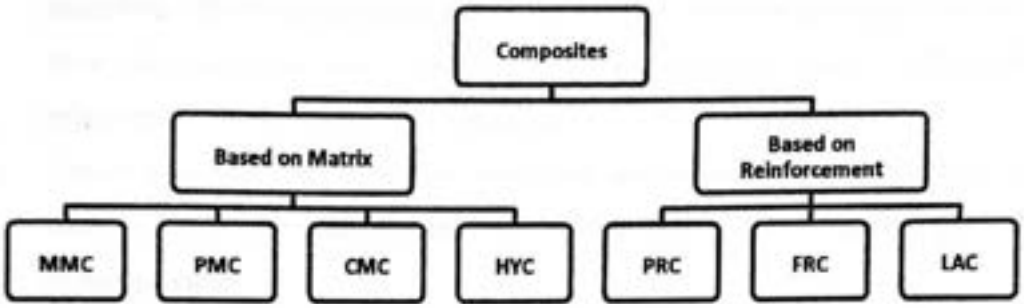


Figure 1.2 Classification of Composites

1.4 Need of Composite Material

The most important reason why we need composite materials is the verstality in their properties which enables them to be applied in large number of fields. Other reasons are their light weight, corrosion resistance and durability.

Nowadays, composite materials are used in large number of vast engineering fields such as aviation, automobile and robotics.

The advantages of composite materials always beat their disadvantages hands down. One might argue that the composites are high in cost and might not be durable in the long run. But the fact of the matter is that the composites can be engineered to work according to our requirements.

The metals are equally strong in all directions, but the composites can be designed and engineered to be strong in a specific direction. The sheer repertoire of the composites is mind boggling. Here are some advantages of composites to illustrate the need of composite materials in brief.

- **Design Flexibility** – Thermoset Composites give designers nearly unlimited flexibility in designing shapes and forms. They be molded into the most intricate components and can be made a wide range of densities and chemical formulations to have precise performance properties.
- **Low cost per cubic inch** – When comparing costs based on volume, thermoset composites have lower material costs than traditional materials such as wood, engineered thermoplastics and metals. In addition, because thermoset composites have a low petroleum-based content, they are not subjected to the price fluctuations experienced in petroleum-based products.
- **Lower material costs** – Because thermoset composites can be precisely molded, there is little waste and therefore significantly lower overall material costs than metals products.
- **Improved productivity** – Industrial Designers and Engineers are able to reduce assembly costs by combining several previously assembles parts into a single component. Also, inserts can be molded directly into the part during the molding process thereby eliminating the need for a post-process. In addition, composites do not usually require additional machining, thereby reducing work-in-process and time to market.

  The continued integration of lightweight composites into automotive and transportation will help alleviate the United Sates dependence on foreign oil. In particular, the US dependence on foreign oil supplied by unstable nations

  Composite materials integrated into aerospace, automotive, trucking, and mass transit will all have fuel saving benefits. Additionally, products manufactured with composites will require less energy to transport or ship then traditional materials.

1.5 TYPES OF COMPOSITES

There are various types of composite based on their matrix material. They are as follows;

(i) Metal Matrix Composites

(ii) Polymer Matrix Composites

(iii) Ceramic Matrix Composites

1.5.1 Metal Matrix Composites

When compared with organic matrices, the Metal matrix has the following advantages.

(i) Retention of strength at elevated temperatures.

(ii) Higher strength at traverse which in.

(iii) Better electrical and Thermal conductivity.

(iv) Higher resistance to Abrasion and erosion.

Some of the disadvantages of the MMC

(i) Higher densities.

(ii) Lower specific mechanical properties.

(iii) Requirement of higher- energy for the fabrication of composite.

In Aerospace industries, the Research focus is done on fibre- reinforced aluminium/ Titanium Metal Matrix composite. The fibres of Boron, Silicon and Alumina are some of the reinforcements that are commonly used. Titanium reinforced with SiC and sometimes Beryllium are used for the manufacture of compressor blades. The unidirectional orientations of fibres / whiskers in the Metal Matrix are used to achieve good elastic modulus, through the bonding between the Matrix and the reinforcement is weak. But a strong Metal Matrix is required for achieving better shear strength and Traverse loading. The incorporation of carbon/ Graphite fibres to the Metal Matrix are under research. The Carbon-Nano tube (CNTS) and Graphene are some of the reinforcement that are added to Metal Matrix for getting better properties.

1.5.2 Polymer Matrix Composites

Polymer Matrix Composites (PMCs) have reinforcements (fibers, whiskers or particulates) embedded in a polymer resin matrix (e.g. Polyesters, vinyl esters, PEEK, PPS). These composites are used in a broad range of applications from aircraft structures to office furniture. Among the PMC's Glass Fibre Reinforced Polymer (GFRP) composites find a diversified range of applications from automobile bodies to containers. Epoxy based polymer matrix composites exhibit high strength to weight ratios which are used in aerospace and space technologies. In addition, a Carbon Fiber Reinforced Polymer (CFRP) composite finds application in sports and recreational equipments, aircraft structural components pressure vessels, Rocket motor cassis. Automotive industries are consume increased amounts of PMCs in an attempt to reduce the weight of the vehicle weight in order to improve the fuel efficiencies.

Plastic materials- both Thermoplastics and Thermosetting plastics are used as Matrix material for polymer Matrix composites with Resin binders. The resins are selected on the basis of Thermal electrical chemical, Fatigue and Moisture resistance. The resin must have strength equal to that of reinforcement with ease in its use and it must with stand up to service conditions. Also, the resin must have a good wettability with the fibres, such that it should penetrate into the fibres and enhance the properties of fibres.

The overall property of the composite is also decided by the type of resin chosen, which determines the usefulness of the laminates in a corrosive atmosphere. If the volume fraction of the fibre is higher, the Matrix material completely covers the reinforcement. At elevated temperature, the interfacial bonding between the Matrix and reinforcement becomes weak, such that the detartion in strength is observed in incorporate as a whole.

The determination in the strength can be attributed more to the Matrix material than the reinforcement. The service temperature of the polymers is restricted around 300-350°C. The researchers suggested the use of polyimidator high-temperature applications. But still the Metal matrix appears to be the best alternatives for high- temperature application.

Table 1.1 Temperature Ranges for Various Resins

Matrix Material	Temperature in °C for	
	Long Term Exposure	Short Term Exposure
Unsaturated polyesters	70	100
Epoxies	125	200
Phenolics	250	1600
Polyimides	315	400
Aluminium	300	350

Table 1.2 Heat Resistant Composites

Matrix material	Maximum Service Temperature (°C)	Density (g/cc)
Carbon / Epoxy	180	1.4
Boron/Epoxy	180	2.1
Borsic / Aluminium	310	2.8
Carbon/Polyimide	310	1.4
Boron/Polyimide	310	2.1
Carbon/Polyaminoxaline	350	1.4
Carbon/Polybenzthiazole	400	1.4
Borsic/Titanium	540	3.6
Carbon/Nickel	930	5.3
Whisker/Metals	1800	2.8-5.6

1.5.3 Ceramic Matrix Composites

Ceramic particles such as alumina (Al_2O_3) and Silicon Carbide (SiC) are preferred for high temperature applications. The silicon Nitride (Si_3N_4) is used in the gas turbine blade by general electronics (GE). Since ceramics are brittle in nature, they are poor in tension and shear, but good in compression. The Matrix is ceramic, such that the reinforcements should be show fibres / whiskers. The silicon carbide (SiC) and Boron Nitride (B_4N) fibres are used as fibres / whiskers.

1.5.3.1 Reinforcement of composites

The role of the reinforcement in a composite material is fundamentally to increase the mechanical properties of the resin system. All of the different fibres used in composites have different properties and so affect the properties of the composite in different ways. For most of the applications, the fibres need to be arranged into some form of sheet, known as a fabric, to make handling possible. Different ways for assembling fibres into sheets and the variety of fibre orientations possible to achieve different characteristics of composites.

1.5.3.2 Interface

The Interface is the region where the binding between the Matrix and the Reinforcement occurs. The binding may be physical, mechanical and (or) chemical. The wetting of the fibre must be done by the Matrix, which is done by incorporating coupling agents for increasing the surface area. The interface also plays a vital role in transferring the load from Matrix to reinforcement. The transferring of loads is correlated with the adhesion of reinforcement with Matrix. Higher the adhesion, higher the load carrying capacity. Failure at the interface is undesirable, which may cause debonding of Matrix and resin forcements.

1.6 Metal matrix components

Metal Matrix Composites (MMCs) are the current propelled materials having the properties of lightweight, great wear resistance, high specific quality and a low warm development coefficient. These composite materials are broadly utilized as a part of aviation, protection and car ventures. MMC were formed by Al6061 as the metallic base material called network which was strengthened with B_4C and graphite a hard clay fortification. From the early endeavors in MMC improvement, numerous MMC models and constrained

generation parts have been machined utilizing different ordinary and non-traditional systems. Saravanan et al. (2015) contacted varioustraditional machining operation on the MMCs and concludethat is highly expensive for machining business high-generation applications. The machining of MMC affected by micro structureand strengthening particles. The delicate constant aluminum matrix requires for cutting apparatus and can slice through the lattice while creating discrete chips of material.

Since the aluminum lattice has low hardness and unassuming quality, the hypothetical vitality required for machining is low, and high metal evacuation rates is conceivable. Shockingly, the trouble in machining MMCs emerges from the inclination of the hard and grating particles thereof to dull the bleeding edge of a traditional machining. Customary rapid steel instruments, applying mind very little to the tungsten or cobalt content, do not last more than a couple of upheavals in contact with the MMC before the bleeding edge is dulled. Tungsten carbide devices, however, do not exhibit a long device life, are as of now utilized with constrained achievement and much trouble, for certain MMC machining operations. MMC wrapping up by granulating with rough grain wheels has never been totally effective as the delicate aluminum matrix tends to rapidly stack the wheels making reliable metal evacuation unreasonable. Another traditional approach for machining molecule strengthened aluminum framework composites is to utilize jewel super abrasives, particularly, single point polycrystalline precious stone (PCD) cutting instruments.

PCD apparatuses are level and do not join any of the unpredictable instrument geometries and chip breaking highlights so regular to fast steel or tungsten carbide embeds and, thus, have, for the most part, been restricted to basic machining operations. Synthetic Vapor Deposition (CVD) precious stone covering innovation has been created to allow the utilization of thin jewel coatings to complex carbide device shapes. At the point of utilization for outer and inward turning, processing, and boring operations on MMCs those contain humble stacking of particulates, the PCD devices have sensible device life and create great surface wrap up.

As a substitute approach to machine MMCs, different specific machining systems, for example, Electro Discharge Machining (EDM), Laser Cutting, and Abrasive Water Jet Cutting have been utilized. While these systems have some constrained utility, these procedures have a tendency to be specific and turn out to be extremely costly. Along these

lines, a need exists for a technique which meets the accompanying necessities in the machining of aluminum metal lattice composites having hard and rough particulates together with a delicate metal framework. That does not experience the ill effects of the quick dulling related with routine machining instruments and the ill effects of the delicacy related to customary machining approaches, more appropriate for AMC machining without bringing about material harm and with sensible speed in material expulsion These necessities can be met by a non-ordinary system known as Electro Chemical Machining (ECM). The procedure can be utilized to machine materials of any hardness and been effectively rehearsed with hard to-machine materials for a long time. Hihara et al. (2000) have licensed their strategy for machining Al6061/SiC composite utilizing ECM handle with sodium nitrate as electrolyte. As a result of the presence of higher hardness and support quality, composite materials are hard to be machined by conventional systems. Consequently ElectrochemicalMachining (ECM) turns into a more practical strategy for machining with required surface harshness.

Electrochemical Machining Process (ECM) follows the basic principle of anodic dissolution in an electrolysis process. Generally ECM process works irrespective of material hardness, exhibits virtually no tool wear, high material removal rate and produces relatively smoother and regular surfaces of the work materials with complex geometry. These benignfeatures of ECM are widely accepted in the machining of high precision complex components for the aerospace and defense industries.For an alloy, anodic dissolution depends upon the dissolution potential of various alloying elements present. Further the inter electrode potential is selected on the basis of the major constituent of the alloy. Successful hybridization of ECM with various un-conventional and conventional machining methods such as electrical discharge, produce highly complex structured components.

Ultrasonic vibration-assisted ECM and magnetic field assisted ECM hybrid machining improves the precision and quality of machined surfaces. Many researchers have attempted to combine the ECM and EDM process that resulted in Electrochemical Discharge Machining (ECDM) technology which can be used to machine special purpose steel grade considered as a difficult to cut. However, the sophistication involved in the machining system of those hybrid processes substantially increases the cost of machining. Another simple way in hybridization was the use of hybrid electrolytes consisting of various

concentrations of $NaClO_3$ and $NaNO_3$ for machining S-03 special purpose stainless steel. This process reported an rise in material removal rate, lower surface roughness and side gap when compared to a single electrolyte. Recently the electrochemical process was used in conjunction with the abrasive slurry jet to machine tungsten carbide. This process removed passive oxide layer completely thereby resulting in a fresh surface to electrochemical machining every time. Now in line to the low cost hybridized process such as abrasive assisted ECM developed by authors exhibited characteristics similar to those of an established ECM hybrid system. An improvement in machining rate, Ra and optimization of process parameters by combining ECM with other processes are still subjects of emerging research.

1.7 Ceramic Particle (B_4C, SiC, Alumina)

The study of mechanical properties evidently presented that anincreasing in hardness of composite occurs which is attributed to positive effect of reinforcement particles in resistance to the movement of dislocations. Furthermore, it was found that the wear weight loss of Al,B_4C,SiC composite decreases monotonically with increasing content and more uniform particle size distribution.

1.8 Self-Lubrication (Graphite, Nano Graphite)

The tribological performance of self-lubricated graphite hybrid composites with various amount of graphite adding created by the semi-solid powder. As the amount of graphite increases, the hardness and Coefficient of Thermal Expansion (CTE) of the composites decreases. Fracture toughness decreases monotonically with graphite content increases.

1.9 ALUMINUM MATRIX COMPOSITES (AMC)

Alluminum alloy is a nonferrous metal alloy that covers an extensive series of materials, from the other widespread metals, for instance, aluminum, to elevated strength, elevated temperature alloys, for example, molybdenum, tungsten and tantalum. While more costly than ferrous metals, alloys receive significant uses in view of their several mechanical, physical, and chemical properties.

The central issues in choosing aluminum and its alloys are their elevated strength-to-weight proportion, defiance to corrosion by numerous chemicals, elevated thermal as well as reflectivity, electrical conductivity, machinability, ease of formability, appearance and nontoxicity. It finds various applications in the areas of marine fittings, electrical fittings as well as connectors, brake components, bicycle frames, couplings, aircraft and aerospace components, transport, valves and drive shafts that weight lessening is of paramount consequence with no giving up on strength.

Mechanical characteristics such as hardness as well as tensile strength of AMC are enriched by strengthening AA 6061 matrix with silicon carbide (SiC) and boron carbide (B_4C) particles. Through stir-casting method, aluminum matrix is capable of being toughened by means of boron carbide particulates as well as silicon carbide particulates through the different weight proportions of 2.5, 5 and 7.5%. Stir-casting entails inclusion of ceramic particulate into liquid aluminum melt as well as permitting the combination to solidify.

1.10 Ground Granulated Blast Furnace Slag

Ground Granulated Blast Furnace Slag (GGBS) is a by-product of the manufacturing of iron in a blast furnace where iron ore, limestone and coke are heated up to 1500°C.When these materials melt in the blast furnace, two products are produced– molten iron, and molten slag. The molten slag is lighter and floats on the top of the molten iron. The molten slag comprises mostly silicates and alumina from the original iron ore, combined with some oxides from the limestone. The process of granulating the slag involves cooling the molten slag through high-pressure water jets. This rapidly quenches the slag and forms granular particles generally no larger than 5mm in diameter. The rapid cooling prevents the formation of larger crystals, and the resulting granular material comprises some 95% non-crystalline calcium-alumino silicates. The granulated slag is further processed by drying and then ground to a very fine powder, which is GGBS (ground granulated blast furnace slag) cement. Grinding of the granulated slag is carried out in a rotating ball mill.

Different forms of slag product are produced depending on the method used to cool the molten slag. These products include air-cooled blast furnace slag (ACBFS), expanded or foamed Slag, palletized slag, and granulated blast furnace slag.

1.11 Advantages of Using GGBS

Utilization of GGBS in cement and concrete results in

1. Improved workability, pump ability and compaction characteristics for concrete placement
2. Increased strength and durability
3. Reduced permeability
4. High resistance to chloride penetration
5. High resistance to sulphate attack
6. High resistance to ASR
7. Very low heat of hydration
8. More chemically stable

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. The chemical composition of a slag varies considerably depending on the composition of the raw materials in the iron production process. Si and aluminate impurities from the ore and coke are combined in the blast furnace with a flux which lowers the viscosity of the slag. In the case of pig iron production the flux consists mostly of a mixture of limestone and forsterite or in some cases dolomite. In the blast furnace the slag floats on top of the iron and is decanted for separation. Slow cooling of slag melts results in an unreactive crystalline material consisting of an assemblage of Ca-Al-Mg silicates. To obtain a good slag reactivity or hydraulicity, the slag melt needs to be rapidly cooled or quenched below 800 °C in order to prevent the crystallization of merwinite and melilite. To cool and fragment the slag a granulation process can be applied in which molten slag is subjected to jet streams of water or air under pressure. Alternatively, in the palletization process the liquid slag is partially cooled with water and subsequently projected into the air by a rotating drum. In order to obtain a suitable reactivity, the obtained fragments are ground to reach the same fineness as Portland cement. The main components of blast furnace slag are CaO (30-50%), SiO2 (28-

38%), Al2O3 (8-24%), and MgO (1-18%). In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength.

Figure 1.3 Ground Granulated Blast Furnace Slag

The MgO and Al2O3 content show the same trend up to respectively 10-12% and 14%, beyond which no further improvement can be obtained. Several compositional ratios or so-called hydraulic indices have been used to correlate slag composition. The latter being mostly expressed as the binder compressive strength.

The glass content of slags suitable for blending with Portland cement typically varies between 90-100% and depends on the cooling method and the temperature at which cooling is initiated. Increased amounts of network-modifiers lead to higher degrees of network de-polymerization and reactivity.

Common crystalline constituents of blast-furnace slags are merwinite and melilite. Other minor components which can form during progressive crystallization are belite, monticellite, rankinite, wollastonite and forsterite. Minor amounts of reduced Sulphur are commonly encountered as old Hamite.

Table 3.1 Chemical Compositions of GGBS

Component	Wt %
Calcium oxide	40%
Silica	35%
Aluminium	13%
Magnesia	8%

Table 3.2 Physical Properties of GGBS

Component	Wt%
Color	Off white
Specific gravity	2.9
Density	1200 kg/m³
Fineness	350 m²/kg

CHAPTER 2

LITERATURE REVIEW

Mahendra.K.V et al (2007), "Composites and their application in automobiles". They studied the effect of reinforcement of Boron Carbide with the Al2024. By adopting stir casting technique fabricated the specimen by varying the wt% of Boron Carbide. The specimens are developed as per the ASTM. In the end they come to know that as the reinforcement Boron Carbide increased by wt% increases the Hardness, Tensile strength and Yield strength. The percentage of elongation decreases with the increase of Boron Carbide in the composition.

Hung N. P et al (1996), "Machinability of aluminium alloys reinforced with siliconcarbide particulates. They investigated the effect of 5 wt% of TiB2 as a reinforcement with the Al356.1 metal matrix at various temperature i.e.750c, 850c, 950c using stir casting technique. They found that at temperature 950c show best result s for Tensile strength and Hardness and the TiB2 particles are homogenously distributed.

Lindroos V.K et al (1995), "Recent advances in metal matrix composites". They investigated the effect of the various weight fraction of SiC i.e.2.5%,5%,7.5% and 10% and 5% flyash is reinforced with Aluminium 6061 metal matrix composite by using the stir casting method. They observed that Tensile strength, Harness and Impact strength increased with the increase in weight fraction of SiC particle. A best tensile strength 115 N/mm2, hardness 93RHN and toughness value 7.8 for 10% SiC and 5% flyash reinforced composite material was obtained.

Mohanty Samrat et al (2007), "Development of fly ash-based automotive brake lining, Tribology International". They investigated the mechanical properties of the developed SiC reinforced with Al6063 metal matrix composite material using Melt stirring technique where the experiment was carried out by varying the reinforcement particle size such as 200 mesh, 300 mesh, 400 mesh with the different weight percentage i.e..5%, 10%, 15% and 20% of SiC particle reinforced material. The stirring process was carried out at the speed of 200rpm using the graphite impeller for a period of 15min. A homogenous dispersion of SiC particle in the aluminium matrix was observed. The tensile

strength, hardness and yield strength were improved with the enlargement of particulate size and weight percentage of SiC. Percentage reduction area and percentage elongation and impact strength decreases as the increase in reinforced particle size and weight percentage of SiC particle. Maximum hardness (HRB) 83 and impact strength 37.01 Nm was achieved.

Rohatgi P.K et al (2006), "Applications of Fly Ash in Synthesizing Low Cost MMCs for Automotive and Other Applications". They investigated the mechanical properties and wear properties of Al7075 with the reinforcement of Boron Carbide. They concluded that using the using Friction Stir casting the fabricated specimens provides uniform mixing and enhances the tensile strength and hardness. Hence the microstructure are studied with the help of Image analyser.

Asthana R et al (1986), " Solidification, structures, and properties of cast metalceramic particle composites". They investigated the effect of flyash and zirconia with the mechanical properties of Aluminium 6061 alloy composite samples developed by using the technique Stir casting. They developed the specimen by varying the zirconia (5% and 10%) and kept the flyash 10% as a fixed percentage by weight fraction. They observed that due to the presence of flyash and zirconia Hardness and Tensile strength was increased where the elongation decreased as compared to the unreinforced aluminium. The characterization will be done using the scanning the electron microscope machine and image analyser.

Sarkar S et al (1986), "Aluminum – fly ash composite produced by impeller mixing". They observed the mechanical properties of aluminium alloy mmc with the reinforcement of fused Zirconia alumina. They developed the specimens by varying by the weight fraction by percentage. They evaluated the mechanical properties which indicates the variations in the Hardness, Tensile strength and Impact strength. The optimum result for mechanical properties found on the reinforcement to be 90 and 10 by weight percentage of the matrix respectively.

William D. Callister et al (2001), "Aluminum – fly ash composite produced by impeller mixing". They investigated the effect of flyash and zircon (zirconium silicate) with the mechanical properties of Aluminium 7075 alloy and the stir casting technique was adopted to develop the specimens by varying weight percentage .They after conducting the different test concluded that keeping the zircon at a fixed weight percentage and varying the

flyash found that the wear rate decreases where the tensile strength and the hardness increases.

Hull D et al (1996), "An Introduction to Composite Materials, Cambridge, UK: Cambridge Univ". They studied the incorporation of Zirconium Nano Particles in Al356.2.The stir casting technique was used for the development of composite specimen where the Al356.2 is heated at around 750c and the Zirconium Nano particles are added .Mechanical properties are increased for 15wt% of reinforcement particle developed at 750c shows homogenous reinforcement particle and through using the Scanning Electron Microscope the microstructure of the specimen shows homogenous reinforcement.

Matthews F.L et al (1994), "Composite materials engineering and science". They investigated the mechanical properties of Aluminium 6063 alloy composite enhance i.e. strengthened by the addition of alumina particle and zircon sand with an overall reinforcement in the Al6063 material matrix. They observed the Hardness and Tensile strength of the composite having higher value at the composite developed specimen, which having reinforcement mixture of 4wt%ZrSiO4+4wt% Al2O3.

Chawla K.K et al (1974), "On the applicability of the "Rule-of-Mixtures" to the strength properties of metal-matrix composites". They studied the effect of various weight fraction of zirconium oxide nanoparticle i.e. 0.5%,1%,1.5% and 2% reinforced with Al356.1 metal matrix composite by using stir casting technique. Here they observed that particle agglomeration in the composite is due to high amount of zirconium oxide nanoparticle. Hardness and wear properties are increased as the increase in weight fraction of zirconium dioxide nanoparticle.

Narciso J et al (1994), "Wettability of binary and ternary alloys of the system Al-Si-Mg with SiC particulates". They studied the mechanical properties of developed composite specimen using the stir casting method where they considered zircon and TiB2 ceramic particles with size 1 micron and the temperature 750c respectively. The microstructure were studied by using scanning electron microscopy and hence the dispersion of reinforcement as noted. Situation of compounds of the developed specimen were examined by XRD. The end results shows mechanical properties and microstructure behavior of composite was improved compared to the monolithic alloy. Microstructures of the composites in as cast conditions shows uniform distribution of the particles and reveals

the better bending in case of zircon reinforced composites compared to the TiB2 composites. But increase in the amount of reinforcement shows better conditions in case of TiB2 reinforced composites.

Rohatgi P.K (1993), "Metal-matrix Composites, Defence Science Journal". They investigated the mechanical properties of Al 6061 reinforced by flyash. They fabricated the composite specimens using the stir casting method. They developed three sets of composites with particle size of flyash of 4-25,45-50 and 75-100μm was used. The three set of composites are developed by varying weight fraction of 10%, 15% and 20%. The mechanical properties are like Tensile strength, Compressive strength, hardness and Ductility are studied. They found that increase of particle size of flyash decreases tensile strength, compressive strength and hardness of the developed specimens. They also find that by increase of weight fraction of flyash increases compressive strength ultimate tensile strength, hardness but decreases with increase of flyash particle size.

Ibrahim, I.A et al (1991), "E.J. Journal of Materials Science". They investigated the effect of flyash reinforced with Al6061.By varying the wt% of flyash using the stir casting method the specimens was developed. The found that increase of flyash increase the mechanical properties upto 20% of fly ash in the metal matrix but the corrosion resistance decreases with increase of flyash addition.

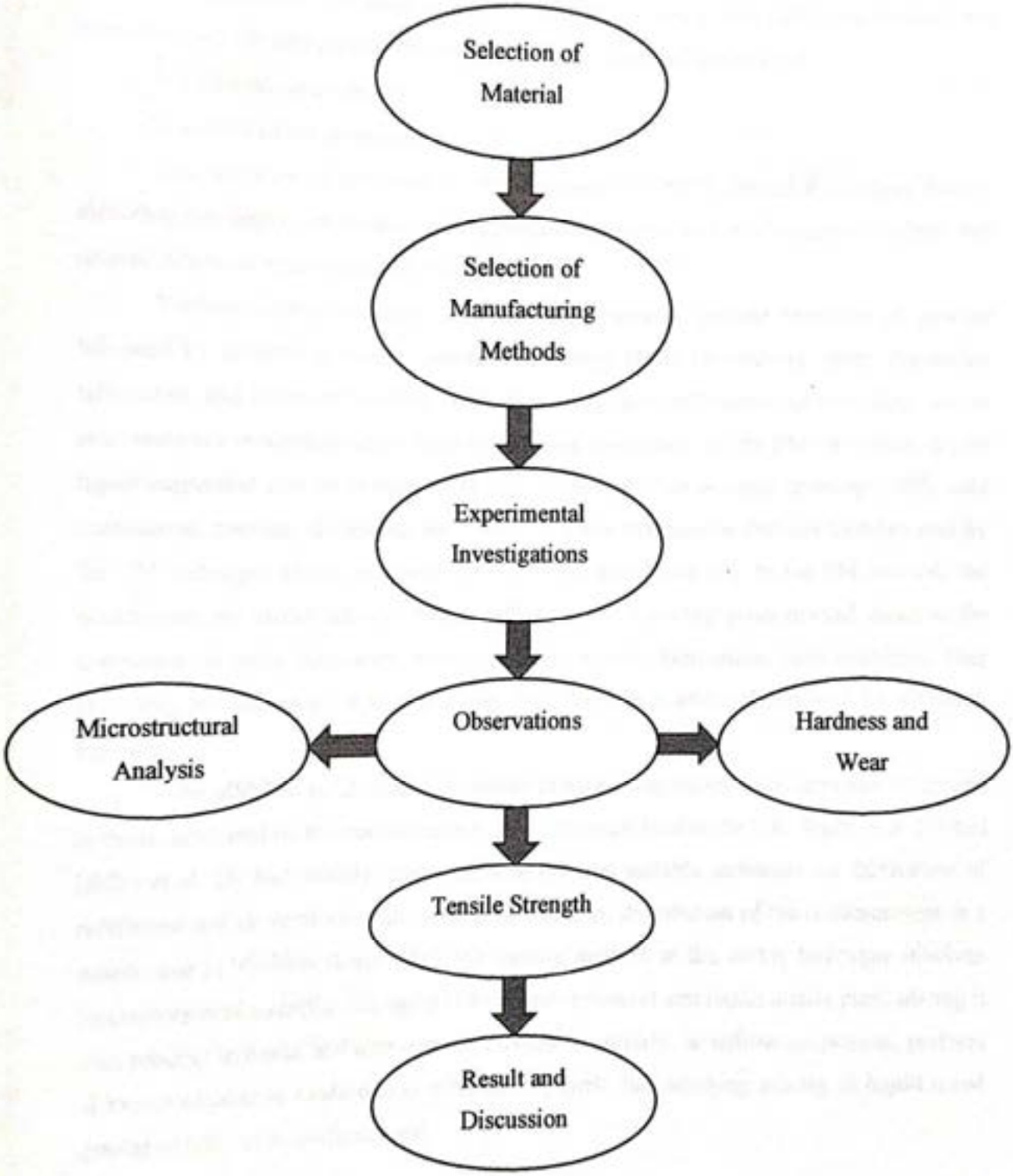
Liu Y. B et al(1994), "Recent development in the fabrication of metal matrix-particulate composites using powder metallurgy techniques". They investigated the Silicon carbide and Flyash reinforced with the Aluminium 6061 alloy.They developed the specimens using the stir casting method.They found that as the reinforcement contents increased in the matrix material, the composites hardness also increased. Tensile strength decreased with increased amount of reinforcement. The wear rate of the composites reduced with increased weight percentages of the reinforcements.

RESEARCH GAP

In this scenario, replacing of conventional material is higher because of lack of attainment of mechanical properties, which is absorbed from the above literatures. So, we are in need to find some suitable alternative materials for automobiles, aerospace industries. In this project, we fabricated a new novel composite (aluminium 6061 verified with GGBS) it act as a replacing material for conventional material. In particular, the researchers are only focusing the mechanical properties, surface morphology, X-ray, EDAX and SEM test is also carried out to clear understanding of behaviour of this AMC composite.

CHAPTER 3

METHODOLOGY



3.1 FABRICATION METHODS

Development of fabrication processes for the production of high-performance composites has been reported in many research studies. Figure 2 illustrates various fabrication techniques that were in use for the last few years. The following methods are most common for fabrication of the MMCs at large-scale industrial level.

1. Solid-phase processes.
2. Liquid-phase processes.

The adoption of the route for the synthesis of MMCs depended on many factors including the matrix temperature during processing, extent and reinforcement loading, and desired degree of microstructural integrity.

Well-established methods in solid-state processes include blending of powder followed by isostatic pressing (powder metallurgy (PM) processing), spray deposition techniques, and diffusion bonding. Melt stir casting, melt infiltration, spray casting, and in situ (reactive) processing come from liquid-state processing. In the PM technique, dry or liquid suspended powder is blended that is followed by hot isostatic pressing (HIP), cold compaction, canning, degassing, etc. There are a few composites that can be fabricated by the PM technique alone, as quoted by Hehmann and Froes [6]. In the PM method, the constituents are mixed into solid-state diffusion, and sintering gives desired shape to the composite. In spray deposition technique for composite fabrication, each individual fiber providing reinforcement is coated along with the matrix material followed by diffusion bonding.

The MMC thus fabricated possesses more homogeneous microstructure compared to those fabricated by the cast technique. In conferences held in the UK, Willis et al. [7] and Miller et al. [8] had already supported it as the best suitable technique for fabrication of reinforced and un-reinforced alloys. It provides even distribution of the reinforcement in a matrix that is 95–98% dense. Melt stir casting method or the vortex technique involves incorporation of a reinforcing agent (particulate=whisker) into liquid matrix melt, stirring it with rotating impeller and allowing the mixture to solidify. In infiltration process, preform of fibers=whisker is made and is infiltrated by melt thus allowing mixing of liquid metal (partial or full) with reinforcement.

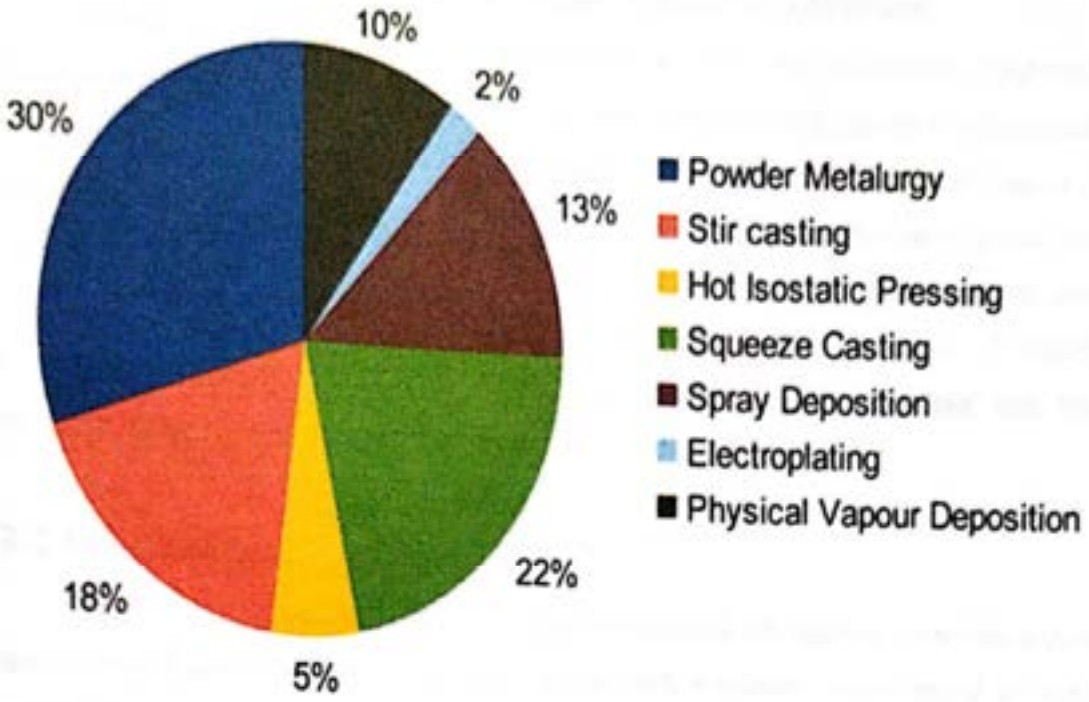


Figure 3.1 Pie Chart Representation of MMC

3.2 TECHNIQUES FOR FABRICATION OF METAL MATRIX COMPOSITE

These metal matrix composites have many advantages as compared to monolithic metals as discussed above so their applications are increasing day by day in various fields. Various processes are used to manufacture MMCs which are described here. These processes are classified on the basis of temperature of the metallic matrix during processing. Accordingly, the processes can be classified into five categories:

(1) liquid-phase processes,

(2) solid–liquid processes,

(3) deposition techniques,

(4) in situ processes.

(5) two- phase (solid–liquid) processes.

3.2.1 Liquid State Fabrication of Metal Matrix Composites

It involves incorporation of dispersed phase into a molten matrix metal, followed by its solidification. In order to provide high level of mechanical properties of the composite, good interfacial bonding (wetting) between the dispersed phase and the liquid matrix should be obtained. Wetting improvement may be achieved by coating the dispersed phase particles (fibers). Proper coating not only reduces interfacial energy, but also prevents chemical interaction between the dispersed phase and the matrix. The methods of liquid state fabrication of Metal Matrix Composites: Stir casting, Infiltration like gas pressure infiltration, Squeeze casting infiltration or Pressure die infiltration.

3.2.2 Stir Casting

It is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibres) is mixed with a molten matrix metal by means of mechanical stirring. Stir casting as shown in figure 2 is the simplest and the most cost effective method of liquid state fabrication. The liquid composite material is then cast by conventional casting methods and may also be processed by conventional Metal forming technologies.

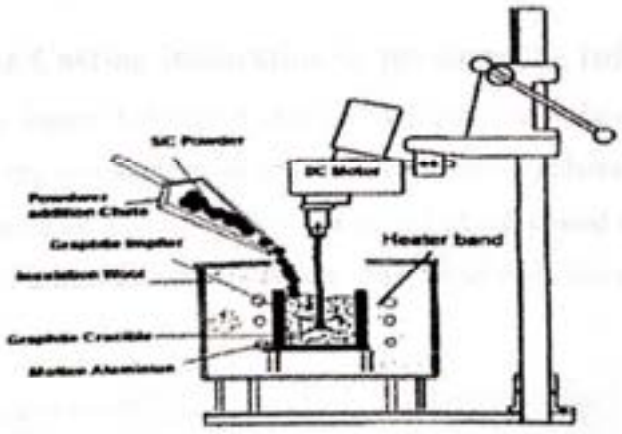


Figure 3.2 Stir Casting

3.2.3 Infiltration

It is a liquid state method of composite materials fabrication, in which a preformed dispersed phase (ceramic particles, fibers, woven) is soaked in a molten matrix metal, which fills the space between the dispersed phase inclusions.

The motive force of an infiltration process may be either capillary force of the dispersed phase (spontaneous infiltration) or an external pressure (gaseous, mechanical, electromagnetic, centrifugal or ultrasonic) applied to the liquid matrix phase (forced infiltration).

Gas Pressure Infiltration – It is a forced infiltration method of liquid phase fabrication of Metal Matrix Composites, using a pressurized gas for applying pressure on the molten metal and forcing it to penetrate into a preformed dispersed phase as shown in figure3. Gas Pressure Infiltration method is used for manufacturing large composite parts.

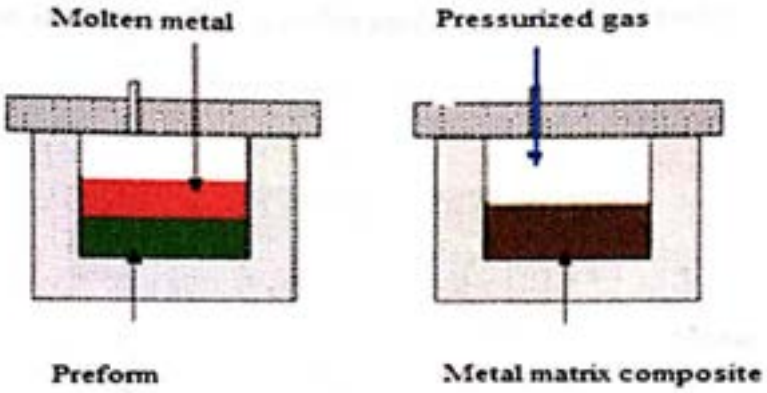


Figure 3.3 Infiltration

3.2.4 Squeeze Casting Infiltration or pressure Die Infiltration

It is a forced infiltration method of liquid phase fabrication of Metal Matrix Composites, using a movable mold part (ram) for applying pressure on the molten metal and forcing it to penetrate into a preformed dispersed phase, placed into the lower fixed mold part The method is used for manufacturing simple small parts like automotive engine pistons.

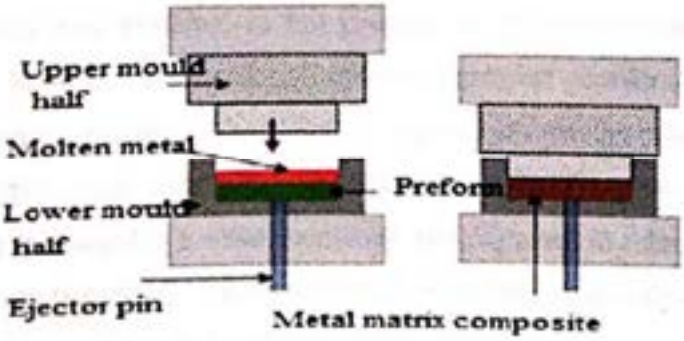


Figure 3.4 Squeeze Casting Infiltration

3.3 Solid state fabrication of Metal Matrix Composites

Solid state fabrication of metal matrix composites is the process , in which MMC are formed as a result of bonding of matrix metal and dispersed phase due to mutual diffusion occurring between them in solid state at elevated temperature and under pressure.

3.3.1 Diffusion Bonding

It is a common solidstate processing technique for joining similar or dissimilar metals. Inter diffusion of atoms between clean metallic surfaces, in contact at an elevated temperature, leads to bonding. It is also used for fabrication of MMC

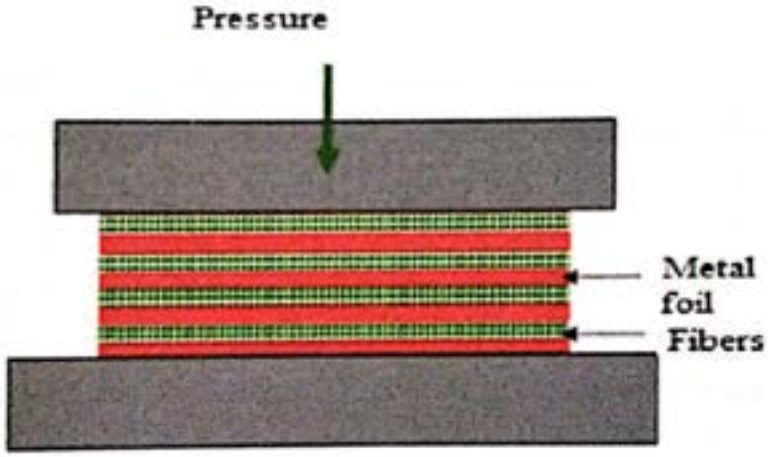


Figure 3.5 Diffusion bonding

3.3.2 Powder processing or powder metallurgy

These methods in conjunction with deformation processing are used to fabricate particulate or short fiber reinforced composites as shown in figure 6. This typically involves cold pressing and sintering, or hot pressing to fabricate primarily particle- or whisker reinforced MMCs. The matrix and the reinforcement powders are blended to produce a homogeneous distribution. The blending stage is followed by cold pressing to produce what is called a green body, which is about 80% dense and can be easily handled. The cold pressed green body is canned in a sealed container and degassed to remove any absorbed moisture from the particle surfaces. The material is hot pressed, uniaxially or isostatically, to produce a fully dense composite and extruded.

Figure 3.6 Powder Metallurgy

3.4 Deposition Techniques

These processes for metal-matrix composite fabrication involve coating individual fibers in a tow with the matrix material needed to form the composite followed by diffusion bonding to form a consolidated composite plate or structural shape. The main disadvantage of using deposition techniques is that they are time consuming. Several deposition techniques are available: immersion plating, electroplating, spray deposition, chemical vapor deposition (CVD), and physical vapor deposition (PVD), spray forming.

3.4.1 Spray Forming

One particular example of this, a co-spray process, uses a spray gun to atomize a molten aluminum alloy matrix, into which heated silicon carbide particles are Dipping or immersion plating is similar to infiltration casting except that fiber tows are continuously passed through baths of molten metal, slurry, sol, or organometallic precursors.

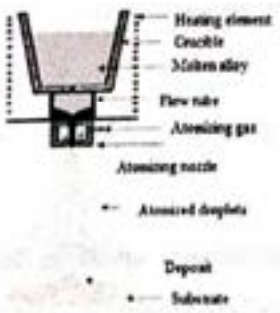


Figure 3.7 Spray Forming

3.5 ELECTRO CHEMICAL MACHINING (ECM)

Electrical energy is used to produce a chemical reaction in ECM. ECM is known as contactless electrochemical forming process. ECM process works on the principle of Faraday's laws of electrolysis. Michael Faraday revealed that proviso two electrodes are positioned in a bath having a conductive liquid, as well as DC potential (5-25V) is put across them, the metal is capable of being washed-out from the anode and coated on the cathode. ECM may be imagined as a restricted anodic closure at atomic echelon of the workpiece, which is electrically conductive by a formed tool as a result of the flow of high current at comparatively little potential difference by means of an electrolyte that is somewhat frequently water-based neutral salt solution (Sahu, 2012). An electrolyte operates as current transporter, and the elevated rate of electrolyte advance in the tool /work-piece gap cleans metal ions passed the work-piece (anode) prior to having an opportunity to plate on the tool (cathode). The cavity created is the female pair off image of the tool. The shaped tool is generally prepared through bronze, brass, stainless steel or copper. The electrolyte is an extremely conductive inorganic salt solution like sodium chloride varied in water or sodium nitrate, and it is propelled at an elevated rate by the ways in the tool.

ECM can be used to make disc for turbine rotor blades made up of HSTR (High Strength high Temperature Resistant) alloys, slotting very thin walled collets. ECM can also be used for the replication of interior and exterior surfaces, machining of complicated patterns, cutting of curvilinear slots, machining of gears, manufacture of extended bent profiles, and chain sprockets, manufacture of integrally bladed nozzle for employment in diesel locomotives and production of satellite rings.

The major advantages of ECM compared to other conventional machining are

- ECM can machine extremely complex and bent surfaces.
- A single tool is capable of being employed to machine a great amount of pieces devoid of several shortfall in its shape and size.

- Machined surfaces exhibit stress-liberated and burr-liberated attributes, having first-rate surface finish

- There is no thermal damage, and burr-free surface can be produced.

Some of the process parameters used in electrochemical machining process are current, voltage, flow rate, electrolyte concentration, gap, pressure, temperature, density and machining feed rate. These parameters can change the output parameters by increasing or decreasing the level, and hence it is also known as controlling parameters. Current, voltage, electrolyte concentration and gap are selected as input parameters for this research work. The predominant output responses considered for experimentation are Metal removal rate (MRR) and Surface Roughness (SR).

CHAPTER 4

CONCLUSIONS AND FUTURE WORK

The investigation was carried out on the fabrication of aluminium matrix composite reinforced with Nano sized GGBS particles of different weight percentage such as (3,6,9,12)

- Alumina particulate reinforced aluminium MMCs at different percentages were successfully prepared through stir casting process.
- We are going to analyse the hardness test and density of amount of GGBS present in it by using scanning electron microscopic test (SEM), and to take the Energy Dispersive X ray Analysis (EDAX), X-Ray diffraction (XRD).

REFERENCE

[1] Mahendra.K.V., Radhakrishna. K., 2007, "Castable composites and their application in automobiles", Proc. I Mech E Vol. 221, pp. 135-140.

[2] Hung N. P.,Boey,F.Y.C. Khor K.A.,Phua Y.S.,Lee H.F.,1996., "Machinability of aluminum alloys reinforced with siliconcarbide particulates", Journal of Materials Processing Technology,56, pp. 966-977.

[3] Lindroos V.K., Talvitie M.J., 1995., "Recent advances in metal matrix composites", J. Mater. Proc. Technol. 53, pp. 273–284.

[4] Mohanty Samrat, Chugh Y.P.,2007., "Development of fly ash-based automotive brake lining", Tribology International 40, pp. 1217–1222.

[5] Rohatgi P.K,Weiss D., and Gupta Nikhil.,2006., "Applications of Fly Ash in Synthesizing LowCost MMCs for Automotive and Other Applications", Journal of the Minerals, Metals and Materials Society, vol 58, pp. 71-76.

[6] Asthana R., Das S.,1986., "Solidification, structures, and properties of cast metalceramic particle composites", International metals reviews,31, pp. 115-139.

[7] Sarkar S., Sen S., Mishra S. C.,2008., "Aluminum – fly ash composite produced by impeller mixing", Journal of reinforced plastics and composites, pp. 1-6.

[8] William D. Callister., 2001., "Materials Science and Engineering-Materials Science and Engineering-An Introduction". Asia, John Wiley & Sons, pp. 115-125.

[9] Hull D., Clyne T W.,1996., "An Introduction to Composite Materials", Cambridge, UK, Cambridge Univ. Press, pp. 1227-1335.

[10] Matthews F.L., Ralwlings R.D.,1994.,"Composite materials engineering ans science", Glasgow, UK, Champaman and hall, pp. 254-275.

[11] Chawla K.K.,1974., "On the applicability of the "Rule-of-Mixtures" to the strength properties of metal-matrix composites, Revista Brasileira de Física,4, pp. 411-418.

[12] Narciso J., Alonso A., Pamies A., Cordovilta C.G., Louis E.,1994., "Wettability of binary and ternary alloys of the system Al-Si-Mg with SiC particulates", Scripta Metall. 31, pp. 1495-1500.

[13] Rohatgi P.K.,1993., "Metal-matrix Composites", Defence Science Journal, Vol 43, No 4, pp. 323-349'

[14] Ibrahim, I.A., Mohamed, F.A., Lavernia, E.J.,1991., "Journal of Materials Science" 26 (5), pp. 1137-1156.

[15] Liu Y. B, Lim S. C., Lu l, Lai M. O.,1994., "Recent development in the fabrication of metal matrix-particulate composites using powder metallurgy techniques", journal of materials science 29, pp. 999-2007.

BASALT FIBER MANAGEMENT IN THE PRODUCTION OF HIGHLY EFFECTIVE PHENOLIC COMPOSITES FOR THERMAL INSULATING APPLICATIONS

PROJECT WORK (PHASE I) REPORT

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ABSTRACT

The composites which made up of fiber reinforcements are universally endorsed option for the automobiles with light weight. They provide enhanced properties such as low weight, high impact strength and improved resilience. Due to unique properties of fiber reinforced composites it became a perfect alternative for traditionally used materials. Most of the engineering and automobile industries prefer Nano particles filled polymer matrix fiber reinforced composites for the reason that its light weight helps in carbon emission reduction. Fiber-reinforced composites are potentially strong, so it has more possibilities for combining advanced materials with technologies that are already familiar from the processing of plastics, for automobile structural components it possess light weight opportunities at a weight of 50% lighter than conventional steel and 30% lighter than aluminum. Composites formed by adding nano-scale particles to a polymer matrix results in improving electrical, mechanical, and thermal properties of the composite. Good tribological properties can be obtained for polymers filled with nano-scale fillers compared to that filled with micro-scale particles.

Compression Molding is a most commonly preferred method for fabricating hybrid composite laminates where as it is economical and efficient method too. In this proposed work Basalt/Phenolic composites filled with Aluminium Trihydrate Nano particles were fabricated and UL 94, Cone Calorimeter and Limiting Oxygen Index (LOI) tests along with pre & post fire mechanical tests were carried out. The Scanning Electron Microscope Imaging (SEM) and Micro Structural Analysis (Olympus Metallurgical Microscope) were carried out for Morphological studies and Failure Analysis. The final outcome of the proposed work results in hybrid composite that possess enhanced thermal, impact and flexural properties with moderate weight, which could be a better replacement for traditionally used glass reinforced composites. This above test will be carried out in the phase II.

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CHAPTER 1

1.INTRODUCTION

The development of composite materials and related design and manufacturing technologies is one of the most important advancement in the history of materials. Composite materials are multi-functional materials having Unprecedented mechanical and physical properties that can be tailored to meet the requirements of a particular application. Many composites also exhibit great resistance to high-temperature corrosion, oxidation and wear. These unique characteristics provide mechanical engineers with design opportunities which are not possible with conventional monolithic (unreinforced) materials. Composite technology also make the use of an entire class of solid materials possible in applications for which monolithic version are unsuited because of their great strength scatter, poor resistance to mechanical and thermal shock. Further, many manufacturing processes for composites are well adapted to the fabrication of large, complex structures, which allows consolidation of parts reducing manufacturing costs. The requirement is for enforcement towards development of new product. Composite materials were developed so that homogeneous structural materials could be found that had all the desired attributes for a given application. Brick-making process can still be seen on Egyptian tomb paintings in the Metropolitan Museum of Art. The most visible applications pave our roadways in the form of either steel or aggregate reinforced Portland cement or concrete. Those composites are closest to our personal hygiene from our shower stalls and bath tubs made of fiber glass. Solid surface, imitation granite and cultured marble sinks and counter tops are widely used to enhance our way of livelihood. Composites are made up of individual materials referred to as constituent materials. There are two categories of constituent materials in a composite: matrix and reinforcement.

1.1 OVERVIEW OF COMPOSITES

Now-a-days, the interest in composite materials is increasing rapidly both in terms of their research and applications. A composite material is composed of
Reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymers, metals, or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. The newly combined materials hence exhibit better strength than each individual material. Composites are combinations of two or more materials in which one of the materials is called the reinforcing phase which is in the form of fibers or particles embedded in the other material called the

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matrix phase. Usually epoxy or polyester resin systems are used for encapsulating a variety of electronic components because of their.

- High thermal stability
- Moisture resistance
- Low cost
- High coefficient of thermal expansion
- Low thermal conductivity

1.2 DEFINITION OF COMPOSITE

A composite (or composite material) is defined as a material that consists of at least two constituents (distinct phases or combinations of phases) which are bonded together along the interface in the composite, each of which originates from a separate ingredient material which pre-exists the composite.

Composite refers to a material, as opposed to a structure or a component, as such a composite material is used for the fabrication of components of various shapes or functions, thus it should be distinguished from a wing or other structure made of several components bonded together and from an electronic device or packaging structure made of layered materials (although one of the materials in the packaging could be considered a composite).

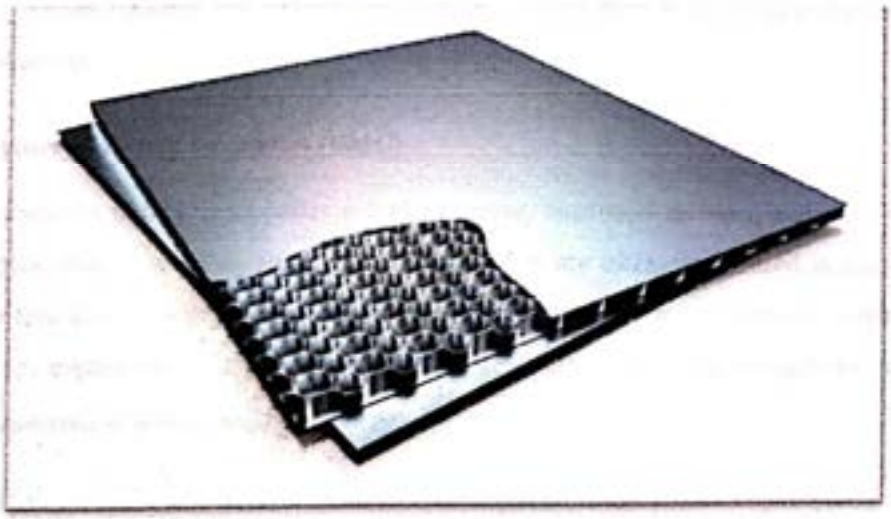

Fig.No: 1.1 Composite materials

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1.3 TYPES OF COMPOSITE MATERIALS

Broadly, composite materials can be classified into three groups on the basis of matrix material use.

- Metal Matrix Composites (MMC)
- Ceramic Matrix Composites (CMC)
- Polymer Matrix Composites (PMC)

1.3.1 Metal Matrix Composites (MMC)

These composites consist of metal alloys reinforced with continuous fibers, whiskers (a version of short fibers that are in the form of single crystals), or particulates (fine particles, as distinct from fibers). They use metals as matrix materials and they have a higher temperature resistance than PMCs but in general are heavier.

1.3.2 ceramic matrix composites (cmc)

Ceramic matrix composites (CMCs) have a ceramic matrix such as alumina calcium alumina silicate reinforced by fibers such as carbon/silicon carbide. Advantages of CMCs include high strength, low density, hardness, high service temperature limits for ceramics and chemical inertness. However, ceramics by themselves have low fracture toughness. For producing ceramic matrix composites one of the main objectives is to increase the toughness of final Material.

1.3.3 Polymer Matrix Composites (PMC)

Polymeric matrix composites are inexpensive, corrosion resistant and easy to form into complex shapes, and they have low densities. They are increasingly used in automotive, aerospace and many other commercial applications. In general the mechanical properties of polymers are inadequate for many structural purposes; particularly their strength and stiffness are low compared to metals and ceramics.

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1.4 TYPES OF POLYMER COMPOSITES

Broadly, polymer composites can be classified into three categories on the basis of reinforcing material. They are given as;

- Fiber reinforced polymer (FRP)
- Particle reinforced polymer (PRP)
- Structural/ Hybrid polymer composites (SPC)

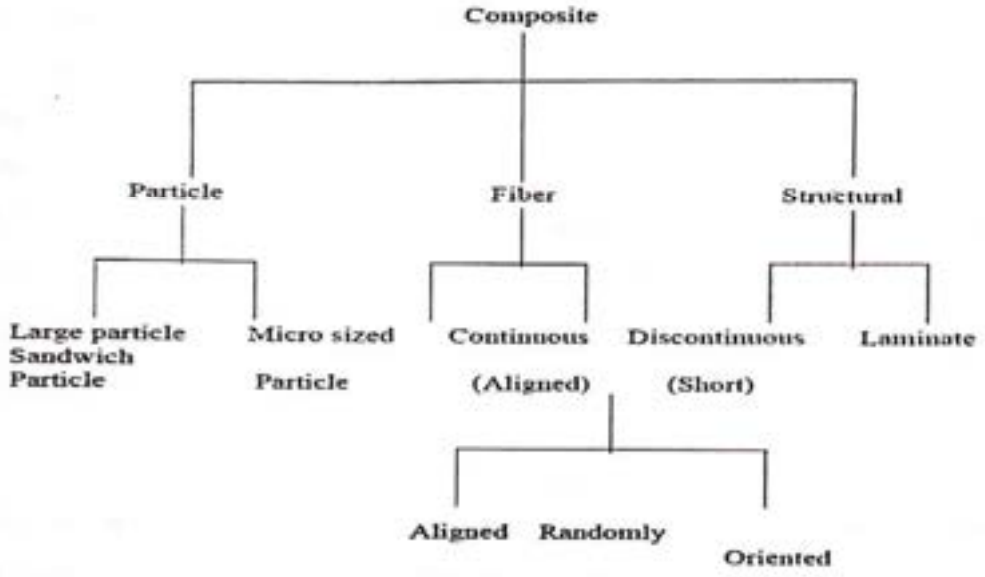

Fig.No:1.2 Classifications of composites

1.4.1 Fiber Reinforced Polymer (FRP)

Fiber reinforced composites contain reinforcements having length much greater than their cross-sectional dimensions. Such a composite is considered to be a discontinuous fiber or short fiber composite if its properties vary with fiber length. Fibers and matrix are the main constituents of common phase of fiber reinforced composites. Fibers are the main source of strength in composite. Main function of fibers is reinforcement and while matrix glues all the fibers together in shape and transfers stresses (load) between the reinforcing fibers.

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1.4.2 Particle Reinforced Polymer(PRF)

These are the cheapest and most widely used. They fall in two categories depending on the size of the particles.

- Large - particle composites, which act by restraining the movement of the matrix, if well bonded.
- Dispersion-strengthened composites, containing 10-100 μm particles. The Matrix bears the major portion of the applied load and the small particles hinder dislocation motion, limiting plastic deformation.

1.4.3 Structural Polymer Composites(SPC)

The laminar composites are composed of layers of materials held together by matrix. Sandwich structures also falls under this category. Previously, it has been found that polymers have replaced many of the conventional metals or materials in various applications. This has been possible due to the advantages of the polymers over conventional materials, ease of processing productivity and cost reduction are the most important advantages of using polymers in composite.

1.5 LAMINATE DEFINITION

A lamina (also called a ply or layer) is a single flat layer of unidirectional fibers or woven fibers arranged in a matrix form. A laminate is a stack of plies of composite material. Each layer can be laid at various orientations and can be made up of different material systems. The average properties of a composite ply are depending on the individual properties of the constituents. The properties are including stiffness, strength, moisture expansion and thermal coefficient.

1.6 FIBER REINFORCED POLYMER

Fiber is a natural or synthetic substance that is significantly longer than it is wide. Fibers are often used in the manufacture of other materials. The strongest engineering materials often incorporate fibers, for example carbon fiber and ultra-high-molecular-weight polyethylene. Synthetic fibers can often be produced very cheaply and in large amounts compared to natural fibers, but for clothing natural fibers can give some benefits, such as comfort, over their synthetic counterparts.

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1.7 TYPES OF FIBER REINFORCED POLYMERS

There are many different types of fibers that can be used to reinforce polymer matrix composites. The most common are carbon fibers (AS4, IM7, etc.) and fiberglass (S-glass, E-glass, etc.). As with the matrix, the fiber chosen will be determined by the end application.

1.8 FIBER REINFORCED COMPOSITES IN INDUSTRY

1.8.1AUTOMOTIVE

The automotive industry has adopted composites slowly due to their higher costs. Particulate reinforced plastics have been used for some time but fiber reinforced composites have only really been used in high end sports cars but are starting to make their way into traditional vehicles. Race cars have used carbon fiber materials for many years. Fiber–reinforced composites are potentially is strong. So it has more possibilities for combining advanced materials with technologies that are already familiar from the processing of plastics. For automobile structural components it possess light weight opportunities at a weight of 50% lighter than conventional steel and 30% lighter than aluminum, more automakers use these materials as the body structure or other car components. With these advantages that coordinate directly with the automotive industry's needs, plastics and polymer composites can be a major part of the solution for automobile manufacturers.

1.8.2AEROSPACE

Carbon fiber composites are now quite common in commercial and military aviation. The Boeing 787 and Airbus A350 XWB have roughly 50% of their structure from composite materials. Carbon fiber materials are also common in helicopter systems, rocket motors, satellite systems, and turbine engines.

1.8.3MARINE

Fiberglass has been the common material for recreational boats and yachts for many years. These are not traditional laminated composites, rather the glass fibers are oriented randomly giving the structure more uniform material properties. Being fairly cheap, glass fiber can be used in large structures; whereas carbon fiber would be too expensive.

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1.8.4 DEFENSE

In the defense sector, fiber-reinforced polymer composites (FRPs) are used in application such as land systems, military aircraft, UAVs, naval vessels, and weapons. The properties that make FRPs desirable for use in defense applications are:

- Lightweight – excellent for protective clothing and for vehicle components.
- Impact resistance – high strain/failure ratio. If the composite does fail on impact it will shatter and be less harmful to those in the surrounding area than metal.
- Can be coupled with other materials (e.g. metals and ceramics) to increase protection properties.
- Corrosion resistant – less "in field" maintenance required.
- Design for manufacture – e.g. full shapes can be designed and moulded as one piece, reducing the amount of parts needed and increasing production speed.
- Embedded functionality – monitoring systems can be integrated into the material.

1.9 BASALT FIBER

As an organic fiber, basalt fiber has good strength, modulus, thermal and chemical properties. Some investigation reported that basalt fibers have better properties than glass fibers and nylon fibers are attractive materials because of their superior impact resistance.

The use of basalt fibers was investigated in low cost composites for civil infra-structure applications requiring excellent mechanical properties and long lifetimes. Basalt fibers were thought to have great potential as reinforcement in both polymer materials and in concrete. However, this research focused on the use of basalt fiber reinforced polymer composites.

In recent years, continuous basalt fibers from naturally fire-resistant basalt are attracted attention as a replacement for a asbestos fibers. In the last decade, basalt has emerged as a contender in the fiber reinforcement of composites. Some manufacturer of basalts claims it offers performance similar to S-2 glass fibers at a price point between S-2 glass and e-glass, and may offer manufactures a less expensive alternative to carbon fiber. Basalt

Fiber (BF) is capable to withstand very high temperature and can act as fire blocking element. Basalt is well known as rock found in virtually every country around the world. Its main use is as a crushed rock used in construction, industrial and highway engineering.

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However it is not commonly known that basalt can be used in aerospace manufacturing .and made into fine, superfine and ultrafine fibers. Comprised of single-ingredient raw material melt, basalt fibers are superior to other fibers in terms of thermal stability, heat and thermal insulation properties, vibration resistant and durability.

Basalt fibers are safer than carbon fibers as they are electron insulators not conductors. Through this attribute they make excellent superior wind turbine blades and aircraft without creating a magnetic field when exposed to the atmosphere, basalt continuous fiber offer the prospect of a completely new range of composite materials and products. Basalt products have to toxic reaction with air or water, are non combustible and explosion proof.

In practice the impact condition may range from the accidental dropping of hand tools to high speed collisions, and the response of a structure may range from localized damage to total disintegration.

If a material is stain rate sensitive, its static mechanical properties cannot be used in designing against impact failure. Furthermore, a fracture modes in impact condition can be quite different from thus observed in static test.

When in contact with other chemicals they produce no chemical reactions that may damage health or the environment. Basalt replaces almost all applications of asbestos and has three times its heat insulation properties. Basalt based composites can replace steel and all known reinforced plastics (1 kg of basalt reinforcement equals 9.6 kg of steel). The life of basalt fiber pipes, designed for a variety of applications, is at least 50 years without maintenance or electrical or technical protection. The application temperature of articles made of basalt fibers markedly higher (from -2600 c to 9000 c).

A variety of standard impact test methods are available for metals (ASTM E23) and unreinforced polymers (ASTM D 256). Some of these tests have been also adapted for fiber reinforced composite material. However, as in the case of metals and unreinforced polymers, the impact tests don't yield basic material property data that can be used for design purposes. They are useful in comparing the failure modes and energy absorption capabilities of two different materials under identical impact conditions. They can also be used in the area of quality control and materials development.

Glass fiber when used as a thermal insulating material is specially manufactured with a bonding agent to trap many small air cells, resulting in the characteristically air-filled low-density "glass wool" family of products.

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1.9.1 BASALT FIBER PROPERTIES

- High Strength to weight ratio
- Rigidity
- Corrosion resistance
- Moderate Electrical Conductivity
- Fatigue Resistance
- Good tensile strength
- Fire Resistance/Not flammable
- High Thermal Conductivity in some forms
- Low coefficient of thermal expansion
- Non poisonous
- Biologically inert
- X-Ray and Radar Permeable

  Excellent EMI (Electromagnetic Interference) Shielding Property

1.10 PHENOLIC RESIN

Phenolic resins are a group of the most versatile polymers yet invented. Although they came into existence at the very start of the age of polymers, they continued to be developed into more and more applications.

Phenolic resins are a type of synthetic thermosetting resin invented by Dr. Leo Baekeland in 1907. The material was originally called Bakelite. This was effectively the first plastic to be sold commercially, and was typified by the old-style black telephones.

1.10.1 Types of Phenolic Resin

Phenolic resins are divided into two different types, *novolacs* and *resoles*. Both have high temperature stability up to 300° – 350° C, high water and chemical stability. Phenolic resins are often dark-colored from yellow to dark red, and have an excellent price/performance profile.

Phenolic resins are found in a myriad of industrial products. They are mainly used in the production of circuit boards. They are better known for the production of molded products including billiard balls, laboratory countertops, and as coatings and adhesives.

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1.10.2 Properties of Phenolic Resin

Phenolic resin retains its

- strength at high temperatures,
- resists creep under load, and
- possesses chemical and corrosive resistance.

1.10.3 Application of Phenolic Resin

Phenolic resins are widely incorporated in

- household appliances because of their excellent electrical resistance,
- dimensional and thermal stability, and
- resistance to water and solvents.

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CHAPTER 2

LITERATURE REVIEW

P.K.MALLIK 2003 fiber reinforced composite, material , manufracturing and Design"Processing and characterization of glass fiber and carbon fiber reinforced vinyl ester based composites' is studied by P.K.Mallik 2003. The mechanical behavior of glass fiber and carbon fiber reinforced vinyl ester composites was studied. From the results it is observed that the carbon fiber & resin of vinyl ester with mixture of Promoter, accelerator, catalyst showed better Mechanical properties. It is concluded that
shortest fibers have good adhesion with the vinyl ester resin for tensile properties.

Ajith Gopinath ,M.Senthil, A.Ilayaperumal 2014, experimental investigation of mechanical properties of jute fiber reinforced composites with polyester and epoxy resin matrix "test... Of Jute Fiber Reinforced Composites with Polyester and Epoxy Resin Matrices. In this research, fiber reinforced composites were prepared with jute fibers of fiber epoxy composite exhibited better mechanical properties than Jute-polyester composite.

A.Dorigato , A.Pegoretti,flexural and impact behaviour of basalt fiber hybrid laminateds. Jorunals of composites materials .Basalt and E-glass fibers fabrics were combined with carbon fiber fabrics in order to prepare epoxy-based interlaminar hybrid composites and to investigate the hybridization effect on the flexural and impact properties of the resulting laminates. The flexural modulus of the composites depended on their composition according to a rule of mixture, while an important synergistic effect was detected for the ultimate flexural properties. Charpy impact tests evidenced a strength increase as basalt and glass fibers content increased. Interestingly, hybridization with basalt fibers promoted an increase of the adsorbed impact energy due to an enhancement of the fracture propagation component.

Amutha Kanan , manikandan and udhay kumar 2014,mechanical properites of basakt and glass fiber reinforced polymer hybrid composites. This study describes the mechanical properties of Basalt fiber and Glass fiber reinforced hybrid composites developed by using compression moulding techniques. Woven Basalt fibers and Glass fibers were used for fabricating the hybrid composites, polyester resin as matrix with different fiber stacking sequences. The mechanical properties of hybrid composites like Flexural strength, Impact strength and tensile strength of the various specimens are calculated by using computer

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assisted Universal testing machine and Charpy Impact testing machine as per the ASTM standards. The result shows that the reinforcement of woven Basalt and Glass fibers hybrid composites significantly influencing on the mechanical properties of the composites and it found that the intermediate properties between basalt glass fibers reinforced composites.of kevlar fiber contains aromatic polyamide structure.

Nunna . 2012 a review on mechanical behaviour of natural fiber based hybrid composites "Hybrid composites are manufactured by combining two or more fibers in a single matrix. Hybrid composites can be made from artificial fibers, natural fibers and with a combination of both artificial and natural fibers. Hybrid composites can help us to achieve a better combination of properties than fiber reinforced composites. The constituent fibers in a hybrid composite can be altered in a number of ways leading to variation in its properties. The importance of this review can be attributed to the significant aspects of natural fiber based hybrid composites which are found to be predominantly affected by factors which include variation in fiber volume/weight fraction, variation in stacking sequence of fiber layers, fiber treatment and environmental conditions.Though, epoxies are used as insulators in electrical machineries, switchgears and transformers .The free charge carrier's presence is very low in concentration; this makes it unsuitable for electronic equipment. In order to achieve different conductivity ranges, epoxies are added with reinforcements for a variety of mechatronics applications.

R.Sasi kumar, M.Sshanthosh , j.Karna, M.sakthivel , K.Vishnu 2017 fabrication and mechanical behavior study of finer reinforced composites for automobile application. Mechanical and electrical characterization is an important milestone in the process of developing new product or novel material for specific industrial application. The present investigation focuses on study of low velocity impact and flexural properties of polymer matrix composites reinforced with Kevlar/E-glass and basalt fabrics. The fiber fabrics are two dimensional plain woven fabrics (2D-P). Two types of hybrid laminates and basalt/E-glass) with sixteen layers of fibers in each laminates were fabricated with Vacuum assisted resin transfer molding process (Vacuum bag molding). In order to evaluate the effect of hybridization on mechanical properties such as static low velocity impact and flexural behavior and electrical conductivity tests

Pegoretti. A, Fabbri E, Migliaresi c 2004 Intraply and interplay hydrid composites based on basalt and phenolic resin ". Basalt is one of the volcanic rock masses. It is in black color and is in concentrated heaps. It is found in the state as mass, vein and stream. Since it is a hard and durable stone, it is used as pavement, building stone, railway,

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bridge material. The basalt, which is abundant on the earth, covers thousands of square kilometers of places in some countries. Since it is a hard and durable stone, it has been used as paving stone, building stone, bridge material since the past.

De Rosa IM, Mara F, Pulci 2011 Post impact mechanical characterization of basalt woven fabric hybrid laminate"Basalt fibres were used to produce both homogeneous and hybrid composites with an orthophthalic unsatured polyester resin. Results are presented regarding the tensile and impact behaviour of both intraply and interply hybrid composites, with particular regard to the effects of the plies stacking sequence and the loading direction. With a proper choice of composition and stacking sequence, E-glass/PVA hybrid composites were proved to achieve a property profile superior to those of homogeneous E-glass laminates in terms of specific properties. In particular, hybridization with PVA fibres resulted in improving the specific impact energy of E-glass laminates. Resistance to impact crack propagation was higher for intraply with respect to interply hybrid composites, as evidenced by their ductility index values.

Bashar M, Sundararaj U and Mertiny P.2011 Study of matrix micro-cracking in nano clay and acrylic tri-block-copolymer modified epoxy/basalt fiber-reinforced pressure retaining structures. Post-impact properties of different configurations (symmetrical and non-symmetrical) of hybrid laminates including E-glass and basalt fibre composites, all with volume fraction of fibres equal to 0.38±0.02 and manufactured by RTM, have been studied. With this aim, interlaminar shear strength tests and four-point flexural tests of laminates impacted with different energies have been performed. Acoustic emission (AE) localisation and AE evolution with applied flexural stress was studied to support impact damage characterisation, provided by SEM and transient thermography. The results indicate that a symmetrical configuration including E-glass fibre laminate as a core for basalt fibre laminate skins presents the most favourable degradation pattern, whilst intercalation of layers may bring to further improvement of the laminate properties, but also to more extended and complex damage patterns.

Zhou1 Y. X., Wu2 P. X., Cheng2, Z-Y., Ingram1 J.and, Jeelani1 S. 2008. Improvement in electrical, thermal and mechanical properties of epoxy by filling carbon nanotube "Express Polymer Letters Basalt fibres fabrics were combined with carbon fiber fabrics in order to prepare epoxy-based interlinear hybrid composites and to investigate the hybridization effect on the flexural and impact properties of the resulting laminates. The flexural modulus of the composites depended on their composition according to a rule of mixture, while an important synergistic effect was detected for the ultimate

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flexural properties. Charpy impact tests evidenced a strength increase as basalt and glass fibers content increased. Interestingly, hybridization with basalt fibers promoted an increase of the adsorbed impact energy due to an enhancement of the fracture propagation component.

Navin Chand and Deepak Jain 2004. Evaluation of A.C. conductivity behaviour of graphite filled polysulphide modified epoxy composites Fire is one of the most frequent accident scenarios in process facilities and it may be responsible of severe escalation scenarios: flames and heat radiation can damage equipment units, support structures, and piping with consequent loss of containment of hazardous materials. Mitigation measures are acquiring increasing importance in the design of the facilities with the goal of reducing the probability of domino effect. Passive Fire Protection Materials (PFP), properly applied, contributes to the protection of industrial equipment against accidental fires. PFP delays the heating of the protected metal and vessel contents, allowing increased time for other mitigation measures. The present contribution focuses on the measurement and modeling of some key properties for the assessment of the performance of fiber fireproofing materials. The results of the experimental activities were used to develop heat transfer models in fire-like conditions applicable to Finite Element Modeling (FEM) simulations for advanced fire and safety analysis. Particular attention was devoted to the development of a unified model for effective thermal conductivity able to account for the role of operative conditions (temperature, deformation of the fireproofing, etc.).

Landucci G, Rossi F, Nicolella C. 2009 Design and testing of innovative materials for passive fire protection. Fire Safety J .In this work, long basalt fiber reinforced composites were investigated and compared with short basalt fiber reinforced compounds. The results show that long fiber reinforced thermoplastic composites are particularly advantageous in the respects of dynamic mechanical properties and injection molding shrinkage. The fiber orientation in long basalt fiber reinforced products fundamentally differs from short basalt fiber reinforced ones. This results in more isotropic molding shrinkage in case of long basalt fiber reinforced composites. The main advantage of the used long fiber thermoplastic technology is that the special long fiber reinforced pellet can be processed by most conventional injection molding machines. During extrusion compounding the fibers in the compound containing 30 wt% fibers are fragmented to an average length of 0.48 mm (typical of short fiber reinforced thermoplastic compounds), this length decreases further during injection molding to 0.20 mm. Contrarily using long fiber reinforced pellets and cautious injection molding parameters, an average fiber length of 1.8 mm can be achieved

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with a conventional injection molding machine, which increased the average length/diameter ratio from 14 to 130.

Carmisciano S, De Rosa IM, Sarasini F, 2011Basalt woven fiber reinforced vinyl ester composites: Flexural and electrical properties. This study focuses on the characterization of panels for passive fire protection made with new composite materials, based on basalt fibers and both organic and inorganic impregnating matrixes. These materials were experimentally investigated to assess their suitability to bear strict exercise conditions imposed by accidental flame impingement. To this end, an experimental facility was specifically designed to simulate jet fires at laboratory scale. The behaviour and the response of different types of materials were characterised by determining temperature profiles, weight losses and time for rupture under conditions of flame impingement.

Deak T, Czigany T, Marsalkova M, et al.2010. Manufacturing and testing of long basalt fiber reinforced thermoplastic matrix composites Basalt fiber and Glass fiber reinforced hybrid composites developed by using compression moulding techniques. Woven Basalt fibers and Glass fibers were used for fabricating the hybrid composites, polyester resin as matrix with different fiber stacking sequences. The mechanical properties of hybrid composites like Flexural strength, Impact strength and tensile strength of the various specimens are calculated by using computer assisted Universal testing machine and Charpy Impact testing machine as per the ASTM standards. The result shows that the reinforcement of woven Basalt and Glass fibers hybrid composites significantly influencing on the mechanical properties of the composites and it found that the intermediate properties between basalt glass fibers reinforced composites.

We have gone through all the above journals , we have found that the previous laminate are the fire withstanding ability is less , in our project the thermal withstanding ability will be increased, the property of the carbon fiber and basalt fiber are similar but the main advantages is that basalt fiber is less in cost, and the brittleness of the laminate is decreased to an extent and flexibility is increased.

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CHAPTER 3

EXPERIMENTAL WORKS

3.1 EXPERIMENTAL PROCEDURE

There are numerous methods for fabrication of composite components. Some methods have been borrowed but many were developed to meet specific design or manufacturing challenges. Selection of a method for a particular part therefore will depend the materials the part design and end use or application.

- Hand lay-up method
- Book press compression Moulding
- Resin infusion processes
- Vacuum bagging process
- Resin film infusion

In this project we have to fabricate the Fiber Laminate by using "Book press Compression Moulding Setup".

3.2 FABRICATION OF BASALT FIBER

The laminates were prepared by Book Press type Hand layup Molding process.

- The book press mold Setup (fig.no 3.1) made up of Five Mild steel plates drilled at four corners to fix fasteners
- Each plate has a weight of 11 Kg and Base plate has 7 Kg weight
- The Plates size was 455 mm X 300 X 5 mm.
- Initially the base plate is covered with perforated release film made up of thin glass sheet.
- Wax is applied on the release film for easy removal of laminate.
- Basalt and Kevlar fiber laminates tailored for a particular dimension is stacked one on another along with evenly distributed Resin hardener mixture.
- After attaining required thickness of laminate additional plates are fixed on the surface of the laminate which is covered with release film and coated with wax and tightened using screw fastener setup.

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- This experimental setup is allowed to cure for 2 hrs then the laminate is removed from the mold and cured in the hot air Owen at 55°C for 2 hrs.
- Finally the cured laminate is cut to the required size specimens by multi cutter.

Fig.No:3.1 Book Press Mould setup

3.3 TESTS COUDUCTED

3.3.1 MECHANICAL TEST

3.3.1.1 FLEXURAL TEST

The four-point bending(fig.no 3.2) flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress–strain response of the material. The main advantage of a four-point flexural test is the ease of the specimen preparation and testing. The test method for conducting the test usually involves a specified test fixture on a universal testing machine. The sample is placed on two supporting pins a set distance apart.

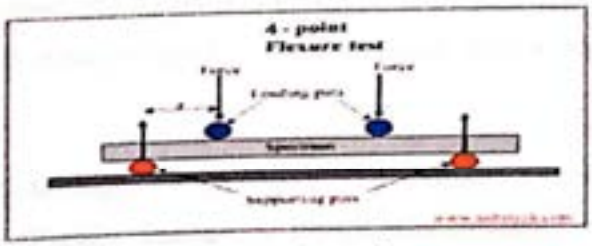

Fig.no 3.2 Flexural test

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3.3.1.2 IMPACT TEST

A Charpy test apparatus consists of a weighted pendulum, which is dropped from a specified height to make contact with the specimen. The energy transferred to the material can be inferred by comparing the difference in the height of the pendulum before and after the fracture. The test specimens were prepared for 55 x 10 x 3.5 mm (ASTM D6110).

The Izod impact test specimen designs are very similar to Charpy impact, with some notable differences, including the orientation of the specimen, which is clamped into the apparatus vertically with the notch facing toward the pendulum. The pendulum then impacts the sample at a specified area above the notch.

Both Charpy and Izod impact testing(fig.no 3.3) are popular methods of determining impact strength, or toughness, of a material. In other words, these tests measure the total amount of energy that a material is able to absorb. This energy absorption is directly related to the brittleness of the material.

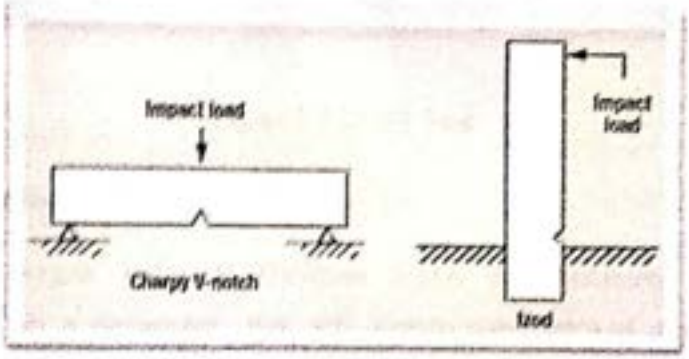

Fig.No: 3.3 Charphy and izod test

3.3.2 THERMAL TEST

3.3.2.1 UL 94 TEST

The Underwriters Laboratories (UL) intends this standard to serve as a preliminary indication of a plastics acceptability for use as part of a device or appliance with respect to its flammability(fig.no 3.4). It is not intended to reflect the hazards of a material under actual fire conditions.

UL 94 flammability testing is the first step toward obtaining a plastic recognition and subsequent listing in the "Plastics Recognized Component Directory" (former known as

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"Yellow Cards"). UL 94 contains the following tests: 94HB, 94V, 94VTM, 94-5V, 94HBF, 94HFandRadiantPanel.

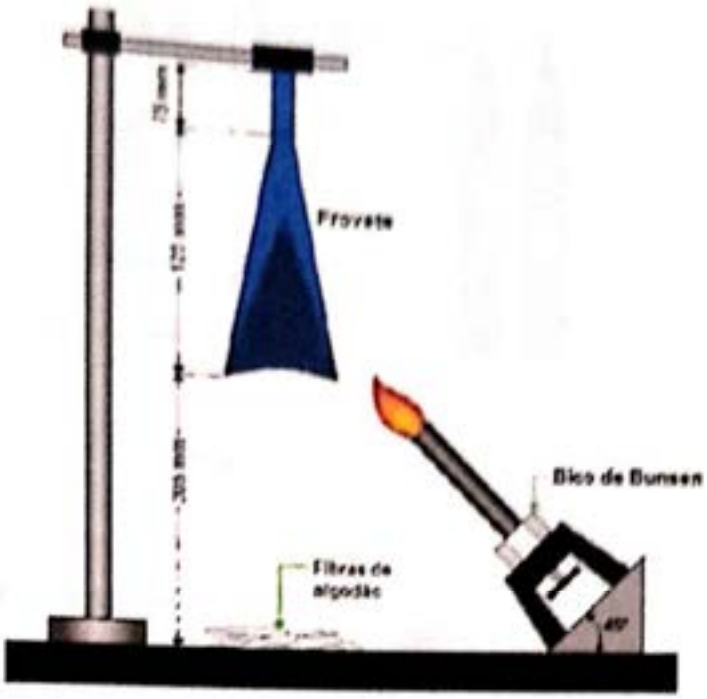

Fig.no 3.4 UL 94 Test

3.3.2.2 LOI(Limited Oxygen Index) Test

The **limiting oxygen index (LOI)(fig.no 3.5)** is the minimum concentration of oxygen, expressed as a percentage, that will support combustion of a polymer. It is measured by passing a mixture of oxygen and nitrogen over a burning specimen, and reducing the oxygen level until a critical level is reached. LOI values for different plastics are determined by standardized tests, such as the ISO 4589 and ASTM D2863.

The LOI value is also dependent on the surrounding temperature of the sample. The percent of oxygen required for combustion reduces as the surrounding temperature is increased.

Plastics and cable material is tested for its LOI value at both ambient temperature and elevated temperature to understand its oxygen requirement under actual fire conditions.Materials with an LOI greater than the atmospheric oxygen concentration are called fire retardant materials.

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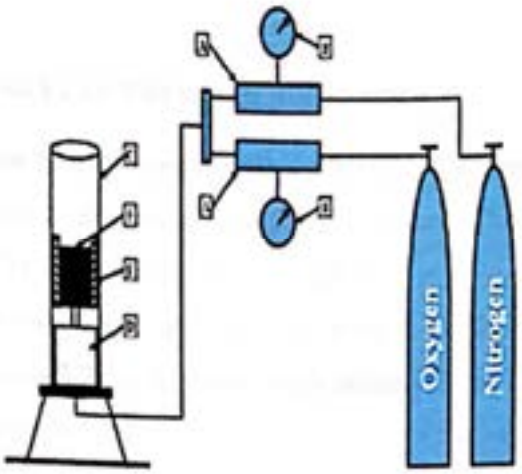

Fig.no 3.5 LOI test

3.3.3 MICROSTRUCTURAL ANALYSIS

3.3.3.1 METTULLURGICAL MICROSCOPE

A **metallurgical microscope** refers to a high power microscope used for the purposes of viewing opaque objects (objects in which light cannot pass through) these types of microscopes are different from the typical biological microscopes in that they use the principle of reflected light microscopy(fig.no 3.6). This makes them ideal for viewing metallurgical samples as well as a variety of other opaque objects (ceramics, plastics, rocks etc).

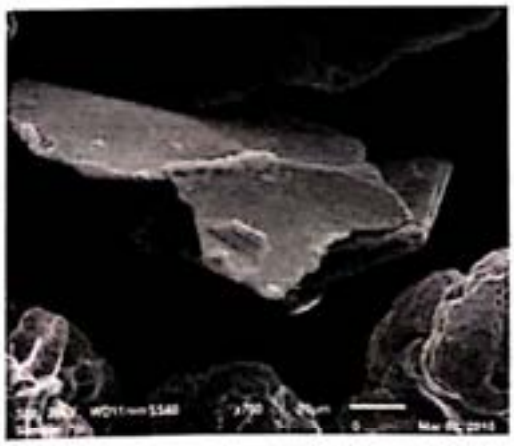

Fig.no 3.6 Metallurgical microscope

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3.3.3.2 SEM (SCANNING ELECTRON MICROSCOPE)

Scanning Electron Microscopy (SEM) is a test process that scans a sample with an electron beam to produce a magnified image for analysis. The method is also known as SEM analysis and SEM microscopy, and is used very effectively in microanalysis and failure analysis of solid inorganic materials. The method is also known as SEM analysis and SEM microscopy(fig.no 3.7), and is used very effectively in microanalysis and failure analysis of solid inorganic materials.

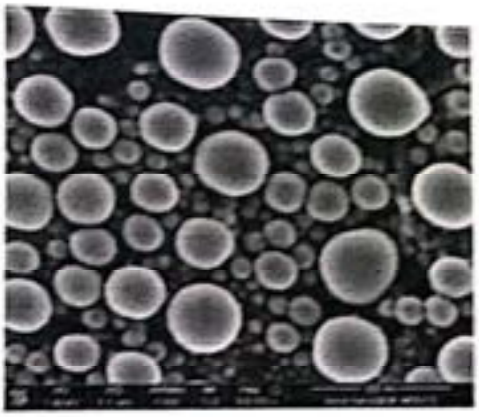

Fig.N0 3.7 SEM Test

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CHAPTER 4

4. BASALT FIBER APPLICATION

Fiberglass is an immensely versatile material due to its light weight, inherent strength, weather-resistant finish and variety of surface textures

Fiberglass is also used in the telecommunications industry for shrouding antennas, due to its RF permeability and low signal attenuation properties. It may also be used to conceal other equipment where no signal permeability is required, such as equipment cabinets and steel support structures, due to the ease with which it can be molded and painted to blend with existing structures and surfaces. Other uses include sheet-form electrical insulators and structural components commonly found in power-industry products.

4.1 Storage Tanks

Storage tanks(fig.no 4.1) can be made of basalt fiber with capacities up to about 300 tones. Smaller tanks can be made with chopped strand mat cast over a thermoplastic inner tank which acts as a perform during construction. Much more reliable tanks are made using woven mat or filament wound fiber, with the fiber orientation at right angles to the hoop stress imposed in the side wall by the contents. Such tanks tend to be used for chemical storage because the plastic liner (often polypropylene) is resistant to a wide range of corrosive chemicals. Fiberglass is also used for septic tanks.

Fig. No 4.1 Storage tanks

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4.2 Automobile Applications

Basalt fiber composites are potentially is strong. So it has more possibilities for combining advanced materials with technologies that are already familiar from the processing of plastics. For automobile structural components it possess light weight opportunities at a weight of 50% lighter than conventional steel and 30% lighter than aluminum, more automakers use these materials as the body structure or other car components(fig.no 4.2). With these advantages that coordinate directly with the automotive industry's needs, plastics and polymer composites can be a major part of the solution for automobile manufacturers.

Fig. No 4.2 Black basalt fiber

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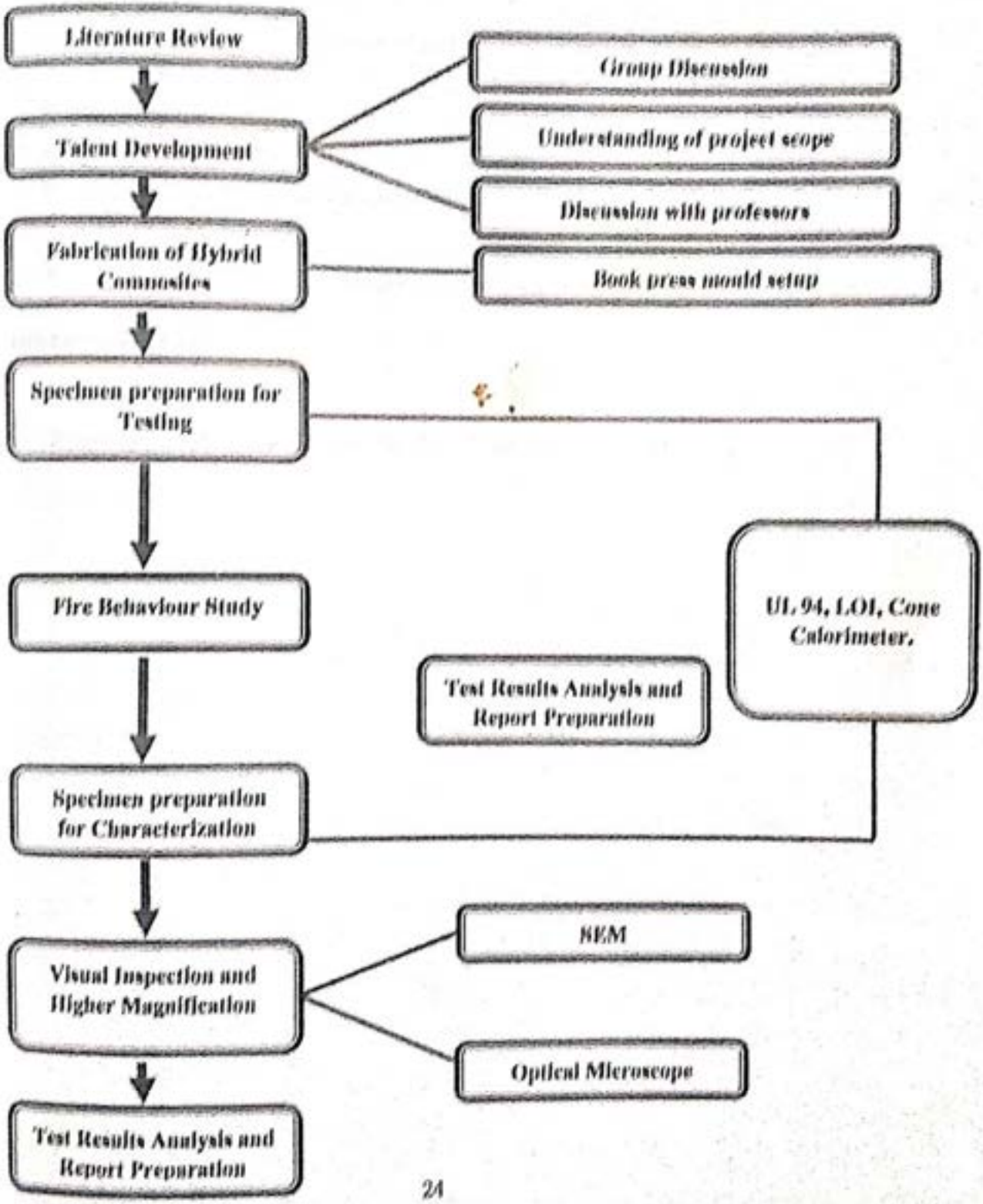
CHAPTER 5

RESEARCH METHODOLOGY



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CHAPTER 6

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Basalt fibers have better mechanical and physical properties than glass fibers, their main advantages being:
- fire resistance,
- good resistance to chemically active environments,
- vibration and acoustic insulation capacity
- better strength characteristics,
- and unlike most glass fibers is highly resistant to alkaline.

DISADVANTAGES

- long term deflection due to creep
- international authorities have yet to acknowledge these basalt fiber

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CHAPTER 7

CONCLUSION AND FUTURE WORK

In this project, polymer matrix (phenolic resin) and fiber reinforced composites (basalt fiber) will be moulded use book press compression moulding. The upcoming reinforced sheets are cost wise low and used in automobile and various areas of fields. The property of carbon fiber and these laminated sheets are similar to the properties. The proposed laminated composite material increase the fire withstands ability than other composites. This will cause the basalt composite undergo softening and decomposition of the polymer matrix and weakening of the fiber at faster rate, resulting in inferior fire resistance compared to glass fiber composite under combined tensile loading and one sided radiant heating.

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References

[1] P.K.Mallik. Fiber reinforced composites, Materials, Manufacturing and Design: *CRC* Press, 2003.

[2] AjithGopinath, M. SenthilKumar. A. Elayaperumal. Experimental investigations on mechanical properties of jute fiber reinforced composites with polyester and epoxy resin matrices. Procedia Engineering. 2014. Vol 97, 2052-2063

[3] A. Dorigato, A. Pegoretti. Flexural and impact behavior of carbon/basalt fibers hybrid laminates. Journal of Composite Materials. 2014, Vol. 48(9) 1121–1130.

[4] Amuthakkannan, Manikandan and Uthaya kumar. Mechanical Properties of Basalt and Glass Fiber Reinforced Polymer Hybrid Composites. Journal of Advanced Microscopy Research. 2014, Vol. 9, 1–6.

[5] Nunna et al. A review on mechanical behavior of natural fiber based hybrid composites. J Reinf Plast Compos 2012, 31:759–69.

[6] R. Sasi kumar, M.S. Santhosh, J. Karna, M. Sakthivel, K. Vishnu. Fabrication and mechanical behavior study of fiber reinforced composites for automobile applications. International Journal for Research in Applied Science & Engineering Technology. 2017, Vol. 5(9), 1599-1604.

[7] Pegoretti A, Fabbri E, Migliaresi C, et al. Intraply and interply hybrid composites based on E-glass and poly (vinyl alcohol) woven fabrics: tensile and impact properties. Polymer Int 2004, 53: 1290–1297.

[8] De Rosa IM, Marra F, Pulci G, et al. Post-impact mechanical characterization of E-glass/basalt woven fabric interply hybrid laminates. Expr Pol Lett 2011, 5: 449–459.

[9] Bashar M, Sundararaj U and Mertiny P. Study of matrix micro-cracking in nano clay and acrylic tri-block-copolymer modified epoxy/basalt fiber-reinforced pressure retaining structures. Expr Pol Lett 2011, 5: 882–896.

[10] Zhou1 Y. X., Wu2 P. X., Cheng2, Z-Y., Ingram1 J.and, Jeelani1 S. 2008. Improvement in electrical, thermal and mechanical properties of epoxy by filling carbon nanotube "Express Polymer Letters 2(1): 40–48.

[11] Navin Chand and Deepak Jain 2004. Evaluation of A.C. conductivity behaviour of graphite filled polysulphide modified epoxy composites. Bull. Mater. Sci., 27(3):227–233.

[12] Landucci G, Rossi F, Nicolella C. Design and testing of innovative materials for passive fire protection. Fire Safety J 2009, 44: 1103–1109.

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[13] Carmisciano S, De Rosa IM, Sarasini F, Basalt woven fiber reinforced vinyl ester composites: Flexural and electrical properties. Mater Des 2011, 32: 337–342.
[14] Deak T, Czigany T, Marsalkova M, et al. Manufacturing and testing of long basalt fiber reinforced thermoplastic matrix composites. Polymer Eng Sci 2010, 50: 2448–2456.

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ANALYSIS OF TRIBOLOGICAL FACTOR ON DRY SLIDING WEAR BEHAVIOR OF PLASMA SPRAY CERAMIC COATING BY TAGUCHI METHOD

PROJECT WORK PHASE-I REPORT

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In partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

OCTOBER 2019

ABSTRACT

Aluminium, iron and cast iron are the common material used for engine manufacturing in which aluminium is selected in our project for wear analysis. By plasma coating method (Al_2O_3, TiO_2, and ZrO2) are coated on the AISI 6061 steel substrate at a thickness of 150µm in which the 50µm (NiCrAlY) bond coat increase the strength of the wear resistance. The Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) characterization test is going to be conducted for structure and composition analysis of coating. The pin on disc test is going to be conducted for wear analysis at different process parameter (load, temperature, velocity). By using taguchi method the minimum wear rate of the coating (Al_2O_3, TiO_2, ZrO_2) at different ratio is find out which is coated in the engine to increase the performance.

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LIST OF SYMBOLS

SYMBOL

ρ	-	Density
E	-	Young's Modulus
σ	-	Tensile Strength
ε	-	Elongation
γ	-	Poison Ratio
T_m	-	Melting Temperature
K	-	Thermal Conductivity
α	-	Linear Thermal Expansion Co-efficient
c	-	Specific Heat Capacity
χ	-	Magnetic Susceptibility
n_D		Refractive Index

ABBREVIATION

SEM	-	Scanning Electron Microscope
XRD	-	X-Ray Diffraction
DCL	-	Double Ceramic Layer
HVOF	-	High Velocity Oxy-Fuel spray
LHR	-	Low Heat Rejection

CHAPTER 1

INTRODUCTION

Tribological performance of piston ring and cylinder liner combination in an internal combustion engine has been recognized as important factor in engine efficiency and durability regarding various aspects like fuel consumption, power loss, oil consumption and even in harmful exhaust emissions. Internal combustion engine uses critical components like (piston, injection valve) in the combustion chamber. If the tribological features of piston cylinder and ring liner are improved, energy consumed by friction will decrease, and overall emission and performance values will improve. The improvement of wear-resistant properties of aluminium piston ring-cylinder liner pair of an internal combustion engine can exert a significant influence on maintaining service properties, extending service life, and reducing the repair costs. The aluminium 6061 steel substrate are selected as the piston material to reduce the wear rate due to high temperature it is coated with Al_2O_3, TiO_2, ZrO_2 at different ratio and to identify the minimum wear rate of this composition.

Aluminium 6061 containing magnesium and silicon as its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is one of the most common alloys of aluminum for general-purpose use.

It is commonly available in pre-tempered grades such as 6061-O (annealed), tempered grades such as 6061-T6 (solutionized and artificially aged) and 6061-T651 (solutionized, stress-relieved stretched and artificially aged).

The Plasma Spray Process is basically the spraying of molten or heat softened material onto a surface to provide a coating. Material in the form of powder is injected into a very high temperature plasma flame, where it is rapidly heated and accelerated to a high velocity. The hot material impacts on the substrate surface and rapidly cools forming a coating. This plasma spray process carried out correctly is called a "cold process" (relative to the substrate material being coated) as the substrate temperature can be kept low during processing avoiding damage, metallurgical changes and distortion to the substrate material.

The pin on disc test has proved useful in providing a simple wear and friction test for low friction coatings such as diamond-like carbon coatings on valve train components in internal combustion engines.

A pin on disc tribometer consists of a stationary pin that is normally loaded against a rotating disc. The pin can have any shape to simulate a specific contact, but cylindrical tips are often used to simplify the contact geometry. The coefficient of friction is determined by the ratio of the frictional force to the loading force on the pin.

A scanning electron microscopy (SEM) test was going to conduct it produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster scan pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image.

CHAPTER 2

LITERATURE REVIEW

J.D. Oliva, et al. [1] (1997) Plasma spray metal coatings of Ni–Al, Cu–Ni, Ni–Cr–Al, and Al on Ti–8Mn were analyzed by X-ray photoelectron spectroscopy to characterizing the surfaces at each step of the coating process to identify the effects. 2-butanone cleaning and grit blasting cleaning methods were used to removing macroscopic contaminants to increase the TiO2 chemistry.

Y.Y. Yang, et al. [2] (1997) Five synthetic lubricants were employed to evaluate the effectiveness of graphite film by ceramic coating at high pressure and 320 °C. Due to combined lubrication of carbonaceous polymer is generated on the Al_2O_3–40%ZrO_2 coating the friction coefficient decreases to 0.04 for dry friction. The ether lubricant performs better than the ester lubricant for anti-friction properties. Zinc dialkyldithio-phosphate (ZDDP) plays an important role in the anti-wear performance of oils.

Ozkan, et al. [3] (2002) He investigated the residual stress of the coating at high temperature upto 1000°C. He coated MgO–ZrO_2/NiCrAlY on Ni metal and AlSi alloy by plasma spray coating method. SEM observations indicated that MgO–ZrO_2 ceramic coatings possesses a very dense structure and the metallic layer, at 1000°C the stress concentration was at higher level in both material which is reduced by the interlayer bond coating(decreases the residual stress).

Hathaipat Koiprasert, et al. [4] (2004) Fretting is a type of wear generally associated with vibration and is one of the major causes of failure. Four types of coating, namely WC-17%Co, Cr_3C_2-25%NiCr, AlSi-graphite and CoMoCrSi, were deposited on stainless steel substrates by thermal spraying techniques to resist fretting wear. The wear behavior of each type of coating was studied by using an in-house flat-on-flat wear tester in a nozzle at 500°C. It was concluded that the CoMoCrSi coating is suitable to use as protection from fretting wear at 500°C in fuel nozzle.

X.Q. Cao, et al. [5] (2004) Ceramic is the composition of two or more metal or oxides used as resistant from oxidation, corrosion and wear as well as thermal insulator so ceramic can be used as thermal barrier coating. Except yttria stabilized zirconia other earth oxides are promising material for thermal barrier coating.

R. Soltani, et al. [6] (2005) To minimize the emission of the engine the most common Yttira partially stabilized Zirconia coating method is done on the turbine blades for 1100°C. To attain this temperature the coating is to be 1mm in thickness for that a multi-layer coating method is done.

Hui Dai, et al. [7] (2006) Double ceramic layer (DCL) coating with various ratio composed of YSZ and lanthanum zirconate were produced by the atmospheric plasma coating. The thermal cycling test were conducted and shows that the cycle life was strongly depend on the DCL coating thickness. Between 150 to 200μm coating thickness have longer lives than single layer coating and it indicating that DCL structure has the advantages to overcome the disadvantages on the application of 1250°C.

Giovanni Bolelli, et al. [8] (2006) the wear resistence of plasma sprayed ceramic coating of (Al_2O_3, Al_2O_3-13% TiO_2, Cr_2O_3) investigated through pin on disc and dry sand-steel wheel test and HVOF spray method. The Al_2O_3 coating display the highest wear resistence. In pin on disc test no coating undergoes wear loss against the $100Cr_6$ ball that possess lower hardness.

M. Senthil Kumar, et al. [9] (2011) The high velocity oxide fuel spray method is used to spray (WC-12%CO and Al_2O_3-13%TiO_2) coating on AISI 1040 steel, the objective is to estimate the wear of coating at different parameter. The surface morphology, composition and phase structure analysis are done with the help of SEM and XRD. The high temperature pin on disc test was used to estimate the wear of the coating. The result show that at 600°C the wear failure mechanism turn from plastic deformation to fracture result crack propagation. The carbide coating exhibits at denser microstructure level with high hardness than ceramic coating.

P. N. Shrira, et al. [10] (2011) Piston crown, cylinder head and valves were coated with a 0.5 mm thickness of 3Al2O3 .2SiO2 (mullite) (Al_2O_3= 60%, SiO_2= 40%) over a 150 μm thickness of NiCrAlY bond coat. The working conditions for the standard engine (uncoated) and low heat rejection (LHR) engine were kept exactly same to emphasis the energy balance

common between two engines. The test were carried out and the result shows 1.07 % decreasing on specific fuel consumption, 16 % decreasing on heat amount to coolant 22 % increasing on heat amount to exhaust of LHR engine compared to standard engine at full load.

Dinesh Gond, et al. [11] (2011) Yttria-Stabilised Zirconia (YSZ) coatings were deposited on a T-22 boiler steel NiCrAlY was used as bond coat. The corrosion test was conducted in coated and uncoated specimen in air as well as salt (75 wt. % Na_2SO_4 + 25 wt. % NaCl) at 900°C under cyclic conditions the SEM, XRD are used to analyses corrosion produce zirconium oxides (ZrO_2) and yttrium oxide (Y_2O_3). YSZ coatings is more effective in salt environment.

Rashmi Mittal, et al. [12] (2012) He studied the wear behavior of the Al-12Si and Al-12Si-Sn/$ZrSiO_4$ by spray forming technique. The spray formed composite coating have lower wear rate than Al-12Si alloy which is due to size of the $ZrSiO_4$, if the size of the coating increases wear rate increases, size decreases wear rate decreases and also by increasing Sn content decreases the wear rate.

Jan Vinas, et al. [13] (2012) the plasma sprayed ceramic coatings of Al_2O_3, Cr_2O_3 Cr_2O_3+5% TiO_2 were evaluated. The addition of TiO_2 to the Cr_2O_3 material increased the coating density, but did not substantially reduce the hardness. Higher values of abrasive wear resistance and the microhardness were observed in the Cr_2O_3 coatings. Finally, the interlayer's coatings increased their resistance to thermal shock for upto 1000°C.

Vinay Kumar Domakonda, et al. [14] (2012) the use of thermal barrier coatings (TBCs) to increase the combustion temperature in diesel engines can increase the efficiency of the engine. The in-cylinder temperatures that can be achieved by the application of ceramic coatings can be as high as 850-9000◦C compared to current temperatures of 650-7000◦C helped in better release of energy in the case of biodiesel fuels thereby reducing the CO and (possibly) the NOx emission rate.

N.Krishnamurthy, et al. [15] (2012) Alumina and yttria stabilized zirconia was coated on the Al6061 substrate using Atmospheric Plasma Spraying technique Al $25Fe_7Cr_5Ni$ and Al_2O_3 (Ni_2Al) were used as bond coats. The coating samples were subjected to abrasive wear test as per ASTM G99.The SEM test indicates thermal stresses developed during spraying were the

main cause for the microcracks in the coating. Coating systems possess α-Al_2O_3 and ZrO_2, they can be used for wear and heat resistant application.

Saifi Usmani, et al. [16] (2013) the carbide size and cobalt content of thermally sprayed tungsten carbide/cobalt coatings (WC-Co) determine the microstructure, fracture strength, friction and abrasion resistance of the coating. Three experimental WC17 wt% Co powders with different carbide size distributions were produced by the high velocity oxy-fuel (HVOF) spray process. Coatings with finer carbides show higher hardness and lower indentation fracture toughness from WC phase to W2C phase.

Sachin Jadav, et al. [17] (2014) He had done ceramic coating of TiO_2, ZrO_2, (TiO_2+ZrO_2 (40%) with different thickness and says that ZrO_2 shows excellent wear property. The abrasive wear resistence of (TiO_2/ZrO_2) strongly depend upon the toughness, density and hardness of the coating.

M. Adam Khan, et al. [18] (2016) the sliding wear behaviour of nickel based superalloy pin was investigated on disc with the plasma sprayed NiCr–Cr_2O_3 coating and Al_2O_3 40% TiO_2 (A40T) coating. The wear resistance of A40T coated disc is superior to NiCr–Cr_2O_3 coated disc. The mass loss of the A40T disc is five times less than that of the NiCr–Cr_2O_3 coated disc. So A40T coating is suggested for all engineering components for better wear resistance coatings.

D.R.P. Rajarathnam, et al. [19] (2016) He investigated various ceramic oxides to determine the good wear resistence. They have coated alumina, titania, chromia, alumina-titania, alumina-chromia, titania-chromia on AISI 1040 steel substrate at 200µm thickness by plasma coating technique. To improve adhesion Ni-Cr used as intermediate bond layer at 20µm thickness. By using the pin-on-disc the dry wear test was conducted at different parameter. The microhardness value of the specimen determine the wear loss, if microhardness increases wear resistence increases. Result 99% of Cr_2O_3 has the highest microhardness value followed by 55%TiO_2-Cr_2O_3, 99%Al_2O_3.

Shailesh Kumar Singh, et al. [20] (2017) the chromium nitride (CrN) coating was coated on piston ring by physical vapor deposition method was investigated under dry conditions at room temperatures. Wear tests were carried out on a Pin-on-Disc tribometer. The rise of temperature from 28 to 42°C results in a reduced coefficient of friction.

CHAPTER 3

MATERIAL DESCRIPTION

MATERIALS USED:

Base metal: Aluminium 6061alloy

Coating powder: Aluminium oxide (Al_2O_3),

Titanium dioxide (TiO_2),

Zirconium oxide (ZrO_2)

3.1 Aluminium 6061 alloy

6061 is a precipitation-hardened aluminum alloy, containing magnesium and silicones its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is one of the most common alloys of aluminum for general-purpose use. The mechanical properties of 6061 depend greatly on the temper, or heat treatment, of the material. Young's Modulus is 69 GPa (10,000 ksi) regardless of temper.

Figure: 3.1 Aluminium 6061 plate

3.1.1 Aluminium 6061-O

Annealed 6061 (6061-O temper) has maximum tensile strength no more than 150 MPa (22,000 psi), and maximum yield strength no more than 83 MPa (12,000 psi) or 110 MPa (16,000 psi). The material has elongation (stretch before ultimate failure) of 10–18%.

Table: 3.1 Aluminium 6061 Specification

Al 6061	
Physical properties	
Density (ρ)	2.70 g/cm³
Mechanical properties	
Young's modulus (E)	68.9 GPa (9,990 ksi)
Tensile strength (σ_t)	124–290 MPa (18.0–42.1 ksi)
Elongation (ε) at break	12–25%
Poisson's ratio (ν)	0.33
Thermal properties	
Melting temperature (T_m)	585 °C (1,085 °F)
Thermal conductivity (k)	151–202 W/(m·K)
Linear thermal expansion coefficient (α)	2.32×10^{-5} K^{-1}
Specific heat capacity (c)	897 J/(kg·K)
Electrical properties	
Volume resistivity (ρ)	32.5–39.2 nOhm·m

3.1.2 Aluminium 6061-T4

T4 temper 6061 has an ultimate tensile strength of at least 180 MPa (26,000 psi) or 210 MPa (30,000 psi) and yield strength of at least 110 MPa (16,000 psi). It has elongation of 10-16%.

3.1.3 Aluminium 6061-T6

T6 temper 6061 has an ultimate tensile strength of at least 290 MPa (42,000 psi) and yield strength of at least 240 MPa (35,000 psi). More typical values are 310 MPa (45 ksi) and 270 MPa (39 ksi), respectively. In thicknesses of 6.35 mm (0.250 in) or less, it has elongation of 8% or more; in thicker sections, it has elongation of 10%. T651 temper has similar mechanical properties. The typical value for thermal conductivity for 6061-T6 at 25 °C (77 °F) is around 152 W/m K. A material data sheet defines the fatigue limit under cyclic load as 97 MPa (14,000 psi) for 500,000,000 completely reversed cycles using a standard RR Moore test machine and specimen. Note that aluminunt does not exhibit a well-defined "knee" on its S-n graph, so there is some debate as to how many cycles equates to "infinite life". Also note the actual value of fatigue limit for an application can be dramatically affected by the conventional de-rating factors of loading, gradient, and surface finish.

3.1.4 Aluminium 6061 uses

- Construction of aircraft structures, such as wings and fuselages, more commonly in homebuilt aircraft than commercial or military aircraft. 2024 alloy is somewhat stronger, but 6061 is more easily worked and remains resistant to corrosion even when the surface is abraded, which is not the case for 2024, which is usually used with a thin Alclad coating for corrosion resistance.
- Yacht construction, including small utility boats.
- Automotive parts, such as the chassis of the Audi A8.
- some tactical flashlights
- Aluminum cans for the packaging of food and beverages.
- SCUBA tanks (post 1995)

3.1.5 Aluminium 6061-T6 uses

- Bicycle frames and components.
- Many fly fishing reels.
- The Pioneer plaque is made of this alloy.
- The secondary chambers and baffle systems in firearm sound suppressors (primarily pistol suppressors for reduced weight and improved mechanical functionality), while the primary expansion chambers usually require 17-4PH or 303 stainless steel or titanium.
- The upper and lower receivers of many non mil-spec AR-15 rifle variants.
- Many aluminum docks and gangways are constructed with 6061-T6 extrusions, and welded into place.
- Material used in some ultra-high vacuum (UHV) chambers
- Many parts for remote controlled model aircraft, notably helicopter rotor components.
- Large amateur radio antennas.

3.1.6 Application

1. Welding

6061 is highly weld able, for example using tungsten inert gas welding (TIG) or metal inert gas welding (MIG). Typically, after welding, the properties near the weld are those of 6061-T4, a loss of strength of around 40%. The material can be re-heat-treated to restore near -T6 temper for the whole piece. After welding, the material can naturally age and restore some of its strength as well. Most strength is recovered in the first few days to a few weeks. Nevertheless, the Aluminum Design Manual (Aluminum Association) recommends the design strength of the material adjacent to the weld to be taken as 165 MPa/24000 PSI without proper heat treatment after the welding. Typical filler material is 4043 or 5356.

2. Extrusion

6061 is an alloy used in the production of extrusions—long constant–cross-section structural shapes produced by pushing metal through a shaped die.

3. **Forging**

6061 is an alloy that is suitable for hot forging. The billet is heated through an induction furnace and forged using a closed due process. This particular alloy is suitable for open die forgings

3.2 Aluminium oxide

Al_2O_3 is an electrical insulator but has a relatively high thermal conductivity (30 $Wm^{-1}K^{-1}$) for a ceramic material. Aluminium oxide is insoluble in water. In its most commonly occurring crystalline form, called corundum or α-aluminium oxide, its hardness makes it suitable for use as an abrasive and as a component in cutting tools.

Table: 3.2 Aluminium oxide Specification

Properties	
Chemical formula	Al_2O_3
Molar mass	101.960 g·mol^{-1}
Appearance	white solid
Odor	odorless
Density	3.987g/cm^3
Melting point	2,072 °C (3,762 °F; 2,345 K)
Boiling point	2,977 °C (5,391 °F; 3,250 K)
Solubility in water	insoluble
Solubility	insoluble in diethyl ether practically insoluble in ethanol
log *P*	0.31860
Magnetic susceptibility (χ)	$-37.0\cdot10^{-6}$ cm^3/mol
Thermal conductivity	30 W·m^{-1}·K^{-1}
Refractive index (*nD*)	n_ω=1.768–1.772 n_ε=1.760–1.763 Birefringence 0.008

Aluminium oxide is responsible for the resistance of metallic aluminium to weathering. Metallic aluminium is very reactive with atmospheric oxygen, and a thin passivation layer of aluminium oxide (4 nm thickness) forms on any exposed aluminium surface. This layer protects the metal from further oxidation. The thickness and properties of this oxide layer can be enhanced using a process called anodizing. A number of alloys, such as aluminium bronzes, exploit this property by including a proportion of aluminium in the alloy to enhance corrosion resistance. The aluminium oxide generated by anodizing is typically amorphous, but discharge assisted oxidation processes such as plasma electrolytic oxidation result in a significant proportion of crystalline aluminium oxide in the coating, enhancing its hardness.

Figure: 3.2 Aluminium oxide

Aluminium oxide was taken off the United States Environmental Protection Agency's chemicals lists in 1988. Aluminium oxide is on the EPA's Toxics Release Inventory list if it is a fibrous form.

3.2.1 Applications

The major uses of specialty aluminum oxides are in refractories, ceramics, polishing and abrasive applications. Large tonnages of aluminium hydroxide, from which alumina is derived, are used in the manufacture of zeolites, coating titania pigments, and as a fire retardant/smoke suppressant.

Over 90% of the aluminium oxide, normally termed Smelter Grade Alumina (SGA), produced is consumed for the production of aluminium, usually by the Hall–Harold process. The remainder, normally called speciality alumina is used in a wide variety of applications which reflect its inertness, temperature resistance and electrical resistance.

1. Fillers

Aluminium oxide is a common ingredient in sunscreen and is sometimes also present in cosmetics such as blush, lipstick, and nail polish.

2. Glass

Many formulations of glass have aluminium oxide as an ingredient.

3. Catalysis

Aluminum oxide catalysis a variety of reactions that are useful industrially. In its largest scale application, aluminium oxide is the catalyst in the Claus process for converting hydrogen sulfide waste gases into elemental sulfur in refineries. It is also useful for dehydration of alcohols to alkenes.

Aluminium oxide serves as a catalyst support for many industrial catalysts, such as those used in hydro desulfurization and some Ziegler–Natta polymerizations.

4. Water purification

Aluminium oxide is widely used to remove water from gas streams.

6. Abrasive

Aluminium oxide is used for its hardness and strength. It is widely used as an abrasive, including as a much less expensive substitute for industrial diamond. Many types of sandpaper use aluminium oxide crystals. In addition, its low heat retention and low specific heat make it widely used in grinding operations, particularly cutoff tools. As the powdery abrasive mineral

aloxite, it is a major component, along with silica, of the cue tip "chalk" used in billiards. Aluminium oxide powder is used in some CD/DVD polishing and scratch-repair kits. Its polishing qualities are also behind its use in toothpaste. It is also used in microdermabrasion, both in the machine process available through dermatologists and estheticians, and as a manual dermal abrasive used according to manufacturer directions.

7. Paint

Aluminium oxide flakes are used in paint for reflective decorative effects, such as in the automotive or cosmetic industries.

8. Composite fiber

Aluminium oxide has been used in a few experimental and commercial fiber materials for high-performance applications (e.g., Fiber FP, Nextel 610, Nextel 720). Alumina Nano fibers in particular have become a research field of interest.

9. Body armor

Some body armors utilize alumina ceramic plates, usually in combination with aramid or UHMWPE backing to achieve effectiveness against most rifle threats. Alumina ceramic armor is readily available to most civilians in jurisdictions where it is legal, but is not considered military grade.

10. Abrasion protection

Aluminium oxide can be grown as a coating on aluminium by anodizing or by plasma electrolytic oxidation (see the "Properties" above). Both the hardness and abrasion-resistant characteristics of the coating originate from the high strength of aluminium oxide, yet the porous coating layer produced with conventional direct current anodizing procedures is within a 60-70 Rockwell hardness C range which is comparable only to hardened carbon steel alloys, but considerably inferior to the hardness of natural and synthetic corundum. Instead, with plasma electrolytic oxidation, the coating is porous only on the surface oxide layer while the lower

oxide layers are much more compact than with standard DC anodizing procedures and present a higher crystallinity due to the oxide layers being remelted and densified to obtain α-Al2O3 clusters with much higher coating hardness values circa 2000 Vickers hardness test.

Alumina is used to manufacture tiles which are attached inside pulverized fuel lines and flue gas ducting on coal fired power stations to protect high wear areas. They are not suitable for areas with high impact forces as these tiles are brittle and susceptible to breakage.

11. Electrical insulation

Aluminium oxide is an electrical insulator used as a substrate (silicon on sapphire) for integrated circuits but also as a tunnel barrier for the fabrication of superconducting devices such as single electron transistors and superconducting quantum interference devices (SQUIDs).

For its application as an electrical insulator in integrated circuits, where the conformal growth of a thin film is a prerequisite and the preferred growth mode is atomic layer deposition, Al_2O_3 films can be prepared by the chemical exchange between trimethylaluminum ($Al(CH_3)_3$) and H_2O:

The Al_2O_3 films prepared using O_3 show 10–100 times lower leakage current density compared with those prepared by H_2O. Aluminum oxide, being a dielectric with relatively large band gap, is used as an insulating barrier in capacitors.

3.2.2 Uses

- In lighting, transparent aluminium oxide is used in some sodium vapor lamps. Aluminium oxide is also used in preparation of coating suspensions in compact fluorescent lamps.
- In chemistry laboratories, aluminium oxide is a medium for chromatography, available in basic (pH 9.5), acidic (pH 4.5 when in water) and neutral formulations.
- Health and medical applications include it as a material in hip replacements and birth control pills.

- It is used as a dosimeter for radiation protection and therapy applications for its optically stimulated luminescence properties.
- Small pieces of aluminium oxide are often used as boiling chips in chemistry.
- It is also used to make spark plug insulators.
- Using a plasma spray process and mixed with titania, it is coated onto the braking surface of some bicycle rims to provide abrasion and wear resistance.[1]

3.3 Titanium dioxide

Titanium dioxide, also known as titanium(IV) oxide or titania, is the naturally occurring oxide of titanium, chemical formula TiO_2. When used as a pigment, it is called titanium white, Pigment White 6 (PW6), or CI 77891. Generally, it is sourced from ilmenite, rutile and anatase. It has a wide range of applications, including paint, sunscreen and food coloring.

Table: 3.3 Titanium dioxide Specification

Properties	
Chemical formula	TiO_2
Molar mass	79.866 g/mol
Appearance	White solid
Odor	Odorless
Density	4.23 g/cm^3 (rutile) 3.78 g/cm^3 (anatase)
Melting point	1,843 °C (3,349 °F; 2,116 K)
Boiling point	2,972 °C (5,382 °F; 3,245 K)
Solubility in water	Insoluble
Band gap	3.05 eV (rutile)[1]
Magnetic susceptibility (χ)	$+5.9 \cdot 10^{-6}$ cm^3/mol

Figure: 3.3 Titanium dioxide

3.3.1 Application

First mass-produced in 1916, titanium dioxide is the most widely used white pigment because of its brightness and very high refractive index, in which it is surpassed only by a few other materials. Titanium dioxide crystal size is ideally around 220 nm (measured by electron microscope) to optimize the maximum reflection of visible light. The optical properties of the finished pigment are highly sensitive to purity. As little as a few parts per million (ppm) of certain metals (Cr, V, Cu, Fe, Nb) can disturb the crystal lattice so much that the effect can be detected in quality control. Approximately 4.6 million tons of pigmentary TiO_2 are used annually worldwide, and this number is expected to increase as use continues to rise.

TiO_2 is also an effective opacifier in powder form, where it is employed as a pigment to provide whiteness and opacity to products such as paints, coatings, plastics, papers, inks, foods, medicines (i.e. pills and tablets) as well as most toothpastes. In paint, it is often referred to offhandedly as "brilliant white", "the perfect white", "the whitest white", or other similar terms. Opacity is improved by optimal sizing of the titanium dioxide particles.

TiO_2 has been flagged as possibly carcinogenic. In 2019, it was present in two thirds of toothpastes on the French market. Bruno Le Maire, a minister in the Edouard Philippe government, promised in March 2019 to remove it from that and other alimentary uses.

1. Thin films

When deposited as a thin film, its refractive index and colour make it an excellent reflective optical coating for dielectric mirrors. it is also used in generating decorative thin films such as found in "mystic fire topaz"

Some grades of modified titanium based pigments as used in sparkly paints, plastics, finishes and cosmetics - these are man-made pigments whose particles have two or more layers of various oxides – often titanium dioxide, iron oxide or alumina – in order to have glittering, iridescent and or pearlescent effects similar to crushed mica or guanine-based products. In addition to these effects a limited colour change is possible in certain formulations depending on how and at which angle the finished product is illuminated and the thickness of the oxide layer in the pigment particle; one or more colours appear by reflection while the other tones appear due to interference of the transparent titanium dioxide layers. In some products, the layer of titanium dioxide is grown in conjunction with iron oxide by calcination of titanium salts (sulfates, chlorates) around 800 °C One example of a pearlescent pigment is Iriodin, based on mica coated with titanium dioxide or iron (III) oxide.

The iridescent effect in these titanium oxide particles is unlike the opaque effect obtained with usual ground titanium oxide pigment obtained by mining, in which case only a certain diameter of the particle is considered and the effect is due only to scattering.

2. Sunscreen and UV blocking pigments

In cosmetic and skin care products, titanium dioxide is used as a pigment, sunscreen and a thickener. As a sunscreen, ultrafine TiO_2 is used, which is notable in that combined with ultrafine zinc oxide, it is considered to be an effective sunscreen that is less harmful to coral reefs than sunscreens that include chemicals such as oxybenzone and octinoxate.

3.3.2 Uses

In ceramic glazes titanium dioxide acts as an opacifier and seeds crystal formation. It is used as a tattoo pigment and in styptic pencils. Titanium dioxide is produced in varying particle sizes, oil and water dispersible, and in certain grades for the cosmetic industry.

3.4 Zirconium oxide

The main use of zirconia is in the production of hard ceramics, such as in dentistry (see below), with other uses including as a protective coating on particles of titanium dioxide pigments, as a refractory material, in insulation, abrasives and enamels. Stabilized zirconia is used in oxygen sensors and fuel cell membranes because it has the ability to allow oxygen ions to move freely through the crystal structure at high temperatures. This high ionic conductivity (and

a low electronic conductivity) makes it one of the most useful electro ceramics. Zirconium dioxide is also used as the solid electrolyte in electro chromic devices.

Zirconia is a precursor to the electro ceramic lead zirconate titanate (*PZT*), which is a high-K dielectric, which is found in myriad component.

Table: 3.4 Zirconium oxide Specification

Properties	
Chemical formula	ZrO_2
Molar mass	123.218 g/mol
Appearance	white powder
Density	5.68 g/cm^3
Melting point	2,715 °C (4,919 °F; 2,988 K)
Boiling point	4,300 °C (7,770 °F; 4,570 K)
Solubility in water	Negligible
Solubility	soluble in HF, and hot H_2SO_4
Refractive index(n_D)	2.13

3.4.1 Chemical reactions

Zirconia is chemically unreactive. It is slowly attacked by concentrated hydrofluoric acid and sulfuric acid. When heated with carbon, it converts to zirconium carbide. When heated with carbon in the presence of chlorine, it converts to zirconium tetrachloride. This conversion is the basis for the purification of zirconium metal and is analogous to the Kroll process.

Figure: 3.4 Zirconium oxide

3.4.2 Engineering properties

Zirconium oxide is one of the most studied ceramic materials. ZrO_2 adopts a monoclinic crystal structure at room temperature and transitions to tetragonal and cubic at higher temperatures. The change of volume caused by the structure transitions from tetragonal to monoclinic to cubic induces large stresses, causing it to crack upon cooling from high temperatures. When the zirconia is blended with some other oxides, the tetragonal and/or cubic phases are stabilized. Effective dopants include magnesium oxide (MgO), yttrium oxide (Y_2O_3, yttria), calcium oxide (CaO), and cerium (III) oxide (Ce_2O_3).

Zirconia is often more useful in its phase 'stabilized' state. Upon heating, zirconia undergoes disruptive phase changes. By adding small percentages of yttria, these phase changes are eliminated, and the resulting material has superior thermal, mechanical, and electrical properties. In some cases, the tetragonal phase can be metastable. If sufficient quantities of the metastable tetragonal phase is present, then an applied stress, magnified by the stress concentration at a crack tip, can cause the tetragonal phase to convert to monoclinic, with the associated volume expansion. This phase transformation can then put the crack into compression, retarding its growth, and enhancing the fracture toughness. This mechanism is known as transformation toughening, and significantly extends the reliability and lifetime of products made with stabilized zirconia.

The ZrO_2 band gap is dependent on the phase (cubic, tetragonal, monoclinic, or amorphous) and preparation methods, with typical estimates from 5–7 eV.

A special case of zirconia is that of tetragonal zirconia polycrystalline, or *TZP*, which is indicative of polycrystalline zirconia composed of only the metastable tetragonal phase.

3.4.3 Uses

The main use of zirconia is in the production of hard ceramics, such as in dentistry (see below), with other uses including as a protective coating on particles of titanium dioxide pigments, as a refractory material, in insulation, abrasives and enamels. Stabilized zirconia is used in oxygen sensors and fuel cell membranes because it has the ability to allow oxygen ions to move freely through the crystal structure at high temperatures. This high ionic conductivity (and a low electronic conductivity) makes it one of the most useful electro ceramics. Zirconium dioxide is also used as the solid electrolyte in electro chromic devices.

Zirconia is a precursor to the electro ceramic lead zirconate titanate (*PZT*), which is a high-K dielectric, which is found in myriad components.

Niche uses

The very low thermal conductivity of cubic phase of zirconia also has led to its use as a thermal barrier coating, or TBC, in jet and diesel engines to allow operation at higher temperatures. Thermodynamically, the higher the operation temperature of an engine, the greater the possible efficiency. Another low thermal conductivity use is a ceramic fiber insulation for crystal growth furnaces, fuel cell stack insulation and infrared heating systems.

This material is also used in dentistry in the manufacture of 1) sub frames for the construction of dental restorations such as crowns and bridges, which are then veneered with a conventional Feld spathic porcelain for aesthetic reasons, or of 2) strong, extremely durable dental prostheses constructed entirely from monolithic zirconia, with limited but constantly improving aesthetics. Zirconia stabilized with yttria (yttrium oxide), known as yttria-stabilized zirconia, can be used as a strong base material in some full ceramic crown restorations.

Transformation toughened zirconia is used to make ceramic knives. Because of the hardness, ceramic-edged cutlery stays sharp longer than steel edged products.

Due to its infusibility and brilliant luminosity when incandescent, it was used as an ingredient of sticks for limelight.

Zirconia is also a potential high-k dielectric material with potential applications as an insulator in transistors.

Zirconia is also employed in the deposition of optical coatings; it is a high-index material usable from the near-UV to the mid-IR, due to its low absorption in this spectral region. In such applications, it is typically deposited by PVD.

In jewelry making, some watch cases are advertised as being "black zirconium oxide" In 2015 Omega released a fully ZrO_2 watch named "The Dark Side of The Moon" with ceramic case, bezel, pushers and clasp, advertising it as four times harder than stainless steel and therefore much more resistant to scratches during everyday use.

CHAPTER 4

TESTING AND ANALYSIS

1. Wear (Pin on Disc method)
2. Hardness (Vickers test)
3. XRD Characterization
4. SEM Characterization
5. Corrosion test
6. Optimization (Taguchi, ANOVA)

4.1 Wear (Pin on disc method)

The pin on disc test has proved useful in providing a simple wear and friction test for low friction coatings such as diamond-like carbon coatings on valve train components in internal combustion engines.

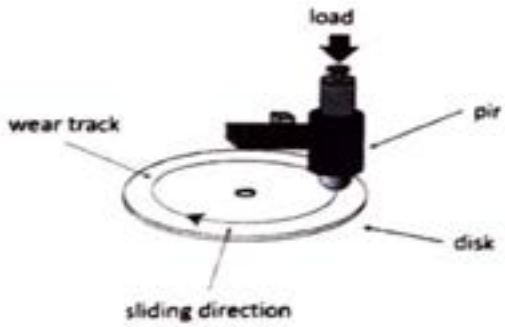

Figure: 4.1 Pin on Disc Method

A pin on disc tribometer consists of a stationary pin that is normally loaded against a rotating disc. The pin can have any shape to simulate a specific contact, but cylindrical tips are often used to simplify the contact geometry.

4.2 Hardness (Vickers test)

The Vickers test is often easier to use than other hardness tests since the required calculations are independent of the size of the indenter, and the indenter can be used for all

materials irrespective of hardness. The basic principle, as with all common measures of hardness, is to observe a material's ability to resist plastic deformation from a standard source. The Vickers test can be used for all metals and has one of the widest scales among hardness tests. The unit of hardness given by the test is known as the Vickers Pyramid Number (HV) or Diamond Pyramid Hardness (DPH). The hardness number can be converted into units of Pascal's, but should not be confused with pressure, which uses the same units. The hardness number is determined by the load over the surface area of the indentation and not the area normal to the force, and is therefore not pressure.

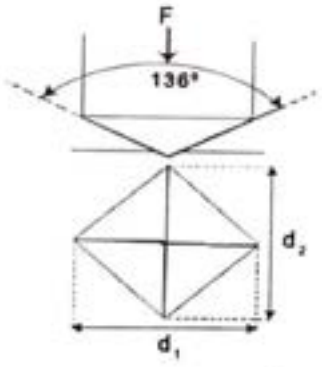

Figure: 4.2 Vickers test

4.3 XRD Characterization

Is the oldest from the modern Non Destructive Testing methods that are used. Although there are many safety considerations for the use of ionizing radiation, an advantage of RT over other methods is that many RT techniques provide a permanent record of test results.

In this method, a specific radiographic film is placed under the sample that is inspected. Then the sample is exposed to radiation, the radiation passes through the sample and is exposed to the radiographic film. Discontinuities within the component that is inspected affect the exposure and the indications on the film.

Radiography Testing provides the NDT operators with high sensitive results, as well as a permanent record for the component that is inspected. In addition, it is applicable to most materials such as welds, castings, forgings and composites.

4.4 SEM Characterization

A scanning electron microscopy (SEM) test was going to conduct it produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster scan pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image.

Figure: 4.4 Scanning Electron Microscopy

4.5 Corrosion test

The salt spray (or salt fog) test is a standardized and popular corrosion test method, used to check corrosion resistance of materials and surface coatings. Usually, the materials to be tested are metallic (although stone, ceramics, and polymers may also be tested) and finished with a surface coating which is intended to provide a degree of corrosion protection to the underlying metal. Salt spray testing is an accelerated corrosion test that produces a corrosive attack to coated samples in order to evaluate (mostly comparatively) the suitability of the coating for use as a protective finish. The appearance of corrosion products (rust or other oxides) is evaluated after a pre-determined period of time. Test duration depends on the corrosion resistance of the coating; generally, the more corrosion resistant the coating is, the longer the period of testing before the appearance of corrosion/ rust. The salt spray test is one of the most widespread and long-established corrosion tests.

4.6 Optimization

Taguchi methods are statistical methods, or sometimes called robust design methods, developed by Genichi Taguchi to improve the quality of manufactured goods, and more recently also applied to engineering, biotechnology, marketing and advertising. Professional statisticians have welcomed the goals and improvements brought about by Taguchi methods, particularly by Taguchi's development of designs for studying variation, but have criticized the inefficiency of some of Taguchi's proposals.

Analysis of variance (ANOVA) is a statistical technique that is used to check if the means of two or more groups are significantly different from each other. ANOVA checks the impact of one or more factors by comparing the means of different samples.

Table: 4.6 Testing parameters

Load(N)	Speed(rpm)	Sliding Velocity(m)
10	500	1
10	750	1.5
10	1000	2
15	500	1.5
15	750	2
15	1000	1
20	500	2
20	750	1
20	1000	1.5

CHAPTER 5

WORK DONE IN PHASE-1

5.1 Material- Al6061

Plate size= 65x35x3mm

6061 is a precipitation-hardened aluminum alloy, containing magnesium and silicones its major alloying elements. It has good mechanical properties, exhibits good weldability, and is very commonly extruded. It is one of the most common alloys of aluminum for general-purpose use. The mechanical properties of 6061 depend greatly on the temper, or heat treatment, of the material.

5.2 Coating powder

Aluminium oxide (Al_2O_3),

Titanium dioxide (TiO_2),

Zirconium oxide (ZrO_2) purchased.

Figure: 5.2 Coating powders

5.3 Ball milling

A ball mill is a type of grinder used to grind, blend and sometimes for mixing of materials for use in mineral dressing processes, paints, pyrotechnics, ceramics and selective laser sintering. It works on the principle of impact and attrition: size reduction is done by impact as the balls drop from near the top of the shell. In our project (Al_2O_3, TiO_2, ZrO_2) are mixed into fine size by using ball milling. And the mixture is injected for plasma spray coating.

Figure: 5.3 Ball Milling

5.4 Plasma Spray Coating

Bond coat (NiCrAlY) = 50µm

Top coat (Al_2O_3, TiO_2, ZrO_2) = 100µm

Total thickness = 150µm

There are many coating methods available (High velocity oxy-fuel coating, Combustion flame coating, Two wire electric arc spraying) in which to achieve the micro thickness coating plasma coating method is selected.

Plasma spray is a thermal spray coating process used to produce a high quality coating by a combination of high temperature, high energy heat source, a relatively inert spraying medium, usually argon, and high particle velocities. For 150µm thickness (Al_2O_3, TiO_2, ZrO_2) coated on the aluminium 6061 substrate.

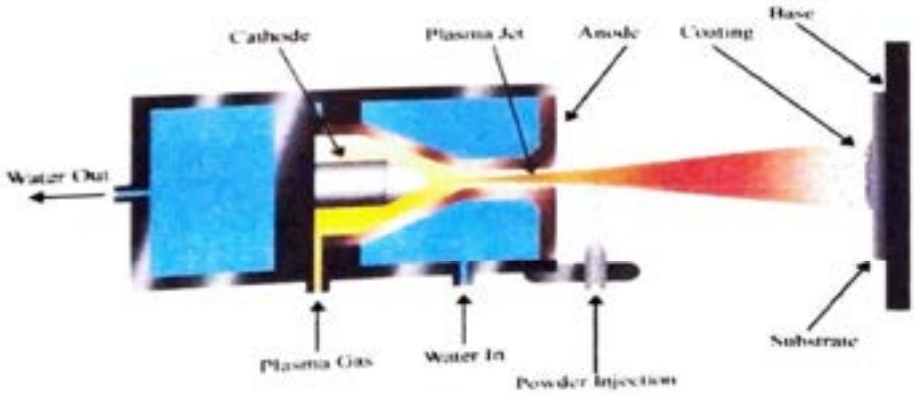

Figure: 5.4.1 Plasma spray coating

Bond coat

Thickness – 50µm

Nickel-based thermal spray Flexicord (NiCrAlY) improves the adhesion of the coating to the substrate, thus enhancing the performance of ceramic coatings in demanding services

The NiCrAlY is coated with 50µm thickness above the bond coat the primary coating (Al_2O_3, TiO_2, ZrO_2) is applied

Table: 5.1 Coating Percentage

Material	With Coating in percentage (%)				
	A1	A2	A3	A4	A5
Al_2O_3	45	40	35	30	25
TiO_2	50	50	50	50	50
ZrO_2	5	10	15	20	25

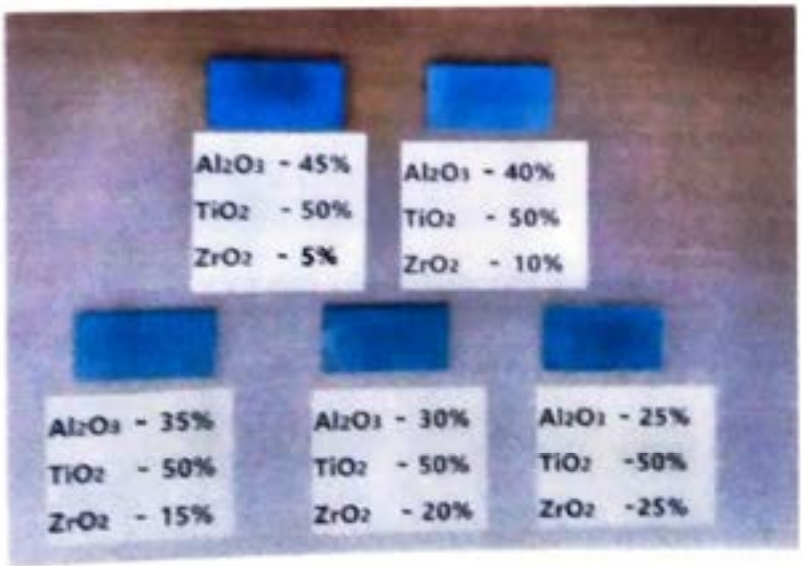

Figure: 5.4.2 Coated Aluminium Billet

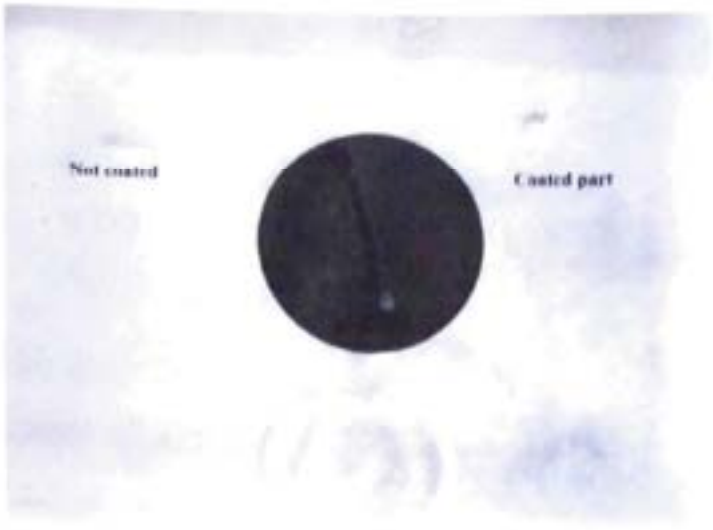

Figure: 5.4.3 Top view of coated injection valve

Figure: 5.4.4 Side view of coated injection valve

CHAPTER 6

WORK TO BE DONE IN PHASE-2

1. Wear analysis the pin on disc test is going to be done.
2. Hardness of the material by the Vickers test is going to be done.
3. To find out the corrosion resistance of the coating the corrosion test is going to be done.
4. The XRD and SEM characterization test is going to be done for surface analysis.
5. And the paper is going to be published in Journals.

CHAPTER 7

CONCLUSION

Thus the (Al_2O_3, TiO_2, ZrO_2) ceramic materials are coated by plasma spray coating at a thickness of 150µm in an aluminium 6061 steel substrate to reduce the wear rate in the engine. The bond coat of 50µm thickness increases the strength of the wear resistance. The Scanning Electron Microscopy (SEM) and pin on disc method test results values will be viewed seriously. And the appropriate value from the ratio of (Al_2O_3, TiO_2, and ZrO2) mixture is choosen for the engine cylinder coating and the engine performance will be increased.

REFERENCES

1. J.D. Olivas, U, C. Mireles, E. Acosta, F.V. Barrera, Surface characterization of plasma spray metal deposition procedures using X-ray photoelectron spectroscopy. Thin Solid Films 299 (1997) 143–148144.
2. Y.Y. Yang, Y.S. Jin, Terras Yah, Effect of a surface film on the friction and wear properties of plasma-swayed Al, O3-40%Zr02 coatings, Wear 210 (1997) 136–144
3. Ozkan Sarikaya , Erdal Celik, Effects of residual stress on thickness and interlayer of thermal barrier ceramic MgO–ZrO coatings on Ni and AlSi substrates using finite 2 element method. Materials and Design 23 (2002) 645–650.
4. Hathaipat Koiprasert, Panadda Niramathumpong1 and Supattanapong Dumrongrattana Thermally Sprayed Coatings for Protection of Fretting Wear National Metals and Materials Technology Center (MTEC), Pathumthani 12120, Thailand J. Sci. Res. Chula Univ., Vol. 29, No. 2 (2004)
5. X.Q. Cao, R. Vassen, D. Stoever, Ceramic materials for thermal barrier coatings Journal of the European Ceramic Society24 (2004) 1–10.
6. R. Soltani, H. Samadi, E. Garcia and T.W.Coyle, Development of Alternative Thermal Barrier Coatings for Diesel Engines Centre for Advanced Coating Technologies University of Toronto, Toronto, Ontario, Canada 2005-01-0650
7. Hui Dai, Xinghua Zhong, Jiayun Li, Yanfei Zhang, Jian Meng, Xueqiang Cao, Thermal stability of double-ceramic-layer thermal barrier coatings with various coating thickness, Materials Science and Engineering A 433 (2006) 1–7.
8. Giovanni Bolelli, Valeria Cannillo, Luca Lusvarghi, Tiziano Manfredini, Wear behaviour of thermally sprayed ceramic oxide coatings Wear 261 (2006) 1298–1315.
9. M. Senthil kumar, S. Natarajan, Analysis of tribological factors on dry sliding wear behaviour of thermally sprayed carbide and ceramic coatings by taguchi method International Journal of Engineering Science and Technology (IJEST) ISSN : 0975-5462 Vol. 3 No. 4 April 2011.

10. P. N. shrirao, A. N. pawar Experimental investigation on performance of single cylinder diesel engine with mullite as thermal barrier coating ISSN: 2180-1053 Vol. 3 No. 1 January-June 2011

11. Dinesh Gond, D. Puri, S. Prakash, Hot Corrosion Behavior of Yttria-Stabilised Zirconia as Plasma Sprayed Coated Boiler Steel in Air and Salt at 900°C under Cyclic Condition, Journal of Minerals & Materials Characterization & Engineering, Vol. 10, No.5, pp.463-478, 2011

12. Rashmi mittal, Devendra Singh Dry sliding wear behaviour of spray formed ZrSio4 reinforced Al-Si-Sn alloy, Department of Metallurgical and Materials Engineering, Indian Institute of Technology Roorkee, Roorkee 247667, India. Published online by the VBRI press in 2012.

13. Ján Viňáš, Janette Brezinová and Anna Guzanová, Tribological properties of selected ceramic coatings Journal of Adhesion Science and Technology 2012, 1–12 ISSN 0169-4243 print/ISSN 1568-5616 online, 2012 Taylor & Franci

14. Vinay Kumar Domakonda, Ravi Kumar Puli Application of Thermal Barrier Coatings in Diesel Engines: a Review Department of Mechanical Engineering, National Institute of Technology, Warangal, 506004, India Energy and Power 2012, 2(1): 9-17 DOI: 10.5923/j.ep.20120201.02

15. N. Krishnamurthy, M.S. Prashantha reddy, H.P. Raju, and H.S.Manohar, A StudyofParametersAffectingWearResistanceofAluminaandYttriaStabilizedZirconiaComposite CoatingsonAl-6061Substrate, International Scholarly Research Network ISRN Ceramics Volume 2012, Article ID 585892, 13 pages doi:10.5402/2012/585892

16. Saifi Usmani, Sanjay Sampath, David L. Houck & David Lee, Effect of Carbide Grain Size on the Sliding and Abrasive Wear Behavior of Thermally Sprayed WC-Co Coatings State University of New York, Department of Materials Science and Engineering Publisher: Taylor & Francis 30 April 2013 470-478.

17. Sachin Jadav N, Anil Kumar C, Ceramic coating [tio2-zro2] on aluminium 6061t6 for anti-wear properties IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-730 Volume: 03 Issue: 07 | Jul-2014

18. M. Adam Khan, S. Sundarrajan, M. Duraiselvam, S. Natarajan & A. Senthil Kumar Sliding wear behaviour of plasma sprayed coatings on nickel based superalloy ISSN 0267-0844 (Print) 1743-2944 (Online) Journal November 2016.
19. D. R. P. Rajarathnam; M. Jayaraman. Enhancement of Wear Resistance of AISI 1040 Forged Steel Roller Shaft by different Ceramic Oxide Coatings using Plasma Spray Process for Sugarcane Industries. Asian Journal of Research in Social Sciences and Humanities Vol. 6, No. 10, October 2016, pp. 1663-1678. ISSN 2249-7315.
20. Shailesh Kumar Singh & Somnath Chattopadhyaya & Alokesh Pramanik & Sanjeev Kumar, Wear behavior of chromium nitride coating in dry condition at lower sliding velocity and load, Int J Adv Manuf Technol DOI 10.1007/s00170-017-0796-x published 2017

EXPERIMENTAL INVESTIGATION OF PROCESS PARAMETERS IN ELECTRO CHEMICAL MICRO MACHINING OF ALUMINIUM METAL MATRIX COMPOSITE BY USING RESPONSE SURFACE METHODOLOGY

PROJECT WORK (PHASE I) REPORT

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MECHANICAL ENGINEERING

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ABSTRACT

Aluminium metal matrix composites (AMCs) are now gaining their usage in aerospace and automotive industries. Among many AMCs, Aluminium 6061 metal matrix reinforced with Ground Granulated blast-furnace slag (GGBS) is a novel composite. This composite is widely used in automotive industries due to high wear resistance, high strength to low weight ratio, elevated temperature toughness and high stiffness. Due to the presence of hard ceramic reinforcement in metal matrix, it is very difficult to machining by conventional methods. Even nontraditional processes such as laser jet machining and electro discharge machining result in significant subsurface damage and heat affected zone to the work. Electrochemical micromachining (EMM) is an advanced machining process for the machining of electrically conducting materials. In the project work, an experimental setup has been designed and fabricated to machine micro-holes. Machining of these features is done using a sewing needle with 47 µm tip diameter with a tool of stainless steel. The salient feature of the present work is that % of reinforcement is considered as one of the input parameter along with the voltage, electrolyte concentration, and temperature of the tool electrode are varied within the selected range to study the metal removal rate (MRR) and Radial overcut (ROC) of EMM at Al6061-GGBS metal matrix composites produced through stir casting process. In addition, surface integrity is observed by using Scanning Electron Microscope (SEM).

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ABBREVIATION

PMC	-	Polymer Matrix composite
MMC	-	Metal Matrix Composite
CMC	-	Ceramic Matrix Composite
ECM	-	Electro Chemical Machining
'CEDM	-	Wire Cut Electro Discharge Machining
AMC	-	Aluminium Metal matrix Composite
GBS	-	Ground Granulated Blast-furnace Slag

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CHAPTER 1

INTRODUCTION

1.1 SIGNIFICANCES OF COMPOSITE MATERIALS

For the last few decades, the development of materials shifted from monolithic alloy to composite materials to meet the global industrial needs. Conventional monolithic materials have limitations to achieve good combination of strength, stiffness, toughness and density. To overcome these shortcomings and to meet the ever increasing demand of modern day technology, composites are the most promising materials of recent interest, and continuous advancements have led to the use of composite materials in more and more diversified applications such as aerospace, defense, automobile, biomaterials as well as sports components. The scope of applications of composites being unlimited, these materials will dominate the materials field for a very long period in the years to come (Surappa 2003).

Composites can be tailor made to possess high strength, high toughness light weight, low cost, good damping capacity, wear resistance, corrosion resistance, hardness, conductivity, creep strength, fatigue strength, negative thermal expansion coefficient and unusual combinations of electric, magnetic, and optical properties. The examples of naturally occurring composites are shell, wood, bone, and teeth.

Composite materials are engineered materials made from two or more constituents material with significantly different physical and chemical properties which remain separate and distinct on a macroscopic level with the finished structure. Using this definition, any two-phase (continuous and discontinuous phase) material can be considered as composite. The discontinuous phase is usually harder and stronger than the continuous phase and is called the 'reinforcement' or 'reinforcing material', whereas the continuous phase is termed as the 'matrix'.

The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector, due to the sheer size of transportation industry (Huda et al 1993). Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years.

While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry.

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1.2 CLASSIFICATION OF COMPOSITE MATERIALS

Based on the type of the matrix used, composite can be classified as (Huda et al 1993).

1. Polymer Matrix Composites (PMC)
2. Metal Matrix Composites (MMC)
3. Ceramic Matrix Composite (CMC)

1.2.1 Polymer Matrix Composites (PMC)

Polymer matrix composites have the advantage of easy fabrication, low cost, low density, good corrosion resistances,chemical inertness, aesthetic colour effects and variety of fabrication techniques available with respect to the part geometry. However, the most advanced resin cannot be used above 300°C for prolonged period. The low transverse strength and operational temperature limits the applications of PMC in mechanical parts.

1.2.2 Metal Matrix Composites (MMC)

Metal matrix composites possess some attractive properties, when compared with organic matrices. These include

(i) strength retention at higher temperatures,

(ii) higher transverse strength,

(iii) better electrical conductivity,

(iv) superior thermal conductivity,

(v) higher erosion resistance etc.

Metal matrix composite can also be used at higher temperature ranges of about 1000°C as in the case of fiber reinforced super alloy. However, the major disadvantage of metal matrix composites is their higher density and consequently lower specific mechanical properties compared to polymer matrix composites.

1.2.3 Ceramic Matrix Composite (CMC)

Ceramic composites have the advantage over metal matrix composites at even higher temperature because of their lower chemical reactivity and greater oxidation reaction resistance and also where environment attack is an issue.

However, their main disadvantages are:

1. Low strain to failure, which limit the stress in the fiber at low levels.
2. Poor in tension and shear applications.
3. Relatively high modulus and lack of ductility.

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1.3 METAL MATRIX COMPOSITES (MMC)

Metal matrix composites in general, consist of two or more chemically distinct macroconstituents, separated by distinct interface. One obviously the primary phase is the metal matrix and the second component is the reinforcement. In the production of the composites, the matrix and the reinforcement are mixed together. This is to distinguish a composite from a two phase alloy where the second phase forms as a particulate, eutectic or eutectoid reaction, etc., in other words a composite initially begins as separate components, i.e., the metal matrix and the reinforcement. In recent years, the development of metal matrix composite has been receiving worldwide attention on account of their superior strength and stiffness in addition to high wear resistance and creep resistance comparison to their corresponding wrought alloys.

The properties of composites are strongly dependent on the properties of their constituent materials, their distribution and the interaction among them. Apart from the nature of the constituent materials, the geometry of the reinforcement (shape, size and size distribution) influences the properties of the composite to a great extent. The concentration distribution and orientation of the reinforcement also affect the properties.

1.3.1 Classification of the Metal Matrix Composites

The Metal Matrix Composites (MMCs) may be classified in many ways, depending on the concept of interest. One useful classification system is based on micro structural aspects, differentiating between composite materials according to the morphology of the constituent phase (Srivatsan et al 1995).

Using this system composite materials fall into following categories:

1. Dispersion strengthened composites.
2. Particle strengthened composites.
3. Fiber reinforced composites.

1.3.1.1 Dispersion strengthened composites

This composite is characterized by a microstructure consisting of an element matrix within which fine particles are uniformly dispersed. The particle diameter ranges from 0.01 to 0.1 m and the volume fraction of particle ranges From 1 to 15%.

1.3.1.2 Particle strengthened composites

As the name indicates, the reinforcement is of particle nature. It may be spherical, cubic, tetragonal, a platelet, or of other regular or irregular shape. Particulates are the most

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common and cheapest reinforcement materials. Particle-reinforced composites have hard particles surrounded by a softer matrix. The particles in these composites are larger than in dispersion- strengthened composites. This composite is characterized by dispersed particles of greater than one-micron diameter with a volume fraction of 5 to 40%. In general, particles are not very effective in improving fracture resistance but they enhance the stiffness of the composite to a limited extent. Particles are widely used to improve the properties of matrix materials. The commonly used particles are SiC, SiO_2, MgO_2, Si_3N_4, TiC, BN, Mica, ZrO_2, B_4C, TiO_2, Al_2O_3, Zircon, Garnet and Glass.

1.3.1.3 Fiber reinforced composites

In fiber reinforced composites, fibers are the principal load carrying members, while the surrounding matrix keeps them in the desired location and orientation. Matrix also acts as a load transfer medium between the fibers, and protects them from environmental damages due to elevated temperature, humidity and corrosion.

The reinforcing phase in fiber composite materials,

(a) spans the entire size range, from a fraction of a m to several mm in diameter,

(b) spans the length from mm to continuous fibers,

(c) spans an entire range of volume concentration, from a few percent to greater than 80%.

The fiber spans the entire size range, from 0.1 to 250 m and spans entire range of volume concentrations from few percent to greater than 90%. The dimensions of the reinforcement determine its capability of contributing its properties to the composite. The most important fibers used in metal matrix composites are alumina, boron, carbon, silicon carbide, boron carbide, silica, zirconia, magnesia, alumina-boria-silica, silicon nitride, mullite, boron nitride and titanium diboride.

1.4 SIGNIFICANCE OF ALUMINIUM METAL MATRIX COMPOSITES

Composite materials consist of matrix and reinforcement. The main function of matrix is to transfer and distribute the load to the reinforcement or fibers. This transfer of load depends on the bonding which depends on the type of matrix and reinforcement and the fabrication technique.

The matrix can be selected on the basis of oxidation and corrosion resistance or other properties (Taya and Arsenault 1989). Generally Al, Ti, Mg, Ni, Cu, Pb, Fe, Ag, Zn, Sn and Si are used as the matrix material, but Al, Ti, Mg are used widely.

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Nowadays the main focus is given to aluminium matrix because of its unique combination of good corrosion resistance, low density and excellent mechanical properties (Huda et al, 1994). Aluminium Matrix Composites (AMC) are usually reinforced by aluminium oxide (Al_2O_3), Silicon Carbide (SiC) and Carbon (C). The reinforcements are in the form of flakes, particulates and fibers. Aluminium matrices are in general Al-Si, Al-Cu, 2xxx, 6xxx, 7xxx alloys.

The major advantages of AMC compared to unreinforced materials are as follows

- Greater strength
- Improved stiffness
- Reduced density (weight)
- Improved high temperature properties
- Controlled thermal expansion coefficient
- Improved abrasion and wear resistance
- Improved damping capabilities

These advantages can be quantified for better appreciation. For example, elastic modulus of pure aluminium can be enhanced from 70 GPa to 240 GPa by reinforcing with 60 vol % continuous aluminium fiber. On the other hand incorporation of 60 vol % alumina fibers in aluminium leads to decrease in coefficient of thermal expansion 60% approximately. Similarly it is possible to process Al-9%Si-20 vol% SiC_p composites having wear resistance equivalent or better than of gray cast iron (Surappa 2003).

The primary disadvantages of all aluminium MMC is, they suffer from low ductility, inadequate fracture toughness and inferior fatigue crack growth and fracture resistance compared to that of the constituent matrix material.

1.5 PROCESSING OF METAL MATRIX COMPOSITES (MMCs)

The evolution of different metal matrix composites systems has led to the development of newer processing techniques, in addition to conventional metal processing techniques. The major criteria for the selection of a process rely on the type of composite system to be fabricated, the properties to be achieved and the component to be produced.

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The processing methods are widely classified into primary and secondary processes. The primary process combines matrix and reinforcements to produce the basic composite systems and their structures. The major primary liquid state processes are stir casting or vortex method, infiltration, squeeze casting, compo casting, and spray deposition processes and solid state processes are powder metallurgy and diffusion bonding.

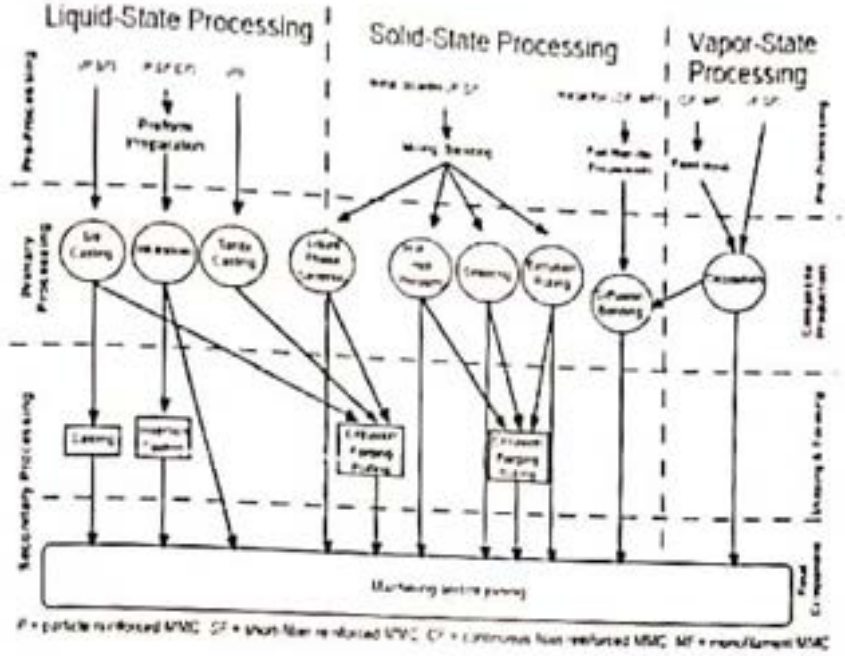

Figure 1.1 Flow chart of MMC processing routes (Surappa 2003)

The secondary process involves processing of primary processed composites with the objective of improving their mechanical properties by further consolidation (reduction or elimination of porosity), break up of dispersed agglomerates, improved interfacial bonding, generating dispersed alignment and /or forming into a required shape to obtain semi finished products. The most commonly used secondary processes for MMCs are extrusion, rolling, forging, superplastic deformation, machining and joining. The primary and secondary processes for producing metal matrix composites are listed in Figure 1.1.

1.5.1 Primary Liquid State Processes

Most of the MMCs are produced by this technique. In this technique, the ceramic particles are incorporated into liquid metal using various processes. The liquid composite slurry is subsequently cast into various shapes by conventional casting techniques or cast into ingots for secondary processing. The process has major advantage that the production costs of MMCs are very low. The major difficulty in such processes is the non-wettability of the particles by liquid aluminium and the consequent rejection of the particles from the

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melt, non-uniform distribution of particles due to their preferential segregation and extensive interfacial reaction. The liquid state process includes liquid metal infiltration, squeeze casting process, spray deposition method, stir casting process and compo casting process.

1.5.2 Solid Phase Fabrication Methods

There are several ways to fabricate MMC using solid-phase materials but among them diffusion bonding and the powder metallurgy route are used widely. The powder metallurgy (PM) route is the most commonly used solid state processing method for the preparation of discontinuous reinforced MMCs (Kelly 1985). Several companies are using this technique to manufacture MMC using either particulates or whiskers as the reinforcement materials. In this process powders of matrix materials and reinforcement are first blended and fed into a mould of the desired shape and then pressure is applied to further compact the powder (cold pressing). In order to facilitate the bonding between the powder particles, the compact is then heated to a temperature below this melting point but sufficiently high to develop significant solid state diffusion (sintering). Alternatively, after blending the mixture can be pressed directly by hot pressing, however Hot Isostatic Pressing (HIP) is helpful for securing high-density material. The consolidated product is then used as a MMC material after some secondary operation (Kaczmara et al 2000).

1.6 SIGNIFICANCE OF HEAT TREATMENT

Heat treating refers to any of the heating and cooling operations that is performed for the purpose of changing the mechanical properties, metallurgical structure, or the residual stress state of a metal product. When the term is applied to aluminum alloys, however, its use is frequently restricted to the specific operations employed to increase strength and hardness of the precipitation hardenable aluminium wrought and cast alloys. These usually are referred to as the "heat-treatable" alloys to distinguish them from those alloys in which no significant strengthening can be achieved by heating and cooling (Polmear 2004).

The Aluminium alloys of this class belong to systems with limited solubility in solid state. These are precipitation hardenable alloys. The main characteristic of these alloys system is temperature dependent equilibrium solid solubility, which increases with rise in temperature. In addition the other requirements are possibility of retaining single phase supersaturated solid solution by quenching, and precipitation of coherent/partially coherent phase by decomposition of the super saturated solid solution.

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Non-heat treatable aluminum alloys do not respond to heat treatment, because they consist of a homogeneous solid solution with or without noncoherent precipitate(s) and show low strength and high ductility. These alloys may be stress hardened. These alloys are used as sheet, bar, plates, wire, extrusion and so on. They are readily bent, formed and welded and possess excellent resistance to corrosion.

1.6.1 Age-Hardening of Aluminium MMCs

The heat treatment for enhance the mechanical properties of aluminium alloy is carried out by precipitate from a supersaturated solid solution. The alloy becomes harder with time or as it ages it develops hardness and strength. The hardness of the quenched alloy increases as a function of ageing time. Ageing of the quenched alloy at room temperature is known as natural ageing while at elevated temperatures is known as artificial ageing. Precipitation in solid solution occurs when the solubility of solute decreases with decreasing temperature. The precipitate of the second phase should be coherent in nature. The object of age hardening is to create in a heat treated alloy a dense of fine dispersions of precipitated particles in a matrix of deformable metal. The precipitate particles act as obstacles to dislocation motion and thereby strengthen the heat-treated alloy. Precipitation hardenable aluminum alloys are heat treated in three-step process: solution heat treatment, quenching and age hardening. The solution treatment aims to dissolve the soluble phases. Quenching aims to preserve the solid solution formed by rapidly cooling to some lower temperature, usually room temperature. Age hardening aims to precipitate out the strengthening phase.

1.7 ENGINEERING APPLICATIONS OF MMCs

Metal matrix composites have emerged as one of the advanced engineering materials having potential application in the areas of aerospace, automotive, defense, electronics, nuclear, general engineering and other advanced structures.

Aluminium matrix composites have been first developed to meet very high performance defense and aerospace needs. Continuous fiber reinforced aluminium was used in the space shuttle and Hubble space telescope. As material cost became a more significant consideration, the emphasis shifted towards particulate reinforced materials, with the goal of a lower cost, high volume product that could be used in automotive and commercial aerospace applications.

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Aluminium metal matrix composites used for tribological components have attracted more and more interests. They are widely used as high speed rotating or reciprocating mass items such as pistons, connecting rods, drive shaft, brake rotors and cylinder liners.

TABLE 1.1 APPLICATION OF MMC

Sl. No	Area of application	Some of the components	Advantages
1	Aerospace Industry	Space structures, Antennas, Aircraft primary and Secondary structures, Engine static and rotating components, transmission static and rotating components, satellite & helicopter structures, compressor blades.	High thrust to weight ratio for engines, High stiffness, low density, controlled thermal expansion, High wear resistance etc.
2	Automotive Industry	Piston & Cylinder blocks for I.C engines, drive shaft, connecting rod, wheels Chassis, fiy wheels, Brake rotors, bicycle frames, brake dises	High wear resistance, Lower cost, Lower density, Elevated temperature strength, fatigue resistance.
3	Electronic packaging	Substrate and housing for electronic microcircuits.	High stiffness, High heat dissipation capacity, controlled thermal expansion, low density.
4	Sports Industry	Bicycle frames, Tennis rackets, Golf club shaft, Base ball shafts.	High stiffness, Low density, High fatigue resistance

The continuing increase in electronic packaging density has resulted in a need for materials with high thermal conductivities. In addition, to minimize thermal stresses that can cause component or solder failure, packaging materials must have coefficients of

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thermal expansion (CTEs) matching those of ceramic substrates and semiconductors. Further, low density is desirable in many applications, including portable systems such as lap-top computers, hand-held telephones, and avionics. Table 1.1 provides the some composite components and their area of application.

1.8 INTRODUCTION OF UCM

Aluminium metal matrix component is tough to machining in conventional machining process. Usually all the small components are to be machining in unconventional machining process. Because all the small machining components have a fine finishing when machined in unconventional machining process.

Unconventional manufacturing processes is defined as a group of processes that remove excess material by various techniques involving mechanical, thermal, electrical or chemical energy or combinations of these energies but do not use a sharp cutting tools as it needs to be used for traditional manufacturing processes.

Extremely hard and brittle materials are difficult to machine by traditional machining processes such as turning, drilling, shaping and milling. Non tradtional machining processes, also called advanced manufacturing processes, are employed where traditional machining processes are not feasible, satisfactory or economical due to special reasons as outlined below.

- Very hard fragile materials difficult to clamp for traditional machining
- When the workpiece is too flexible or slender
- When the shape of the part is too complex

Several types of non-traditional machining processes have been developed to meet extra required machining conditions. When these processes are employed properly, they offer many advantages over non-traditional machining processes. The common nontraditional machining processes are described in this section.

Manufacturing processes can be broadly divided into two groups:

a) primary manufacturing processes : Provide basic shape and size
b) secondary manufacturing processes : Provide final shape and size with tighter control on dimension, surface characteristics

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Material removal processes once again can be divided into two groups

1. Conventional Machining Processes
2. Non-Traditional Manufacturing Processes or Unconventional Machining processes

Conventional Machining Processes mostly remove material in the form of chips by applying forces on the work material with a wedge shaped cutting tool that is harder than the work material under machining condition.

The major characteristics of conventional machining are:

- Generally macroscopic chip formation by shear deformation
- Material removal takes place due to application of cutting forces – energy domain can be classified as mechanical

Non-conventional manufacturing processes is defined as a group of processes that remove excess material by various techniques involving mechanical, thermal, electrical or chemical energy or combinations of these energies but do not use a sharp cutting tools as it needs to be used for traditional manufacturing processes.

Material removal may occur with chip formation or even no chip formation may take place. For example in AJM, chips are of microscopic size and in case of Electrochemical machining material removal occurs due to electrochemical dissolution at atomic level.

1.8.1 Classification Of UCM Processes

1. Mechanical Processes
   - Abrasive Jet Machining (AJM)
   - Ultrasonic Machining (USM)
   - Water Jet Machining (WJM)
   - Abrasive Water Jet Machining (AWJM)
2. Electrochemical Processes
   - Electrochemical Machining (ECM)
   - Electro Chemical Grinding (ECG)
   - Electro Jet Drilling (EJD)

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3. Electro-Thermal Processes
   - Electro-discharge machining (EDM)
   - Laser Jet Machining (LJM)
   - Electron Beam Machining (EBM)
4. Chemical Processes
   - Chemical Milling (CHM)
   - Photochemical Milling (PCM)

Need For Unconventional Machining Processes

- Extremely hard and brittle materials or Difficult to machine material are difficult to machine by traditional machining processes.
- When the workpiece is too flexible or slender to support the cutting or grinding forces When the shape of the part is too complex.

1.9 ELECTRO CHEMICAL MACHINING

The Electro chemical machining is the preferred process for the Aluminium metal matrix component. So that here we are using the Electro chemical machining. Electrochemical machining (ECM) is a metal-removal process based on the principle of reverse electroplating. In this process, particles travel from the anodic material (workpiece) toward the cathodic material (machining tool). A current of electrolyte fluid carries away the deplated material before it has a chance to reach the machining tool. The cavity produced is the female mating image of the tool shape.

Similar to EDM, the workpiece hardness is not a factor, making ECM suitable for machining difficult-to –machine materials. Difficult shapes can be made by this process on materials regardless of their hardness.

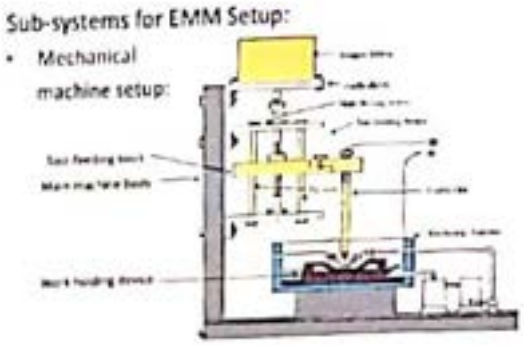

Figure 1.2 ECM process

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The ECM tool is positioned very close to the workpiece and a low voltage, high amperage DC current is passed between the workpiece and electrode. Some of the shapes made by ECM process is shown in Figure 1.3

Figure 1.3 Parts made by ECM

1.9.1 Advantages of ECM

- The components are not subject to either thermal or mechanical stress.
- No tool wear during ECM process.
- Fragile parts can be machined easily as there is no stress involved.
- ECM deburring can debur difficult to access areas of parts.
- High surface finish (up to 25 μm in) can be achieved by ECM process.
- Complex geometrical shapes in high-strength materials particularly in the aerospace industry for the mass production of turbine blades,
- jet-engine parts and nozzles can be machined repeatedly and accurately.
- Deep holes can be made by this process.

1.9.2 Limitations of ECM

- ECM is not suitable to produce sharp square corners or flat bottoms because of the tendency for the electrolyte to erode away sharp profiles.
- ECM can be applied to most metals but, due to the high equipment costs, is usually used primarily for highly specialized applications.

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1.9.3 Material removal rate, MRR, in ECM

MRR = C I h (cm /min)

C specific (material) removal rate (e.g., 0.2052 cm /amp-min for nickel);

I current (amp),

h current efficiency (90–100%).

The rates at which metal can electrochemically remove are in proportion to the current passed through the electrolyte and the elapsed time for that operation. Many factors other than current influence the rate of machining. These involve electrolyte type, rate of electrolyte flow, and some other process conditions.

1.10 ELECTROLYSIS

Electrolysis is the name given to the chemical process which occurs, for example, when an electric current is passed between two conductors dipped into a liquid solution. A typical example is that of two copper wires connected to a source of direct current and immersed in a solution of copper sulphate in water, as shown in Figure 1.4. An ammeter, placed in the circuit, will register a flow of current; from this indication, the electric circuit can be deduced

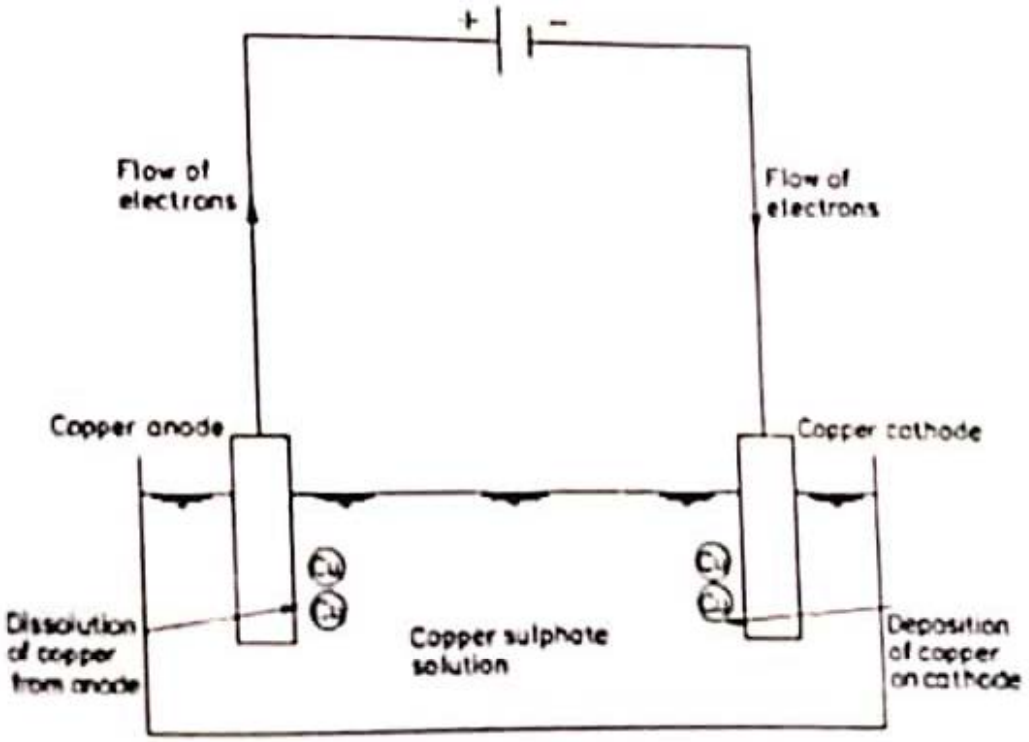

Figure 1.4 Electrolysis of copper sulphate solution.

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to be complete. A significant conclusion that can be made from an experiment of this sort is that the copper sulphate solution obviously has the property that it could conduct electricity.

Such solution is termed an electrolyte. The wires are called electrodes, the one with positive polarity being the anode, and the one with negative polarity the cathode. The system of electrodes and electrolyte is referred to as the electrolytic cell, whilst the chemical reactions which occur at the electrodes are called the anodic or cathodic reactionsor process.

Reactions that occur during the electrolysis of copper sulphate (Figure 1.5) are as follows.

The anodic reaction is ionizing of copper:

$$Cu \Longrightarrow Cu^{2+}(aq) + 2e^{-}$$

While at the cathode the copper ions are discharged to form copper metal:

$$Cu^{2+}(aq) + 2e^{-} \Longrightarrow Cu$$

Electrolytes are different from metallic conductors of electricity in that the current is carried not by electrons but by atoms, or group of atoms, which have either lost or gained electrons, thus acquiring either positive or negative charges. Such atoms are called ions. Ions which carry positive charges move through the electrolyte in the direction of the positive current, that is toward the cathode and are called cations.

Similarly, the negatively charged ions travel toward the anode and are called anions. The movement of the ions is accompanied by the flow of electrons, in the opposite sense to the positive current in the electrolyte, outside the cell and both reactions are a consequence of the applied potential difference, that is, voltage, from the electric source.

A cation reaching the cathode is neutralized, or discharged, by the negative electrons on the cathode. Since the cation is usually the positively charged atom of a metal, the result of this reaction is the deposition of metal atoms.

To maintain the cathodic reaction, electrons are required to pass around the external circuit. These are obtained from the atoms of the metal anode, and these atoms thus become the positively charged cations which pass into solution. In this case, the reaction is the reverse of the cathodic reaction.

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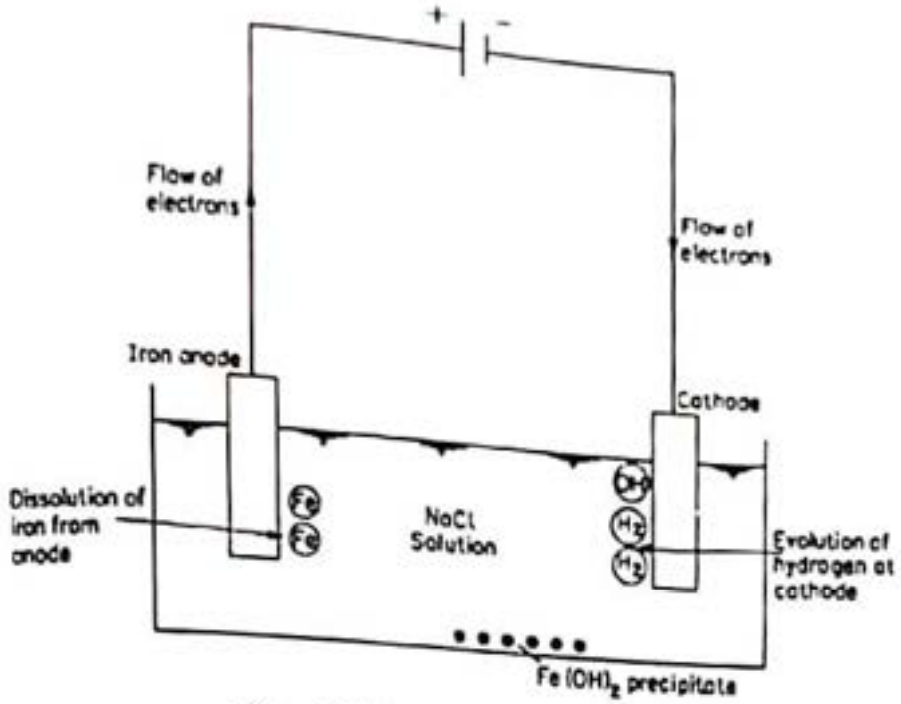

Figure 1.5 Electrolytic dissolution of iron.

The electrolyte in its bulk must be electrically neutral; that is, there must be equal numbers of opposite charges within it, and thus there must be equal amounts of reaction at both electrodes. Therefore, in the electrolysis of copper sulphate solution with copper electrodes, the overall cell reaction is simply the transfer of copper metal from the anode to the cathode. When the wires are weighted at the end of the experiment, the anodic wire will be found to have lost weight, whilst the cathodic wire will have increased in weight by an amount equal to that lost by the other wire.

Reactions that occur during the electrolysis of iron (1.3) are as follows. The anodic reaction is ionizing of iron:

$$Fe \Longrightarrow Fe^{2+}(aq) + 2e^-$$

At the cathode, the reaction is likely to be the generation of hydrogen gas and the production of hydroxyl ions:

$$H_2O + 2e^- \Longrightarrow H_2 + 2OH^-$$

The net reaction is thus

$$Fe + 2H_2O \Longrightarrow Fe(OH)_2(s) + H_2$$

The ferrous hydroxide may react to form ferric hydroxide:

$$4Fe(OH)_2 + 2H_2O + O_2 \Longrightarrow 4Fe(OH)_3$$

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1.10.1 FARADAY'S LAW OF ELECTROLYSIS

During ECM, metal from the anode is removed atom by atom by removing negative electrical charges that bind the surface atoms to their neighbors. The ionized atoms are then positively charged and can be attracted away from work piece by an electric field. In electrolytic cell material removal is governed by faraday's law of electrolysis which states that,

I. The amount of chemical changes produced by an electric current or the amount of substance deposited or dissolved is proportional to the quantity of electricity passed.

II. The amounts of different substances deposited or dissolved by the same quantity of electricity are proportional to their chemical equivalent weights." It can expressed mathematically as follows,

M αItE M=ItE/F

Where,

I is the current in amperes

E is the gram equivalent of the material (or A/Z, where A is the atomic weight and Z is the valence of dissolution)

F is Faraday's constant (96500 Coulombs/mole).

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CHAPTER 2

LITERATURE REVIEW

After going through all the selected paper related to Electrochemical micro-machining, all the paper are broadly classified into two different category, one related to recent trends in micro ECM and second related to the effect of parameters on machining rate(MR) and overcut.

2.1 OVERVIEW ON MICRO ECM

Senthil Kumar , G Ganesan and R Karthikeyan (2010) "Bi-performance optimization of electrochemical machining characteristics of Al/20%SiCp composites using NSGA -2" explained that, the cutting parameters used for the experiments were electrolyte concentration, electrolyte flowrate, applied voltage, and tool feed rate. Experiments were carried out according to response surface methodology (RSM). The non- dominated sorting genetic algorithm (NSGA-II) tool was used to optimize the ECM process parameters to maximize MRR and minimize Ra. ECM is an extremely prominent machining process among newly developed non-traditional machining techniques. The main purpose of this work is to study the intervening variables in electrochemical machining of LM25 Al/20%SiCp on metal removal rate (MRR), and surface roughness (Ra).

Senthil Kumar, G. Ganesan, R. Karthikeyan (2011) "Parametric optimization of electrochemical machining of Al/15% SiCp composites using NSGA-II" highlighted in this paper, ECM is often used for machining difficult-to-cut materials because electrochemical dissolution is independent of the material hardness and toughness. Additionally, ECM generates no burrs, no stress, and has a long tool life, high material removal rate and good surface quality. In the ECM process, a low voltage (0–30 V) is normally applied between electrodes, producing a high current density of the order 10–100 A cm–2. Electrolyte (typically NaCl or $NaNO_3$ aqueous solutions) is supplied to flow through the gap with high velocity to flush away the reaction products (usually gases and hydroxides) and heat generated by the passage of cur- rent and electrochemical reactions.

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N. S. Qu & X. L. Fang & Y. D. Zhang & D. Zhu . (2013) "Enhancement of surface roughness in electrochemical machining of Ti6Al4V by pulsating electrolyte" explained in this report a pulsating electrolyte, which is one of the unsteady flows that are characterized by periodic fluctuations of the mass flow rate and pressure. The goal of this report is to present experimental results of the surface roughness obtained on ti6al4v samples using a developed pulsating electrolyte supply system in ECM. The surface roughness Ra is5.7μm, the material removal rate is 0.85 g/min at a constant electrolyte, the lowest surface roughness is 3.69μm and the largest material removal rate is 0.92 g/min, whichare obtained at a pulsating frequency of 10 Hz and amplitude of 0.2 MPa. In pulsedcurrent ECM, the surface roughness Ra and material removal rate are 0.67μm and 0.38 g/min at a constant electrolyte, respectively, and both the minimum surface roughness Ra of 0.53 μm and maximum material removal rate of 0.39 g/min

S. Rama Rao and G. Padmanabhan (2013) "Modeling of Radial over Cut in Electrochemical Machining of Al-B4C MMC Using Response Surface Methodology" highlighted in this paper, the Ruszaj and Zybura- skrabalak developed a mathematical model for ECM utilizing a flat ended universal electrode. It was observed that better material removal rates and low surface waviness can be achieved when compared with the ball ended electrodes. Later on, Hocheng et al. used the concept of redistribution of electric energy to erode a hole in the thin metal of sheet. But it is very difficult to identify the optimal process parameters of ECM with this type of experimental study. Study the characteristics of ECM of Al SiC P composites. Contour plots were constructed between the responses MRR and SR, and process parameters, namely applied voltage, electrolyte concentration, electrolyte flow rate and tool feed rate.

S.Dharmalingam, P.Marimuthuá and K.Raja (2014) "Machinability Study On Al-10% Tic Composites And Optimum Setting Of Drilling Parameters In Electrochemical Micro Machining" highlighted in this paper present the theoretical analysis of the ECM process of curvilinear surfaces. Micro drilling is an essential process in the electronics, aviation, and semiconductor industries. Since micro drills have low rigidness and a high aspect ratio, precise drilling parameters are required to prevent tool breakage from excessive thrust force or torque. Have made an attempt to machine the alumina ceramic to investigate the effects of drilling parameters on whole characteristics (Chang and Lin, 2012). The EMM micro hole making process satisfies the quality requirements with respect to their geometrical characteristics like over-cut, taper, aspect ratio or metallurgical characteristics.

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P.Satishkumar, S.Dharmalingam, K.Raja, K.Lingadurai, G.Padmanaban (2015) "Investigation on Electrochemical Micro Machining of Al 6061-6% wt Grabbed on Taguchi design of experiments" in Taguchi's analysis method, the design parameters and noise parameters which influence the product quality are consider. In the study, they reported that a considerable amount of MRR at a moderate accuracy can be achieved with a machining voltage of 6–10 V, pulse-on time of 10–15ms, and electrolyte concentration of 15– 20 g/l. The micro ECM process is complex, and it is not easy to decide the optimal machining parameters for improving the output quality.

M.Sankara, A.Gnanavelbabub, K.Rajkumar , (2014) "Effect of reinforcement particles on the abrasive assisted electrochemical machining of Aluminium-Boron carbide-Graphite composite" In this paper, attempts have been made to model and optimize process parameters in Abrasive assisted Electro- Chemical Machining (AECM) of Aluminium-5-15% boron carbide- 5-10% graphite composite using pre-shaped cylindrical copper tool electrodes. Sic abrasive particle size of 50μm is used along with NaCl electrolyte. The dominant characteristics of ECM is researched through sets of experiments according to various parameters, such as machining voltage, pulse on time, pulse frequency, feed rate, electrode diameter, and shape of electrode etc.

S. Ayyappan, M. Kalaimathi, G. Venkatachalam (2015) "Cost- Tolerance Prediction Models For Electrochemical Machining Of Metal Matrix Composites" In this paper, the machinability issues of MMCs with different machining methods. Taweel studied the machining characteristics of Al/Al2O3 composite by using electrochemical turning (ECT) with magnetic abrasive finishing (MAF) investigated the electrochemical machining characteristics of Al/SiCp composites by using response surface methodology. Machining suitability of Al/B4C composites with electrochemical machining was also investigated. The influence of reinforcement of SiC particles in aluminum matrix was investigated and other ECM process parameters were optimized.

C.Venkatesh, N.M.Arun, R.Venkatesan (2014) "Optimization of micro drilling parameters of B4C DRMM Al 6063 composite in μECM using Taguchi coupled Fuzzy Logic" examined, the numerical simulation experiments as per Taguchi's method and

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concluded that the ram speed was chief significant process parameters. Ilhan Asiltuk, Harun Akkus presented the optimized model to determine the effect of cutting parameters on surface roughness under Taguchi's method. Yan-Cherng Lin et al. Have investigated the effect of magnetic force on EDM machining characteristics with L18 orthogonal arrays and concluded that the magnetic assisted EDM has the higher metal removing rate and lower electrode wear.

A.Ranjithkumar and R.Malayalamurthi, (2013) "Investigations on Micro-ECM Compatibility of Al6082 Metal Matrix Composite Material" in this research study, in this work six samples of Al6082 metal matrix composites were fabricated with different combinations of reinforcements, silicon carbide (SiC) and soda white lime glass powder. The fabricated specimens were then machined to 1mm thickness plate in wire-cut electro discharge machining (wire-cut EDM) and micro holes are machined by electro chemical micro machining (ECMM) to study the effect of process parameters like duty cycle, electrolyte concentration and voltage on metal removal rate (MRR).

Charanjit Singh Kalra, Vinod Kumar and Alakesh Manna (2018) "Analysis of electrochemical behavior on micro-drilling of cast hybrid Al/ (Al2O3p þSiCp þCp)-MMC using micro-ECM process" in this paper, presents the results of an experimental investigation on machining of micro-hole during electrochemical micromachining (ECMM) of stir-cast hybrid aluminum (alumina þsilicon carbideþcarbon particulates) metal matrix composite. An ECMM set-up was developed and utilized for carrying out the experimental investigation. The supply current (Ip), supply voltage (v), pulse-on time (Ton), pulse-off time (Toff), electrolyte concentration (EC), and electrolyte flow rate (FR) were selected as process parameters. The effect of process parameters on material removal rate (MRR), electrode wear rate (EWR), surface roughness height (SR), taper cut (TC), over cut (OC), and micro-spark-affected zone (MSAZ) were analyzed through various graphs.

Ashish Kumar Srivastava, Amit Rai Dixit and Sandeep Tiwari (2015) "A review on the intensification of metal matrix composites and its nonconventional machining" This paper reviews various research works on the development of MMCs and the subsequent hybrid composites and evaluates their performances. Further, it discusses the influence of the process param- eters of conventional and nonconventional machining on the performance of MMCs. At the end, it identifies the research gaps and future scopes for further investigations in this field.

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Sadineni Rama Rao and G. Padmanabhan, (2013) "Modeling of Radial over Cut in Electrochemical Machining of Al-B4C MMC Using Response Surface Methodology" in the present work the percentage of rein- forcement of the particulates in the matrix is considered one of the process parameters along with the applied voltage, electrode feed rate and electrolyte concentration. A mathematical prediction model of the radial over cut (ROC) was developed using response surface methodology (RSM). The effects of electrochemical machining parameters on the Radial over cut were evaluated.

Sadineni Rama Raoa, G. Padmanabhanb, K. Mahesh Naidua, A. Rukesh Reddya (2014) "Parametric Study for Radial over Cut in Electrochemical Drilling of Al-5%B4Cp Composites" in this paper, Metal-matrix composites (MMCs) have been increasingly used in automotive and aerospace industries because of their superior properties compared to unreinforced alloys.. The present work investigates the effect of voltage, electrolyte concentration and feed rate on radial over cut in electrochemical drilling of Al/B4Cp metal matrix composites. Experiments have been conducted on electrochemical machine according to the principles of Taguchi's design of experiments method. Regression analysis was employed to develop mathematical model for radial over cut.

Maniraj.S., and Thanigaivelan.R (2019) "optimization of Electro chemical micro machining of AMCs with different % composition of GGBS using Taguchi and Topsis method " machinability of ground-granulated blast furnace slag (GGBS)-reinforced aluminium 6061 metal matrix composites using electro chemical micro machining for material removal rate (MRR) and radial overcut, input voltage, duty cycle, electrolyte concentration and % of composition are selected as the input process parameters.

Krishna Kumar Saxena, Jun Qian, Dominiek Reynaerts (2018) "A review on process capabilities of electrochemical micromachining and its hybrid variants." International journal of machine tools and manufacture Electrochemical micromachining (micro-ECM) is an unconventional micromachining technology that has capability to fabricate high aspect ratio micro-holes, micro-cavities, micro-channels and grooves on conductive and difficult-to-cut materials.

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RESEARCH GAP

Among many AMCs, Aluminium 6061 metal matrix reinforced with Ground Granulated blast-furnace slag (GGBS) is a novel composite. This composite is widely used in automotive industries due to high wear resistance, high strength to low weight ratio, elevated temperature toughness and high stiffness. Nobody have made a project in this composite for the future scope in aerospace industires. The testing of this composite is made by electro chemical micro machining by the process parameters of different % of composition and by the input voltage, electrolyte concentration and temperatures. The experiments was designed based on the Response Surface Methodology (RSM).

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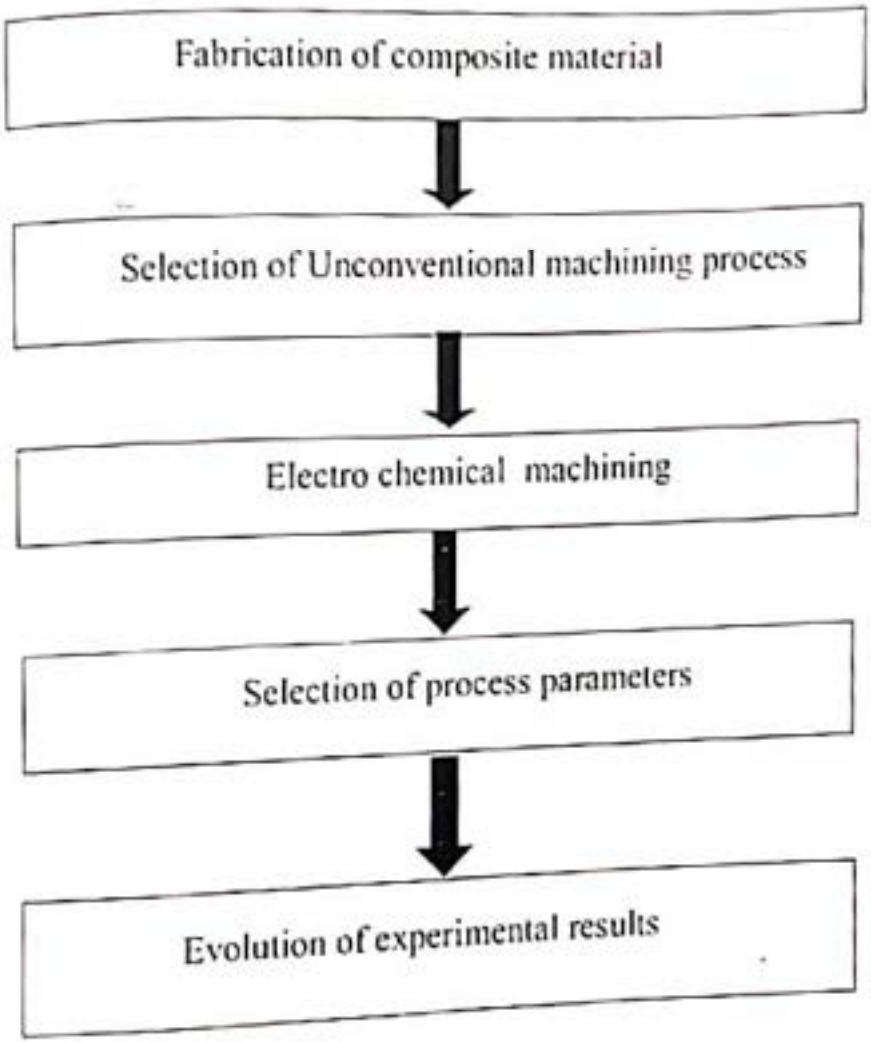
CHAPTER 3

METHODS AND MATERIALS

3.1 Flow chart of methodology



3.2 STIR CASTING

Liquid state fabrication of Metal Matrix Composites involves incorporation of dispersed phase into a molten matrix metal, followed by its Solidification. In order to provide high level of mechanical properties of the composite, good interfacial bonding (wetting) between the dispersed phase and the liquid matrix should be obtained. Wetting improvement may be

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achieved by coating the dispersed phase particles (fibers). Proper coating not only reduces interfacial energy, but also prevents chemical interaction between the dispersed phase and the matrix. The simplest and the most cost effective method of liquid state fabrication

Stir Casting is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring is shown in figure 3.1

The liquid composite material is then cast by conventional casting methods and may also be processed by conventional Metal forming technologies.

Stir Casting is characterized by the following features:

- Content of dispersed phase is limited (usually not more than 30 vol. %).
- Distribution of dispersed phase throughout the matrix is not perfectly homogeneous:

STIR CASTING EQUIPMENT

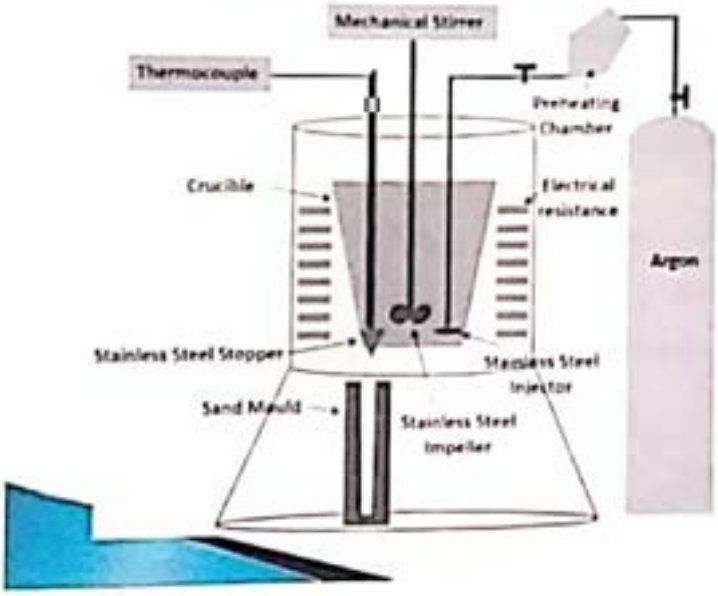

Figure 3.1 2D of stir casting setup.

1. There are local clouds (clusters) of the dispersed particles (fibers);
2. There may be gravity segregation of the dispersed phase due to a difference in the densities of the dispersed and matrix phase.

- The technology is relatively simple and low cost.

Distribution of dispersed phase may be improved if the matrix is in semi-solid condition. The method using stirring metal composite materials in semi-solid state is called the casting is shown in figure 3.2.

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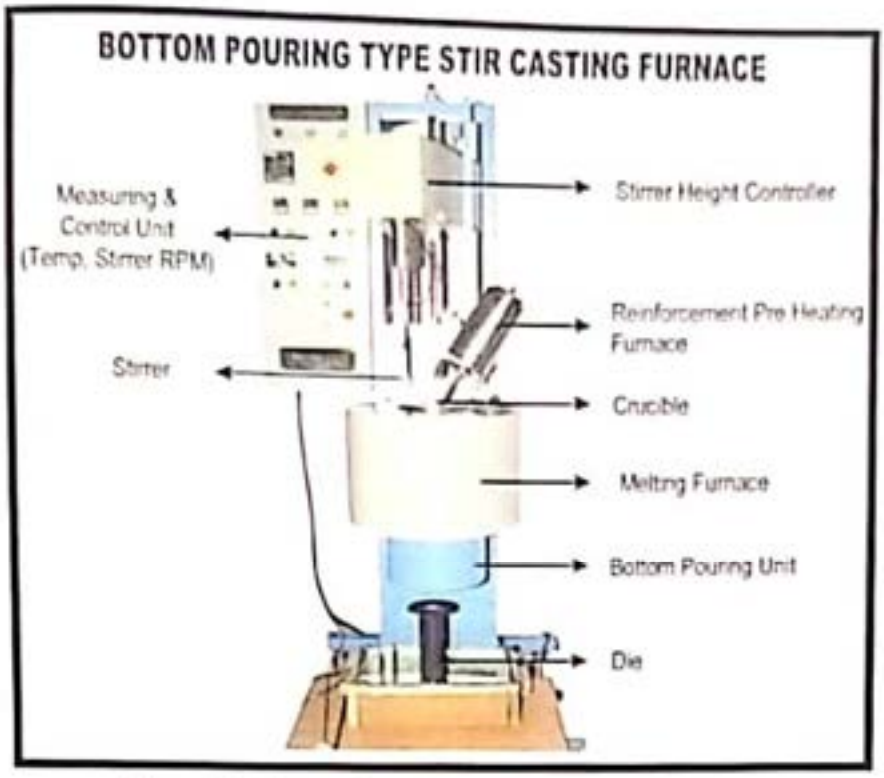

Figure 3.2 Bottom Pouring Type Stir Casting Setup

3.3 WIRE CUT ELECTRO DISCHARGE MACHINING (WEDM)

Electrical discharge machining (EDM), also known as spark machining, spark eroding, burning, wire burning or wire erosion, is a manufacturing process whereby a desired shape is obtained by using electrical discharge (sparks) is shown in figure 3.3.

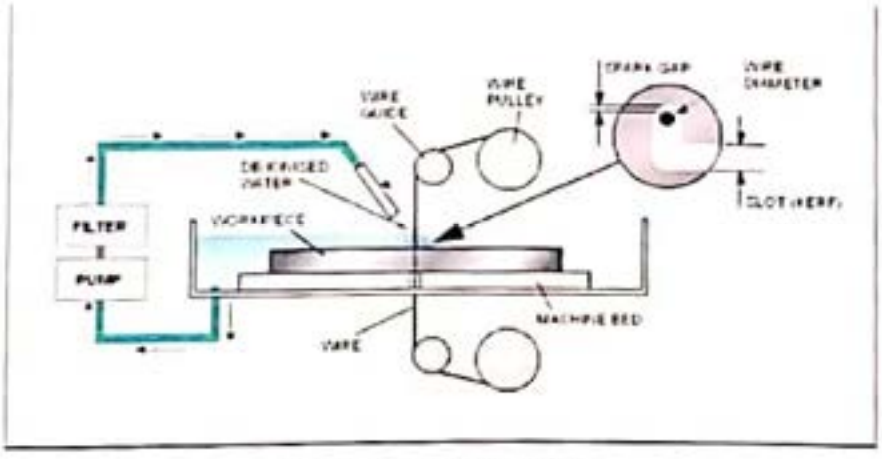

Figure 3.3 Wire cut EDM

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Material is removed from the work piece by a series of rapidly recurring current discharges between two electrodes, separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the "tool" or "electrode," while the other is called the work piece-electrode, or "work piece." The process depends upon the tool and work piece not making actual contact. When the voltage between the two electrodes is increased, the intensity of the electric field in the volume between the electrodes becomes greater than the strength of the dielectric (at least in some places), which breaks down, allowing current to flow between the two electrodes. This phenomenon is the same as the breakdown of a capacitor (condenser) (see also breakdown voltage). As a result, material is removed from the electrodes. Once the current stops (or is stopped, depending on the type of generator), new liquid dielectric is usually conveyed into the inter-electrode volume, enabling the solid particles (debris) to be carried away and the insulating properties of the dielectric to be restored.

Adding new liquid dielectric in the inter-electrode volume is commonly referred to as "flushing." Also, after a current flow, the difference of potential between the electrodes is restored to what it was before the breakdown, so that a new liquid dielectric breakdown can occur.

3.3.1 Advantages of WEDM include:

- Complex shapes that would otherwise be difficult to produce with conventional cutting tools.
- Extremely hard material to very close tolerances.
- Very small work pieces where conventional cutting tools may damage the part from excess cutting tool pressure.
- There is no direct contact between tool and work piece. Therefore, delicate sections and weak materials can be machined without perceivable distortion.
- A good surface finish can be obtained; a very good surface may be obtained by redundant finishing paths.
- Very fine holes can be attained.
- Tapered holes may be produced.
- Pipe or container internal contours and internal corners down to R .001".

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3.3.2 Disadvantages of WEDM include:

- Difficulty finding expert machinists.
- The slow rate of material removal.

3.4 ELECTRO CHEMICAL MACHINING:

Electrochemical machining is a material removal process similar to electro plating. In this process, the work piece to be machined is made the anode and the tool is made the cathode of an electrolytic cell with a salt solution being used as an electrolyte. The tool and the work piece are located so that there is a gap between them. The tool is designed so that it is the exact inverse of the feature to be machined.

On the application of a potential difference between the electrodes and when adequate electrical energy is available between the tool and the work piece, positive metal ions leave the work piece. Since electrons are removed from the work piece, oxidation reaction occurs at the anode. The electrolyte accepts these electrons resulting in a reduction reaction.

Hence the positive ions from the metal react with the negative ions in the electrolyte forming hydroxides and thus the metal is dissolute forming a precipitate. The electrolyte is constantly flushed in the gap between the tool and the work piece to remove the unwanted machining products which otherwise would grow to create a short circuit between the electrodes. The electrolyte also carries away heat and hydrogen bubbles. The tool is advanced into the work piece for the machining to be carried out. A pump system must filter the electrolyte and circulate it because the electrolyte carries away machining waste. The block diagram of ECM set up is shown in the following figure 3.4.

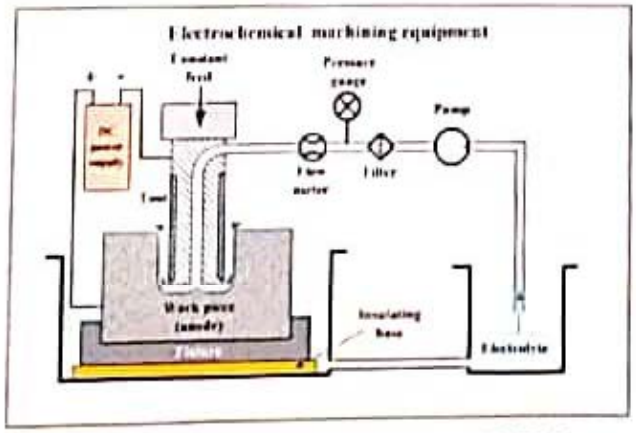

Figure 3.4 Block Diagram of ECM

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In ECM metal removal is obtained by anodic dissolution of the work piece. Here the work piece is made the anode and the tool is made the cathode. The shape of the anodic dissolution will be that of the mirror image of the shape on the cathodic tool. Hard metals can be shaped electrolytic by using ECM and the rate of machining does not depend on their hardness. The tool electrode used in the process does not wear, and therefore soft metals can be used as tools to form shapes on harder work pieces, unlike conventional machining methods.

The tool is guided towards the work piece to maintain a constant inter-electrode gap between them. Under short-circuit conditions the gap width goes to zero. If some process conditions, such as too small equilibrium gap width caused by a too high movement of the tool towards the work piece, a contact between the two electrodes occurs. This causes a short circuit between the electrodes and hence premature termination of machining. Hence a constant inter electrode gap should be maintained for the machining operation to be carried out on the given work piece.

3.4.1 PRINCIPLE OF ELECTRO CHEMICAL MACHINING

ECM is an anodic dissolution process. It is developed on the principle of Faradays and Ohm. In this process, an electrolyte cell is formed by the anode (work piece) and the cathode (tool) in the midst of a following electrolyte. The metal is removed by the controlled dissolution of the anode according to the well-known Faradays law of electrolysis. When the electrodes are connected to electric supply source, flow of current in the electrolyte is established due to positively charged ion being attracted towards cathode and vice-versa. Due to electrolysis process at cathode hydroxyl ion are released which combine with the metal ions of anode to form insoluble metal hydroxide. Thus the metal is removed in the form of sludge and precipitated in electrolytic cell. This process continues till the tool has produced its shape in the work piece.

3.5 PROCESS PARAMETERS

The main process parameters governing the ECM process are

- Electrolyte concentration,
- Current, and voltage settings,
- Electrode gap,
- Duty cycle, and
- Frequency.

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3.5.1 ELECTROLYTE CONCENTRATION

The electrolyte is one of the main components of the machining system. The electron movement from the cathode to the anode is dependent on the properties of the electrolyte. The electrolyte conductivity in the gap between the cathode and the anode was dependent on the following parameters: the starting electrode distance, concentration of salt in the solution, local hydroxide concentration in electrolyte, bulk and local temperature, electrolyte flow rate, and the velocity of electrolyte. High flow rates of electrolyte were not desirable as they caused tool erosion.

Surface brightening was achieved only under conditions where the dissolution mechanism was independent of structure. One of the main considerations in the design of the tool is that it should provide the desired agitation of the electrolyte. The control of electrolyte speed and flow direction was important for the machining process to continue. It is a difficult task to maintain the flow of electrolyte in the extremely small gap without affecting the tool stability.

Electrolyte removes the machining products generated at the electrodes and dissipates the heat generated. Machining performance is governed by the behaviour of anodic work piece in a given electrolyte. In micro machining because of the small gap between the tool and the electrode, the density of current is very high which results in vaporization of the electrolyte. The electrolyte must be chosen in such a way that it does not vaporize and carries the machining products away from the workpiece.

The main functions of the electrolyte are to provide the ideal conditions for the dissolution of the work piece material, conduct electricity, carry away the unwanted machining products and heat generated, and maintain a constant temperature in the machining gap.

3.5.2 CURRENT AND VOLTAGE

Current density depended on the rate at which ions arrived at respective electrodes which was proportional to the applied voltage, concentration of electrolyte, gap between the electrodes, and tool feed rates. As the tool approached the work, the length of the conductive current path decreased and magnitude of current increased. This lessening of the gap and increase in current continued until the current was just sufficient to remove the metal at a rate corresponding to the rate of tool advance.

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3.5.3 INTER ELECTRODE GAP

Inter-Electrode Gap (IEG) should be as small as possible. If the electrode gap is kept small, the resolution of the machined shape becomes better and the possibility of applying ECM to micro- machining increases. Localization of the Dissolution process can be increased by reducing the gap width. The gap width is only one parameter characterizing the micro-machining precision. It can also increase accuracy and unit removal. In the EMM process, the IEG is kept in the order of 10– 50 micro meter maintaining the specific range of IEG, i.e. 15–20 micro meters uniformly is an important requirement to achieve high accuracy and surface finish. The electrical conduction method for maintaining the electrode gap distance between the tool electrode and work piece can be applied.

Around 1 V can be applied between the tool electrode and the workpiece for measuring the current so that the electrical contact of the micro tool electrode with the work piece can be checked In a pulsed EMM system, the IEG and tool position monitoring can be conducted during pulse off- time, leading to a significant reduction in the indeterminacy of the gap. Machining inaccuracy is directly proportional to the IEG size.

3.6 LIST OF SUPPLIERS AND SHOPS

Aluminium 6061-T6	- Purchased at Jayalakshmi metal mart, Gandhipuram, Coimbatore.
Ground Granulated Blast Furnace Slag	- JSW Cement, Erode.

3.7 EQUIPMENTS

Stir Casting	- Kongu Engineering College
Wire Cut EDM	- WEDM Origins, Coimbatore.
Electrochemical Micro Machining	- Sona College of Technology, Salem.
Scanning Electron Machining	- Government College of Engineering, Salem.

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CHAPTER - 4

CONCLUSIONS AND FUTURE WORK

The aluminium 6061 is reinforced with ground granulated blast-furnace slag. The composition of material is made in a three different percentage of ground granulated blast-furnace slag. The experiments was designed based on the Response Surface Methodology (RSM).The selected process parameters are input voltage, electrolyte concentration, % of reinforcement and temperature of the tool electrode where selected as a process parameters. Further we need to calculate the percentage of individual process parameters by using Analysis of Variants (ANOVA) test. The primary objective of experimental evaluation is for maximizing the Metal Removal Rate (MRR) and to minimizing the Radial Overcut (ROC). Additionally, the scientific reason is also to identified with different % of reinforcement.

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REFERENCES

[1] C Senthilkumar, G Ganesan and R Karthikeyan, 2010, "Bi-performance optimization of electrochemical machining characteristics of Al/20%SiCp composites using NSGA -2" pp. 1399.

[2] C. Senthilkumar, G. Ganesan, R. Karthikeyan, April 2011 "Parametric optimization of electrochemical machining of Al/15% SiCp composites using NSGA-II" pp.2294-2230

[3] N. S. Qu & X. L. Fang & Y. D. Zhang & D. Zhu, 26 March 2013 "Enhancement of surface roughness in electrochemical machining of Ti6Al4V by pulsating electrolyte" pp.2703-2709.

[4] S.Rama Rao and G. Padmanabhan, 2013 "Modeling of Radial over Cut in Electrochemical Machining of Al-B4C MMC Using Response Surface Methodology". J. Manuf. Sci. Prod. pp.31 – 36.

[5] S.Dharmalingam, P.Marimuthu and K.Raja, 2014 "Machinability Study On Al- 10% Tic Composites And Optimum Setting Of Drilling Parameters In Electrochemical Micro Machining". Using Grey Relational Analysis. pp.331-338

[6] P.Satishkumar, S.Dharmalingam, K.Raja, K.Lingadurai, G Padmanaban,2015. "Investigation on Electrochemical Micro Machining of Al 6061-6% wt Grabbed on Taguchi design of experiments". CODEN (USA): IJCRGG ISSN: pp 0974-4290,

[7] M.Sankar, A.Gnanavelbabu, K.Rajkumar, 2014 "Effect of reinforcement particles on the abrasive assisted electrochemical machining of Aluminium-Boron carbide-Graphite composite". Procedia Engineering. pp.381 – 389.

[8] S. Ayyappan, M. Kalaimathi and G. Venkatachalam, 2015. "Cost- Tolerance Prediction Models For Electrochemical Machining Of Metal Matrix Composites". Vol. 35, Issue 3, pp.299-307

[9] C.Venkatesh, N.M.Arun, R.Venkatesan, 2014 "Optimization of micro drilling parameters of B4C DRMM Al 6063 composite in μECM using Taguchi coupled Fuzzy Logic". pp. 975 – 985.

Scanned with CamScanner

[10] A Ranjithkumar and R.Malayalamurthi, 2013 "Investigations on Micro-ECM Compatibilty of Al6082 Metal Matrix Composite Material"., pp.1748-0345.

[11] Charanjit Singh Kalra, Vinod Kumar and Alakesh Manna, 2018 "Analysis of electrochemical behavior on micro-drilling of cast hybrid Al/ (Al2O3p þSiCp þCp)-MMC using micro-ECM process". pp.67–79.

[12] Ashish Kumar Srivastava, Amit Rai Dixit and Sandeep Tiwari, 2015 "A review on the intensification of metal matrix composites and its nonconventional machining",pp.0287.

[13] Sadineni Rama Rao and G. Padmanabhan, 2013 "Modeling of Radial over Cut in Electrochemical Machining of Al-B4C MMC Using Response Surface Methodology"J. Manuf. Sci. Prod. pp.31–36.

[14] Sadineni Rama Raoa, G. Padmanabhanb, K. Mahesh Naidua, A. Rukesh Reddya, 2014 "Parametric Study for Radial over Cut in Electrochemical Drilling of Al-5%B4Cp Composites". 97 pp.1004 – 1011.

[15] Maniraj, S., and R. Thanigaivelan. 2019 "Optimization of Electrochemical Micromachining Process Parameters for Machining of AMCs with Different % Compositions of GGBS Using Taguchi and TOPSIS Methods." Transactions of the Indian Institute of Metals pp.1-10.

[16] Saxena, Krishna Kumar, Jun Qian, and Dominiek Reynaerts. 2018 "A review on process capabilities of electrochemical micromachining and its hybrid variants." International journal of machine tools and manufacture 127 pp. 28-56.

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ANALYSIS OF MECHANICAL BEHAVIOUR OF COCONUT COIR AND BANANA JUTE FIBRE

PROJECT WORK (PHASE-II) REPORT

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ABSTRACT

Now-a-days, the natural fibres and fillers from renewable natural resources offer the potential to act as a reinforcing material for polymer composite material alternative to the use of natural fibres and other man-made fibres. Among various natural fibres and fillers like banana, wheat straw, rice husk, wood powder, sisal, jute, hemp etc. are the most widely used natural fibres and fillers due to its advantages like easy availability, low density, low production cost and reasonable physical and mechanical properties. This research work presents the effects of natural fillers, hybrid composite structure is formed. The result of test depicted that hybrid composite has far better properties than single fibre reinforced composite under impact and flexural loads. How ever it is found that the hybrid composite have better strength as compared to single glass fibre composites.

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CHAPTER 1

INTRODUCTION

In the current era of composites, natural fibre based polymeric bio composites have drawn wide attention in the field of research and development. Due to many advantages and environmental friendliness in comparison with the conventional composites, green composites are beneficial to the future development and can reduce carbon foot print. As a renewable source, the incorporation of natural fibres as fillers/reinforcements improves the properties of the composites and fulfilling the market demand. Natural fibres such as coir, jute, palm, kenaf are most available fibres with light weight, biodegradable, inexpensive which are more generally competent to synthetic fibres.

Coir is a lignocellulosic fibers, which are hydrophilic in nature and their main constituents are cellulose, hemicellulose and lignin as compared to other natural fibres, coir fibres have high lignin content due to the presence of strong polarized hydroxyl group, moisture absorption is high and lead to limited applications in industrial and technical field . Natural fibers using as reinforcement in polymer composite is their polarity which makes it incompatible with hydrophobic matrix. The results lead to poor interfacial bonding between the fibers and the matrix leads to diminish the mechanical properties of the composites. This defect can be rectified by modifying the fibers so as to make it less hydrophilic. The coir fibre is relatively water proof and is resistant to damage by salt water. Coir being a natural fibre that is environment friendly in the strictest sense of the term, is now seen as the fibre of the future.

The green composites would serve as major drivers of sustainable developments to automakers, making significant shift towards eco-friendly composites to reduce manufacturing cost and fuel usage while meeting the consumer demand for greener product natural fibre the reinforced bio-composites can compete economically because of the low cost of natural fibres compared to synthetic fibres. It is therefore, imperative to derive cost-effective bio-based products or bio-composites through the use of inexpensive natural fibre reinforcement. New applications and uses for bio-composites will spur large scale demand for bio-plastics which will

help the attainment long-term sustainability. The foundation for development of new and emerging bio-based composite materials industry lies in detailed understanding of natural fibres, bio plastics and bio-composite formulations. Although natural fibres lag behind from the impressive property of synthetic fiber, their eco-friendly nature has made them attractive. The objective of present research is to develop green composite by using lingo cellulosic coir fibres which are abundant, inexpensive and eco-friendly and improving the new era of green composite.

In this current work, chemically treated coir fibre is used to reinforce polypropylene matrix to form a bio-composite material and fabricate value added products by injection molding. The chemical treatment of coir fibre leads to minimize the hydrophilic characteristics and diminish the water absorption property of the composite.

CHAPTER 2

LITERATURE REVIEW

This section of project report provides background information on the bio-fibres and green composites. At the end of this chapter a summary of the literature survey and knowledge gap in the published literature is presented.

D. Maldas et al (1991), Studies on the preparation and properties of particle boards made from bagasse and PVC: II. Influence of the addition of coupling agents.

Under study was the effect of thermoplastics (e.g. polyvinyl chloride and polystyrene), as well as a coupling agent — poly (methylene (polyphenylisocyanate)) (PMPPIC) — and bagasse lignin, on the mechanical properties of particle boards of sugarcane bagasse. The mechanical properties of bagasse particle boards were compared to those of hardwood aspen fiber particle boards, dignified bagasse particle boards, as well as those of composites made from bagasse, polymers and coupling agents. Particle boards of bagasse comprising both thermoplastics and a coupling agent offer superior properties compared to those made of only thermoplastic or a coupling agent. The extent of improvement in the mechanical properties of particle boards depended on the concentration of polymers and the coupling agent; nature of the fiber, polymer and coupling agent; composition of PMPPIC and bagasse; as well as lignin content of the bagasse. Moreover, the mechanical properties and dimensional stability of coupling agent-treated particle boards are superior to non-treated ones.

G. C. Stael et al (2001) studied on Impact behavior of sugarcane bagasse waste–EVA composites.

They evaluated the impact performance of chopped bagasse–EVA matrix composites and compared it with the behavior of bagasse filled PP and PE matrix composites and wood based materials. The volume fraction and size of the chopped bagasse used as filler was varied. The experimental results show that the incorporation of bagasse strongly reduces the deformation capacity of EVA polymer.

The reduction of the deformation capacity of the composites was also inferred by solid-state NMR relaxation analysis. The impact strength was independent of the bagasse size, but varied with the volume fraction. As a function of the volume fraction it was shown that the mechanical performance of bagasse–EVA composites could be tailored to reproduce the behavior of wood based particle boards.

K. N. Matsui et al (2004) analyzed the influence of impregnation with starch acetate on tensile strength and water absorption properties in their study.

A fibrous residue rich in non-extracted starch (bagasse) obtained from the industrial production of cassava starch was used to obtain a composite that is similar to cardboard, through a technique used in small scale artisan production of recycled paper. A mixture of 90% cassava bagasse and 10% of Kraft paper was used for the production of these composites. Kraft paper was added as a source of long fibres, in order to improve the mechanical properties of the material. The prepared material has similar characteristics to the molded fibre packaging made using recycled paper, as used in egg boxes. However, cassava bagasse has advantages over recycled paper, in view of the fact that it is obtained from known and renewable sources. The impregnated and non-impregnated materials were submitted to tests of tensile strength and to direct contact with water by complete immersion of the samples. The cassava bagasse-Kraft paper composites obtained had a slight resistance to direct contact with water. The water mass absorbed by the materials impregnated with starch acetate was approximately half that of the materials without impregnation. However, the impregnation had little influence on the tensile strength of the tested samples. Starch acetate is therefore an attractive additive for use in the manufacture of waterproof materials, such as disposable trays.

William Hoareau et al (2004), Sugar cane bagasse and curaua lignins oxidized by chlorine dioxide and reacted with furfuryl alcohol: characterization and stability.

Sugarcane bagasse and curia acidosis lignin's were used to get a better understanding of the mechanism involved in a new chemical modification of sugar cane bagasse and curia fibres, consisting in a selective oxidation of lignin by chlorine dioxide and reacting some of the created unsaturated units (quinines or moronic

derivatives) with furfural alcohol (FA). The objective of the treatment was to create a fibre coating increasing compatibility between fibres and phenolic resins in composites. The lignin's were reacted with chlorine dioxide to oxidize the phenolic units of the polymer and then treated with furfural alcohol. Weight percent gain of 14% and 10% were obtained for sugar cane bagasse and curia, respectively. ^{1}H and ^{31}P NMR, as well as FT-IR results showed that bagasse lignin had more guaiac than syringe units and the reverse for curia lignin. ^{1}H NMR of oxidized lignin's revealed a decrease of the aromatic and methyl content after the ClO_2 oxidation, due to partial degradation of the macromolecule. Thermal analysis showed that sugar cane lignin decomposes at lower temperature than curia lignin, partly due to the high content of condensed structural units present in curia lignin. Condensed units decompose at higher temperatures than uncondensed ones. The reaction of oxidized lignin with FA shifted the decomposition exothermic to lower temperature for both curia and sugar cane bagasse lignin's, due to the modification introduced into their structures.

S.M. Luz et al (2004), Cellulose and cell lignin from sugarcane bagasse reinforced polypropylene composites: Effect of acetylation on mechanical and thermal properties.

This current work is concerned with the development of polypropylene composites reinforced with cellulose and cell lignin fibers attained from sugarcane bagasse. Moreover, the fibers were chemically modified by acetylating process and its effects on the fiber/matrix interaction were also evaluated. The chemical modification efficiency was verified by FTIR analysis and the fibers morphological aspects of fibers by SEM. Likewise, the influence of modified fibers content in the composites was studied by mechanical (tensile, shear and flexural tests) and thermal analyses (TGA and DSC). After the chemical modification, the FTIR results showed the appearance of acetyl groups and reduction of OH bonds for all fibers. Together with, SEM characterization showed that the acetylation changed the morphology of fibers, resulting in mechanical properties decreases, probably because of the new morphological aspect. The thermal characterization of composites based on untreated and treated cellulose and cell lignin presented intermediary stability in respect to matrix and fiber. Finally, DSC results revealed that the composites reinforced with untreated fibers were more crystalline than neat Polypropylene.

J. Zandersons et al (2004), Carbon materials obtained from self-binding sugar cane bagasse **and deciduous wood residues plastics.**

It is demonstrated that dispersed biomass residues (bagasse, sawdust) can be processed into hard carbonaceous blocks, panels or boards with good strength and thermodynamic properties. There are two possible approaches: to mound dispersed biomass charcoal with a phenol–formaldehyde binder or to produce this material by carbonizing the biomass fiberboard prepared by making use of steam explosion auto hydrolysis pulp or steam explosion lignin as a binder. In the first step, steam explosion lignin, as a modifier and a binder is introduced to the lingo cellulosic biomass by impregnation or during the hot pressing process to form a hard fiberboard. By subsequent carbonization of the fiberboard panels or blocks, carbonized panels or blocks with high bending and crushing strength and suitable thermodynamic properties are obtained due to the formation of an internal lignin reinforcement in cell Lumina and impregnation of cell walls with lignin solution or molten lignin. The carbonized panels demonstrate a good dimensional stability after a standard treatment with water. The bending strength of the carbonized panels after 24 h soaking in water is 93% of that in dry state. The thermodynamic properties and porosity of the carbonized panels demonstrate their suitability for use as a building material. Lignin, a natural binder of fiberboards, has proven to be suitable for preparation of carbonaceous panels and boards. In this respect new carbon building blocks and panels from molded biomass and carbonized steam exploded biomass act as a concentrated form of long term carbon storage and will be a factor stabilizing the growing CO_2 concentration in the atmosphere. [Proceedings of the First Workshop of QITS, Materials Life-Cycle and Environmentally Sustainable Development, March 2–4, Campinas, UNU/IAS San Paulo, Brazil, 1998, pp. 95–101; Proceedings of the Workshop in "Targeting Zero Emissions for the Utilization of Renewable Resources", ANESC, Tokyo, 1999, pp. 2–11.]

P. Rezayati-charani et al (2005), Effect of pulping variables with dimethyl formamide on the characteristics of bagasse-fiber.

Organosolv pulping of bagasse was conducted following a central composite design using a two-level factorial plan involving three pulping variables

(temperature: 190–210 °C, time: 120–180 min, organic solvent ratio: 40–60% dimethyl formamide). Responses of pulp and hand sheets properties to the process variables were analyzed using statistical software (MINITAB 14). Using values of the indep endent variables the variation ranges considered provided the following optimum values of the dependent variables: 82.7% (yield), 92.9 (kappa number), 1.403% (ash), 370 ml (freeness), 6290 m (breaking length), 9.4 (folding endurance), 5.955 m N m^2 g^{-1} (Tear index) and 2.811 kNg^{-1} (Burst index) for pulps and hand sheets. Results showed that acceptable physical and mechanical properties of pulps and papers similar the pulp used for bleaching could be achieved at 210 °C for 150 min and 50% DMF. These are the most suitable conditions for obtaining paper sheets with a high breaking length, tear and burst indices. Also bagasse could be pulped with ease to about 55.72% yield with kappa number -35. The cooking temperature was a significant factor while the DMF ratio and cooking time were not as important in term of the properties of the resultant pulps and papers.

P. Rezayati-Charani et al (2006), Influence of dimethyl formamide pulping of bagasse on pulp properties.

Organosolv pulping of bagasse was conducted following a central composite design using a two-level factorial plan involving three pulping variables (temperature: 190–210 °C, time: 120–180 min, organic solvent charge: 40–60% dimethyl form amide). Responses of pulp properties (yield and holocellulose, α-cellulose, kappa number, ash and ethanol–dichloromethane extractives contents) and the pH of the resulting wastewater to the process variables were analyzed using statistical software (MINITAB). Main factor analysis revealed that optimum pulp has the following characteristics: 82.7% (yield), 92.9 (kappa number), 95.84% (halo cellulose), 83.53% (α-cellulose), 1.403% (ash), 2.562% (ethanol–dichloromethane extractives contents) and 6.39 (pH). These results showed that acceptable properties of pulps could be gained at 200–210 °C for 150 min and 40–60% DMF. Based on these results, this method could be used for pulping of bagasse equivalent NSSC concerning high yield at a fixed kappa number. In addition, bagasse could be pulped with ease to approximately 55% yield with a kappa number approximately 31. Numerical analyses showed that cooking temperature had the greatest influence on

properties of obtained pulps within the DMF concentrations and cooking time as cooking variables.

K. Ganesan et al (2006), Evaluation of bagasse ash as supplementary cementations' material.

The utilization of waste materials in concrete manufacture provides a satisfactory solution to some of the environmental concerns and problems associated with waste management. Agro wastes such as rice husk ash, wheat straw ash, hazel nutshell and sugarcane bagasse ash are used as pozzolanic materials for the development of blended cements. Few studies have been reported on the use of bagasse ash (BA) as partial cement replacement material in respect of cement mortars. In this study, the effects of BA content as partial replacement of cement on physical and mechanical properties of hardened concrete are reported. The properties of concrete investigated include compressive strength, splitting tensile strength, water absorption, permeability characteristics, chloride diffusion and resistance to chloride ion penetration. The test results indicate that BA is an effective mineral admixture, with 20% as optimal replacement ratio of cement.

Yu-Tao Zheng et al (2007), Study on the interface modification of bagasse fibre and the mechanical properties of its composite with PVC.

The surface treatments of bagasse fibre (BF) with benzoic acid as a surface/interface modifier and the mechanical properties of BF-polyvinyl chloride (PVC) composite were studied. A typical process for the preparation of the composite was as follows: A mixture of PVC, BF, benzoic acid, and other processing additives were dry-blended in a two-roll mill followed by compression molding. The experimental results indicated that the ratio of PVC/BF, the content of benzoic acid, and processing temperature had a significant effect on the mechanical properties of the composite, which was examined by the orthogonal optimal method. The interface modifier improved significantly on the tensile strength and little on the impact strength of the composite, for example, the tensile strength changed between 42 and 52MPa comparing to the tensile strength of untreated BF/PVC composite (38 MPa), and the impact strength changed between 8.3 and 9.2 kJ/m^2 comparing to the impact

strength of untreated BF/PVC composite (7.5 kJ/m^2) when the content of benzoic acid changed between 3 and 10%

CHAPTER 3

MATERIALS REQUIRED

3.1 BANANA FIBERS

The epoxy composite reinforced with pseudo-stem banana woven fiber was prepared by the hand lay-up method. The fibers were extracted from banana stems by hand and dried in sunlight for 12 hours until all the moisture was removed. The woven banana fibers used for the study .

Figure no. 3.1 Banana fiber

3.2 COIR FIBER

Coir is a coarse fiber extracted from fibrous outer shell of a coconut. The individual fiber cells are narrow and hollow with thick walls made of cellulose. Traditionally, it has been used in tropical regions of Asia, Africa, and South America in a variety of simple item, such as rugs, couch and mattress stuffing, as well as gardening pots. The coir fibers used for the study .

Figure on 3.2 coconut fiber

3.3 EPOXY RESIN

Epoxy or polyepoxide is a thermosetting polymer formed from the reaction of an epoxide "resin" with a polyamine "hardener". Epoxy has a wide range of applications, including fiber-reinforced plastic materials and general-purpose adhesives. The resin consists of monomers or short-chain polymers with an epoxide group at either end. Most common epoxy resins are produced from a reaction between epichlorohydrin and bisphenol-A, although the latter may be replaced by similar chemicals. The hardener consists of polyamine monomers, for example, Triethylenetetramine (TETA). When these compounds are mixed together, the amine groups react with the epoxide groups to form a covalent bond. Each NH group can react with an epoxide group, such that the resulting polymer is heavily cross-linked and thus, becomes rigid and strong. The process of polymerization is called "curing", and can be controlled through temperature .

Figure on 3.1epoxy resin

CHAPTER 4

ANALYSIS

TEST TO BE PERFORMED

- Tensile test
- Impact test
- Bending test
- Compression test

4.1 TENSILE TEST

Tensile test Natural fibers of banana and coconut fiber reinforced epoxy resin composites prepared by hand layup technique with the amount of the weight of the fibers 3% 5% 10% 15% 20% and 30% were studied. The results obtained show that the tensile strength and tensile modulus of both banana and coconut fiber reinforced epoxy resin composites increased with increasing fiber loading. Moreover, the composites shows that with the increase in the value of the tensile and tensile modulus greatly compared with the pure epoxy resin, except that the fiber content 30% wt for tensile strength, and it is shows the highest value that the tensile strength of banana and coconut fiber reinforced composites is 73.23 MPa and 30.86 MPa respectively. These were illustrated in Fig 3. and Fig 4. Some research shows that the result was contrary trend to the strength of composites increases with increasing fiber content. This can be attributed to many reasons such as digestion fiber stripes unsuitable, incompatibility between the fiber and the matrix, process for preparing fiber and so on. Usually, the hydrophilic natural fibers are incompatible with the polymer matrix. These show that the fiber is resistance to humidity low, which causes the water absorption is high. From this result in poor tensile strength properties of composites reinforced with natural fiber.

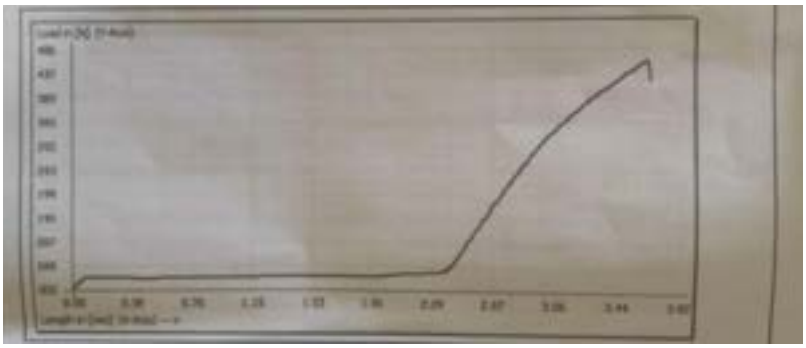

Figure 4.1 Tensile test

4.2 IMPACT TEST

The effect of fiber content and loss of energy on the impact strength of coconut fiber reinforced epoxy resin composites is found out on the reading obtained from the impact testing machine. Comparison of impact strength.The results showed that the highest impact strength is obtained for coconut fibers reinforced composites which value that the impact strength is by weight of fibers. However, it is the quality of the higher impact strength compared with banana fiber reinforced composites which strength by weight of fibers. Properties and the interfacial bonding between fiber and matrix are important factors to the impact strength of fiber reinforced polymer. The fiber fracture, matrix deformation and the combination of fiber pull out will make the energy absorbing with decreased when the composites undergo force suddenly. Normally, the fracture of fibers and increasing of fiber pull out can result from the fiber content increases in fiber reinforced polymer composites. However, in the case of impact strength decreased with the fiber content increases. The reason may be due to interfacial bonding between fiber and matrix is bad. Therefore, the transfer matrix is not strength to the fibers. Also, due to the nature of moisture absorption fiber resulting in forming of composites using fiber high volume have holes occur and force accumulated the area had inspected the break more easily.

S.NO	Izod Impact Value in J for 3mm thickness
1	0.33

Table 4.1

4.3 BENDING TEST

Compression tests are used to determine how a product or material reacts when it is compressed, squashed, crushed or flattened by measuring fundamental parameters that determine the specimen behavior under a compressive load. These include the elastic limit, which for "Hookean" materials is approximately equal to the proportional limit, and also known as yield point or yield strength, Young's Modulus (these, although mostly associated with tensile testing, may have compressive analogs) and compressive strength.Compression tests can be undertaken as part of the design process, in the production environment or in the quality control laboratory, and can be used to Assess the strength of components e.g. automotive and aeronautical control switches, compression springs, bellows, keypads, package seals, PET containers, PVC / ABS pipes, solenoids etc.Characterise the compressive properties of materials e.g. foam, metal, PET and other plastics and rubberAssess the performance of products e.g. the expression force of a syringe or the load-displacement characteristics of a tennis ballCompression testing provides data on the integrity and safety of materials, components and products, helping manufacturers ensure that their finished products are fit-for-purpose and manufactured to the highest quality.The data produced in a compression test can be used in many ways including:To determine batch quality

- To determine consistency in manufacture
- To aid in the design process
- To reduce material costs and achieve lean manufacturing goals
- To ensure compliance with international and industry standards

Certain materials subjected to a compressive force show initially a linear relationship between stress and strain. This is the physical manifestation of Hooke's Law, which statwhere E is known as Young's Modulus for compression. This value represents how much the material will deform under applied compressive loading before plastic deformation occurs. A material's ability to return to its original shape after deformation has occurred is referred to as its elasticity. Vulcanized rubber, for instance, is said to be very elastic, as it will revert back to its original shape after considerable compressive force has been applied.

Once a certain force or stress threshold has been achieved, permanent or plastic deformation will occur and is shown on graphs as the point where linear behavior stops. This threshold is known as the proportional limit and the force at which the material begins exhibiting this behavior is called the yield point or yield strength. A specimen will then exhibit one of two types of behavior; it will either continue to deform until it eventually breaks, or it will distort until flat. In either case a maximum stress or force will be evident, providing its ultimate compressive strength value.Each of these parameters offers useful information relating to the physical characteristics of the material in question.Some materials, such as a PET bottle, distort during a compression test and are measured by the degree of distortion, whereas other materials such as ceramics fracture, produce a definitive compressive strength value.

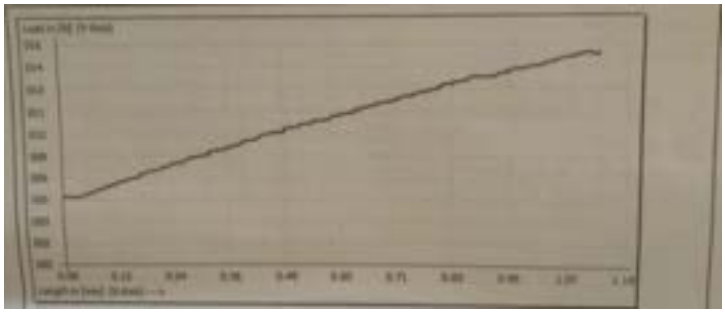

Figure4.2 Bending test

4.4 COMPRESSION TEST

The compression specimen is prepared as per the standard. A compression test involves mounting the specimen in a machine and subjecting it to the compression. The compression process involves placing the test specimen in the testing machine and applying compress to it until it fractures. The compress force is recorded as a function of displacement. During the application of compression, the elongation of the gauge section is recorded against the applied force.

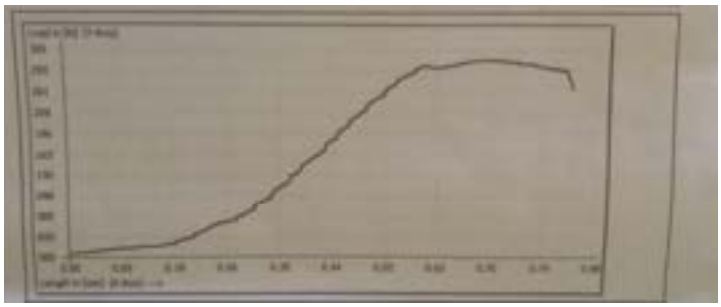

Figure4.3 compression test

CHAPTER 5

COMPOSITE

"Composites are multifunctional material systems that provide characteristics not obtainable from any discrete material. They are cohesive structures made by physically combining two or more compatible materials, years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be different in composition and characteristics and sometimes in form". Over the last thirty an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

5.1 DEFINITION OF GREEN COMPOSITE

Green composites combine plant fibres with natural resins to create natural composite materials that are environment friendly and bio-degradable. To develop green composite materials, natural fibers, such as hemp, flax, jute, knave and sisal have been used to replace conventional synthetic fibers. In other words, they can be defined as biopolymers or bio-derived polymers reinforced with natural fibers.

5.1.1 CHARACTERISTICS OF THE COMPOSITES

Composites consist of one or more discontinuous phases embedded in a continuous phase. The discontinuous phase is usually harder and stronger than the continuous phase and is called the 'reinforcement' or 'reinforcing material', whereas the continuous phase is termed as the 'matrix'. Properties of composites are strongly

dependent on the properties of their constituent materials, their distribution and the interaction among them. The composite properties may be the volume fraction sum of the properties of the constituents or the constituents may interact in a synergistic way resulting in improved or better properties. Apart from the nature of the constituent materials, the geometry of the reinforcement (shape, size and size distribution) influences the properties of the composite to a great extent. The concentration distribution and orientation of the reinforcement also affect the properties.

The shape of the discontinuous phase (which may by spherical, cylindrical, or rectangular cross-sanctioned prisms or platelets), the size and size distribution (which controls the texture of the material) and volume fraction determine the interfacial area, which plays an important role in determining the extent of the interaction between the reinforcement and the matrix. Concentration, usually measured as volume or weight fraction, determines the contribution of a single constituent to the overall properties of the composites. It is not only the single most important parameter influencing the properties of the composites, but also an easily controllable manufacturing variable used to alter its properties.

5.2 COMPONENTS OF A COMPOSITE MATERIAL

In its most basic form a composite material is one, which is composed of at least two elements working together to produce material properties that are different to the properties of those elements on their own. In practice, most composites consist of a bulk material (the 'matrix'), and a reinforcement of some kind, added primarily to increase the strength and stiffness of the matrix.

5.2.1 MATRIX

Many materials when they are in a fibrous form exhibit very good strength property but to achieve these properties the fibres should be bonded by a suitable matrix. The matrix isolates the fibres from one another in order to prevent abrasion and formation of new surface flaws and acts as a bridge to hold the fibres in place. A good matrix should possess ability to deform easily under applied load, transfer the load onto the fibres and evenly distributive stress concentration.

5.2.2 REINFORCEMENT

The role of the reinforcement in a composite material is fundamentally one of increasing the mechanical properties of the neat resin system. All of the different fibres used in composites have different properties and so affect the properties of the composite in different ways. For most of the applications, the fibres need to be arranged into some form of sheet, known as a fabric, to make handling possible. Different ways for assembling fibres into sheets and the variety of fibre orientations possible to achieve different characteristics.

5.2.3 INTERFACE

It has characteristics that are not depicted by any of the component in isolation. Then interface is a bounding surface or zone where a discontinuity occurs, whether physical, mechanical, chemical etc. The matrix material must "wet" the fibre. Coupling agents are frequently used to improve wettability. Well "wetted" fibres increase the interface surfaces area. To obtain desirable properties in a composite, the applied load should be effectively transferred from the matrix to the fibres via the interface. This means that the interface must be large and exhibit strong adhesion between fibres and matrix. Failure at the interface (called de-bonding) may or may not be desirable.

5.3 CLASSIFICATION

Composite materials can be classified into many categories depending on the type of matrix material, reinforcing material type etc. According to the type of matrix material they can be classified as follows:

Metal matrix type composites: MMC are composed of a metallic matrix (Al, Mg, Fe, Co, Cu)

Ceramic matrix composites: CMC is a material consisting of a ceramic combined with a ceramic dispersed phase.

Polymer matrix material: PMC are composed of a matrix from thermosetting (unsaturated polyester, epoxy) or thermoplastic (nylon, polystyrene) and embedded glass carbon, steel or Kerler fibres (dispersed phase). Some of the major advantages and limitations of resin matrices.

Table 5.1 Advantages and limitations of polymeric matrix materials

Advantages	Limitations
Low densities	Low transverse strength
Good corrosion resistance	Low operational temperature limits
Low thermal conductivities	
Low electrical conductivities	
Translucence	
Aesthetic Color effects	

Generally speaking, the resinous binders (polymer matrices) are selected on the basis of adhesive strength, fatigue resistance, heat resistance, chemical and moisture resistance etc. The resin must have mechanical strength commensurate with that of the reinforcement. It must be easy to use in the fabrication process selected and also stand up to the service conditions. According to the type of reinforcing material type they can be classified into the following categories:

Particle composites- particle reinforced composites consist of a matrix reinforced by a dispersed phase in the form of particles. It can be either of random orientation or preferred orientation.

Fibrous composite-.Short fibre: they consist of a matrix reinforced by a dispersed phase in the form of discontinuous fibres either of random or preferred orientations.

Long fibre- they consist of a matrix reinforced by a dispersed phase in the form of continuous fibres. They can be either unidirectional or bidirectional.

Laminate composites- when a fibre reinforced composite consists of several layers with different fibre orientations, it is called multilayer composite. Apart from that the

two broad classes of composites are (1) Particulate composites and (2) Fibrous composites.

5.4 PARTICULATE COMPOSITES

As the name itself indicates, the reinforcement is of particle nature (platelets are also included in this class). It may be spherical, cubic, tetragonal, a platelet, or of other regular or irregular shape, but it is approximately equiaxed. In general, particles are not very effective in improving fracture resistance but they enhance the stiffness of the composite to a limited extent. Particle fillers are widely used to improve the properties of matrix materials such as to modify the thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface hardness and reduce shrinkage.

5.4.1 FIBROUS COMPOSITES

A fibre is characterized by its length being much greater compared to its cross-sectional dimensions. The dimensions of the reinforcement determine its capability of contributing its properties to the composite. Fibres are very effective in improving the fracture resistance of the matrix since a reinforcement having a long dimension discourages the growth of incipient cracks normal to the reinforcement that might otherwise lead to failure, particularly with brittle matrices.

Man-made filaments or fibres of non-polymeric materials exhibit much higher strength along their length since large flaws, which may be present in the bulk material, are minimized because of the small cross-sectional dimensions of the fibre. In the case of polymeric materials, orientation of the molecular structure is responsible for high strength and stiffness. Fibres, because of their small cross-sectional dimensions, are not directly usable in engineering applications. They are, therefore, embedded in matrix materials to form fibrous composites.

5.5 BIO-COMPOSITES

Bio-composites are composite materials comprising one or more phases derived from a bio-logical origin. In terms of the reinforcement, this could include plant fibre such as cotton, flax, hemp, coir, and like fibres from recycled wood or waste paper, or even by products from food crops. Regenerated cellulose fibres like

rayon are also included in this definition\, since ultimately they to come from a renewable resource, as are natural 'Nano fibrils' of cellulose and chitin. Matrices may be polymers, ideally derived from renewable resources such as vegetable oils or starches. Alternately, and more commonly at the present time, synthetic, fossil-derived polymers preponderate and may be either 'virgin' or recycled thermoplastics such as polyethylene, polypropylene, polystyrene and polyvinyl chloride.

5.5.1 COIR FIBRE BASED BIO-COMPOSITES

Pretreatments are done on the coir fibre which are used for composite preparation namely alkali treatment, cyano ethylation bleaching and vinyl grafting in general purpose polyester resin as matrix. [3] In alkali treatment the fibre was treated with Na-OH and then washed in water.[12] After drying, Acrylo Nitrile and Methyl methacrylate are grafted on the surface of the fibre. In cyanoethylation the fibres were obtained by refluxing the alkali treated coir with AN, acetone and pyridine (as catalyst)

At 60°C for 2 hours, then washing the fibres with acetic acid acetone followed by washing with distilled water and finally vacuum drying. The fibre content used was from 30 to 50% [3]. The mechanical properties of composites like tensile, flexural and impact strength as a result of surface modification. Among all modifications bleached (65°C) coir-polyester composites show better flexural strength (61.6 MPa) where as 2% alkali-treated coir/polyester composites show better improvement in tensile strength (26.80 MPa). Hybrid composites comprising glass fibre mat (7 wt. %), coir fibre mat (13 wt. %) and polyester resin matrix are prepared. Hybrid composites comprising glass fibre mat (7 wt. %), surface modified coir fibres show significant improvement in flexural strength. Water absorption studies of coir/polyester and hybrid composites show significant reduction in water absorption due to surface modifications of coir fibres.

Surface treatment of coir fibre was determining the effect of water absorption behavior and moisture absorption of the composites was studied. [4].Coir fiber was treated with Na-OH solution, Acetic Acid, Potassium per magnate and also treated at 1500C and their moisture absorption capacity and surface topology were

comparing with untreated coir. Water absorption property is higher in untreated coir than chemically treated coir. This was due to the more water soluble portion (may be hemicelluloses) present on the surface. In humid conditions the moisture absorption capability is highest in case of alkali treated coir fiber. But the trends are not same for all the temperatures.

Coir fibres were treated with ethylene glycol methacrylate (EGDMA) mixed with methanol (Me-OH) under UV radiation. A series of solution of different concentrations of EGDMA in methanol along with a photo initiator, Irgacure-500 (mixture of 1-hydroxylcyclohexylphenylketone and benzophenonc), were prepared. Monomer concentration, soaking time, and radiation intensity were optimized in terms of polymer loading (PL) and mechanical properties. EGDMA (50%) , 5 min soaking time at the 4th pass of radiation, produced higher PL and tensile strength (TS), and the values of PL is 17% and TS is 1.3 times of the untreated one. Then, coir fiber was pretreated with detergent and then treated with the optimized monomer formulation, which exhibited a higher PL of 69% and produced TS of the coir fiber of 4.4 times of the untreated one. Coir fiber pretreated with detergent along with UV radiation showed the highest TS, which is 18.2 times of untreated one. Water uptake, degradable properties, and simulated weathering of treated and virgin fibers were also monitored, which showed that EGDMA treatment under UV radiation improved the degradable property.

Natural fibres such as coir fibre and rise husk were selected a reinforced in epoxy resin. Brown coir fibres and rise husk are treated with 6% of Na-OH separately to increase the fibre strength and the treated natural fibres are reinforced in epoxy matrix to fabricate the composite. It was found that on examining the mechanical behavior such as its tensile strength and flexural of various combinations of coir fibre and risk husk reinforced epoxy composites, higher tensile strength and flexural strength is found in mixing ratio of coir to risk husk(80;20)which shows the rice husk acts as a filler to increase the strength . It is also evident that chemical treatment alters the properties of fibre such as adhesion, surface morphology and so on.

Fiber was divided into two parts, namely the untreated fibers and fibers with early treatment. Fiber with initial treatment Na-OH soaked with a solution of 3% by various

time 1,2,3,4 and 5 hours. After soaking the fiber is washed with distilled water to remove the chemical effects after it is dried at room temperature without sunlight.aturated polyesters, phenol formaldehyde isocyanates and epoxide. Treatment of alkali in the fiber gave the effect of decreasing the tensile strength of the fiber caused by the release of a binding component between micro fiber Coir yarn PP based unidirectional composite were prepared through compression moulding.20% yarn content was optimized to show higher mechanical properties. Incorporation of jutefiber.

CHAPTER 6
PROJECT AND PHASE WORK

6.1 EXPERIMENTAL OF PROCEDURE

Chemical Treatment

Alkali treatment of natural fibers, also called mercerization, is the common method to produce high-quality fibers. Mercerization leads to fibrillation, which causes the breakdown of the composite fiber bundle into smaller fibers. Mercerization reduces fiber diameter, thereby increasing the aspect ratio, which leads to the development of a rough surface topography that results in better fiber-matrix interface adhesion and an increase in mechanical properties. Moreover, mercerization increases the number of possible reactive sites and allows better fiber wetting. Mercerization has an effect on the chemical composition of the flax fibers and degree of polymerization. The degree of polymerization is the number of repeat units in an average polymer chain at time t in a polymerization reaction. The length is in monomer units. The degree of polymerization is a measure of molecular weight and molecular orientation of the cellulose crystallites due to cementing substances, such as lignin and hemicelluloses, which are removed during the mercerization process. As a result, mercerization had a long-lasting effect on the mechanical properties of flax fibers; mainly on fiber strength and stiffness.

Properties of Hardener

In the present work, the hardener (EH758) has been used. The properties of the hardener are shown in Table 1.

Banana Fiber Treatment

Banana fibers were immersed in 6% NaOH solution for two hours at room temperature, as shown in Figure 1(b). Following the alkali treatment, the fibers were washed thoroughly by immersion in water tanks, followed by running water. The material was then filtered and dried at 80 °C for 24 hours. The banana fiber immersed in 6%NaOH solution. The banana fibers obtained after the final washing are shown in Figure 1(a).

Coconut Fiber Treatment

Prior to treatment, all fibers were pre-washed with large amounts of distilled

water and dried at 50 ºC until constant weight. The mercerization process consisted of immersing the coir fibers (200 g) in a 10% (w/v) NaOH aqueous solution (2 L) for three hours at 70 ºC with occasional shaking, followed by repeated washing with distilled water to remove any absorbed alkali. Then, the fibers were dried in sunlight. The coir fiber was treated in a heater, as shown in Figure 2(a).

Fabrication of Composites

There is a wide variety of fiber-reinforced plastic processes. The choice of process depends on many factors, such as type of reinforcement and matrix materials, size, shape, quantity, and cost. There are many specialized processes available, but only the most commonly used commercial process, hand lay-up, has been used here in the preparation of the composites. The experimental setups are shown in Figure 2(b). A weight press was needed for the hand lay-up method. The base plate was cleared of rust by scrubbing with an abrasive paper. Then, the surface was allowed to dry after cleaning it with a thinner solution. After drying, the surface was coated with silicone gel. The surface was given a few minutes to set before the mold lay-up. The company codes for the epoxy semi-polymerized resin and the Hardener/Curing agent were EP-306 and EH- 758, respectively. They were mixed in the proportion of 10:1 (EP-306 and EP-758). The curing time or the pot life, which is how it is usually denoted on laboratory charts, was 20 minutes once mixed. Care was taken that the resin did not cure in the curing pot itself. A constant watch was maintained over the blend in the pot with the aid of a stopwatch. A plate of dimensions 300 × 300 × 8 mm was fabricated by this process. First, the epoxy-banana-coir composite was fabricated. The matrix material was poured slowly into the mold to avoid trapping air. The mixture was left for 2 minutes until it became a little tacky. After that, the banana fiber ply was laid unidirectionally on the matrix layer, which was covered by another layer of matrix poured slowly onto the surface of the fiber ply. A small pressure was applied by using a roller to distribute the matrix material and to avoid

CHAPTER 7
HELMET

7.1 Motivation of the project

Composite materials with thermoplastic matrices and a reinforcement of natural fibers are increasingly regarded as an alternative to material replacement for various applications. The Composite materials with thermoplastic matrices and a reinforcement of natural fibers are increasingly regarded as an alternative to material replacement for various applications. The substitution of the traditionally used composite of natural fibers such as sisal, banana and jute can lead to a reduction of the component's weight and furthermore to a significant improvement of specific properties like impact strength, compression strength.One of the major fields of application for such materials can be found in structural components manufacturing of industrial safety helmets.on of the traditionally used composite of natural fibers such as sisal, banana and jute can lead to a reduction of the component's weight and furthermore to a significant improvement of specific properties like impact strength, compression strength.One of the major fields of application for such materials can be found in structural components manufacturing of industrial safety helmets.

7.2 AIM OF THE PROJECT

Improved torsional stiffness and impact properties .Higher fatigue endurance limit (up to 60% of ultimate tensile strength).The substitution of the traditionally used composite of natural fibers such as sisal, banana and jute can lead to a reduction of the component's weight and furthermore to a significant improvement of specific properties like impact strength,

Figure 7.1 helmet

A helmet is a form of protective gear worn on the head to protect it from injuries. Most helmets are made from resin or plastic, which may be reinforced with fibers such as aramid. All helmets attempt to protect the user's head by absorbing mechanical energy and protecting against penetration. Their structure and protective capacity are altered in high-energy impacts. Beside their energy-absorption capability, their volume and weight are also important issues, since higher volume and weight increase the injury risk for the user's head and neck.

Specification

- MATRIX -EPOXY RESIN
- REINFORCEMENT-COIR,BANANA,
- VOLUME FRACTION- 10%COIR,10%BANANA,
- PATTERN TYPE- RANDOM
- MANUFACTURING METHOD-HAND LAY UP

Hand lay-up

Hand lay-up is a simple method for composite production. A mold must be used for hand lay-up parts unless the composite is to be joined directly to another structure.The mold can be as simple as a flat sheet or have infinite curves and edges. For some shapes, molds must be joined in sections so they can be taken apart for part removal after curing.

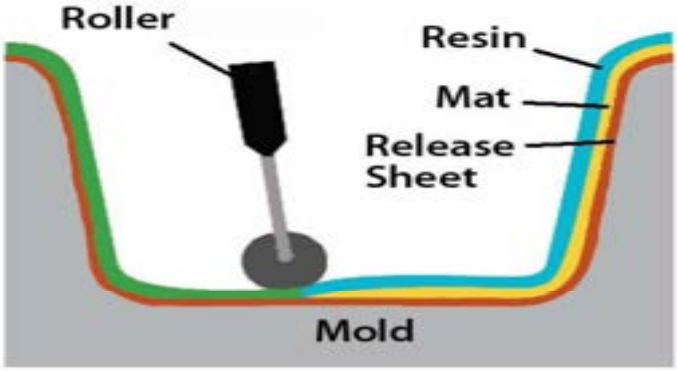

Figure 7.2

CHAPTER 8

MERITS, DEMERITS AND APPLICATIONS

Merits:

- It reduces unstrung weight & suspension weight by 85%.
- The strength-weight ratio & stiffness is is higher than other materials.The composite material has more elastic strain energy, storage capacity and excellent corrosion resistance.
- It reduces the fuel consumption over leaf spring using steel.

Demerits:

- High cost than leaf spring using steel.
- Complex repair occur.

Applications:

- The major structural application areas, which include aircraft, space, automotive, sporting goods, and marine engineering.
- A potential for weight saving with composites exists in many engineering field
- structural chassis components, such as drive shafts and road wheels, have been successfully tested in the Laboratories and are currently being developed for future cars and vans

PROJECT WORK

REFERENCE

1 D. Maldas et al (1991), Studies on the preparation and properties of particle boards made from bagasse and PVC: II. Influence of the addition of coupling agents, Chmrev157,57-47-76

2 G. C. Stael et al (2001) studied on Impact behavior of sugarcane bagasse waste–EVA composites, carbohydrates polymers 88,2012 , 329-335

3 K. N. Matsui et al (2004) analyzed the influence of impregnation with starch acetaontensile strength and water absorption properties in their study j mater sci 2005,40,6263-73

4 William Hoareau et al (2004), Sugar cane bagasse and curaua lignins oxidized by chlorine dioxide and reacted with furfuryl alcohol: characterization and stability January , 2012,1,189-92

5 S.M. Luz et al (2004), Cellulose and cell lignin from sugarcane bagasse reinforced polypropylene composites: Effect of acetylation on mechanical and thermal properties. Appla coust 2011, 72 ,108-14

6 J. Zandersons et al (2004), Carbon materials obtained from self-binding sugar cane bagasse and deciduous wood residues plastics**,** part A-applscimanuf 2006,37,2213-20

7 P. Rezayati-charani et al (2005), Effect of pulping variables with dimethyl formamide on the characteristics of bagasse-fiber volume 9,2009,1009-1015

8 P. Rezayati-Charani et al (2006), Influence of dimethyl formamide pulping of bagasse on pulp properties, bio-macromolecules 2006,7,2783-9

9 K. Ganesan et al (2006), Evaluation of bagasse ash as supplementary cementations' material. Compos scitechnol 2003,63,1307-60

10 Yu-Tao Zheng et al (2007), Study on the interface modification of bagasse fibre and the mechanical properties of its composite with PVC**,** composites –part B ,2013 ,44,120-127

MACHINING OF ALUMINIUM COMPOSITE BY EDM PROCESS

PROJECT WORK (PHASE II) REPORT

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ABSTRACT

The composite materials are extensively used globally in major industries. It is very difficult to machine the metal matrix composite materials impeded with reinforcement by conventional machining methods . Hence non conventional machining techniques are employed to overcome these difficulties. The influence of process parameters of Electrical discharge machining such as current, pulse on- time and pulse -off time on Metal Removal Rate (MRR) and Surface Roughness (SR) were analysed for Al356 hybrid metal matrix composite reinforced with Silicon carbide (SiC) in this paper. The hybrid metal matrix composite was fabricated using stir casting process and machining was performed by EDM using copper tool with the machining parameters. The machining characteristics for different set of experiments were analysed. The optimum parameters were identified with the help of Taguchi's *L*9 orthogonal.and the optimum values were verified.

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LIST OF ABBREVIATIONS

EDM	: Electrical Discharge Machining
Ip	: Discharge Current
V	: Discharge Voltage
Ton	: Pulse-On Time
Toff	: Pulse-Off Time Or Pause Time
fp	: Flushing Pressure

CHAPTER 1

INTRODUCTION

1.1 COMPOSITE MATERIAL

A composite material (also called a composition material or shortened to composite, which is the common name) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure, differentiating composites from mixtures and solid solutions.

The new material may be preferred for many reasons. Common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials.

Composites are made up of individual materials referred to as constituent materials. There are two main categories of constituent materials: matrix (binder) and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. A synergism produces material properties unavailable from the individual constituent materials, while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination.

Engineered composite materials must be formed to shape. The matrix material can be introduced to the reinforcement before or after the reinforcement material is placed into the mould cavity or onto the mould surface. The matrix material experiences a melding event, after which the part shape is essentially set. Depending upon the nature of the matrix material, this melding event can occur in various ways such as chemical polymerization for a thermoset polymer matrix, or solidification from the melted state for a thermoplastic polymer matrix composite.

A variety of moulding methods can be used according to the end-item design requirements. The principal factors impacting the methodology are the natures of the chosen

matrix and reinforcement materials. Another important factor is the gross quantity of material to be produced. Large quantities can be used to justify high capital expenditures for rapid and automated manufacturing technology. Small production quantities are accommodated with lower capital expenditures but higher labour and tooling costs at a correspondingly slower rate.

Many commercially produced composites use a polymer matrix material often called a resin solution. There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamide, polypropylene, PEEK, and others.

The reinforcement materials are often fibres but also commonly ground minerals. The various methods described below have been developed to reduce the resin content of the final product, or the fibre content is increased. As a rule of thumb, lay up results in a product containing 60% resin and 40% fibre, whereas vacuum infusion gives a final product with 40% resin and 60% fibre content. The strength of the product is greatly dependent on this ratio.

Martin Hubbe and Lucian A Lucia consider wood to be a natural composite of cellulose fibres in a matrix of lignin.

1.2 MATRICES

1.2.1 Organic

Polymers are common matrices (especially used for fibre reinforced plastics). Road surfaces are often made from asphalt concrete which uses bitumen as a matrix. Mud (wattle and daub) has seen extensive use. Typically, most common polymer-based composite materials, including fibreglass, carbon fibre, and Kevlar, include at least two parts, the substrate and the resin.

Polyester resin tends to have yellowish tint, and is suitable for most backyard projects. Its weaknesses are that it is UV sensitive and can tend to degrade over time, and thus generally is also coated to help preserve it. It is often used in the making of surfboards and for marine applications. Its hardener is a peroxide, often MEKP (methyl ethyl ketone peroxide). When the peroxide is mixed with the resin, it decomposes to generate free radicals, which initiate the curing reaction. Hardeners in these systems are commonly called catalysts, but since they do not

re-appear unchanged at the end of the reaction, they do not fit the strictest chemical definition of a catalyst.

Vinyl ester resin tends to have a purplish to bluish to greenish tint. This resin has lower viscosity than polyester resin and is more transparent. This resin is often billed as being fuel resistant, but will melt in contact with gasoline. It tends to be more resistant over time to degradation than polyester resin and is more flexible. It uses the same hardeners as polyester resin (at a similar mix ratio) and the cost is approximately the same.

Epoxy resin is almost transparent when cured. In the aerospace industry, epoxy is used as a structural matrix material or as a structural glue.

Shape memory polymer (SMP) resins have varying visual characteristics depending on their formulation. These resins may be epoxy-based, which can be used for auto body and outdoor equipment repairs; cyanate-ester-based, which are used in space applications; and acrylate-based, which can be used in very cold temperature applications, such as for sensors that indicate whether perishable goods have warmed above a certain maximum temperature. These resins are unique in that their shape can be repeatedly changed by heating above their glass transition temperature (T_g). When heated, they become flexible and elastic, allowing for easy configuration. Once they are cooled, they will maintain their new shape. The resins will return to their original shapes when they are reheated above their T_g. The advantage of shape memory polymer resins is that they can be shaped and reshaped repeatedly without losing their material properties. These resins can be used in fabricating shape memory composites.

Traditional materials such as glues, muds have traditionally been used as matrices for papier-mâché and adobe.

1.2.2 Inorganic

Cement (concrete), metals, ceramics, and sometimes glasses are employed. Unusual matrices such as ice are sometime proposed as in pykecrete.

1.3 REINFORCEMENTS

1.3.1 Fiber

Differences in the way the fibres are laid out give different strengths and ease of manufacture

Reinforcement usually adds rigidity and greatly impedes crack propagation. Thin fibers can have very high strength, and provided they are mechanically well attached to the matrix they can greatly improve the composite's overall properties.

Fibre-reinforced composite materials can be divided into two main categories normally referred to as short fibre-reinforced materials and continuous fiber-reinforced materials. Continuous reinforced materials will often constitute a layered or laminated structure. The woven and continuous fiber styles are typically available in a variety of forms, being pre-impregnated with the given matrix (resin), dry, uni-directional tapes of various widths, plain weave, harness satins, braided, and stitched.

The short and long fibres are typically employed in compression moulding and sheet moulding operations. These come in the form of flakes, chips, and random mate (which can also be made from a continuous fibre laid in random fashion until the desired thickness of the ply / laminate is achieved).

Common fibres used for reinforcement include glass fibres, carbon fibres, cellulose (wood/paper fibre and straw) and high strength polymers for example aramid. Silicon carbide fibers are used for some high temperature applications.

1.3.2 Particle

Particle reinforcement adds a similar effect to precipitation hardening in metals and ceramics. Large particles impede dislocation movement and crack propagation as well as contribute to the composite's Young's Modulus

The most common particle reinforced composite is concrete, which is a mixture of gravel and sand usually strengthened by addition of small rocks or sand. Metals are often reinforced with ceramics to increase strength at the cost of ductility. Finally polymers and rubber are often reinforced with carbon black, commonly used in auto tires.

1.3.3 Cores

Many composite layup designs also include a co-curing or post-curing of the prepreg with various other media, such as honeycomb or foam. This is commonly called a sandwich structure. This is a more common layup for the manufacture of radomes, doors, cowlings, or non-structural parts.

Openandclosedcellstructured foams like polyvinylchloride, polyurethane, polyethylene or polystyrene foams, balsa wood, syntactic foams, and honeycombs are commonly used core materials. Open- and closed-cell metal foam can also be used as core materials. Recently, 3D graphene structures (also called graphene foam) have also been employed as core structures. A recent review by Khurram and Xu et al., have provided the summary of the state-of-the-art techniques for fabrication of the 3D structure of graphene, and the examples of the use of these foam like structures as a core for their respective polymer composites.

1.3.4 Semi-Crystalline Polymers

Although the two phases are chemically equivalent, semi-crystalline polymers can be described both quantitatively and qualitatively as composite materials. The crystalline portion has a higher elastic modulus and provides reinforcement for the less stiff, amorphous phase. Polymeric materials can range from 0% to 100% crystallinity aka volume fraction depending on molecular structure and thermal history. Different processing techniques can be employed to vary the percent crystallinity in these materials and thus the mechanical properties of these materials as described in the physical properties section. This effect is seen in a variety of places from industrial plastics like polyethylene shopping bags to spiders which can produce silks with different mechanical properties. In many cases these materials act like particle composites with randomly dispersed crystals known as spherulites. However they can also be engineered to be anisotropic and act more like fiber reinforced composites. In the case of spider silk, the properties of the material can even be dependent on the size of the crystals, independent of the volume fraction. Ironically, single component polymeric materials are some of the most easily tunable composite materials known.

1.4 FABRICATION METHODS

Fabrication of composite materials is accomplished by a wide variety of techniques, including:

- Advanced fibre placement (Automated fibre placement)
- Tailored fibre placement
- fibreglass spray lay-up process
- Filament winding

- Lanxide process
- Tufting
- Z-pinning

Composite fabrication usually involves wetting, mixing or saturating the reinforcement with the matrix, and then causing the matrix to bind together (with heat or a chemical reaction) into a rigid structure. The operation is usually done in an open or closed forming mold, but the order and ways of introducing the ingredients varies considerably.

1.5 FINISHING METHODS

The finishing of the composite parts is also critical in the final design. Many of these finishes will include rain-erosion coatings or polyurethane coatings.

1.6 TOOLING

The mold and mold inserts are referred to as "tooling." The mold/tooling can be constructed from a variety of materials. Tooling materials include invar, steel, aluminium, reinforced silicone rubber, nickel, and carbon fibre. Selection of the tooling material is typically based on, but not limited to, the coefficient of thermal expansion, expected number of cycles, end item tolerance, desired or required surface condition, method of cure, glass transition temperature of the material being moulded, moulding method, matrix, cost and a variety of other considerations.

1.7 TESTING

To aid in predicting and preventing failures, composites are tested before and after construction. Pre-construction testing may use finite element analysis (FEA) for ply-by-ply analysis of curved surfaces and predicting wrinkling, crimping and dimpling of composites. Materials may be tested during manufacturing and after construction through several nondestructive methods including ultrasonics, thermography, shearography and X-ray radiography, and laser bond inspection for NDT of relative bond strength integrity in a localized area.

CHAPTER 2

LITERATURE REVIEW

A. Mouangue (2011) edal reported that

Aluminium Metal Matrix Composites (AMMCs) are making inroads in various engineering applications requiring higher strength and stiffness than those offered by conventional aluminium alloys. Traditional machining of AMMCs however is difficult due to the hard reinforcement present in the AMMC material which tends to wrap around the cutting tool-bit leading to tool breakage. Electro-Discharge Machining (EDM) has been successfully applied on standard aluminium alloy such as Al 6061 but yet to be tested on 30% (by volume) A12O3 reinforced AMMC. In this study, specific machining performance characteristics on AMMC reinforced with 30 % A12O3 is assessed in comparison with Al 6061. The characteristics under study are Material Removal Rate (MRR) and Tool Wear Ratio (TWR). Key process parameters such as the peak current, pulse and pause durations (ON-time and OFF-time), were varied to determine their influences on the MRR and TWR of 30% A12O3reinforced AMMC. Results indicate that 30% A12O3 reinforced aluminium metal matrix composite can be machined using EDM to obtain acceptable result in terms of MRR and TWR. A high value of peak current and ON-time increase rapidly MRR of Al 6061 rather than AMMC while it decreases with increasing of OFF-time. Tool wears more at low peak current and ON-time than OFF-time.

Ahmad-Majdi(2012) edal was proposed that

Aluminium alloys are conventional materials widely used in aviation, marine, automobile and electrical equipment. Aluminium alloy materials are relatively low cost, light weight and can be easily machined by both traditional and non-traditional machining processes. Aluminium Metal Matrix Composites (AMMCs), have been making inroads into various engineering applications where there are demands for strength and stiffness higher than those offered by the conventional aluminium alloys. Traditional machining of AMMCs, however, is challenging as their hard reinforcement tends to wrap around the conventional tool bit that leads to tool

breakage. To address this problem, Electro-Discharge Machining (EDM) is being considered as a viable alternative to conventional machining. Key input process parameters of EDM such as the peak current, the pulse duration (ON-time) and pause duration (OFF-time) are varied to study their influences on the surface finish. The quality of the surface finish is indicated by the surface Roughness (Ra) and surface morphology of the metal surface. The effects of these parameters on the surface finish quality of alumina (A1203) particle-reinforced AMMC are then compared with those of an aluminium alloy. Performance of EDM machining on AMMC shows satisfactory result in surface roughness at low peak current, short ON-time and longer OFF-time. Response surface methodology is used to analyze and generate the mathematical model of output response.

Balamurugan adhithan(2017) edal was proposed that

Metal matrix composites have superior mechanical properties in comparison to metals over a wide range of operating conditions. This makes them an attractive option in replacing metals for various engineering applications. This paper provides a literature review, on machining of aluminium metal matrix composites (ammc) especially the particle reinforced aluminium metal matrix composites. This paper is an attempt to give brief account of recent work over ammc. By suitably selecting the machining parameters, machining of ammc can be made economical.

Keywords — aluminium metal matrix composites, reinforcement, cutting speed, feed, depth of cut, surface finish, mach inability etc

Bisaria (2015) edal was reported that

Nowadays the keen interest of the automobile and aerospace sector on metal matrix composites (MMCs) is increasing due to is attractive mechanical properties and applications. The machining of MMCs by advance machining process is the relatively new field of attention for researchers and scientist as conventional machining of MMCs is complex and difficult. Electric discharge machining (EDM) is widely used process among advance machining process for machining MMCs. This research work investigates different variants of EDM for machining the wide range of MMCs. The effect of process parameters (spark gap, pulse current, duty cycle etc.) on response parameter such as material removal rate (MRR), tool wear rate (TWR),

surface finish (SR) etc. during the machining of different MMC martials with different variants of EDM were studied under this review paper.

Kathiresan.M (2010) edal was proposed that

Aluminum based metal matrix composites (MMCs) offer potential for advanced structural applications when high specific strength and modulus, as well as good elevated temperature resistance, are important. In the present work, aluminum alloy-silicon carbide composites were developed using a new combination of vortex method and pressure die casting technique. Electrical Discharge Machining (EDM) studies were conducted on the aluminum alloy-silicon carbide composite work piece using a copper electrode in an Electrical Discharge Machine. The Material Removal Rate (MRR) and surface roughness of the work piece increases with an increase in the current. The MRR decreases with increase in the percent weight of silicon carbide. The surface finish of the machined work piece improves with percent weight of silicon carbide. Keywords: Aluminum Alloy, Silicon carbide, Die-casting, Electric Discharge Machining, Surface roughness.

Mohammad Junaid Khan (2016) reported that

Manufacturing industries are facing difficulties from newly developed, advanced materials viz. composites, ceramics and super alloys, which fall under the category of difficult-to-machine materials. To overcome these challenges, non-conventional machining processes are being employed which give better material removal rate, accuracy and surface finish. Electrical Discharge Machining (EDM) is the process in which electrically conductive materials are machined irrespective of their hardness using controlled sparks in the presence of dielectric. Aluminium Metal Matrix Composites (AMMC's) are new generation engineering materials that possess superior physical and mechanical properties compared to non-reinforced alloys. This paper presents a review of research work done on Al-SiC metal matrix composite on EDM, Wire EDM, Powder Mixed EDM, EDM in Water, Micro EDM. The paper also discusses the future scope of work in the same area.

Mumtaz Rizwee (2019) edal was proposed that

Among all the advanced Metal matrix composite (MMC) materials is among the important and beneficial materials for industry because of their characteristics

such as high specific strength, high corrosive resistance, good wear resistance, light weight, and high thermal coefficient. It is very critical to do operation due to high hardness and reinforcement of the MMC by using conventional machining which is responsible for retard the development of MMC. Machining of MMC by using conventional machining process is a serious cause of higher Tool Wear Rate (TWR) because of abrasive properties of reinforcement particles. Machining of such materials can be done by using different type of non-convectional machining processes like that Laser beam machining (LBM) and water jet machining (WJM). But both processes are limited to linear machining only. This Articles represent a literature survey on Electric discharge machining (EDM) of reinforced MMC and different methodology used such as Analysis of variance (ANOVA), Response Surface Methodology (RSM), Taguchi methodology etc. which helps in optimizing the results. This review is analyzing the suitable process parameters and machining performance for machining of MMC and also reveals the research work area in which maximum research work can be done in future.

Sudhakar.B (2018) edal was reported that

Metal Matrix Composites (MMC) have become a large leading material in composite field and particle reinforced aluminium MMCs have received considerable attention due to their excellent engineering properties. These materials are known as the difficult-to-machine materials, because of the hardness and abrasive nature of reinforcement element like alumina, silicon carbide particles. One of the most common problems encountered in drilling is that the continuous chips curl up on the body of the tool, which might damage the drilled hole. In process we are taking 6061 grade of Aluminium and adding some of the reinforcement materials like Graphite (Gr) and Alumina (Al2O3) to improve the properties of Aluminium. Here we are adding the Graphite (Gr) and Alumina (Al2O3) to Aluminium 6061 in different percentages .Graphite (Gr) is added for the purpose of smoothness, so that we can get a smooth surface finish and machining is made easier. Alumina (Al2O3) is added to improve the strength of the aluminium. The sample pieces are going to run some of the tests to find the hardness, impact strength. By using of some tests we can gather the information about the changes in property of the aluminium metal matrix composites.

Vijaya Ramnath.B (2006) edal was reported that

Aluminium matrix composites (AMCs) are potential materials for various applications due to their good physical and mechanical properties. The addition of reinforcements into the metallic matrix improves the stiffness, specific strength, wear, creep and fatigue properties compared to the conventional engineering materials. This paper presents the overview of the effect of addition on different reinforcements in aluminium alloy highlighting their merits and demerits. Major issues like agglomerating phenomenon, fiber-matrix bonding and the problems related to distribution of particles are discussed in this paper. Effect of different reinforcement on AMCs on the mechanical properties like tensile strength, strain, hardness, wear and fatigue is also discussed in detail. Major applications of different AMCs are also highlighted in this work.

Suresh kumar.S(2014)edal was reported that

The goal of the present experimental work is to optimize the electrical discharge machining (EDM) parameters of aluminum alloy (Al 6351) matrix reinforced with 5 wt.% silicon carbide (SiC) and 10 wt.% boron carbide (B4C) particles fabricated through the stir casting route.Multiresponse optimization was carried out through grey relational analysis (GRA) with an objective to minimize the machining characteristics, namely electrode wear ratio (EWR), surface roughness (SR) and power consumption (PC).The optimal combination of input parameters is identified, which shows the significant enhancement in process characteristics. Contributions of each machining parameter to the responses are calculated using analysis of variance (ANOVA). The result shows that the pulse current contributes more (83.94%) to affecting the combined output responses.

Rajesh Kumar Bhuyan(2014)edal was proposed that

In the present study, pure aluminium alloy is mixed with 12% SiC on weight basis to fabricate the metal matrix composite (MMC) material. The objective of this paper is to investigate the effect of process parameters such as pulse on time(Ton), peak current (Ip) and flushing pressure (Fp) on metal removal rate (MRR), tool wear rate (TWR) and surface roughness (SR) during electrical discharge machining (EDM) of Al-SiC12% MMC .The experiment is followed by Central composite design (CCD) method under different combination of process parameters .In this paper Response surface methodology (RSM) is used to develop the mathematical model and to correlate the process parameters with the response. Also Analysis of Variance

(ANOVA) technique is used to check the significance of the model and confirmation test is conducted to compare the experimental data with the predicted data to identify the effectiveness of the proposed method. From the main effective plot it is found that peak current is the most significant parameter among the other. Further the morphology study of the composite is carried out by the Field emission Scanning electron microscope (FESEM) of the surface after machining to make a relation with the model.

Naveenkumar. K(2016) edal was reported that

The composite materials are extensively used globally in major industries. It is very difficult to machine the metal matrix composite materials impeded with reinforcement by conventional machining methods . Hence non conventional machining techniques are employed to overcome these difficulties. The influence of process parameters of Electrical discharge machining such as current, pulse on- time and pulse -off time on Metal Removal Rate (MRR) and Surface Roughness (SR) were analysed for Al7075 hybrid metal matrix composite reinforced with Silicon carbide (SiC) and Titanium carbide (TiC) in this paper. The hybrid metal matrix composite was fabricated using stir casting process and machining was performed by EDM using copper tool with the machining parameters and the run order obtained from design expert software. The machining characteristics for different set of experiments were analysed. The optimum parameters were identified with the help of design expert software and the optimum values were verified. It has been observed that the metal removal rate decreases when the weight fraction of reinforcement increases and surface roughness increases.

B. H. Yan(2000) was reported that

This work optimises the cutting of Al2O3/6061Al composite using rotary electro-discharging machining (EDM) with a disklike electrode by using Taguchi methodology. The Taguchi method is used to formulate the experimental layout, to analyse the effect of each EDM parameter on the machining characteristics, and to predict the optimal choice for each EDM parameter. Four observed values, MRR, EWR, REWR, and SR, are used to verify this optimisation of the machining technique. In addition, six independent parameters are chosen as variables in evaluating the Taguchi method and are categorised into two groups: 1. Electrical parameters, e.g. polarity, peak current, pulse duration, and powder supply voltage.

2. Non-electrical parameters, e.g. circumferential speed of electrode, reciprocating speed. The analysis of the Taguchi method reveals that, in general, the electrical group more significantly affects the machining characteristics than the non-electrical group. Also derived herein are semi-empirical equation that contain all of the machining characteristics. Experimental results are presented to illustrate the proposed approach.

S. Venkatesan(2018) edal was reported that

Wire-electrical discharge machining (WEDM) is an emerging non - conventional processes for machining of hard to machine materials involved with complex profiles which are not possible with existing conventional manufacturing techniques. Metal matrix composite material (MMC) is a complex material with two or more different physical and metallurgical properties. Conventional manufacturing process for machining of composite materials failed in many aspects such as good surface finish, complex profile etc. In this research work, investigation on the effect of few process parameters of Wire Cut EDM process such as Metal removal rate, Surface Finish and Kerf Width during machining of Aluminium based hybrid metal matrix composites were studied. Aluminium based hybrid Metal Matrix Composite materials were prepared through stir casting method by varying the percentage inclusions of reinforcements like Silicon Carbide of particle size 120 μm (5%) and Graphite powders of mesh size 100μm (1- 2 %) . The experimental outcomes suggests that the effect of machining parameter such as Current, Pulse on time, Servo Voltage on the achievement of better performance of the machine to produce a good quality machining on the materials considered. The experimental outcomes indicates that the most influencing parameters for the best machinability of Aluminium based hybrid composite materials is the servo voltage as compared to other process parameters considered in this research work.

CHAPTER 3

METHODOLOGY AND WORKING

3.1 STIR CASTING

Discontinuous reinforcement is stirred into molten metal, which is only dissolved by intense stirring. However, here gas access into the melt must be absolutely avoided, since this could lead to unwanted porosities or reactions. The melt can be cast directly or processed with alternative procedures such as stir casting method. Stir-Casting is a liquid state method of composite materials fabrication, in which a dispersed Phase (ceramic particles, short fibres) is mixed with a molten matrix metal by means of mechanical stirring. The liquid composite material is then cast by conventional casting methods and may also be processed by conventional metal forming technologies. For the casting process, 18 centimeter crucible and 9 centimeter crucible were used. The 9 centimeter crucible was used to preheat the reinforcement material such as aluminium oxide and silicon carbide and the 18 centimeter crucible used to melt aluminium 356. Aluminium 356 was preheated at 400-600°C and then put into the 18 centimeter crucible and kept into the casting chamber. Then the temperature was increased gradually and when the temperature attained 650°C, aluminium 356 started to melt. The process continued till aluminium 7075 attained liquid stage. At this stage, the preheated reinforcements were put into the casting furnace and mixed with the help of stirrer run by a motor at 100-1800 rpm. The molten materials were poured into the mould of size 100x100x10 mm.

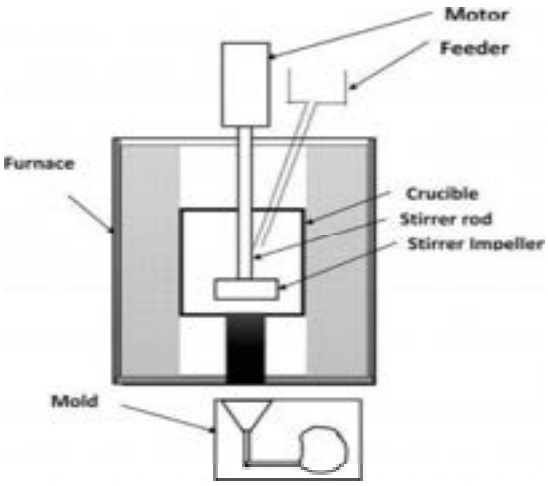

Figure 3.1:Basic stir casting

3.2 MATERIALS

The material used for tests in the present study consists of Al 356 alloy as the base matrix. Aluminium 356 alloys have strong corrosion resistance and high strength. At subzero temperatures, their strength increases, thus making them a useful low-temperature alloy. Their strength decreases if they are subjected to very high temperatures. The chemical composition of Al356 in weight percentage is Si =7.16, Cu = 0.01, Mg = 0.36, Zn = 0.01, Fe = 0.11, Ti =0.13, and balance as Al. The aluminium matrix reinforced with silicon carbide is used in this research. Silicon Carbide is the only chemical compound of silicon and carbon. Silicon carbide is composed of tetrahedral arrangement of carbon and silicon atoms with strong bonds in the crystal lattice. Silicon Carbide is not attacked by any acids or alkalis or molten salt up to 8000C.

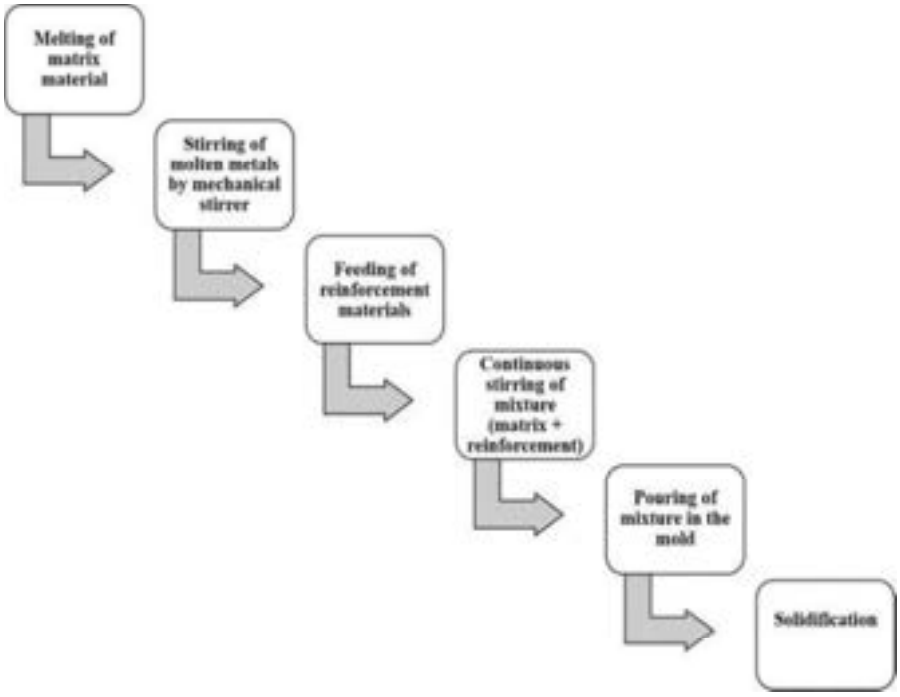

Figure 3.2:Flowchart for stir casting

3.3 ELECTRICAL DISCHARGE MACHINING(EDM)

3.3.1 Principle of EDM

Electrical Discharge Machining (EDM) is a controlled metal-removal process that is used to remove metal by means of electric spark erosion. In this process an electric spark is used as the cutting tool to cut (erode) the workpiece to produce the finished part to the desired shape.

The metal-removal process is performed by applying a pulsating (ON/OFF) electrical charge of high-frequency current through the electrode to the work piece. This removes (erodes) very tiny pieces of metal from the work piece at a controlled rate.

3.3.2 EDM Process

EDM spark erosion is the same as having an electrical short that burns a small hole in a piece of metal it contacts. With the EDM process both the work piece material and the electrode material must be conductors of electricity. The EDM process can be used in two different ways:

- A preshaped or formed electrode (tool),usually made from graphite or copper, is shaped to the form of the cavity it is to reproduce. The formed electrode is fed vertically down and the reverse shape of the electrode is eroded (burned) into the solid work piece.
- A continuous-travelling vertical-wire electrode, the diameter of a small needle or less, is controlled by the computer to follow a programmed path to erode or cut a narrow slot through the work piece to produce the required shape.

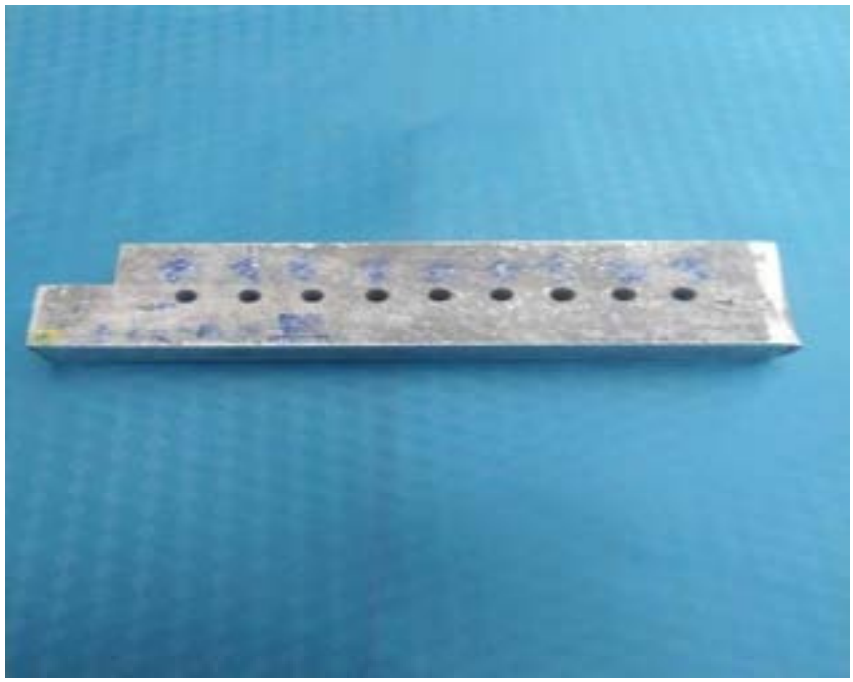

Figure 3.3.2: Machined Component

3.3.3 EDM Process Parameter

As per the discharge phenomena explained earlier, some of the important process parameters which influence the responses are:

Discharge current (Ip)

It is the most important machining parameter in EDM because it relates to power consumption of power while machining. The current increases until it reaches a preset level.

Discharge voltage (V)

It is the open circuit voltage which is applied between the electrodes. The discharge voltage de-ionizes the dielectric medium, which depends upon the electrode gap and the strength of the dielectric, prior to the flow of current. Once the current flow starts, the open circuit voltage drops and stabilizes the electrode gap. It is a vital factor that influences the spark energy.

Pulse-on time (Ton)

It is the time during which actual machining takes place and it is measured in µs. In each discharge cycle, there is a pulse on time and pause time/Pulse off time, and the voltage between the electrode and work piece is applied during Ton duration. The longer the pulse Duration higher will be the spark energy that creates wider and deeper crated.

Pulse-off time or pause time (Toff)

In a cycle, there is a pulse off time or pause time during which the supply voltage is cut off as a consequence the Ip diminishes to zero. It is also the duration of time after which the next spark is generated and is expressed in µs analogous to Ton. Since, the dielectric must de-ionized after sparking and regain its strength, it required some time and moreover the flushing of debris also takes place during the Toff time.

Flushing Pressure (fp)

Flushing is an important factor in EDM because debris must be removed for efficient cutting, moreover it brings fresh dielectric in the inter electrode gap.

Flushing is difficult if the cavity is deeper, inefficient flushing may initiate arcing and may create unwanted cavities which can destroys the work piece. There are several methods generally used to flush the EDM gap: jet or side flushing, pressure flushing, vacuum flushing and pulse flushing.

Polarity

Polarity refers to the potential of the work piece with respect to tool i.e. in straight or positive polarity the work piece is positive, whereas in reverse polarity work piece is negative. Varying the polarity can have dramatic effect, normally electrode with positive polarity wear less, whereas with negative polarity cut faster

3.3.4 Advantages of EDM

Conventional EDM machines can be programmed for vertical machining, orbital, vectorial, directional, helical, conical, rotational, spin and indexing machining cycles. This versatility gives Electrical Discharge Machines many advantages over conventional machine tools.

- Any material that is electrically conductive can be cut using the EDM process.
- Hardened workpieces can be machined eliminating the deformation caused by heat treatment.
- X, Y, and Z axes movements allow for the programming of complex profiles using simple electrodes. Complex dies sections and molds can be produced accurately, faster, and at lower costs.
- The EDM process is burr-free.
- Thin fragile sections such as webs or fins can be easily machined without deforming the part.

3.4 Taguchi Method

The technique of laying out the conditions of experiments involving multiple factors was first proposed by the Englishman, Sir R.A.Fisher. The method is popularly known as the factorial design of experiments. A full factorial design will identify all possible combinations for a given set of factors. Since most industrial experiments usually involve a significant number of factors, a full factorial design results in a large number of experiments.

To reduce the number of experiments to a practical level, only a small set from all the possibilities is selected. The method of selecting a limited number of experiments which produces the most information is known as a partial fraction experiment. Although this method is well known, there are no general guidelines for its application or the analysis of the results obtained by performing the experiments. Taguchi constructed a special set of general design guidelines for factorial experiments that cover many applications.

3.4.1 Definition

Taguchi has envisaged a new method of conducting the design of experiments which are based on well defined guidelines. This method uses a special set of arrays called orthogonal arrays. These standard arrays stipulates the way of conducting the minimal number of experiments which could give the full information of all the factors that affect the performance parameter. The crux of the orthogonal arrays method lies in choosing the level combinations of the input design variables for each experiment.

3.4.2 A typical orthogonal array

While there are many standard orthogonal arrays available, each of the arrays is meant for a specific number of independent design variables and levels.

For example, if one wants to conduct an experiment to understand the influence of 4 different independent variables with each variable having 3 set values (level values), then an L9 orthogonal array might be the right choice. The L9 orthogonal array is meant for understanding the effect of 4 independent factors each having 3 factor level values. This array assumes that there is no interaction between any two factor. While in many cases, no interaction model assumption is valid, there are some cases where there is a clear evidence of interaction. A typical case of interaction would be the interaction between the material properties and temperature.

$L_9 (3^4)$ Orthogonal array					
	Independent Variables				Performance Parameter Value
Experiment #	Variable 1	Variable 2	Variable 3	Variable 4	
1	1	1	1	1	p1
2	1	2	2	2	p2
3	1	3	3	3	p3
4	2	1	2	3	p4
5	2	2	3	1	p5
6	2	3	1	2	p6
7	3	1	3	2	p7
8	3	2	1	3	p8
9	3	3	2	1	p9

Table 3.1 Layout of L_9 orthogonal array.

There are totally 9 experiments to be conducted and each experiment is based on the combination of level values as shown in the table. For example, the third experiment is conducted by keeping the independent design variable 1 at level 1, variable 2 at level 3, variable 3 at level 3, and variable 4 at level 3.

3.4.3 Properties of an orthogonal array

The orthogonal arrays has the following special properties that reduces the number of experiments to be conducted.

1. The vertical column under each independent variables of the above table has a special combination of level settings. All the level settings appears an equal number of times. For L9 array under variable 4 , level 1 , level 2 and level 3 appears thrice. This is called the balancing property of orthogonal arrays.
2. All the level values of independent variables are used for conducting the experiments.

3. The sequence of level values for conducting the experiments shall not be changed. This means one can not conduct experiment 1 with variable 1, level 2 setup and experiment 4 with variable 1 , level 1 setup. The reason for this is that the array of each factor columns are mutually orthogonal to any other column of level values. The inner product of vectors corresponding to weights is zero. If the above 3 levels are normalized between -1 and 1, then the weighing factors for level 1, level 2 , level 3 are -1 , 0 , 1 respectively. Hence the inner product of weighing factors of independent variable 1 and independent variable 3 would be,

$$(-1 * -1+-1*0+-1*1)+(0*0+0*1+0*-1)+(1*0+1*1+1*-1)=0$$

3.4.4 Minimum number of experiments to be conducted

The design of experiments using the orthogonal array is, in most cases, efficient when compared to many other statistical designs. The minimum number of experiments that are required to conduct the Taguchi method can be calculated based on the degrees of freedom approach.

$$N_{Taguchi} = 1 + \sum_{i=1}^{NV}(L_i - 1) \qquad (2.\ 1)$$

For example, in case of 8 independent variables study having 1 independent variable with 2 levels and remaining 7 independent variables with 3 levels (L18 orthogonal array) , the minimum number of experiments required based on the above equation is 16. Because of the balancing property of the orthogonal arrays, the total number of experiments shall be multiple of 2 and 3. Hence the number of experiments for the above case is 18.

3.4.5 Assumptions of the Taguchi method

The additive assumption implies that the individual or main effects of the independent variables on performance parameter are separable. Under this assumption, the effect of each factor can be linear, quadratic or of higher order, but the model assumes that there exists no cross product effects (interactions) among the

individual factors. That means the effect of independent variable 1 on performance parameter does not depend on the different level settings of any other independent variables and vice versa. If at anytime, this assumption is violated, then the additivity of the main effects does not hold, and the variables interact.

3.4.6 Designing an experiment

The design of an experiment involves the following steps

1. Selection of independent variables
2. Selection of number of level settings for each independent variable
3. Selection of orthogonal array
4. Assigning the independent variables to each column
5. Conducting the experiments
6. Analyzing the data
7. Inference

The details of the above steps are given below.

3.4.7 Selection of the independent variables

Before conducting the experiment, the knowledge of the product/process under investigation is of prime importance for identifying the factors likely to influence the outcome. In order to compile a comprehensive list of factors, the input to the experiment is generally obtained from all the people involved in the project.

3.4.8 Deciding the number of levels

Once the independent variables are decided, the number of levels for each variable is decided. The selection of number of levels depends on how the performance parameter is affected due to different level settings. If the performance parameter is a linear function of the independent variable, then the number of level setting shall be 2. However, if the independent variable is not linearly related, then one could go for 3, 4 or higher levels depending on whether the relationship is quadratic, cubic or higher order. In the absence of exact nature of relationship between the independent variable and the performance parameter, one could choose 2

level settings. After analyzing the experimental data, one can decide whether the assumption of level setting is right or not based on the percent contribution and the error calculations.

3.4.9 Selection of an orthogonal array

Before selecting the orthogonal array, the minimum number of experiments to be conducted shall be fixed based on the total number of degrees of freedom present in the study. The minimum number of experiments that must be run to study the factors shall be more than the total degrees of freedom available. In counting the total degrees of freedom the investigator commits 1 degree of freedom to the overall mean of the response under study. The number of degrees of freedom associated with each factor under study equals one less than the number of levels available for that factor. Hence the total degrees of freedom without interaction effect is 1 + as already given by equation 2.1. For example, in case of 11 independent variables, each having 2 levels, the total degrees of freedom is 12. Hence the selected orthogonal array shall have at least 12 experiments. An L12 orthogonal satisfies this requirement.

Once the minimum number of experiments is decided, the further selection of orthogonal array is based on the number of independent variables and number of factor levels for each independent variable.

3.4.10 Assigning the independent variables to columns

The order in which the independent variables are assigned to the vertical column is very essential. In case of mixed level variables and interaction between variables, the variables are to be assigned at right columns as stipulated by the orthogonal array .

Finally, before conducting the experiment, the actual level values of each design variable shall be decided. It shall be noted that the significance and the percent contribution of the independent variables changes depending on the level values assigned. It is the designers responsibility to set proper level values.

3.4.11 Conducting the experiment

Once the orthogonal array is selected, the experiments are conducted as per the level combinations. It is necessary that all the experiments be conducted. The interaction columns and dummy variable columns shall not be considered for conducting the experiment, but are needed while analyzing the data to understand the interaction effect. The performance parameter under study is noted down for each experiment to conduct the sensitivity analysis.

3.4.12 Analysis of the data

Since each experiment is the combination of different factor levels, it is essential to segregate the individual effect of independent variables. This can be done by summing up the performance parameter values for the corresponding level settings. For example, in order to find out the main effect of level 1 setting of the independent variable 2 ,sum the performance parameter values of the experiments 1, 4 and 7. Similarly for level 2, sum the experimental results of 2, 5 and 7 and so on.

Once the mean value of each level of a particular independent variable is calculated, the sum of square of deviation of each of the mean value from the grand mean value is calculated. This sum of square deviation of a particular variable indicates whether the performance parameter is sensitive to the change in level setting. If the sum of square deviation is close to zero or insignificant, one may conclude that the design variables is not influencing the performance of the process. In other words, by conducting the sensitivity analysis, and performing analysis of variance (ANOVA), one can decide which independent factor dominates over other and the percentage contribution of that particular independent variable.

3.4.13 Inference

From the above experimental analysis, it is clear that the higher the value of sum of square of an independent variable, the more it has influence on the performance parameter. One can also calculate the ratio of individual sum of square of a particular independent variable to the total sum of squares of all the variables.

This ratio gives the percent contribution of the independent variable on the performance parameter.

In addition to above, one could find the near optimal solution to the problem. This near optimum value may not be the global optimal solution. However, the solution can be used as an initial / starting value for the standard optimization technique.

CHAPTER 4

EXPERIMENT AND ANALYSIS

4.1 Input Parameters

Here the input parameters has been chosen for the EDM process are current, Pulse on time , Pulse off time.

The values taken for the process are given as in the following table.

S.NO.	PARAMETER	LEVEL 1	LEVEL 2	LEVEL 3
1	Current (A)	25	30	35
2	Pulse ON time (μs)	35	45	55
3	Pulse OFF time (μs)	10	11	12

Table 4.1 Input parameters

4.2 Output parameters

Generally the output parameters are

- Material Removal Rate(MMR)
- Electrode Wear Rate(EWR)
- Surface Roughness(SR)

4.2.1 Material Removal Rate (MMR)

The mathematical relationship for correlating the material removal rate and the considered process variables is obtained as follows;

$$MRR = 20.12185 + (0.015014 * T_{ON}) - (0.23106 * T_{OFF}) - (0.42890 * I_P) + (2.88377E^{-005} * T^2_{ON}) + (4.52138E^{-003} * I^2_P) - (8.47222E^{-004} * T_{ON} * T_{OFF}) + (0.013052 * T_{OFF} * I_P)$$

4.2.2 Electrode Wear Rate (EWR)

The mathematical relationship for correlating the Electrode Wear Rate and the considered process variables is obtained as follows;

$$EWR = +1.51042 - (7.34375E^{-003} * T_{ON}) + (0.16875 * T_{OFF}) + (0.028125 * I_P) + (7.13976E^{-005} * T^2_{ON}) - (2.17014E^{-003} * T^2) - (1.46875E^{-003} * I^2) - (8.15972E^{-004} * T_{ON} * T_{OFF}) - (9.89583E^{-005} * T_{ON} * I_P) + (2.70833E^{-003} * T_{OFF} * I_P)$$

4.2.3 Surface Roughness(SR)

The mathematical relationship for correlating the Surface Roughness and the considered process variables is obtained as follows:

$$SR = 2.88516 + (5.88455E^{-003} * T_{ON}) + (0.072066 * T_{OFF}) + (0.099094 * I_P) + (6.09809E^{-006} * T^2_{ON}) - (3.22049E^{-003} * T^2) - (1.24687E^{-003} * I^2) - (5.93750E^{-004} * T_{OFF} * I_P)$$

S.NO	I_P (A)	T_{ON} (μs)	T_{OFF} (μs)
1	30	45	11
2	30	45	11
3	25	35	11
4	30	55	12
5	30	45	11
6	35	45	10
7	30	45	11
8	35	35	11
9	30	55	10
10	30	35	10
11	25	55	11
12	30	45	11
13	25	45	10
14	35	45	12
15	35	55	11
16	25	45	12
17	30	35	12

Table 4.2: Different parameter levels for analysis

S.NO	I_P (A)	T_{ON} (µs)	T_{OFF} (µs)	MRR (mm3/min)	EWR (mm3/min)	SR (µm)
1	30	45	11	13.40	2.084	7.86
2	30	45	11	13.39	2.083	7.85
3	25	35	11	13.50	2.38	6.92
4	30	55	12	13.56	2.83	7.94
5	30	45	11	13.36	2.08	7.86
6	35	45	10	13.25	1.56	8.76
7	30	45	11	13.39	2.08	7.86
8	35	35	11	13.36	1.51	8.73
9	30	55	10	13.37	2.15	7.90
10	30	35	10	13.19	1.91	7.77
11	25	55	11	13.67	2.59	7.05
12	30	45	11	13.40	2.08	7.86
13	25	45	10	13.52	2.38	6.97
14	35	45	12	13.62	1.68	8.81
15	35	55	11	13.52	1.74	8.85
16	25	45	12	13.64	2.56	6.99
17	30	35	12	13.45	2.05	7.81

Table 4.3: Output parameters

The SEM images for the holes has been recorded and analysed for its quality.

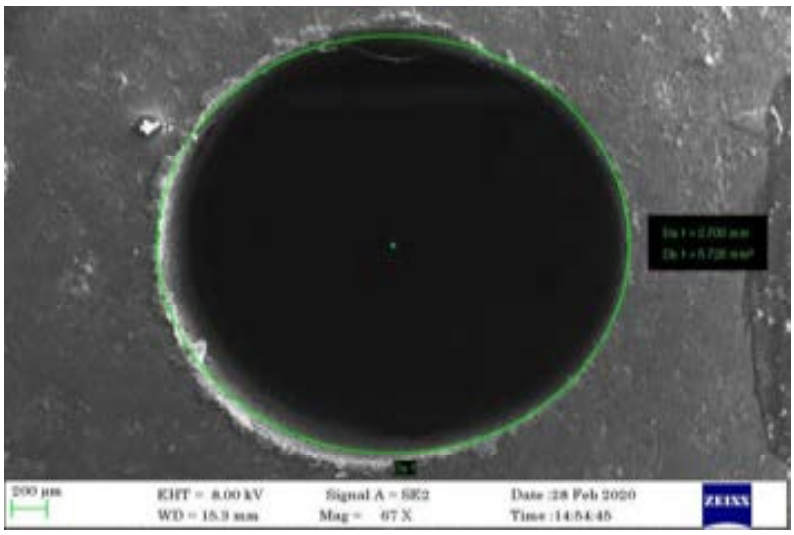

Figure 4.3.1: R1-01

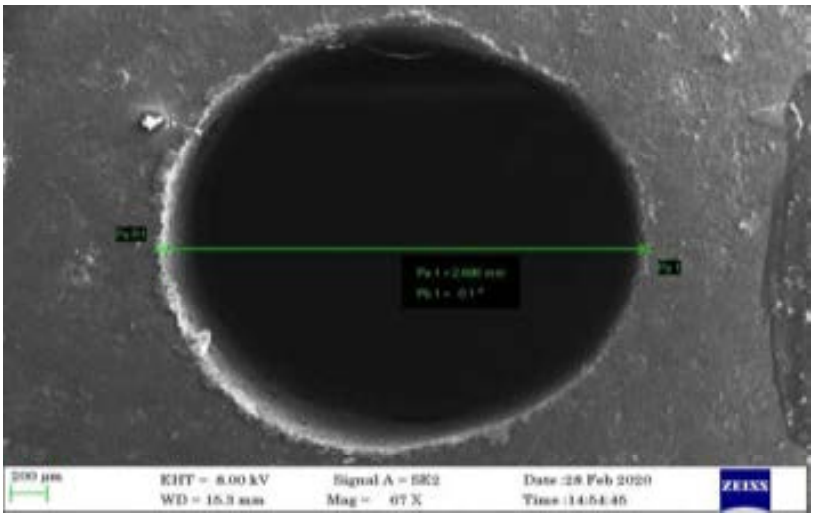

Figure 4.3.2: R1-02

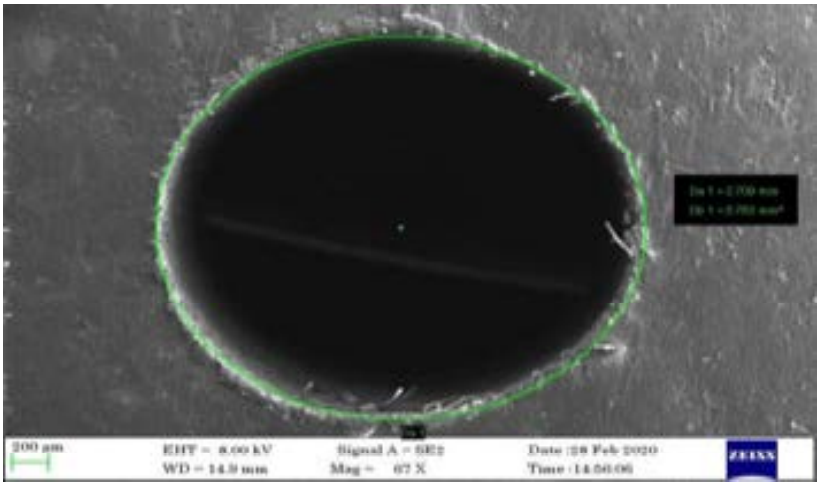

Figure 4.3.3: R2-01

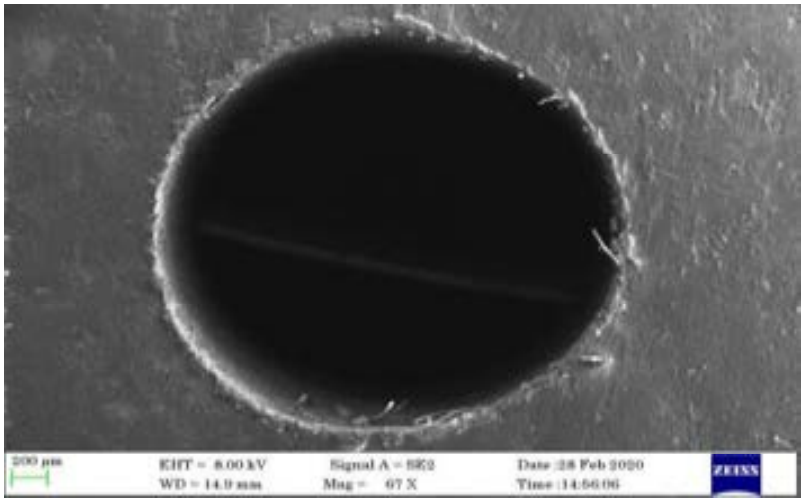

Figure 4.3.4: R2-02

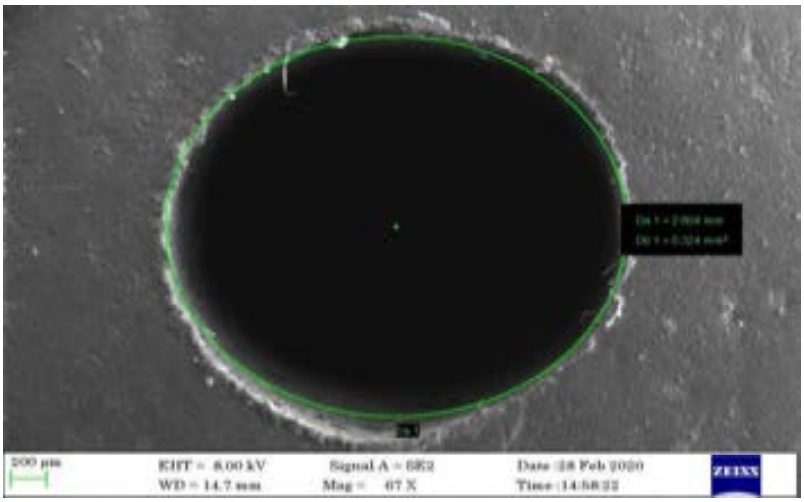

Figure 4.3.5: R3-01

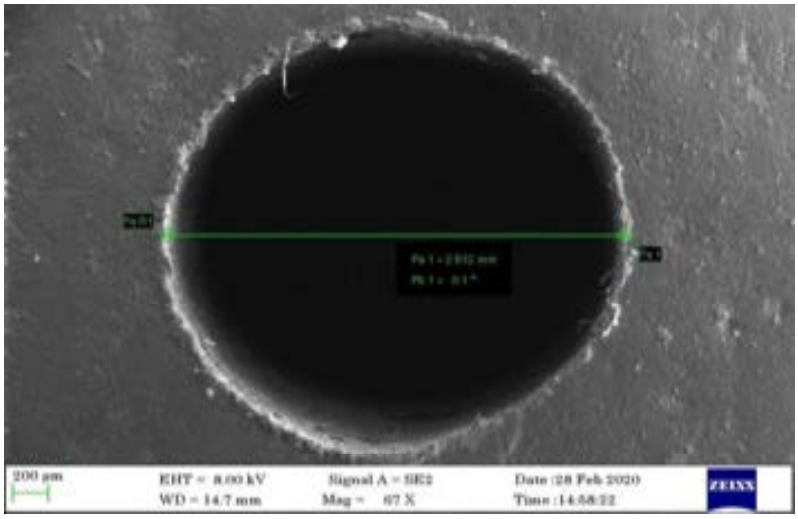

Figure 4.3.6: R3-02

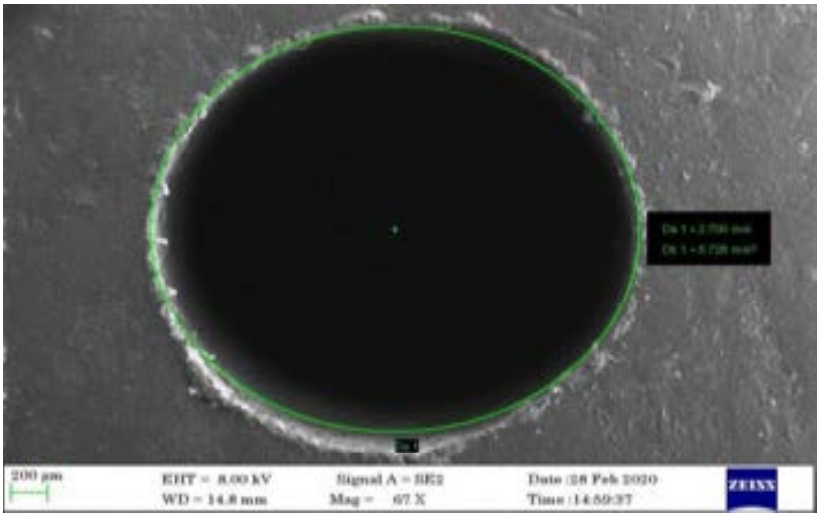

Figure 4.3.7: R4-01

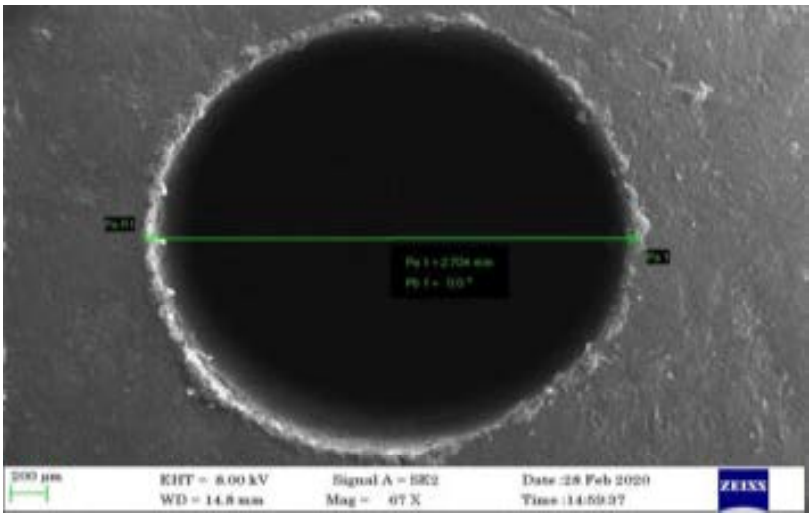

Figure 4.3.8: R4-02

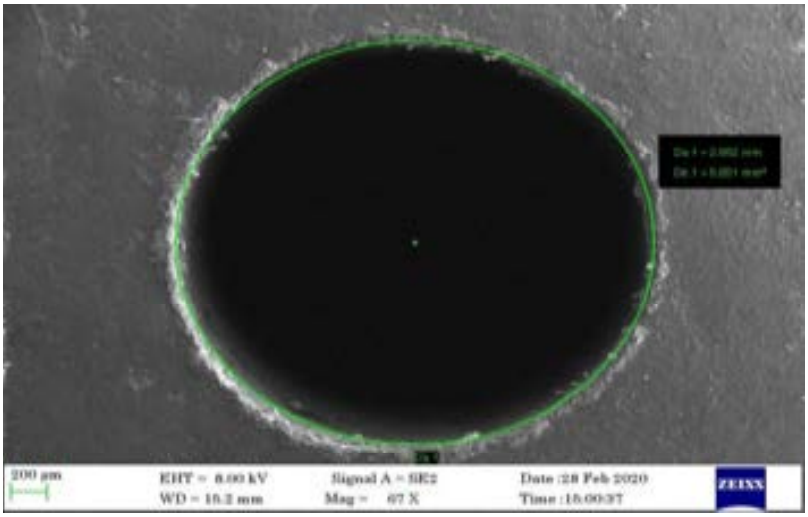

Figure 4.3.9: R5-01

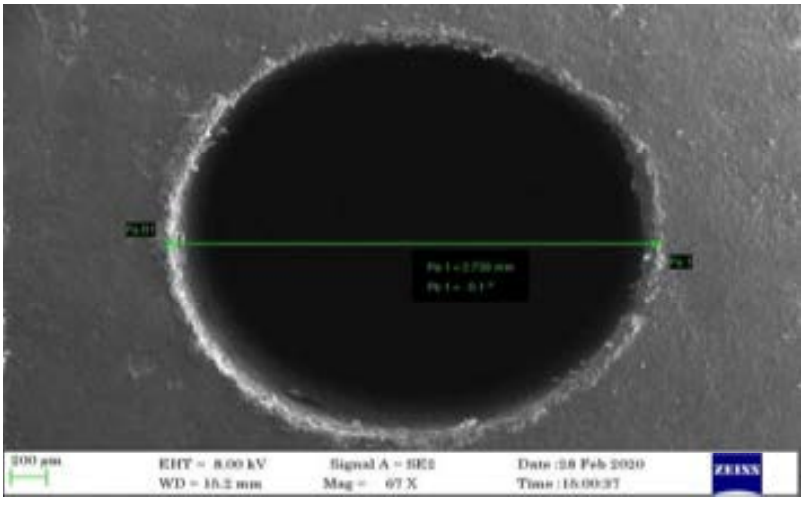

Figure 4.3.10: R5-02

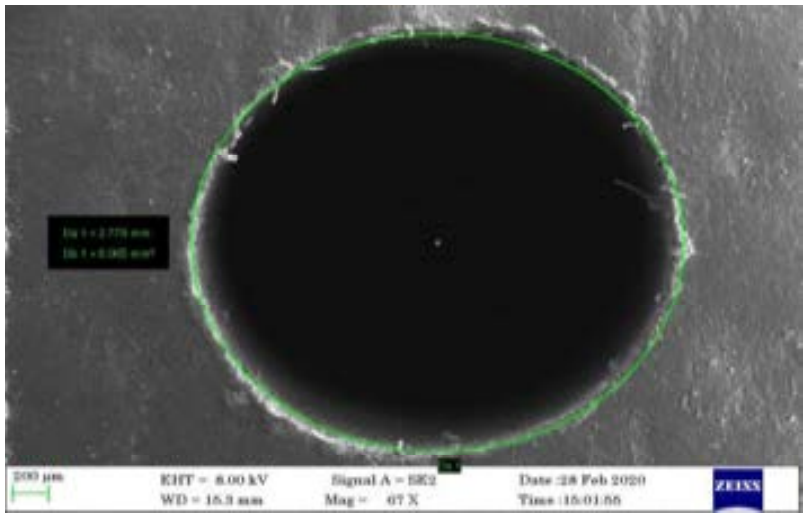

Figure 4.3.11: R6-01

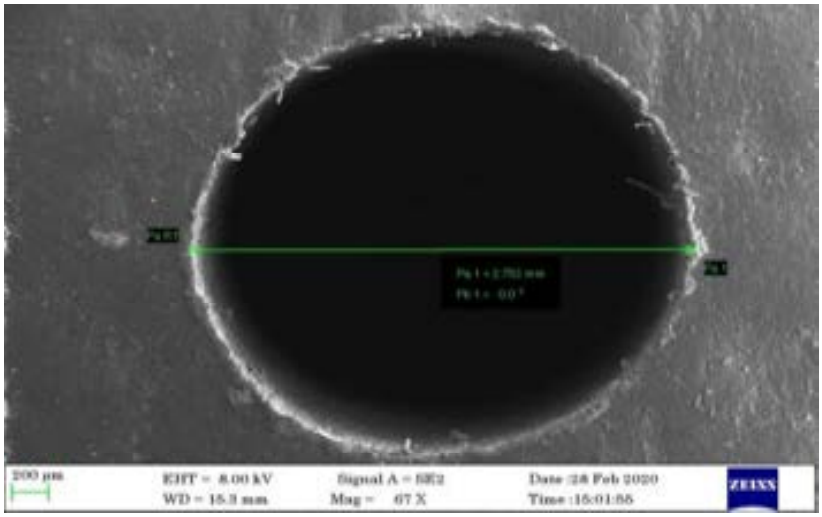

Figure 4.3.12: R6-02

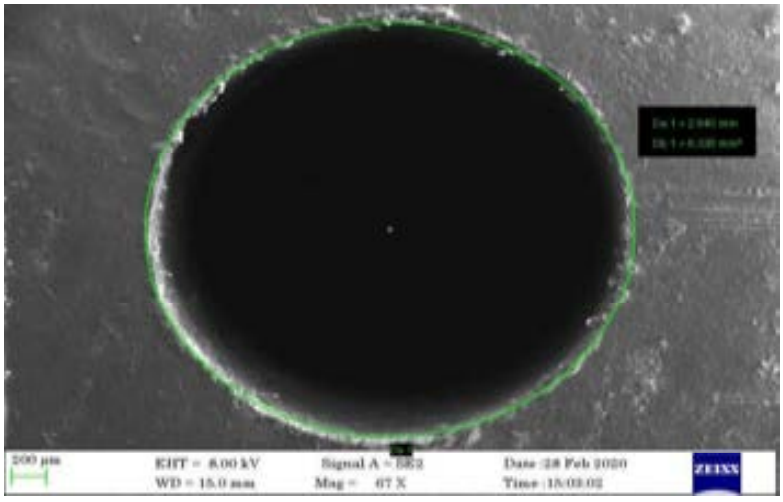

Figure 4.3.13: R7-01

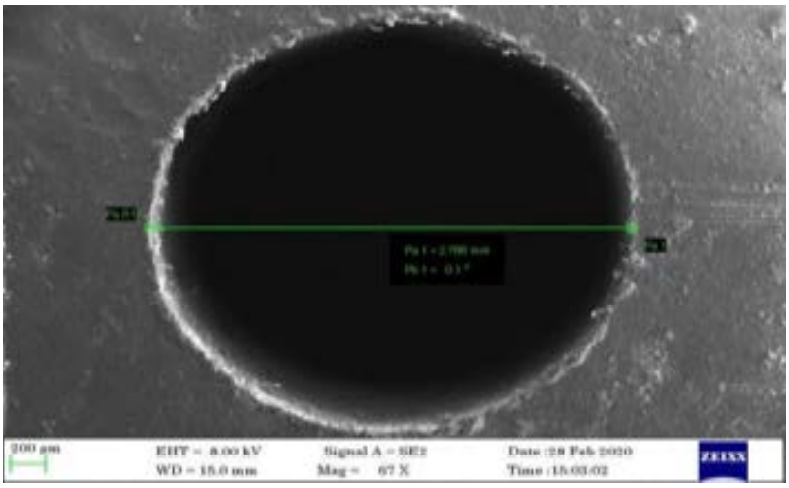

Figure 4.3.14: R7-02

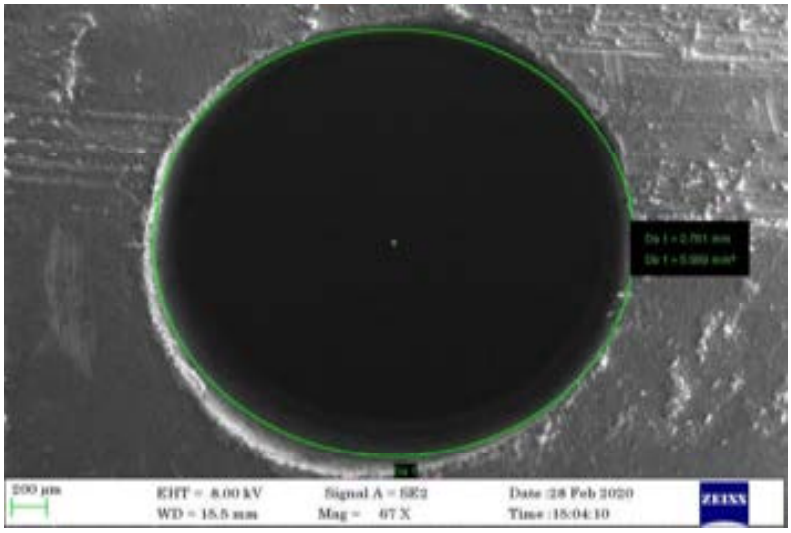

Figure 4.3.15: R8-01

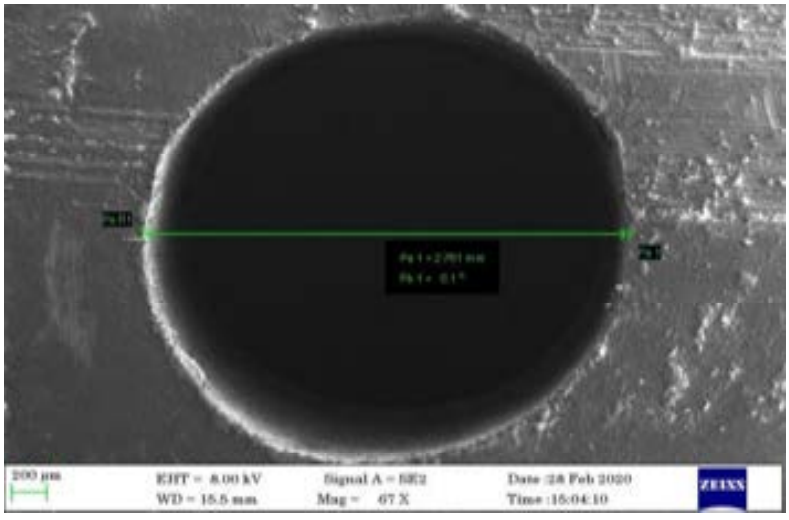

Figure 4.3.16: R8-02

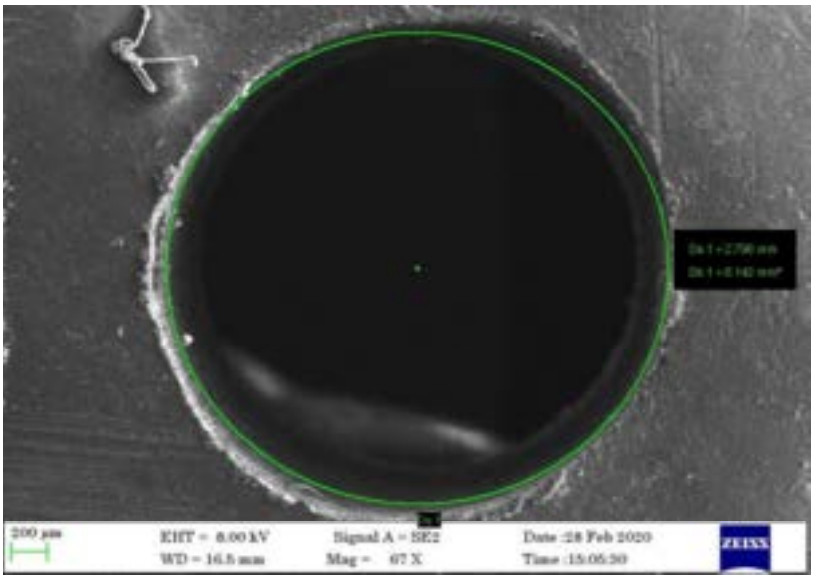

Figure 4.3.17: R9-01

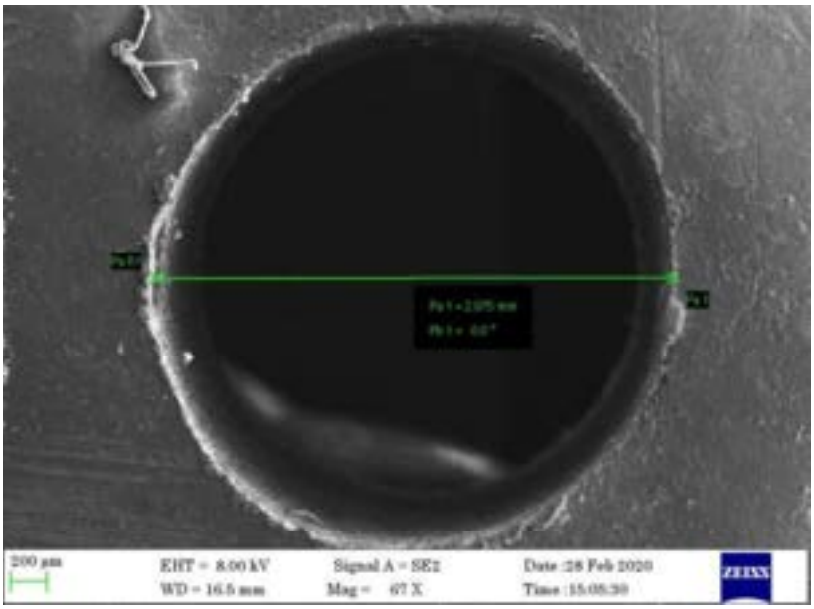

Figure 4.3.18: R9-02

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

The following conclusions can be obtained for the Al356 metal matrix composite reinforced with silicon carbide

- The material removal rate for the copper tool strongly depends on the current and then the pulse on time. Pulse off time has a relatively less influence on MRR.
- The surface roughness for copper tool depends more on the pulse on time and then the current. Similar to MRR the influence of pulse off time on SR is minimum compared to the other two input parameters.

The optimum input parameters for the machining of the composite using a copper tool by EDM process are

- Current – 35 amps
- Pulse on time – 45 μs
- Pulse off time – 10 μs

The machining characteristics for different set of experiments were analysed. The optimum parameters were identified with the help of Taguchi's *L*9 orthogonal and the optimum values were verified.

REFERENCES

1) Effects Of Electro-Discharge Machining On Aluminium Metal Matrix Composite .A. Mouangue N,Ahmad-Majdi Abdul-Rani,Faiz Ahmad,A. Zainuddinarticle In Journal Of Applied Sciences 11(9):1668-1672 · September 2011 With 98 Reads Doi: 10.3923/Jas.2011.1668.1672
2) Surface Quality Of Electro-Discharge Machined Aluminum Metal Matrix Composite Ahmad-Majdi Abdul-Rani, Alexis Mouangue Nanimina.Article In Journal Of Applied Sciences 12(23):2442-2447 · December 2012 With 14 Reads Doi: 10.3923/Jas.2012.2442.2447
3) Machining Of Metal Matrix Composites By Edm And Its Variants Bisaria, H. & Shandilya, P. Daaam International Scientific Book 2015 Pp. 267-282 Chapter 23
4) A Review Study On Electro Discharge Machining On Al-Sic Composites Vol 1, No 1 (2016),Pages: 35-43
5) EDM Studies On Aluminum Alloy-Silicon Carbide Composites Developed By Vortex Technique And Pressure Die Casting M. Kathiresan And T. Sornakumar.Journal Of Minerals & Materials Characterization & Engineering, Vol. 9, No.1, Pp.79-88, 2010 Jmmce.Org
6) Electric Discharge Machining Method For Various Metal Matrix Composite Materials Mumtaz Rizwee, Sumit Swapnil Minz, Md. Orooj, Md. Zahid Hassnain , Mohammad Junaid Khan International Journal Of Innovative Technology And Exploring Engineering (Ijitee) Issn: 2278-3075, Volume-8 Issue-9, July, 2019
7) Machining Of Aluminium Metal Matrix Composites B. Sudhakar , R.Vignesh , S.Sheik Asraf,International Journal Of Engineering Research And General Science Volume 6, Issue 1, January-February, 2018 Issn 2091-2730
8) Study Of Aluminium Metal Matrix Composites – Review
9) Balamurugan Adhithan1, Dhanusiya B International Journal Of Recent Trends In Engineering & Research (Ijrter) Volume 03, Issue 04; April - 2017 [Issn: 2455-1457]
10) Aluminium Metal Matrix Composites - A Review B. Vijaya Ramnath1, C. Elanchezhian1, Rm. Annamalai1, S.Aravind1, T. Sri Ananda Atreya1, V.

Vignesh1 And C.Subramanian Aluminium Metal Matrix Composites - A Review 55-60

11) Indumati Deshmanya And G.K. Purohit, "Effect Of Forging On Micro-Hardness Of Al7075 Based Al2o3 Composites Produced By Stir-Casting", Iosr Journal Of Engineering, Vol. 2 (2012), Pp. 020-031.
12) N. Altinkok, A. Demir, I. Ozsert, "Processing Of Al2o3/Sic Ceramic Cake Performs And Their Liquid Metal Infiltration, Composites Part A Applied Science And Manufacturing, 34 (2003) Pp 577-582.
13) G.G. Kang, Y.H. Seo, "The Influence Of Fabrication Parameters On The Deformation Behaviour Of The Perform Of Metal-Matrix Composites During The Squeeze-Casting Processes", Journal Of Materials Processing Technology, 61 (1996) Pp 241-249.
14) Asm Handbook Of Composites, Volume 21.
15) Boothroyd, G. "Non-Conventional Machining Processes." Fundamentals Of Machining And Machine Tools 491 (1989).

MECHANICAL AND MORPHOLOGICAL BEHAVIOUR OF S-GLASS REINFORCED POLYMER MATRIX COMPOSITES FOR DEFENCE APPLICATIONS

PROJECT WORK (PHASE II) REPORT

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In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

SEPTEMBER 2020

ABSTRACT

Fiber reinforced polymer matrix composites are considered as main alternate for the metallic materials due to its unique properties like cost economic nature, strength to weight ratio and lower density. Carbon fiber plays a dominant role in the aerospace, automobile, marine, sports goods, and other industrial and construction applications over the past few decades due to its high fatigue resistance, chemical resistance, modulus and thermal insulation. Even though carbon fiber has all superior properties over other traditional fiber its applications is limited in the defense industries due to its brittleness, high electrical conductivity, high cost and catastrophic failure over impact load.

Sandwich structured composites are a special class of composite materials which have become very popular due to high specific strength and bending stiffness. Low density of these materials makes them especially suitable for aeronautical, defense and marine applications. S-Glass fibers (ultimate in high strength glass fiber) were widely used in the defense applications. It offers ultimate physical properties including high tensile and compressive strength, high temperature resistance, and improved impact resistance. Similarly Carbon fibers plays vital role in the production of structural components of defense and aerospace industry.

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LIST OF SYMBOLS

SYMBOLS	EXPLANATION	UNITS
D	Depth (or) thickness of beam	mm
B	Width of test beam	Mm
F	Load at given point	N
L	Support spam	Mm
σf	Flexural stress	MPa
Ef	Flexural modulus of elasticity	MPa

CHAPTER 1

1. INTRODUCTION

The development of composite materials and related design and manufacturing technologies is one of the most important advancement in the history of materials. Composite materials are multi-functional materials having unprecedented mechanical and physical properties that can be tailored to meet the requirements of a particular application. Many composites also exhibit great resistance to high-temperature corrosion, oxidation and wear. These unique characteristics provide mechanical engineers with design opportunities which are not possible with conventional monolithic (unreinforced) materials. Composite technology also make the use of an entire class of solid materials possible in applications for which monolithic version are unsuited because of their great strength scatter, poor resistance to mechanical and thermal shock. Further, many manufacturing processes for composites are well adapted to the fabrication of large, complex structures, which allows consolidation of parts reducing manufacturing costs. The requirement is for enforcement towards development of new product. Composite materials were developed so that homogeneous structural materials could be found that had all the desired attributes for a given application. Brick-making process can still be seen on Egyptian tomb paintings in the Metropolitan Museum of Art. The most visible applications pave our roadways in the form of either steel or aggregate reinforced Portland cement or concrete. Those composites are closest to our personal hygiene from our shower stalls and bath tubs made of fiber glass. Solid surface, imitation granite and cultured marble sinks and counter tops are widely used to enhance our way of livelihood. Composites are made up of individual materials referred to as constituent materials. There are two categories of constituent materials in a composite: matrix and reinforcement.

1.1 OVERVIEW OF COMPOSITES

Now-a-days, the interest in composite materials is increasing rapidly both in terms of their research and applications. A composite material is composed of Reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymers, metals, or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. The newly combined materials hence exhibit better strength than each

individual material. Composites are combinations of two or more materials in which one of the materials is called the reinforcing phase which is in the form of fibers or particles embedded in the other material called the matrix phase. Usually epoxy or polyester resin systems are used for encapsulating a variety of electronic components because of their.

- High thermal stability
- Moisture resistance
- Low cost But unfortunately, they have
- High coefficient of thermal expansion
- Low thermal conductivity

1.2 DEFINITION OF COMPOSITE

A composite (or composite material) is defined as a material that consists of at least two constituents (distinct phases or combinations of phases) which are bonded together along the interface in the composite, each of which originates from a separate ingredient material which pre-exists the composite.

Composite refers to a material, as opposed to a structure or a component, as such a composite material is used for the fabrication of components of various shapes or functions, thus it should be distinguished from a wing or other structure made of several components bonded together and from an electronic device or packaging structure made of layered materials (although one of the materials in the packaging could be considered a composite).

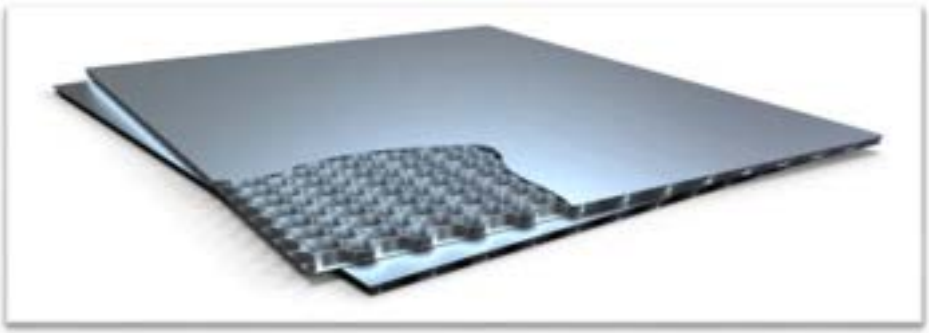


Fig No: 1.1 Composite materials

1.3 APPLICATIONS OF COMPOSITE MATERIALS

1.3.1 AEROSPACE

Major OEMs such as Airbus and Boeing have shown the potential for large-scale composite applications in aviation, and NASA is continually looking to composites manufacturers for innovative space solutions for rockets and other spacecraft.

Fig No:1.2 Aerospace

1.3.2 AUTOMOTIVE

As the largest composites market, the automotive industry is no stranger to composites. In addition to enabling groundbreaking vehicle designs, composites help make vehicles lighter and more fuel efficient.

Fig No:1.3 Automotive

1.3.3 MARINE

The marine industry uses composites to help make hulls lighter and more damage-resistant. Composites can be found in many more areas of a maritime vessel, including interior moldings and furniture on super yachts.

Fig No:1.4 Marine

1.3.4 PIPE&TANK

Fiber-reinforced polymer composite pipes are used for everything from sewer upgrades and wastewater projects to desalination, oil and gas applications. When corrosion becomes a problem with pipes made with traditional materials, FRP is a solution.

Fig No:1.5 Pipe & Tank

1.3.5 Sports & Recreation

From football helmets and hockey sticks to kayaks and bobsleds, carbon fiber and fiberglass composite materials help athletes reach their highest performance capabilities and provide durable, lightweight equipment.

Fig No:1.6 Sports & Recreation

1.4 Advantages of Composite materials

- Weight reduction is the single greatest advantage of composite material usage and is the key factor in using it in aircraft structure.
- Fiber-reinforced matrix systems are stronger than traditional aluminum found on most aircraft, and they provide a smooth surface and increase fuel efficiency, which is a huge benefit
- Also, composite materials don't corrode as easily as other types of structures.
- They don't crack from metal fatigue and they hold up well in structural flexing environments. Composite designs also last longer than aluminum, which means fewer maintenance and repair costs.
- Composites resist damage from weather and harsh chemicals that can eat away at other materials. That makes them good choices for applications that face constant exposure to salt water, toxic chemicals, temperature fluctuations and other severe conditions.

- Composites – fibers per pound, composites are stronger than other materials such as steel. The two primary components of and resins – contribute to their strength. Fibers carry the load, while resins distribute the weight throughout the composite part as required.
- Lower material costs – Because thermoset composites can be precisely molded, there is little waste and therefore significantly lower overall material costs than metals products.
- A higher performance for a given weight leads to fuel savings.

1.5 Disadvantages of composite materials

- Because of composite materials don't break easily, that makes it hard to tell if the interior structure has been damaged at all and this, of course, is the single most concerning disadvantage for using the composite material.
- In contrast, because of aluminum bends and dents easily, it is quite easy to detect structural damage. Additionally, repairs can be much more difficult when a composite surface is damaged, which ultimately becomes costly.
- Also, the resin used in composite material weakens at temperatures as low as 150 degrees, making it important for these aircraft to take extra precautions to avoid fires.
- Fires involved with composite materials can release toxic fumes and micro-particles into the air, causing health risks.
- Temperatures above 300 degrees can cause structural failure.
- Finally, composite materials can be expensive, although it can be argued that the high initial costs are typically offset by long-term cost savings.

1.6 TYPES OF COMPOSITE MATERIALS

Broadly, composite materials can be classified into three groups on the basis of matrix material use.

- Metal Matrix Composites (MMC)
- Ceramic Matrix Composites (CMC)
- Polymer Matrix Composites (PMC)

1.6.1 Metal Matrix Composites (MMC)

These composites consist of metal alloys reinforced with continuous fibers, whiskers (a version of short fibers that are in the form of single crystals), or particulates (fine particles, as distinct from fibers). They use metals as matrix materials and they have a higher temperature resistance than PMCs but in general are heavier.

Fig No:1.7 Metal Matrix Composite

a) Composition

MMCs are made by dispersing a reinforcing material into a metal matrix. The reinforcement surface can be coated to prevent a chemical reaction with the matrix. For example, carbon fibers are commonly used in aluminium matrix to synthesize composites showing low density and high strength.

b) Matrix

The matrix is the monolithic material into which the reinforcement is embedded, and is completely continuous. This means that there is a path through the matrix to any point in the material, unlike two materials sandwiched together. In structural applications, the matrix is usually a lighter metal such as aluminum, magnesium, or titanium, and provides a compliant support for the reinforcement

c) Reinforcement

The reinforcement material is embedded into a matrix. The reinforcement does not always serve a purely structural task (reinforcing the compound), but is also used to change physical properties such as wear resistance, friction coefficient, or thermal conductivity. The reinforcement can be either continuous or discontinuous. Discontinuous MMCs can be isotropic and can be worked with standard metalworking techniques, such as extrusion, forging, or rolling. In addition, they may be machined using conventional techniques, but commonly would need the use of polycrystalline diamond tooling (PCD).Continuous reinforcement uses monofilament wires or fibers such as carbon fiber or silicon carbide. Because the fibers are embedded into the matrix in a certain direction, the result is an anisotropic structure in which the alignment of the material affects its strength. One of the first MMCs used boron filament as reinforcement. Discontinuous reinforcement uses "whiskers", short fibers, or particles. The most common reinforcing materials in this category are alumina and silicon carbide.

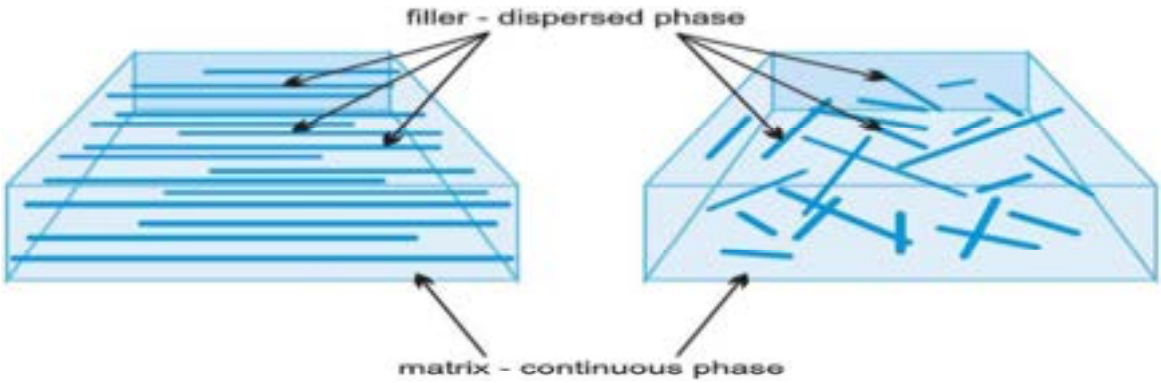


Fig No:1.8 Composition of MMC

d) TYPES OF METAL MATRIX COMPOSITE

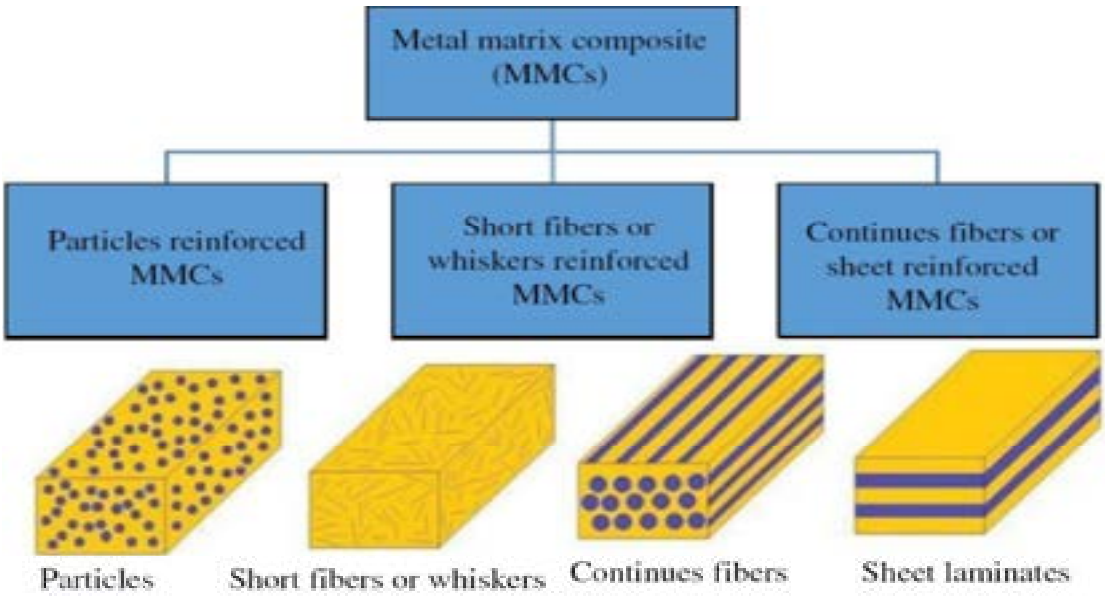


Fig No: 1.9 Types of Metal Matrix Composite

e) Manufacturing and forming methods

- Solid state methods
- Liquid state methods
- Semi-solid state methods

f) Applications

- Some tank armors may be made from metal matrix composites, probably steel reinforced with boron nitride
- Some automotive disc brakes use MMCs
- Aluminium - Graphite composites are used in power electronic modules because of their high thermal conductivity
- High performance tungsten carbide cutting tools are made from MMC.

g) Advantage

- Higher strength-to-density ratios.
- Higher stiffness-to-density ratios.
- Better fatigue resistance.
- Better elevated temperature properties. -- Higher strength. -- Lower creep rate.
- Lower coefficients of thermal expansion.
- Better wear resistance.
- High electric and thermal conductivity
- Better radiation resistance
- No moisture absorption

h) Disadvantage

- Higher cost of some material systems.
- Relatively immature technology.
- Iron and steel can rust, severely weakening the structure.
- Costly fabrication techniques
- Complex fabrication methods for fiber-reinforced systems (except for casting)

1.6.2 Ceramic Matrix Composites (CMC)

They consist of ceramic fibers embedded in a ceramic matrix. Both the matrix and the fibers can consist of any ceramic material, whereby carbon and carbon fibers can also be considered a ceramic material. Ceramic matrix composites (CMCs) have a ceramic matrix such as alumina calcium alumina silicate reinforced by fibers such as carbon/silicon carbide. However, ceramics by themselves have low fracture toughness. For producing ceramic matrix composites one of the main objectives is to increase the toughness of final Material.

Fig No:1.10 Disc Break

a) APPLICATIONS

- Thrust control flaps for military jet engines
- Components for fusion and fission reactors
- Friction systems for various applications
- Nuclear applications
- heat treatment, high temperature, soldering fixtures
- Components for slide bearings under heavy loads requiring high corrosion and wear resistance.
- Brake disks and brake system components, which experience extreme thermal shock
- Heat shield systems for space vehicles

b) ADVANTAGES

- Higher load-carrying capacity of the system
- As molded dimensional accuracy. Tight tolerance, repeatable moldings. ...
- Chemical Resistance.
- Consolidated Parts and Function.
- Corrosion Resistance.
- Design Flexibility.
- Durable.

c) DISADVANTAGES

- Dimensional tolerances difficult to control during processing.
- Weak in tension.
- Poor shock resistance.
- Can crack when hit with heavy items.

1.6.3 Polymer Matrix Composites (PMC)

Polymeric matrix composites are inexpensive, corrosion resistant and easy to form into complex shapes, and they have low densities. They are increasingly used in automotive, aerospace and many other commercial applications. In general the mechanical properties of polymers are inadequate for many structural purposes; particularly their strength and stiffness are low compared to metals and ceramics.

Fig No: 1.11 Polymer Matrix Composite

1.7 TYPES OF POLYMER COMPOSITES

Broadly, polymer composites can be classified into three categories on the basis of reinforcing material. They are given as;

- Fiber reinforced polymer (FRP)
- Particle reinforced polymer (PRP)
- Structural polymer composites(SPC)

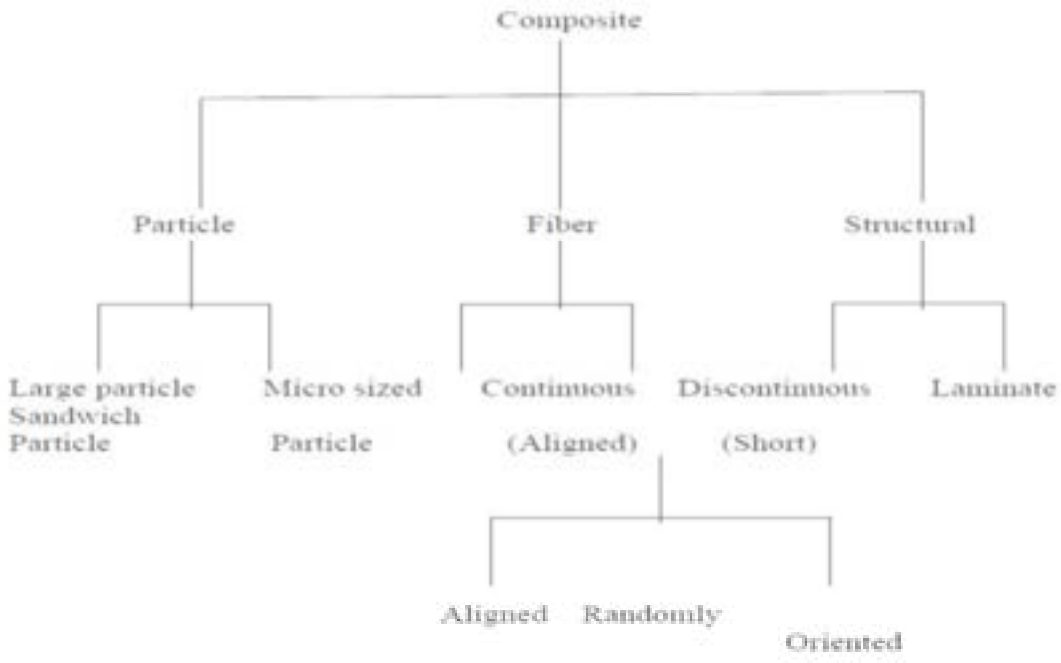


Fig.No:1.12 Classifications of composites based on reinforcement type

1.7.1 Fiber Reinforced Polymer (FRP)

Fiber reinforced composites contain reinforcements having length much greater than their cross-sectional dimensions. Such a composite is considered to be a discontinuous fiber or short fiber composite if its properties vary with fiber length. Fibers and matrix are the main constituents of common phase of fiber reinforced composites. Fibers are the main source of strength in composite. Main function of fibers is reinforcement and while matrix glues all the fibers together in shape and transfers stresses (load) between the reinforcing fibers.

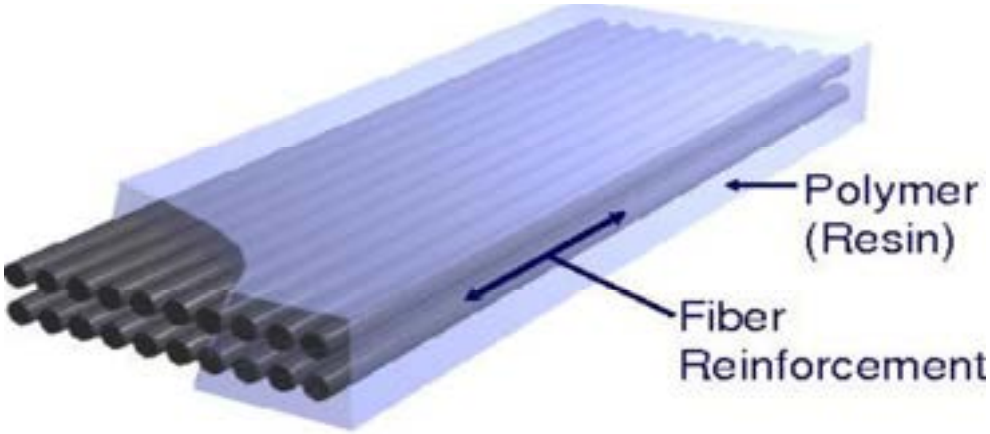


Fig No:1.13 Fiber Reinforced Polymer

1.7.2 Particle Reinforced Polymer

These are the cheapest and most widely used. They fall in two categories depending on the size of the particles.

- Large - particle composites, which act by restraining the movement of the matrix, if well bonded.
- Dispersion-strengthened composites, containing 10-100 μm particles. The Matrix bears the major portion of the applied load and the small particles hinder dislocation motion, limiting plastic deformation.

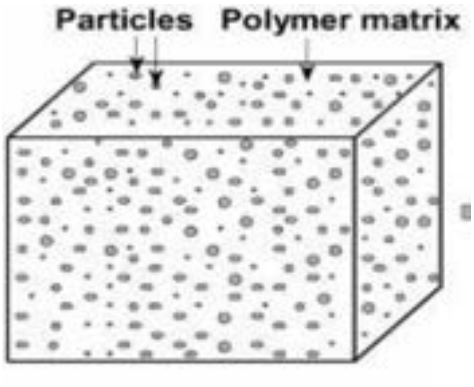


Fig No: 1.14 Particle Reinforced Polymer

1.7.3 Structural Polymer Composites

The laminar composites are composed of layers of materials held together by matrix. Sandwich structures also falls under this category. Previously, it has been found that polymers have replaced many of the conventional metals or materials in various applications. This has been possible due to the advantages of the polymers over conventional materials, ease of processing productivity and cost reduction are the most important advantages of using polymers in composite.

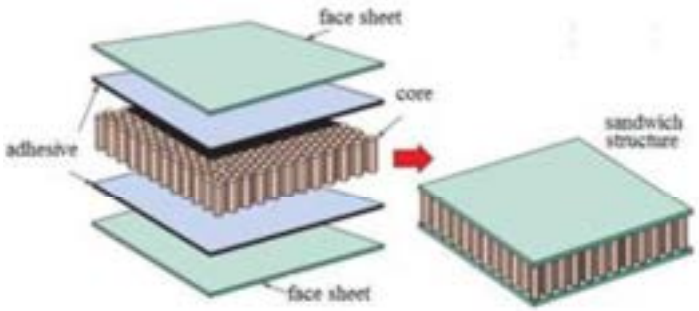


Fig No: 1.15 Structural polymer Composite

1.8 LAMINATE DEFINITION

A lamina (also called a ply or layer) is a single flat layer of unidirectional fibers or woven fibers arranged in a matrix form. A laminate is a stack of plies of composite material. Each layer can be laid at various orientations and can be made up of different material systems. The average properties of a composite ply are depending on the individual properties of the constituents. The properties are including stiffness, strength, moisture expansion and thermal coefficient.

1.9 FIBER REINFORCED POLYMER

Fiber is a natural or synthetic substance that is significantly longer than it is wide. Fibers are often used in the manufacture of other materials. The strongest engineering materials often incorporate fibers, for example carbon fiber and ultra-high-molecular-weight polyethylene. Synthetic fibers can often be produced very cheaply and in large amounts compared to natural fibers, but for clothing natural fibers can give some benefits, such as comfort, over their synthetic counterparts.

1.10 TYPES OF FIBER REINFORCED POLYMERS

There are many different types of fibers that can be used to reinforce polymer matrix composites. The most common are carbon fibers (AS4, IM7, etc.) and fiberglass (S-glass, E-glass, etc.). As with the matrix, the fiber chosen will be determined by the end application.

1.11 FIBER REINFORCED COMPOSITES IN INDUSTRY

1.11.1Automotive

The automotive industry has adopted composites slowly due to their higher costs. Particulate reinforced plastics have been used for some time but fiber reinforced composites have only really been used in high end sports cars but are starting to make their way into traditional vehicles. Race cars have used carbon fiber materials for many years. Fiber–reinforced composites are potentially is strong. So it has more possibilities for combining advanced materials with technologies that are already familiar from the processing of plastics. For automobile structural components it possess light weight opportunities at a weight of 50% lighter than conventional steel and 30% lighter than aluminum, more automakers use these materials as the body structure or other car components. With these advantages that coordinate directly with the automotive industry's needs, plastics and polymer composites can be a major part of the solution for automobile manufacturers.

1.11.2Aerospace

Carbon fiber composites are now quite common in commercial and military aviation. The Boeing 787 and Airbus A350 XWB have roughly 50% of their structure from composite materials. Carbon fiber materials are also common in helicopter systems, rocket motors, satellite systems, and turbine engines.

1.11.3Marine

Fiberglass has been the common material for recreational boats and yachts for many years. These are not traditional laminated composites, rather the glass fibers are oriented randomly giving the structure more uniform material properties. Being fairly cheap, glass fiber can be used in large structures; whereas carbon fiber would be too expensive.

1.11.4 Defense

In the defense sector, fiber-reinforced polymer composites (FRPs) are used in application such as land systems, military aircraft, UAVs, naval vessels, and weapons. The properties that make FRPs desirable for use in defense applications are:

- Lightweight – excellent for protective clothing and for vehicle components.
- Impact resistance – high strain/failure ratio. If the composite does fail on impact it will shatter and be less harmful to those in the surrounding area than metal.
- Can be coupled with other materials (e.g. metals and ceramics) to increase protection properties.
- Corrosion resistant – less "in field" maintenance required.
- Design for manufacture – e.g. full shapes can be designed and moulded as one piece, reducing the amount of parts needed and increasing production speed.
- Embedded functionality – monitoring systems can be integrated into the material.

1.12 CARBON FIBER

Carbon fibers are partially conductive, have an excellent combination of high modulus and high tensile strength, have a very low (slightly negative) CTE and offer good resistance to high temperatures and impact penetrations. Carbon fibers are frequently categorized using excellent tensile modulus. There are five categories of Carbon fibers generally used in composites; low modulus, standard modulus, intermediate modulus, high modulus and ultra-high modulus. The exact cut-off for these categories will vary depending on the reference consulted, but in general, low modulus fibers have a tensile modulus of less than 30Msi and ultra-high modulus fibers have tensile modulus greater than 75Msi. As a point of comparison, steel has a tensile modulus of 29Msi.

As the modulus increases, the fibers tend to get more brittle, more expensive and harder to handle. Further, the tensile strength of the fibers generally increases as the modulus increases from low to intermediate, but then tends to fall off in the high and ultra-high modulus fibers.

I.e. the tensile strength of Carbon fibers tends to be the greatest for the intermediate modulus fibers. For these reasons, standard and intermediate modulus fibers tend to give the best overall performance, unless the application is very stiffness oriented. This is illustrated even more clearly when fiber price and availability is also taken into consideration.

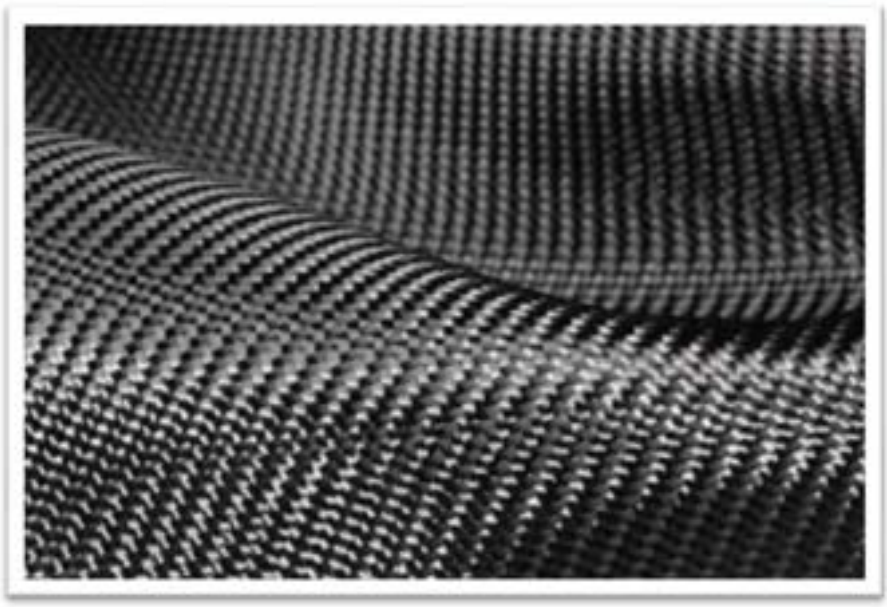


Fig.No:1.16 Carbon Fiber

1.12.1 CARBON FIBER PROPERTIES

- High Strength to weight ratio
- Rigidity
- Corrosion resistance
- Moderate Electrical Conductivity
- Fatigue Resistance
- Good tensile strength
- Extreme Fire Resistance/Not flammable
- High Thermal Conductivity in some forms
- Low coefficient of thermal expansion
- Non poisonous
- Biologically inert
- X-Ray and Radar Permeable
- Self-Lubricating

- Excellent EMI (Electromagnetic Interference) Shielding Property
- Relatively Expensive
- Requires specialized experience and equipment to use
- High Resistance to Impact loads.

1.12.2 Carbon Fiber Has High Strength To Weight Ratio

Strength of a material is the force per unit area at failure, divided by its density. Any material that is strong AND light has a favorable Strength/Weight ratio. Materials such as Aluminium, titanium, magnesium, Kevlar and glass fiber, high strength steel alloys all have good strength to weight ratios. It is not surprising that Balsa wood comes in with a high strength to weight ratio. The following figures are offered for comparison only and will vary depending on composition, alloy, type of spider, density of wood etc. The units are kN.m/kg.

- Spectra fiber - 3619
- Kevlar - 2514
- Carbon Fiber - 2457
- Glass Fiber - 1307
- Carbon Epoxy Composite – 785

1.12.3 Carbon Fiber is very rigid

Rigidity or stiffness of a material is measured by its Young Modulus and measures how much a material deflects under stress. Carbon fiber reinforced plastic is over 4 times stiffer than Glass reinforced plastic, almost 20 times more than pine, 2.5 times greater than aluminium.

1.12.4 Light in Weight and Strong

Carbon Fiber Reinforced Plastics (CFRP) is superior to steel or glass fiber reinforced plastics (GFRP) in its specific tensile strength and specific elastic modulus (specific rigidity). That is to say, CFRP is "Light in Weight and Strong" in its mechanical performances.

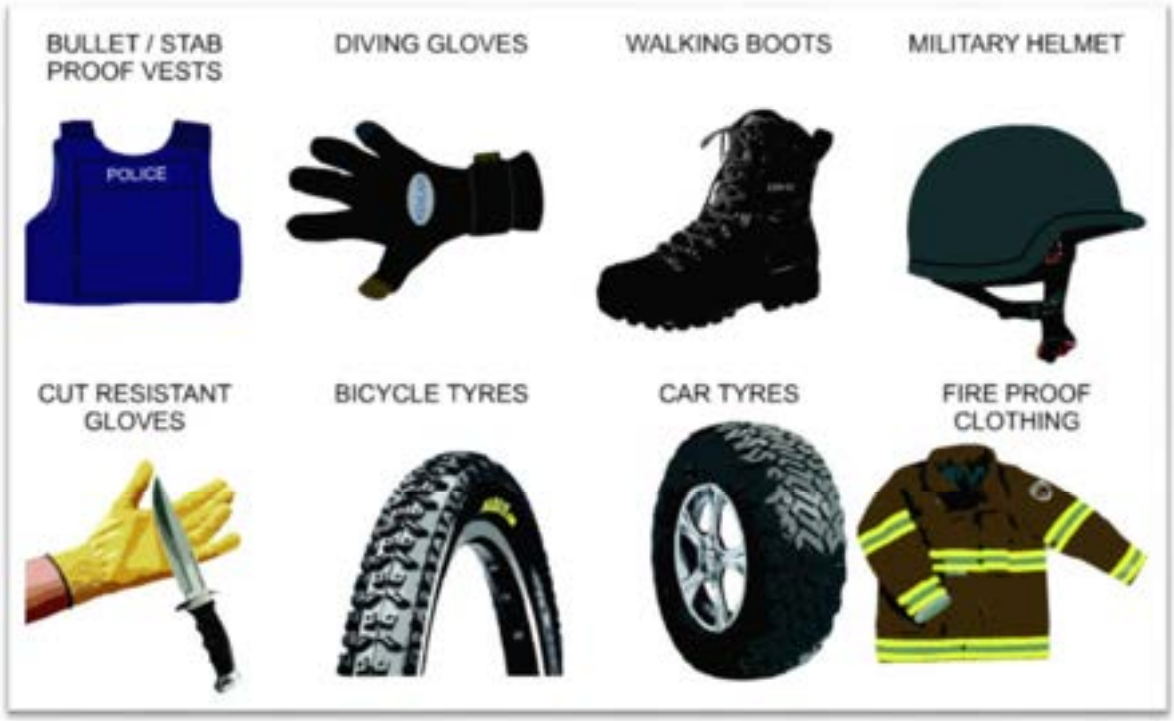


Fig.No:1.17Applications of Carbon Fiber

1.12.5 ADVANTAGES OF CARBON FIBER

- High stiffness and strength.
- Lightweight.
- Corrosion resistance.
- X-ray transparency.
- Low CTE (Coefficient of Thermal Expansion)
- Chemical resistivity.
- Thermal and electrical conductivity.

1.12.6 DISADVANTAGES OF CARBON FIBER

- High cost
- Time consuming manufacture
- If carbon fiber cracked we can't fix easily
- Carbon fiber is not easy recyclable

1.13 S-GLASS FIBER

Glassmakers throughout history have experimented with glass fibers, but Mass manufacture of glass fiber was only made possible with the invention of finer machine tooling. In 1893, Edward Drummond Libby exhibited a dress at the World & Columbian Exposition incorporating glass fibers with the diameter and texture of silk fibers. This was first worn by the popular stage actress of the time Georgia Cay Van. Glass fibers can also occur naturally, as Pele & hair.

Glass wool, which is one product called fiberglass & today, was invented in 1932–1933 by Russell Games Slayter of Owens-Corning, as a material to be used as thermal building insulation. It is marketed under the trade name Fiberglas, which has become a generalized trademark. Glass fiber when used as a thermal insulating material is specially manufactured with a bonding agent to trap many small air cells, resulting in the characteristically air-filled low-density glass wool family of products.

1.13.1 Composition Of S-Glass Fiber

They are alumina-borosilicate glass with less than 1% w/w alkali oxides, mainly used for glass-reinforced plastics.

1.13.2 Glass Fiber Properties

The high performance and unique production of the numerous structural fibers composite material and forms now available to designers are proof of their many advantages

- Improved torsional stiffness.
- Improved weather ability.
- High dimensional stability.
- Improvement in the wear and friction properties.
- Improved or reduced thermal conductivity.
- Reduced material wastes.
- High corrosion resistance.
- Excellent impact and damage tolerance properties.

1.13.3 APPLICATIONS

- Fiberglass grating is greatly used for rust resistance.
- It is used in many areas like bottling lines.
- Fiberglass is used to manufacture parts for both military and civilian aerospace industry.
- Fiberglass is extensively used in automobile industries like body kits.

CHAPTER 2
LITERATURE REVIEW

L.J. Desk, S.D. Bartus, U.K. Vidaya. "Multi-site impact response of S2-glass / epoxy composite laminates", composite science and technology, vol-69.

S-glass fibres are widely used in defence applications due to its ultimate physical properties including high tensile, compressive strengths, high temperature resistance, and improved impact resistance. This paper discusses thetensile and low velocity impact behaviour of Carbon/S-Glass reinforced polymer matrix hybrid compositelaminatesfabricated via compression moulding process.Compression or open moulding is one of the commercial polymer composite fabrication method which is well known for its low cost and ease of accessibility. As per the ASTM standard, the tensile and impact tests were carried out, in order to evaluate the influencing parameters on the mechanical behaviour of composite laminates.

M. S. Santhosh, G. Karthikeyan, R. Sasikumar et al., Mechanical and morphological behaviour of rice husk/prosopis juliflora rein-forced bio composites,

Materials Natural fiber composites with discrete filler reinforcements are extensively used over various monetary and engineering applications due to its colossal availability, and offhand processing methods. Over a few decades researchers worldwide directing on biodegradable and environmentally friendly natural fiber composites for various engineering applications. One such fiber prosopis juliflora (PJ), universally available around arid, semi-arid and Asian countries. All parts of the tree species have a wide range of usage . Results reveal that the inclusion of rice husk significantly improves the mechanical behaviour of PREHC up to 45% than unfilled Prosopis Juliflora/Epoxy composites (PJEC).

Andy Vanderklok , Andy Stamm , Jmaes Dorer , Hu Eryi , Matthew Auvenshine, J. Michael Pereia, Xinran Xiao . "An experimental investigation into the high velocity impact responses of S2-glass/SC15 epoxy composite panels with a gas gun", international journal of impact engine eering,

The single-stage gas gun testing methodology was investigated. A thermodynamics based method was used to estimate the required pressures for a targeted velocity. The transmitted impact force was measured with four load cells installed behind the testing frame. The out-of-plane deformation was measured with a projection grating profilometry method using a high speed camera. The velocity of the projectile was determined from the high speed video footage. The improved gas gun experiment was used to investigate the high velocity impact behavior of a S2-glass/SC15 epoxy composite. The ballistic limit was found to be 338 m/s and 406 m/s for the 6-ply and 10-ply composite panels, respectively. It was observed that the failure modes of the composite panels evolved with the impact velocity.

J.R. Xiao , B.A. Gama , J.W. Gillespie Jr. "Progressive damage and delamination in plain weave S-2 glass/SC-15 composites under quasi-static punch-shear loading",

composite structurs Quasi-static punch-shear tests are carried out on plain weave (PW) S-2 glass/SC-15 epoxy composite laminates with a right circular cylinder punch. Load–unload tests are performed to identify the sequence and extent of damage and the corresponding displacements at which they occur for a wide range of laminate thicknesses. Two different support spans of 25.4 mm (1 in.) and 101.6 mm (4 in.) diameter with different layers (1, 2, 4, 6, 11, and 22 with 0.6 mm ply thickness) of composite laminates are tested under quasi-static loading to identify compression-shear and tension-shear dominated modes of damage. Numerical punch-shear experiments are conducted using LS-DYNA 970. The numerical modeling is carried out using a newly developed composite damage model, namely MAT 162, which has been incorporated into LS-DYNA. MAT 162 uses damage mechanics principle for progressive damage and material degradation. Input data required in MAT 162 have been calibrated to match the experimental results of 22-layer composite plate of both spans (25.4 and 101.6 mm).

N. Maniselvam, M.S. Santhosh et al. "Study of Corrosion Behaviour of Carbon Fiber Reinforced Plastics (CFRPs)", Materials Science Forum,

This paper is intended to find the corrosion behavior of carbon fiber reinforced Plastics (CFRPs). Some of the corrosion parameters such as 3.5% of NaCl, current density and voltage were taken into consideration. They were examined by potentiostatic polarization and scanning electron microscopy to find the corrosion rate of the CFRPs. The experiments were done by applying different voltages to the CFRPs and the corresponding current obtained will denote the corrosion rate. Based on the corrosion rates observed, the better combination can be selected in order to eliminate corrosion.

M.V. Hosur, U.K. Vaidya, D. Myers, S. Jeelani. "Studies on the repair of ballistic impact damaged S2-glass/vinyl ester laminates", composite structures,

In the current study, repair strategies for thick section woven S2-glass/vinyl ester composites subjected to ballistic impact loading are investigated. Several alternative approaches are outlined for repairing S2-glass/vinyl ester composites damaged by ballistic impact loading. Thick section laminates were subjected to ballistic impact loading using a gas-gun impact facility. The damaged laminates were subjected to repair. Various steps involved in the repair include: evaluation of extent of damage through NDE, removal of damaged material, preparation of surface for repair, repair through alternative approaches like patching with dry fabric followed by resin infusion, fiber filled resin infiltration, use of stiff lamina patch

Diptikanta Das, Om Prakash Dubey, Milind Sharma a, Ramesh Kumar Nayak, Chandrika Samal," Mechanical properties and abrasion behaviour of glass fiber reinforced polymer composites – A case study", materials today proceedings

Glass fiber reinforced polymer matrix composites have enticed the researchers since last few decades, due to their excellent mechanical properties and wear resistance behaviour. In this paper woven roving E-glass fiber reinforced epoxy resin composite was prepared by hand lay-

up method, followed by curing at 140 °C for 6 h. Density, porosity and different mechanical properties, such as hardness, tensile strength and impact strength were evaluated experimentally, and the test results were compared and validated with the experimental results of open literature. Three-body dry abrasion behaviour of the composite sample was also investigated.

Devi, G. R., & Palanikumar, K. (2018). Analysis on drilling of woven glass fibre reinforced aluminium sandwich laminates. Journal of Materials Research and Technology.

Fibre metal laminates being used in aerospace industries becomes primary composite material under research, since its application finds on the outer covering of the fuselage skin structure, the holes are need to be drilled on it, to assemble it. The effective way of getting good quality hole is to minimize the responses thrust force and torque engendered during the drilling operation. It is achieved through proper choosing of suitable process parameters. The main parameters that have a high impact on the response is feed rate and drill diameter. This paper mainly deals with optimizing the parameters that alter the response in drilling fibre metal sandwich laminate by solid carbide drill bit.

Santiago, R. C., Cantwell, W. J., Jones, N., & Alves, M. (2018). The modelling of impact loading on thermoplastic fibre-metal laminates. Composite Structures,

A finite element model of the thermoplastic fibre metal laminate (TFML) has been developed using the LS-Dyna software package, with input from data collected following mechanical tests conducted over a wide range of strain-rates. Plates having different stacking sequences were modelled numerically under both low and high velocity impact loading, where the effect of varying stacking sequence and the thickness of the constituent material were investigated. An improved TFML configuration is proposed which, when impact energy absorption is considered, should outperform both commercial FMLs as well as monolithic aluminium alloys.

Gonzalez-Canche, N. G., Flores-Johnson, & E. A., Carrillo, J. G. (2017)." Mechanical characterization of fiber metal laminate based on aramid fiber reinforced polypropylene". Composite Structures,

In this paper, the tensile properties of fiber-metal laminates (FMLs) made of a low-ductility aluminum alloy and aramid fabric/polypropylene matrix composite are evaluated. The tensile testing results show that the FMLs exhibit a more ductile behavior than that of their constituents, indicated by the increased strain to failure. The excellent adhesion between FML constituents, as confirmed by single lap joint shear test and optical microscopy, enabled a more globalized plastic deformation in the aluminum sheet of the FML leading to an increase of strain to failure, which offers an advantage in engineering structural applications where large deformations are present and strain to failure is more important than strength.

Aghamohammad, H., Abbandanak, N. H., Eslami-Farsani, R., & Siadati, S. M. H. (2018). "Effects of various aluminum surface treatments on the basalt fiber metal laminates interlinear adhesion". International Journal of Adhesion and Adhesives,

Fiber metal laminates (FMLs) are a new class of advanced materials consisting of metal and fiber reinforced polymer layers. Surface treatment of the metal layers can have significant effects on the interlaminar properties and thus the overall properties of FMLs. The aim of this study was to apply four different surface treatment methods on the aluminum layers and investigate their effects on the flexural behavior of a FML made up of Al2024, basalt fibers and epoxy Epon 828. To study the surface morphologies and fracture surface of samples, scanning electron microscopy (SEM), optical microscopy (OM) and profilometry were utilized. Results of the four methods applied, showed that the mechanical abrasion and alkaline etching treatments were not found suitable for enhancing the flexural properties due to weak interfacial adhesive bonding. OM images revealed that the adhesive failure was the failure type of mechanical abrasion and alkaline treated samples.

Sandeep P. Patil , Parag Shendye, Bernd Markert , "Mechanical properties and behaviour of glass fiber-reinforced silica aerogel Nano composites: Insights from all-atom simulations", scripta materials

The primary goal of this work is to understand the influence of the amount and dimensions of glass fibers in silica aerogel matrix on the mechanical properties using molecular dynamics (MD) simulations. By adding the glass fibers, the tensile strength, elastic modulus and compressive behavior of silica aerogel were significantly improved due to the resistance offered to bending and axial deformation of the fibers. Moreover, this work proposes a linear relationship between the elastic modulus and density of nanocomposites for particular fiber dimensions. The extraordinary mechanical performance of the proposed nanocomposites has a broad spectrum of mechanical-loading applications.

L. Prabhu , V. Krishnaraj , S. Sathish , S. GokulKumar , N. Karthi, "Study of mechanical and morphological properties of jute-tea leaf fiber reinforced hybrid composites: Effect of glass fiber hybridization" ,materials today Proceedings ,

Fiber reinforced plastic composites replace wood and metals due to their light weight, high strength to weight ratio, non corrosive nature and stiffness. Bio based fibers are used in place of petroleum based fibers because of environmental concerns. Natural fibers exhibit low specific strength and light density, processing and recycling are simple. New materials are being developed ang grow every day. The high strength , light weight and biodegradability of natural fiber composites such as sisal, jute, kenaf, snake grass and banana fiber has made polymer composites were more attractive. The fiber is subjected to chemical pretreatments using alkali treatment (mercerization). This research has created composites of glass-jute-tea leaf fiber reinforced polymers and assessed their mechanical characteristics such as tensile, flexural and impact test.

Santhosh M.S, Sasikumar R. "Influences of Aluminium / E-Glass Volume Fraction on Flexural and Impact Behaviour of GLARE Hybrid Composites", Journal of Engineering Sciences,

Composites with different configuration of fiber (E-Glass) and metal (Aluminium) laminates were fabricated and tested for grasping optimum hybrid structure. GLARE (Glass laminate aluminium reinforced epoxy) is a unique composite recently being used by wide engineering domains like defense body and vehicle armors, aerospace, marine and structural applications. The GLARE hybrid composites are manufactured by adding very thin layer of aluminium sheets (surface treated) on the surface of unidirectional E-Glass fiber fabrics in presence of epoxy polymer. Firstly three hybrid GLARE laminates were fabricated with different volume fractions. Consequently, impact and flexural behaviors are measured by izod, charpy impact and flexural tests for all volume configurations.

Golshahr, A., Natarajan, E., Santhosh, M. S., Sasikumar, R., Ramesh, S., &Durairaj, R. (2018). "Multiwall Carbon Nanotube Reinforced Silicone for Aerospace Applications". International Journal of Mechanical and Production Engineering Research and Development,

Product design firstly requires the clear understanding of the requirement of the product. Strength and cost of the material are predominantly considered during the design. The strength of any material can be increased by incorporating fillers of the requirement. The percentage of filler, adhesion of filler with the material matrix, processing method is some parameters deciding the mechanical properties of the resultant composite. This research is focused on increasing the mechanical properties of Silicone elastomer by loading of 5wt% of multi-wall carbon nanotubes (MWCNTs) as fillers. The Silicone/MWCNT composite was masticated in two roll milling followed by compression molding. The tensile properties were measured through experiments as per ASTM D412 standard. The tensile strength, modulus and elongation at break of the filled nanocomposite are 7.21 MPa, 1.673 MPa and 235 mm. The compression strength of the filled composite was observed as 18.6 MPa at 83.3% of the compression. The shore hardness of the filled composite was increased from 40 to 64.

M.S. Santhosh, T. Thangavel, R. Sasikumar. "Mechanical Behaviour of Aluminium Powder Modified Carbon/Basalt Reinforced Vinyl Ester Composites", IOSR Journal of Polymer and Textile Engineering.

Polymer matrix composites (PMCs) deserves a significant role in the new age engineering materials due to its unique properties like formability, room temperature processing, and economic nature. Main aspire of this proposed work is to investigate mechanical behaviour (flexural and tensile) of unfilled and 5, 10 Wt. % aluminium powder filled carbon/basalt hybrid composites produced via open mould followed by a compression process. Void fraction and densities intensified reasonably by the annexation of Al powder while the tensile strength shows a steady decrease. Carbon/basalt with 5 wt. % Al possess better properties whereas 10 wt. % Al reinforcement shows better tensile modulus.

Crupi. V., Kara .E., Epasto,G., guglielmino, E., & Aykul, H (2014). "prediction model for the impact response of glass fiber reinforced aluminium foam sandwiches.International journal of Impact Engineering.

The use of sandwich structures combines low weight with high energy absorbing capacity, so they are suitable for applications in the transport industry (automotive, aerospace, shipbuilding industry), where the "lightweight design" philosophy and the safety of vehicles are very important aspects. The goal of this paper was the analysis of the bending and the low - velocity impact response of aluminium foam sandwiches reinforced by the outer skins made of glass fibre reinforced epoxy matrix. The results were compared with those obtained for aluminium foam sandwiches without glass fibre skins. An analytical model for the peak load prediction under low velocity impact was developed and the predicted values are in good agreement with the experimental measurements. The impact response of the sandwiches was investigated using a theoretical approach, based on the energy balance model and the model p.

Kumar, S., Shivashankar, G. S., Dhotey, K., & Singh, J. (2017). "Experimental study wear rate of glass fiber reinforced epoxy polymer composites filled with aluminium powder". Materials Today,

In this work an attempt has been made to analyze experimentally the wear rate of polymer composite made up of glass fiber reinforced epoxy resin filled with aluminium powder. The wear behavior of the materials was described by experimentally obtaining the friction coefficients along with wear rates by using a pin-on-flat test apparatus for tribological applications. Firstly, the effects of operating variables such as load, speed were observed. The wear rate increased linearly as the load increased by keeping the speed constant and also the wear rate increased as the speed increased by keeping the load constant. Secondly, by the observations of the worn surfaces recorded by using microscope, basic wear mechanisms were observed and recorded as a function of fiber orientation.

Mariam, M., Afendi, M., Majid, M. S. A., Ridzuan, M. J. M., & Gibson, A. G. (2017). "Tensile and fatigue properties of single lap joints of aluminium alloy/glass fiber reinforced composites fabricated with different joining methods". Composite Structures,

The tensile and fatigue properties of single similar and dissimilar lap joints of aluminium alloy(AA7075) and glass fibre reinforced epoxy (GRE) composite were investigated. Three joining methods were employed: mechanically fastened Huck bolted joints, Araldite epoxy adhesive bonded joints and hybrid joints comprising adhesive and Huck bolts. Tensile-shear fatigue tests were performed using single lap joint specimens at the stress ratio R = 0.1 to determine the fatigue behaviour of the joints. Subsequently, S–N curves were drawn for different levels of stress amplitude (30%, 40%, 50%, 60%, 70%, 80% and 90%). The microstructures of the fractured surfaces were examined by field emission scanning electron microscopy.

Sarkar, P., Modak, N., & Sahoo, P. (2018). "Mechanical and Tribological Characteristics of Aluminium Powder filled Glass Epoxy Composites". Materials Today,

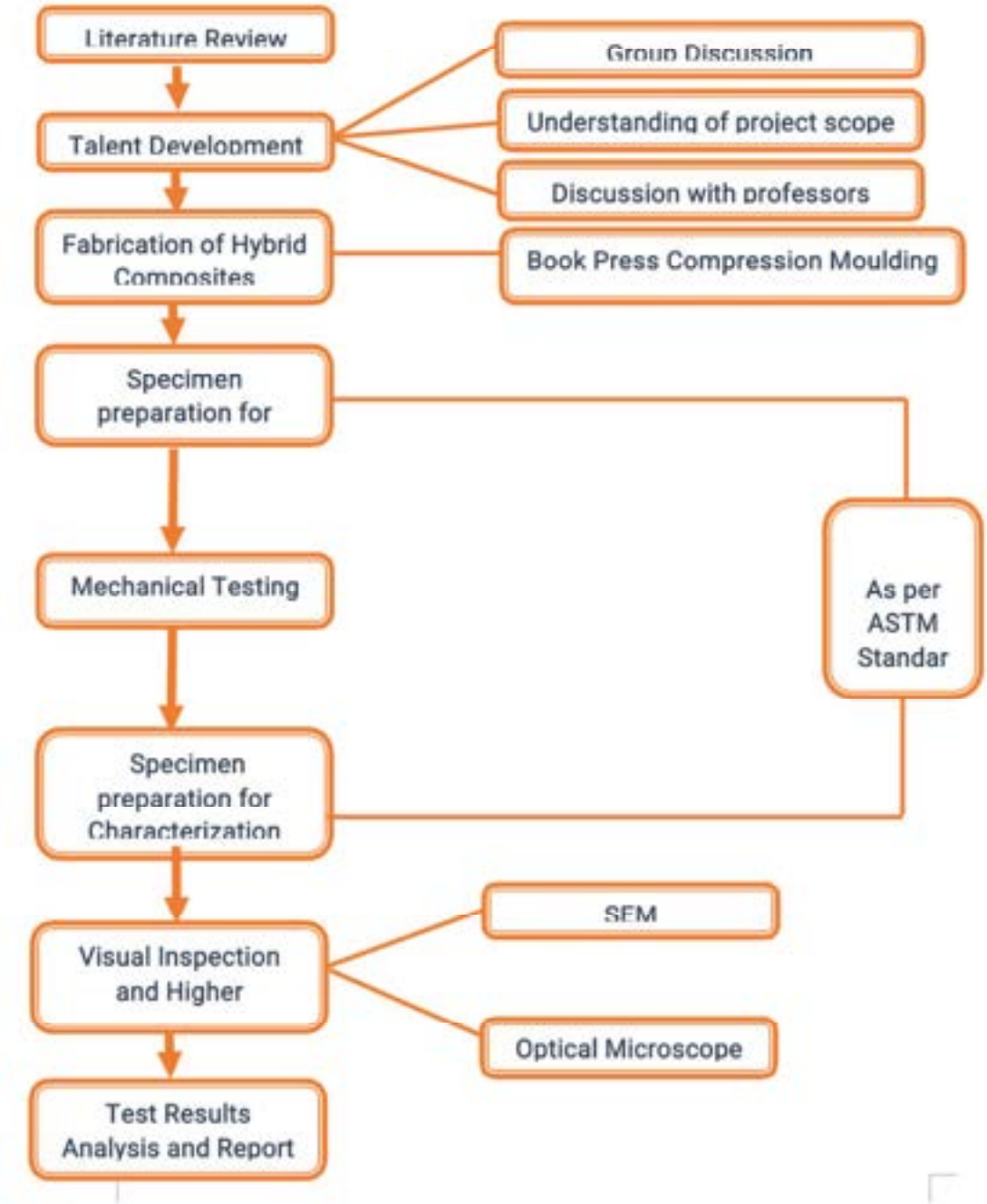
Mechanical and tribological characteristics of glass epoxy composites with aluminium particulate (5-15 wt%) filler are experimentally investigated. Mechanical test is conducted on INSTRON 8801 whereas tribological characterization is done using a pin on disc type friction and wear monitor as per ASTM standards. With a fixed wt% of fiber reinforcement, and different wt% aluminium powder filler, glass epoxy composites are fabricated in conventional hand lay up technique followed by light compression moulding process. Results show steady decrease of tensile strength with aluminium powder addition. Friction and wear of 5 and 10 wt% aluminium content composites are less than unfilled glass epoxy composite. Glass epoxy composite with 5 wt% aluminium has the lowest frictional and wear characteristics whereas composite having 15 wt% aluminium shows the highest friction and wear.

Trzepiecinski, T., Kubit, A., et al. (2018). "Strength properties of aluminium/glass-fiber reinforced laminate with additional epoxy adhesive film interlayer". International Journal of Adhesion and Adhesives.

This paper studies the strength analysis of two types of fibre-metal laminates (FMLs), with a different way of preparing the adhesive coupling between 2024-T3 aluminium alloy sheets and a polymer/fibre layer. In the first variant, the 3 M structural adhesive film AF 163-2 K is used as an intermediate layer between prepreg and adherends. The adhesive layer is co-cured with prepreg and adherends. In the second FML variant, coupling between adherends was produced using epoxy resin. Two types of strength test, – i.e., tensile/shear test and 90° peel test – were used to measure the adhesion between the layers of FML composite. However, the application of the additional adhesive film in the analysed 2/1 laminate lay-up increased the mass of the laminate by about 10%. Furthermore, a significant increase in the FML peel strength was achieved, with the increased cost of the additional adhesive film at about 20%.

CHAPTER 3

RESEARCH METHODOLOGY



3.1 MATERIALS

In this present work carbon and S-Glass fiber hybrid laminates and epoxy matrix were used for fabricating laminates. Carbon and S-Glass fibers were supplied by Hindustan composites ltd, Maharashtra. Epoxy resin matrix LY 556 (density - 0.9 g/cm3, viscosity - 1.25x104 cP) and hardener W152 LR (density - 1.2 g/cm3, viscosity 1.30x104 cP) were supplied by AYPOLS, Coimbatore, Tamilnadu. The properties of fiber reinforcement as mentioned by supplier were depicted in table 1.

Fiber	Specific Gravity	Max Temp. of Application (oC)	Elongation at Break (%)	Elastic Modulus (GPa)	Tensile Strength (MPa)
Carbon	1.75-1.95	400	0.5-1.5	230-800	2900-3450
S-Glass	2.65-2.8	650	3.1 -6	93-110	3000-4840

Fig No: 3.1 Properties of Fiber Reinforcement Materials

There are numerous methods for fabrication of composite components. Some methods have been borrowed but many were developed to meet specific design or manufacturing challenges. Selection of a method for a particular part therefore will depend the materials the part design and end use or application.

- Hand lay-up method
- Book press compression Moulding
- Resin infusion processes
- Vacuum bagging process
- Resin film infusion

In this project we have to fabricate the Fiber Laminate by using “Book press Compression Moulding Setup”.

3.2 FABRICATION OF CARBON/S-GLASS EPOXY HYBRID COMPOSITES

- The laminates were prepared by Book Press type Hand layup Molding process.
- The book press mold Setup made up of Five Mild steel plates drilled at four corners to fix fasteners
- Each plate has a weight of 11 Kg and Base plate has 7 Kg weight
- The Plates size was 455 mm X 300 X 5 mm.
- Initially the base plate is covered with perforated release film made up of thin glass sheet.
- Wax is applied on the release film for easy removal of laminate.
- Basalt and Kevlar fiber laminates tailored for a particular dimension is stacked one on another along with evenly distributed Resin hardener mixture.
- After attaining required thickness of laminate additional plates are fixed on the surface of the laminate which is covered with release film and coated with wax and tightened using screw fastener setup.
- This experimental setup is allowed to cure for 2 hrs then the laminate is removed from the mold and cured in the hot air Owen at 55^0C for 2 hrs.
- Finally the cured laminate is cut to the required size specimens by multi cutter.

Fig.No:3.2 Book Press Mould setup

3.3 SPECIMEN PREPARATION AND TESTING

Three tensile test specimens were prepared for testing as per ASTM standard to get accurate results. Tensile tests were done repeatedly for all the three specimens in FIE 11/98- 2450 make universal tensile testing machine. Similarly izod impact tests were done in the AIT-300N impact pendulum testing machine (ASTM D256). For each testing three specimens were tested and the results were reported. Figure 2 shows the prepared tensile and izod test specimens. Figure 1, 2 and 3 represents the fabricated carbon/S-Glass/Epoxy laminate, Tensile and impact test samples respectively.

Fig.No: 3.3 Tensile, Impact and Flexural Test Samples

CHAPTER 4
EXPERIMENTAL WORKS

4.1 TENSILE TEST

The tensile tests are conducted on INSTRON 8801 as per ASTM D3039 07 standards test method for tensile properties of composite specimens. This test method determines the in plane tensile properties of glass epoxy composites with or without aluminium particulate filler. The dimension of the sample is 150 mm x 12 mm x 6 mm with a fixed gauge length of 100 mm. Tests are conducted for the samples at normal room temperature (27Deg C) and quasistatic strain-rate of 10E-4/s. At least three specimens for each composite are tested to get the mean value of the tensile strength. INSTRON 8801 with tensile test setup and the test specimens are shown in Figure

Fig No: 4.1 Instron Tensile Test setup

4.2 FLEXURAL TEST

The three-point bending flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress–strain response of the material. The main advantage of a three-point flexural test is the ease of the specimen preparation and testing. The test method for conducting the test usually involves a specified test fixture on a universal testing machine. Details of the test preparation, conditioning, and conduct affect the test results. The sample is placed on two supporting pins a set distance apart.

Fig.No:4.2 Experimental setup

4.3 IMPACT TEST

The Izod impact test specimen designs are very similar to Charpy impact, with some notable differences, including the orientation of the specimen, which is clamped into the apparatus vertically with the notch facing toward the pendulum. The pendulum then impacts the sample at a specified area above the notch.

Both Charpy and Izod impact testing are popular methods of determining impact strength, or toughness, of a material. In other words, these tests measure the total amount of energy that a material is able to absorb. This energy absorption is directly related to the brittleness of the material.

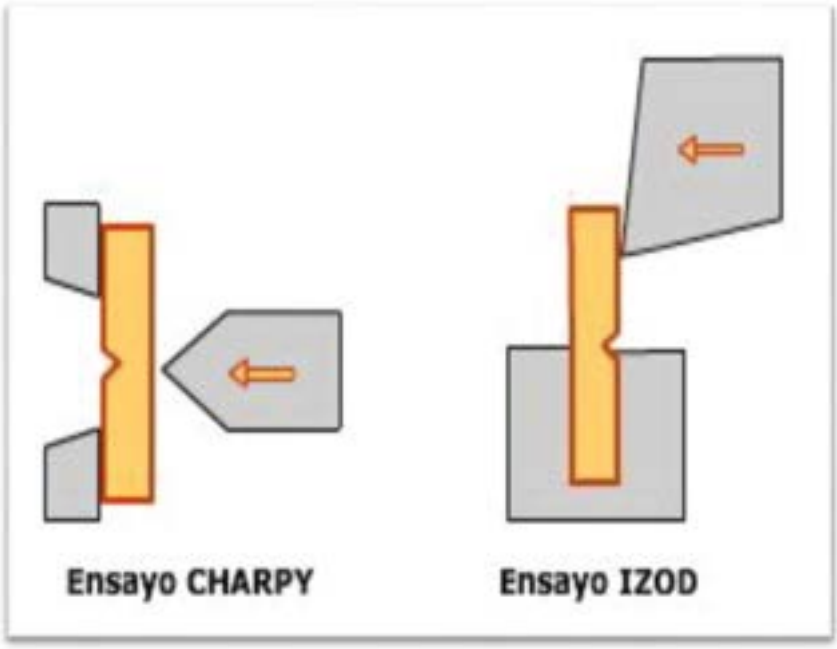


Fig.No: 4.3 Experimental Setup

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Tensile Test Results

The results obtained through various experiments like tensile and impact tests were presented for the investigation. Figure 5.1 represents tensile results of the specimens. Three samples were tested to acquire the average tensile strength of the hybrid specimens.

Stress strain relationship curves clearly indicates that the gradual increase in strain rate for the corresponding stress levels. It has been identified that specimen 2 possess lower strain values because of the moderate bonding of fiber and matrix in that particular region. Similarly the force – displacement curve indicates that hybrid laminates shows better resistance towards applied force.

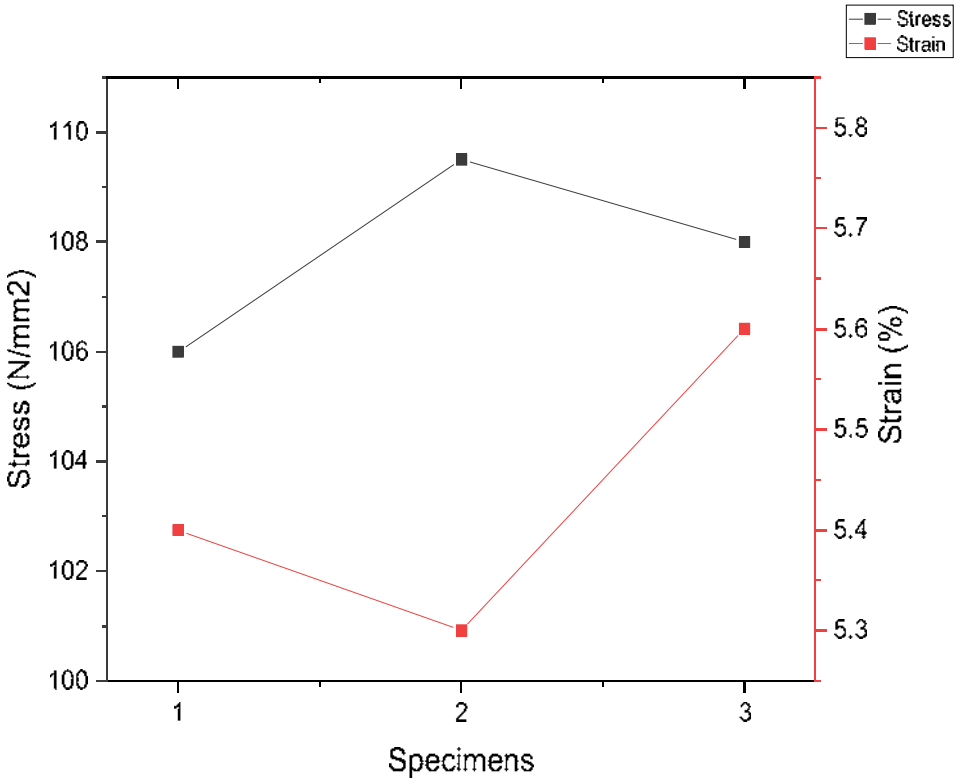


FIG NO:5.1 TENSILE RESULT,STRESS-STRAIN CURVE

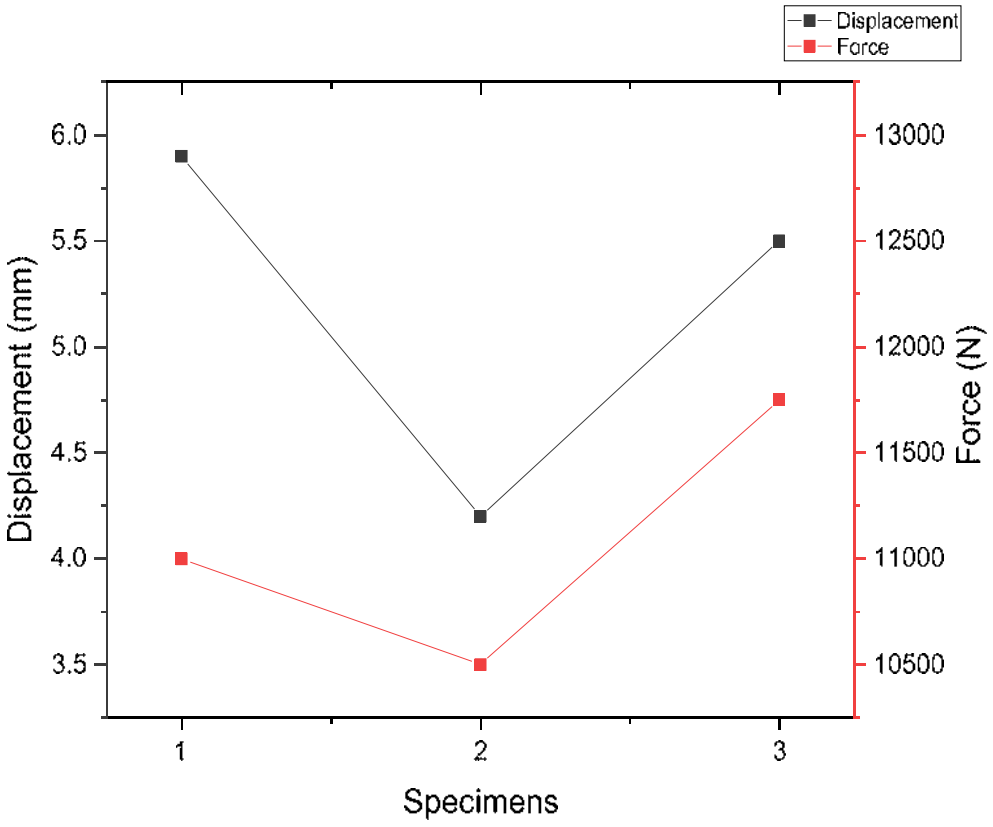


Fig No: 5.2 Tensile Results, Load-displacement curve

5.2 Impact Test Results

Figure 5.2 represents impact test results of the specimens. The proposed hybrid configuration possess excellent impact and tensile properties than any other fiber reinforced polymer laminates.

It is due to the combination of carbon and S-Glass fibers, where S-Glass is well known for its impact resistance and energy absorption and carbon fiber is for better mechanical and thermal properties.

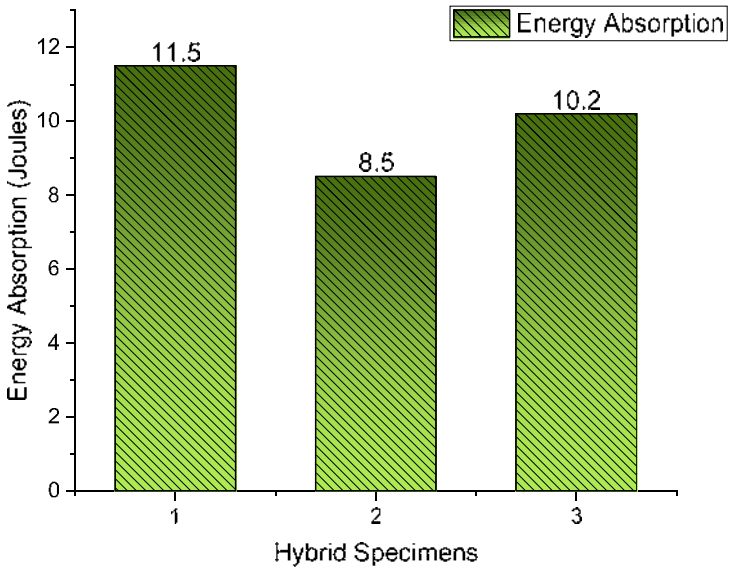


Fig.No: 5.3 Impact results graph

5.3 FLEXURAL TEST

Force vs. Displacement

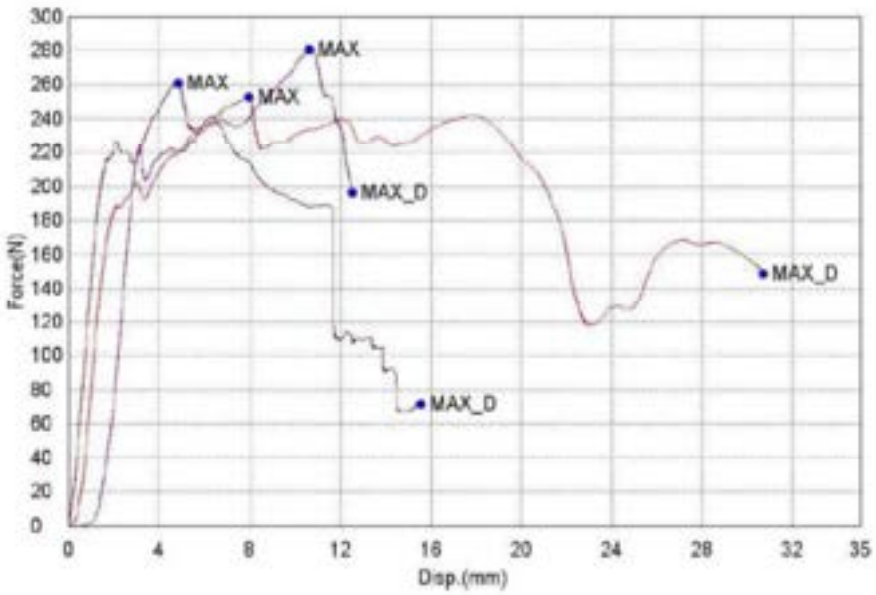


Fig No. 5.4 Force vs Displacement

Stress vs. strain

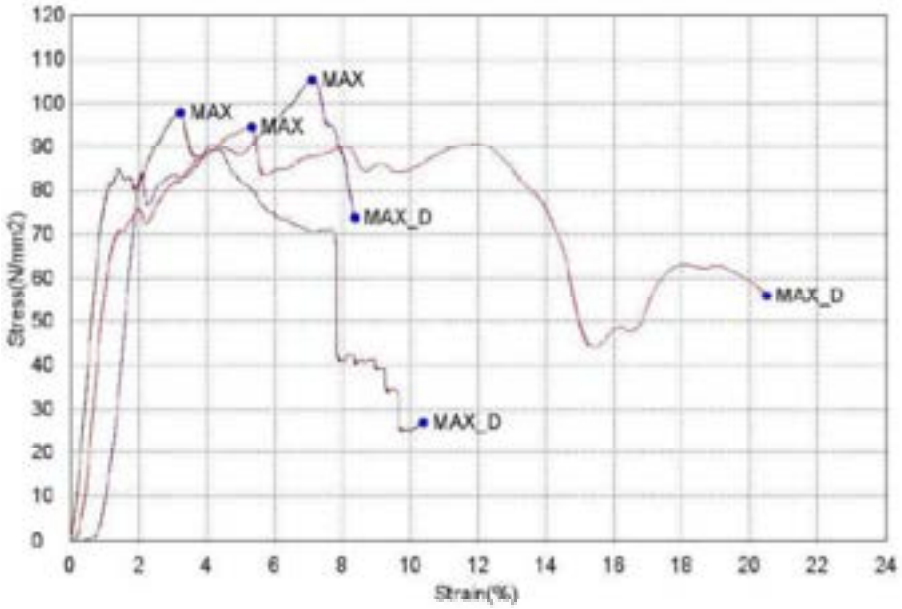


Fig No:5.5 Stress vs. strain

Composites of structural applications are prone to fail under bending load, it is essential to produce composites with higher flexural strength for specific engineering needs. Flexural behavior of prepared hybrid composites obtained from three point bending flexural test have been shown in figure 5.4.

5.4 Scanning Electron Microscopic Analysis

The SEM images of fractured specimen surfaces were shown in figure 6. It represents that the bonding between metal and fiber laminates are rigid enough to form uniform stress concentrations in FML. Microstructure SEM analysis reveals that delamination's and pull outs present in the fractured samples. Mostly minor de bonding and fiber pull outs occurred between fiber and matrix. The damage tolerance of fiber gets improved with the matrix concentration. Equivalently the energy dissipation and absorption behaviour of carbon/S-Glass fibers protects the core fiber plate from the fracture.

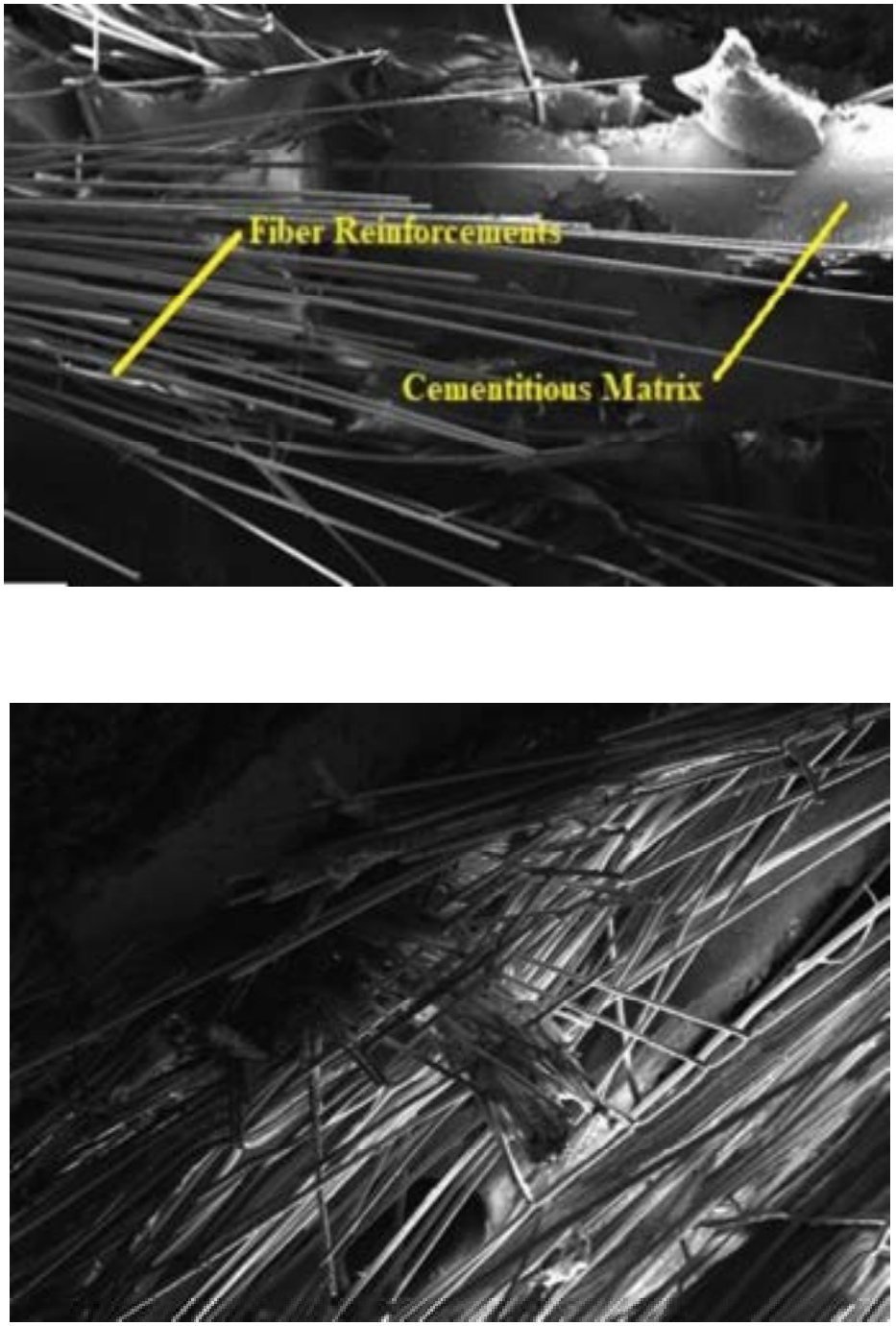


Fig No: 5.6 SEM Images of Fractured Surfaces

CHAPTER 6

APPLICATIONS OF CARBON FIBER/S-GLASS FIBER

Fiberglass is an immensely versatile material due to its light weight, inherent strength, weather-resistant finish and variety of surface textures.

Fiberglass is also used in the telecommunications industry for shrouding antennas, due to its RF permeability and low signal attenuation properties. It may also be used to conceal other equipment where no signal permeability is required, such as equipment cabinets and steel support structures, due to the ease with which it can be molded and painted to blend with existing structures and surfaces. Other uses include sheet-form electrical insulators and structural components commonly found in power-industry products.

6.1 Storage Tanks

Storage tanks can be made of fiber glass with capacities up to about 300 tones. Smaller tanks can be made with chopped strand mat cast over a thermoplastic inner tank which acts as a perform during construction. Much more reliable tanks are made using woven mat or filament . wound fiber, with the fiber orientation at right angles to the hoop stress imposed in the side wall by the contents. Such tanks tend to be used for chemical storage because the plastic liner (often polypropylene) is resistant to a wide range of corrosive chemicals.

Fig.No:6.1 Storage tanks

6.2 Automobile Applications

Carbon/S-Glass fiber reinforced composites are potentially is strong. So it has more possibilities for combining advanced materials with technologies that are already familiar from the processing of plastics. For automobile structural components it possess light weight opportunities at a weight of 50% lighter than conventional steel and 30% lighter than aluminum, more automakers use these materials as the body structure or other car components. With these advantages that coordinate directly with the automotive industry's needs, plastics and polymer composites can be a major part of the solution for automobile manufacturers.

Fig. No: 6.2 Application of Carbon / S-glass fiber laminates

CHAPTER 7

COST ESTIMATION

S.NO	DESCRIPTION	QUANTITY	TOTAL COST
1	S-glass fiber material	3Sqm	7000
2	Epoxy resins and hardner	2Kg	1800
3	Glass mould	2	800
4	Carbon fiber	1 Sqm	1000
5	Cutting charge	21 samples	600
6	Other materials	-	1000
7	Testing	4 Tests	10500
8	Others	-	500

CHAPTER 8

CONCLUSION

In this proposed research Carbon/S-Glass/Epoxy reinforced hybrid laminates were prepared by compression moulding to study its mechanical properties. From the experimental results the following outcomes has been obtained.

- Hybrid configuration shows great tensile modulus and strength with the increasing stress conditions than conventional fiber reinforced polymer matrix laminates.
- Tensile and impact properties are intensively great in the hybrid laminate due to the hybrid reinforcement of Carbon and S-Glass fibers.
- SEM microstructure analysis clearly indicates the delamination, de bonding, cracks and pit formations of the fractured samples.
- The fabricated hybrid sandwich structure is preferably suitable for high strength commercial automobile applications.

REFERENCES

[1] L.J. Desk, S.D. Bartus, U.K. Vidaya. "Multi-site impact response of S2-glass / epoxy composite laminates", composite science and technology, vol-69,725-723, 2008.

[2] M. S. Santhosh, G. Karthikeyan, R. Sasikumar et al., Mechanical and morphological behaviour of rice husk/prosopis juliflora rein-forced bio composites, Materials Today: Proceedings, https://doi.org/10.1016/j.matpr.2019.12.021.

[3] Andy Vanderklok , Andy Stamm , Jmaes Dorer , Hu Eryi , Matthew Auvenshine, J. Michael Pereia, Xinran Xiao . "An experimental investigation into the high velocity impact responses of S2-glass/SC15 epoxy composite panels with a gas gun", international journal of impact engineering, 244-254, 2017.

[4] J.R. Xiao , B.A. Gama , J.W. Gillespie Jr. "Progressive damage and delamination in plain weave S-2 glass/SC-15 composites under quasi-static punch-shear loading", composite structurs,vol-,2005.

[5] N. Maniselvam, M.S. Santhosh et al. "Study of Corrosion Behaviour of Carbon Fiber Reinforced Plastics (CFRPs)", Materials Science Forum, Vol. 969, 175-181, 2019.

[6] M.V. Hosur, U.K. Vaidya, D. Myers, S. Jeelani. "Studies on the repair of ballistic impact damaged S2-glass/vinyl ester laminates", composite structures, vol-61, 281-290, 2003.

[7] Diptikanta Das, Om Prakash Dubey, Milind Sharma a, Ramesh Kumar Nayak, Chandrika Samal," Mechanical properties and abrasion behaviour of glass fiber reinforced polymer composites – A case study", materials today proceedings, DOI: 10.1016/j.matpr.2019.07.644.

[8] Devi, G. R., & Palanikumar, K. (2018)." Analysis on drilling of woven glass fibre reinforced aluminium sandwich laminates. Journal of Materials Research and Technology", Doi: 10.1016/j.jmrt.2018.06.021.

[9] Santiago, R. C., Cantwell, W. J., Jones, N., & Alves, M. (2018). "The modelling of impact loading on thermoplastic fibre-metal laminates. Composite Structures", Vol. 189, pp. 228–238.

[10] Gonzalez-Canche, N. G., Flores-Johnson, & E. A., Carrillo, J. G. (2017)."Mechanical characterization of fiber metal laminate based on aramid fiber reinforced polypropylene". Composite Structures, Vol. 172, pp. 259–266.

[11] Aghamohammad, H., Abbandanak, N. H., Eslami-Farsani, R., & Siadati, S. M. H. (2018). "Effects of various aluminum surface treatments on the basalt fiber metal laminates interlinear adhesion". International Journal of Adhesion and Adhesives, doi: 10.1016/j.ijadhadh.2018.03.005.

[12] Sandeep P. Patil , Parag Shendye, Bernd Markert , "Mechanical properties and behaviour of glass fiber-reinforced silica aerogel Nano composites: Insights from all-atom simulations", scripta materials,vil-,65-68,2019.

[13] L. Prabhu , V. Krishnaraj , S. Sathish , S. GokulKumar , N. Karthi, "Study of mechanical and morphological properties of jute-tea leaf fiber reinforced hybrid composites: Effect of glass fiber hybridization" ,materials today Proceedings ,

[14] Santhosh M.S, Sasikumar R. "Influences of Aluminium / E-Glass Volume Fraction on Flexural and Impact Behaviour of GLARE Hybrid Composites", Journal of Engineering Sciences, Volume 6 (1), 2019. DOI: 10.21272/jes.2019.6(1).c2.

[15] Golshahr, A., Natarajan, E., Santhosh, M. S., Sasikumar, R., Ramesh, S., &Durairaj, R. (2018). "Multiwall Carbon Nanotube Reinforced Silicone for Aerospace Applications". International Journal of Mechanical and Production Engineering Research and Development, Vol. 8(4), pp. 743–752

.

[16] M.S. Santhosh, T. Thangavel, R. Sasikumar. "Mechanical Behaviour of Aluminium Powder Modified Carbon/Basalt Reinforced Vinyl Ester Composites", IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE), Vol. 6 (1), 52-58, 2019.

[17] Kumar, S., Shivashankar, G. S., Dhotey, K., & Singh, J. (2017). “Experimental study wear rate of glass fiber reinforced epoxy polymer composites filled with aluminium powder”. Materials Today, Vol. 4, pp. 10764–10768.

[18] Crupi. V., Kara .E., Epasto,G., guglielmino, E., & Aykul, H (2014). “prediction model for the impact response of glass fiber reinforced aluminium foam sandwiches.International journal of Impact Engineering ,Doi;10.1016.

[19] Mariam, M., Afendi, M., Majid, M. S. A., Ridzuan, M. J. M., & Gibson, A. G. (2017). “Tensile and fatigue properties of single lap joints of aluminium alloy/glass fiber reinforced composites fabricated with different joining methods”. Composite Structures, doi: 10.1016/j.compstruct.2018.06.003.

[20] Sarkar, P., Modak, N., & Sahoo, P. (2018). “Mechanical and Tribological Characteristics of Aluminium Powder filled Glass Epoxy Composites”. Materials Today, Vol. 5, pp. 5496–5505.

[21] Trzepiecinski, T., Kubit, A., et al. (2018). “Strength properties of aluminium/glass-fiber reinforced laminate with additional epoxy adhesive film interlayer”. International Journal of Adhesion and Adhesives, doi: 10.1016/j.ijadhadh.2018.05.016.

PERFORMANCE TEST OF THE PETROL ENGINE BY USING ALTERNATIVE FUELS

PROJECT WORK PHASE-II

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ABSTRACT

Now a days alternative fuels like biodiesel on locomotive engines provides an opportunity for Indian Railways (IR) to reduce diesel consumption, reduce carbon footprint and reduce associated environmental degradation. Biodiesel can act as a drop-in fuel for diesel locomotives. Biodiesel is known to reduce emissions of harmful particulates and smoke, reduce life-cycle emissions of greenhouse gases (GHG) by more than 70%, and helps local agricultural economy. In the present study, two large bore locomotive engines were operated on various blends of locally produced biodiesels (cotton seed methyl ester, pongamia seed methyl ester, mahua seed methyl ester and waste fish oil methyl ester) and results of engine performance, emissions and combustion are presented . For this research work, non-edible feedstocks with sufficient availability in country were selected to produce biodiesel. Biodiesels were tested according to the Indian Standards (BIS 15607, 2005) for B100 and additional tests as per European biodiesel standard (EN14214). Ester compositions of biodiesels were determined by gas chromatography. Chemical data banks and open literature were used to compute biodiesel properties at different temperatures. Computed biodiesel properties were used to develop temperature based correlations for fuel's bulk modulus of compressibility, speed of sound, density, viscosity and surface tension. Two different test setups were created to test the two large bore locomotive diesel engines. These included acquisition of engine temperature and pressures, in- cylinder pressures, fuel injection pressures and injector needle lift. Regulated emissions of NOx, THC, CO and PM were measured using emission bench and a partial dilution tunnel based gravimetric PM measurementsystem.

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CHAPTER 1

INTRODUCTION

The introduction of Internal Combustion (IC) engines, over a century ago, has provided a robust and relatively inexpensive means of transportation. Indeed the operating principal of an IC engine has also not changed since their introduction. Gasoline IC engines utilize the four-stroke 'Otto' cycle which was developed around 1867 by Nikolaus Agust Otto. Initially, research and development on IC engines concentrated on improving performance and efficiency. However, after a century of use, it became apparent that IC engine emissions contributed towards global warming and other environmental impact. Coupled with dwindling oil reserves, it became apparent that IC engine research and development had to be shifted towards reducing engine-out emissions and fuel consumption. World-wide various emission legislation has been put in place, in a concerted effort to motivate vehicle manufacturers to produce cleaner and more fuel efficient vehicles. Although other technologies exist, such as fuel cells and electric vehicles, which in theory seem to offer a viable power-plant alternative to the IC engine; these technologies still have related short comings. These namely are high cost, efficiency and power density concerns, well to wheel emission issues, hydrogen storage and lack of infrastructure to support thesetechnologies.

In the absence of any feasible alternatives to the IC engine, the last two decades have seen immense steps towards the reduction of emissions and fuel consumption while at the same time enhancing power output. These improvements have been realized due to the application of new technologies to the IC engine, such as three-way catalysts and improved engine management systems. Furthermore, other innovative developments are under progress and expected to be introduced in the near future, these include gasoline direct injection systems, cylinder de-activation, flexible valve operation and cam profile switching. Based on current trends and tightening emission legislation, it can be expected that future IC engines will incorporate technologies which will allow them to be considerably cleaner and have better fuel economy than current IC engines.

1.1 Emission from S.Iengine

The major emission from automobiles are carbon monoxide (CO), hydro carbons (HC), oxides of nitrogen (NO_x), smoke, sulphur compounds and particulate matter. Large engines emit large quantities of pollutants compared to smaller engines and the quality of pollutants dumped into the atmosphere depends on the vehiclepopulation.

1.1.1 Formation of hydrocarbonemission

Hydrocarbon emissions are caused by incomplete combustion. These emissions are actually molecules of unburned gasoline. Even en engine in good condition with satisfactory ignition and fuel system will release some HC. When the flame front in the combustion chamber approaches the cooler cylinder wall, the flame front quenches, leaving some unburned HC. An excessively lean air/fuel ratio causes higher-than-normal HC emission. At the stoichiometric air/fuel ratio, HC emission is low. Evaporated emission from fuel tanks, carburetor float bowls and evaporative systems are also a source of HC emission. On cars with catalytic converters, the HC reading at the tail pipe is very low if the engine, ignition, fuel and emission systems are in normal working condition. When a cylinder misfires, all the unburned gas in the cylinder is delivered to exhaust system, resulting in a high HC reading. Cylinder misfiring and HC reading may be caused by ignition defects, such as defective spark plugs, spark plug wires, coil and distributor cap or rotor. Low cylinder compression ratio also causes high HC emission.

1.1.2 Formation of carbon monoxideemission

Carbon monoxide is a by-product of combustion. CO is poisonous chemical compound of carbon and oxygen. It forms in the engine when there is not enough oxygen to combine with the carbon during combustion. When there is enough oxygen in the mixture, carbon dioxide (CO_2) is formed. CO_2 is not a pollutant and is the gas used by plants to manufactureoxygen.

CO is primarily found in the exhaust, but can also be in the concentrated form, it is toxic. CO emission is caused by a lack of air or too much fuel in the air/fuel mixture. CO will not occur if combustion does not take place in the cylinders; therefore, the presence of CO means combustion is taking place. As the air/fuel ratio becomes richer, the CO levels increase. At the stoichiometric air/fuel ratio,the CO emissions are a good indicator of a rich air/fuel ratio, but they are not an accurate indication of a lean air/fuel ratio.

When cylinder misfiring occurs, there is less total combustion in the engine cylinders. Since CO is a byproduct of combustion; cylinder misfiring does not increase CO emission. If a cylinder is misfiring, CO emission may decrease slightly.

1.1.3 Formation of oxides ofnitrogen

A major hurdle in understanding the mechanism of formation and controlling its emission is that combustion is highly heterogeneous and transient in diesel engines. While NO and NO_x, there are some differences between these two pollutants, NO is a colorless and odorless gas, while NO_2 is a reddish brown gas with pungent odors. Both gases are considered toxic, but NO_2 is largely formed from oxidation of NO. Attention has been given, on how NO can be controlled before and after combustion.

NO is formed during the post flame combustion process in a high temperature region. The principal source of NO formation is the oxidation of the nitrogen present in atmospheric air. The nitric oxide formation chain reactions are initiated by atomic oxygen, which forms form the combustion process. The principal reactions governing the formation of NO from molecular nitrogenare,

$$N_2 + O \rightarrow NO + N \quad \text{.....(1)}$$

$$N + O_2 \rightarrow NO + O \quad \text{.....(2)}$$

$$N + OH \rightarrow NO + H \quad \text{.....(3)}$$

Chemical equilibrium consideration indicates that for burnt at typical temperature, NO_2/NO ratios should be negligible small. While experimental data show that this is true for spark ignition engines, in diesel, NO_2 can be 10 to 30% of total exhaust emission of oxides of nitrogen. A plausible mechanism for the persistence of $N0_2$ is as follows. NO formed in the flame zone can be rapidly converted to $N0_2$ via reactions suchas

$$NO + HO_2 \rightarrow NO_2 + OH \quad \text{.....(4)}$$

Subsequently, conversion of this NO_2 to NO occurs via

$$NO_2 + O \rightarrow NO + O_2$$

Unless the NO_2 formed is quenched by mixing with cooler fluid. This explanation is consistent with the highest NO_2/NO ration occurring at high load in diesel, when cooler regions which could quench the conversion back to NO.

The local atomic oxygen concentration depends on molecular oxygen concentration as well as local temperatures. Formation of NO_x is almost absent at temperatures below 2000 K.

Hence any technique, that can keep the instantaneous local temperature in the instantaneous local temperature in the combustion chamber below 2000K, will be able to reduce NO_xformation.

1.2 Emission controllingtechniques

1.2.1 Air injectionsystem

Air injection into the hot escaping exhaust gases can reduce emission of HC, CO and aldehydes by oxidation. The variables controlling the reactions are: Temperature, time, homogeneity (mixing of exhaust) and composition of the exhaust constituents.

In this system a positive displacement vane pump driven by the engine, inducts air from the air cleaner. In the check valve provided in the circuit to prevent the backfire. The air passes in at a distributing manifold with tubes feeding a metered amount into the exhaust port of each cylinder and close to the exhaust valve. Since the exhaust gases are Pit high temperature the injected air reacts which HC, CO and aldehydes to reduce greatly the concentrations of such emissions. The injected air must be closely metered also it can decrease the exhausttemperature.

Though air injection system is most effective with rich carburetion (4-6 percent CO with consequent 10 rich or leaner mixtures. This is because exhaust temperatures in either case are relatively high and so increase the effect of an optimum quantity of added air on even small amounts of HC and CO.

The effectiveness of an air injection system depends upon the following conditions:

1. The strength of the air-fuel mixture, generally a marginally rich mixture improves the exhaust gas-air injected mixture oxidation reactionprocess.
2. The temperature and pressure of the exhaust gas-airmixture.
3. The time for the exhaust gas-air mixturereaction.
4. The heat losses from exhaust reaction zone, these should be minimized for efficientconversion.
5. An adequate reaction volume to enable the exhaust gas-air mixture to complete the continuous oxidationprocess.

1.2.2 Catalytic converter

A catalytic converter is a device that uses a catalyst to convert three harmful compounds in car exhaust into harmless compounds.

The three harmful compounds are:

- Hydrocarbons (in the form of un burned gasoline)
- Carbon monoxide (formed by the non combustion ofgasoline)
- Nitrogen oxides (created when the heat in the engine nitrogen in the air to combine withoxygen)

In a catalytic converter, the catalyst (in the form of platinum and palladium) is coated onto a ceramic honeycomb or ceramic beads that are housed in a muffler – like package attached to the exhaust pipe. The catalyst helps to convert carbon monoxide into carbon dioxide. It converts the hydrocarbons into carbon dioxide and water. It also converts the nitrogen oxides back into nitrogen and oxygen.

Most modern cars are equipped with three-way catalytic converters. "Three-way" refers to the three regulated emissions it helps to carbon monoxide, and NO_xmolecules. The converter uses two different types of catalysts, a reduction catalyst and an oxidation catalyst. Both types consist of a ceramic structure coated with a metal catalyst, usually platinum, rhodium and or palladium. The idea is to create a structure that exposes the maximum area of catalyst to the exhaust stream while also minimizing the amount of catalyst required they are veryexpensive.

1.2.3 Fuel modification technique

To modify the fuel quality, additives can be added in small quantity either to enhance engine performance or to reduce the emission. Fuel additives have been one of the most prolific innovations of liquid engineering as well as material science giving natural fuel sources and additional properties which help us drive that little extra out of them. Whether it's an additive to alter a fuels burn rate, increase surface area, prevent corrosive effects or simply color, innovators have developed a range of additives over the years which give these fuels an added property which serves a pressing need from consumers. While fuel additives are largely associated with additives to gasoline and oil based fuels in the interest of environmental protection, unburning emission and increasing mileage, the innovation around additives has a broader impact of being able to change ,alter or enhance specific attributes of a fuel whether liquid ,solid orgas.

Additives have been developed to increase combustion rates, as anti oxidants, to effect burn rates ,to enable fuels to work under extreme temperatures, reduce harmful emissions and more. Over the years various hybrid compounds and blends have been engineered to create better fuels for industries commercial use and end consumers alike.

CHAPTER 2

LITERATUREREVIEW

A. Abdel Rahman, and **M. M. Osman, [1997]** described that using different ethanol-gasoline fuel blends, a VARICOMP engine was used to study the effect of varying the compression ratio on SI engine performance. The performance tests were carried out using different percentages of ethanol in gasoline fuel, up to 40%, under variable compression ratio conditions. The results show that the engine indicated power improves with the percentage addition of the ethanol in the fuel blend. The maximum improvement occurs at 10% ethanol—90% gasoline fuelblend.

C. Ananda Srinivasan and **C.G. Saravanan, [2010]** investigated that the effects of ethanol-blended gasoline with oxygenated additives on a multi – cylinder Spark Ignition (SI) Engine. The experiments were conducted in two stages. In stage I, the test fuels were prepared using 99.9% pure ethanol and gasoline with a cycloheptanol blend, in the ratio of E69.5 + 0.5 cycloheptanol, E64.6 + 0.4 cycloheptanol, E59.7+ 0.3 cycloheptanol, E49.8 + 0.2 cycloheptanol. The remainder was gasoline. In stage II, the test fuels were prepared using 99.9% pure ethanol and gasoline with cyclooctanol blend, in the ratio of E69.5 + 0.5 cyclooctanol, E64.6 + 0.4 cyclooctanol l, E59.7 + 0.3 cyclooctanol, E49.8 + 0.2 cyclooctanol. The remainder was gasoline. Performance and emission tests were conducted on a multi – cylinder SI Engine coupled with an eddy current dynamometer. The emission tests were measured using an exhaust gas analyzer. The experimental results proved that the blend increased brake thermal efficiency more than a sole fuel, such as gasoline. The emission tests found that the CO slightly decreased, while HC and O_2 increased moderately and CO_2 and NO_x appreciably decreased. In addition, combustion analyses were made with the help of combustion analyzer, in which cylinder pressure and heat release rate wereanalysed.

V. Balaji Raman and **X. Alexander, [2018]** presented that the cold-start exhaust gas emission levels and also performance test on a petrol engine by using the fuel blends. The vehicle, powered by gasoline fuelled engine, was used in the experiments. The fuel for the engine is supplied using the conventional carburettor system. Cold-start emission levels are measured for gasoline-ethanol andgasoline-

isobutanol blends at different proportion. Emission values are recorded for E5 to E20 in steps of 5% and for isobutanol, it is from IB10 to IB50 insteps of 10% increase. The cold start emission test results show that hydrocarbon and carbon monoxide content is lowest for IB 30. And IB30 showed the highest increase of brake thermal efficiency of 8.7%.

T. Shanmuga Vadivel *et al,* **[2018]** studied that alternative fuels are important due to the worldwide depletion and accelerated exploitation of oil reserves. In this study, experiments were conducted to study the performance, emission, and specific fuel consumption of a spark ignition (SI) engine using ethanol based fuels. Experiments were carried out in three different stages. In the first phase, base reading was obtained using gasoline. In the other two phases, the engine performance was studied by blending of ethanol with gasoline in different percentage. The results of various blends have been compared with that of the gasoline. A number of tests are conducted in a SI engine using different fuel mix ratios. To validate the result, the trials are repeated two times. The engine works at a fixed full load, but at different speeds, i.e., 2000 rpm, 2400 rpm, 2600 rpm, 2800 rpm and 3000 rpm. The performance, specific fuel consumption, and the emission characteristics of exhaust gases of the engine are analyzed and compared. The reduction in engine soot emission has been observed to increase with the increase of ethanol percentage in the fuel blend. The effect of ethanol addition to gasoline on oxides of nitrogen, hydrocarbon, exhaust gas temperature, and thermal efficiency has been experimentally investigated. The goal of this work is to study the engine performance when ethanol–gasoline blends areused.

N.Basavaraju *et al,* **[2018]** stated that single cylinder small engines have low compression ratio (CR), and they run with slightly rich mixture, their power are low and emission values are high. In this work, methanol was used to increase performance and decrease emissions of a single-cylinder engine. Initially, the engine whose CR was 7.5/1 was tested with gasoline and methanol at full load and various speeds. This method is used for increasing the fuel efficiency of a vehicle by adding different percentage of methanol to the petrol and to decrease the pollutants produced during combustion process. Due to the continuously increases in the cost of fossil fuels, demands for clean energy have also been increasing. Therefore, alternative fuels sources are sought to have

alternate source for petrol without altering the existing engine or slight changes in the engine at low cost. In this paper the engines is tested without blending and with blending of methanol in various proportions with petrol and the measurements of CO and the corresponding readings wererecorded.

V. Saikrishnan *et al,* **[2017]** found that the effect of ethanol–gasoline blends as fuel on the performance and exhaust emission of a spark ignition (SI) engine. A four-stroke three-cylinder SI engine was used for this study. Performance tests were conducted for the three blends E5 (5% ethanol), E10 (10% ethanol) and E15 (15% of ethanol) as well as E0 (100% gasoline) to evaluate their brake thermal efficiency, specific fuel consumption and mechanical efficiency, while exhaust emissions were also analysed for carbon monoxide (CO), hydrocarbons (HC), carbon dioxide (CO2) and oxides of nitrogen (NOx) with varying torque conditions and constant speed of the engine. The results showed that blends of gasoline and ethanol increased the brake power, brake thermal efficiency and the fuel consumption. The CO and HC emissions concentration in the engine exhaust decreased while the NOx concentration increased.

Sebastian Verhelst *et al.,* **[2019]** reported that the methanol (CH_3OH) is one of these alternatives, which was demonstrated in large fleet trials during the 1980s and 1990s, and is currently again being introduced in various places and applications. It can be produced from fossil fuels, but also from biomass and from renewable energy sources in carbon capture and utilization schemes. It can be used in pure form or as a blend component, in internal combustion engines (ICEs) or in direct methanol fuel cells (DMFCs). These features added to the fact it is a liquid fuel, making it an efficient way of storing and distributing energy, make it stand out as one of the most attractive scalable alternatives. Methanol's performance, in terms of power output, peak and part load efficiency, and emissions formation is summarized, for so-called flex-fuel engines as well as for dedicated engines. We also briefly touch upon engine hardware changes and material compatibility. Methanol fuel reforming using engine waste heat is discussed, as a potential route towards further increases in efficiency and decreases in emission. Next to the experimental work, research efforts into modelling the behaviour of methanol as a fuel are also reviewed, including mixture formation, normal and abnormal combustion. Methanol's proper- ties such as high latent heat, fastburning

velocity, high knock-resistance and no carbon-to-carbon bonds are shown to leverage engine technology developments such as increased compression ratios, downsizing and dilution; enabling much increased engineefficiencies.

Ashraf Elfasakhany, [2015] discussed that the performance and exhaust emissions from spark-ignition engine fuelled with ethanol-methanol gasoline blends. The test results obtained with the use of low content rates of ethanol-methanol blends (3-10 vol.%) in gasoline were compared to ethanol-gasoline blends, methanol-gasoline blends and pure gasoline test results. Combustion and emission characteristics of ethanol, methanol and gasoline and their blends were evaluated. Results showed that when the vehicle was fuelled with ethanol-methanol-gasoline blends, the concentrations of CO and UHC (unburnt hydrocarbons) emissions were significantly decreased compared to the neat gasoline. Methanol-gasoline blends presented the lowest emissions of CO and UHC among all test fuels. Ethanol-gasoline blends showed a moderate emission level between the neat gasoline and ethanol-methanol-gasoline blends, e.g., ethanol-gasoline blends presented lower CO and UHC emissions than those of the neat gasoline but higher emissions than those of the ethanol-methanol-gasoline blends. In addition, the CO and UHC decreased and CO_2 increased when ethanol and/or methanol contents increased in the fuelblends.

Prakhar Chansauria and **R. K. Mandloi, [2018**] discusses the effect of ethanol gasoline blends as a bio-fuel in the conventional spark- ignition engine. This work reviews and brings into light the properties of ethanol, production procedure and the effect of various ethanol blends on the performance of engine. The parameters focused for this study are the engine brake torque, engine volumetric efficiency and thermal efficiency with the effect on the exhaust emissions, which is one of the present prime concerns. The merits as well as the disadvantages of using ethanol as a fuel in Spark Ignition Engines also discussed. It has been seen that with the increasing proportion of ethanol in the blend, the overall thermal efficiency, heat release rate, engine volumetric efficiency and cylinder gas pressure increases. The requirement of compression ratio for occurrence of ignition also rises with the proportion of ethanol in the blend.

Sandip Shyamsundar Gadewad *et al.,* **[2017]** discussed ethanol is widely used as an alternative fuel or an effective additive of gasoline due to the advantage of its high octane number and its self-sustaining concept, which can be supplied regardless of the fossil fuel. As a result, vast study has been carried out to study its effects on engine performance and emission. In this experimental study ethanol- blends Gasoline in different ratios and as a result shows that carbon monoxide (co), emitted from exhaust of 4-stroke SI engine lower into environment. i.e. after blends Ethanol-Gasoline mixture emission of carbon monoxide (co) reduces. Ethanol blends Gasoline have been used in 4-stroke single cylinder SI engine for performance and analysis under fullload.

CHAPTER 3

OBJECTIVES AND METHODOLOGY

3.1 Objectives

The objective of the present work is to reduce the gasoline engine emission parameters by blending 1,4 Dioxane with petroleum fuel.

1. Selecting the suitable alternate fuel for blending with gasolinefuel
2. Based upon the literature survey 1,4 Dioxane have been chosen to blend with sole gasolinefuel.
3. Selecting the suitable proportion of 1,4 Dioxane quantity to mix with gasolinefuel.

3.2 Methodology

1. In this work, 1,4 Dioxane are identified for the experimental investigation by blending them with 10% 20%, 30% with gasoline solefuel.
2. The physical and chemical properties of the 1,4 Dioxanewere tested through ASTM standards andreported.
3. The experimental investigations have been carried out on TATA NANO engine with MPFI, twin cylinder, four stroke, water cooled gasoline engine with all necessary equipments to study the engine performance and emission characteristics.
4. The experimental investigation of the engine fuelled with 1,4 Dioxaneblended with sole fuel and compared with gasoline sole (petrol) fuel by various load condition and maintained constant speed of theengine.

CHAPTER 4

1,4 DIOXIANE

4.1 1,4-Dioxane

1,4-Dioxane is a heterocyclicorganic compound, classified as an ether. It is a colorless liquid with a faint sweet odor similar to that of diethyl ether. The compound is often called simply dioxane because the other dioxane isomers (1,2- and 1,3-) are rarely encountered.

Dioxane is used as a solvent for a variety of practical applications as well as in the laboratory, and also as a stabilizer for the transport of chlorinated hydrocarbons in aluminum containers.

4.1.1 Synthesis

Dioxane is produced by the acid-catalysed dehydration of diethylene glycol, which in turn is obtained from the hydrolysis of ethylene oxide.

In 1985, the global production capacity for dioxane was between 11,000 and 14,000 tons In 1990, the total U.S. production volume of dioxane was between 5,250 and 9,150 tons

4.1.2 Structure

The dioxane molecule is centrosymmetric, meaning that it adopts a chair conformation, typical of relatives of cyclohexane. However, the molecule is conformationally flexible, and the boat conformation is easily adopted, e.g. in the chelation of metal cations. Dioxane resembles a smaller crown ether with only two ethyleneoxyl units.

4.1.3 Trichloroethane transport

In the 1980s, most of the dioxane produced was used as a stabilizer for 1,1,1-trichloroethane for storage and transport in aluminium containers. Normally aluminium is protected by a passivating oxide layer, but when these layers are disturbed, the metallic aluminium reacts with trichloroethane to give aluminium trichloride, which in turn catalyses the dehydrohalogenation of the remaining trichloroethane to vinylidene chloride and hydrogen chloride. Dioxane "poisons" this catalysis reaction by forming an adduct with

aluminum trichloride.

4.1.4 As a solvent

Dioxane is used in a variety of applications as a versatile aprotic solvent, e. g. for inks, adhesives, and cellulose esters.[It is substituted for tetrahydrofuran (THF) in some processes, because of its lower toxicity and higher boiling point (101 °C, versus 66 °C for THF).

While diethyl ether is rather insoluble in water, dioxane is miscible and in fact is hygroscopic. At standard pressure, the mixture of water and dioxane in the ratio 17.9:82.1 by mass is a positive azeotrope that boils at 87.6 C.

The oxygen atoms are Lewis-basic, and so dioxane is able to solvate many inorganic compounds and serves as a chelating diether ligand. It reacts with Grignard reagents to precipitate the magnesium dihalide. In this way, dioxane is used to drive the Schlenk equilibriumDimethylmagnesium is prepared in this manner

$$2\ CH_3MgBr + (C_2H_4O)_2 \rightarrow MgBr_2(C_2H_4O)_2 + (CH_3)_2Mg$$

4.1.5 Spectroscopy

Dioxane is used as an internal standard for nuclear magnetic resonance spectroscopy in deuterium oxide

4.1.6 Safety

Dioxane has an LD_{50} of 5170 mg/kg in rats This compound is irritating to the eyes and respiratory tract. Exposure may cause damage to the central nervous system, liver and kidneys In a 1978 mortality study conducted on workers exposed to 1,4-dioxane, the observed number deaths from cancer was not significantly different from the expected number Dioxane is classified by the National Toxicology Program as "reasonably anticipated to be a human carcinogen It is also classified by the IARC as a Group 2B carcinogen: possibly carcinogenic to humans because it is a known carcinogen in other animal The United States Environmental Protection Agency classifies dioxane as a probable human carcinogen (having observed an increased incidence of cancer in controlled animal studies, but not in epidemiological studies of workers using the compound), and a known irritant (with a no-observed-adverse-effects level of 400 milligrams per cubic meter) at concentrations significantly higher than those

found in commercial product Under California Proposition 65, dioxane is classified in the U.S. State of California to cause cancecer Animal studies in rats suggest that the greatest health risk is associated with inhalation of vapors in the pure form.

4.1.7 Explosion hazard

Like some other ethers, dioxane combines with atmospheric oxygen upon prolonged exposure to air to form potentially explosive peroxides. Distillation of dioxanes concentrates these peroxides, increasing the danger.

4.1.8 Environment

Dioxane has affected groundwater supplies in several areas. Dioxane at the level of 1 µg/L (~1 ppb) has been detected in many locations in the US In the State of New Hampshire alone in 2010 it had been found at 67 sites, ranging in concentration from 2 ppb to over 11,000 ppb. Thirty of these sites are solid waste landfills, most of which have been closed for years. It also has low toxicity to aquatic life and can be biodegraded via a number of pathways The problems are exacerbated since dioxane is highly soluble in water, does not readily bind to soils, and readily leaches to groundwater. It is also resistant to naturally occurring biodegradation processes. Due to these properties, a dioxane plume can be larger (and further downgradient) than the associated solvent plume.

4.1.9 Cosmetics

As a byproduct of the ethoxylation process, a route to some ingredients found in cleansing and moisturizing products, dioxane can contaminate cosmetics and personal care products such as deodorants, perfumes, shampoos, toothpastes and mouthwashes The ethoxylation process makes the cleansing agents, such as sodium laureth sulfate and ammonium laureth sulfate, less abrasive and offers enhanced foaming characteristics. 1,4-Dioxane is found in small amounts in some cosmetics, a yet unregulated substance used in cosmetics in both China and the U.S. Since 1979 the U.S. Food and Drug Administration (FDA) have conducted tests on cosmetic raw materials and finished products for the levels of 1,4-dioxane 1,4-Dioxane was present in ethoxylated raw ingredients at levels up to 1410 ppm (~0.14%wt), and at levels up to 279 ppm (~0.03%wt) in off the shelf cosmetic products Levels of 1,4-dioxane exceeding 85 ppm (~0.01%wt) in children's shampoos .

CHAPTER 5

FORMATION AND EFFECTS OF SI ENGINE POLLUTANTS

5.1 SI ENGINE POLLUTANTS IN THE EXHAUSTGAS

- Oxides of nitrogenNO_x
- Carbon monoxideCO
- Unburned hydrocarbonsHC
- Little amount of aldehydes, soot, compounds of sulphur andlead
- Vaporization of fuel into the atmospheric form the fueltank
- Evaporation of the fuel from carburetor and spillage 'loss.The maximum amount of toxic substance goes to atmosphere due to incomplete combustion of fuel and during acceleration of' the engine with engine the exhaustgas.

Table 5.1 Composition of exhaust gases in SI engine.

Pollutants	Parts per million (ppm)	%	g/kg of fuel
NOx	500 to 1000	65 to 85	20
CO	-	1-2	200
HC	3000	65-85	-
Aldehydes, ether, peroxide, acids esters	-	65-85	-
Crankcase breathering	-	20	-
Fuel tank	-	5	-
Breather carburetor (evaporation of spillage loss)	-	5 to 10	-

5.2 FORMATION OF OXIDES OF NITROGENNO_x

NO is a colourless gas which oxidizes of NO_2 in air. It is considered a severe hemotoxin, as it combines with hemoglobin in the blood to cause rapid central paralysis. $N0_2$ is a reddish brown gas with a sharp, pungent odor. It causes pronounced irritation of the respiratory system and damages lung tissues. In combination with unsaturated hydrocarbons, oxides of nitrogen causesmog.

5.3 GENERAL MECHANISMS OFFORMATION

The nitric oxide formation during the combustion process is the result of a group of elementary reactions involving the nitrogen and oxygen molecules. Different mechanisms proposed are discussed below.

5.4 SIMPLE REACTION BETWEEN O_2 ANDN_2

$$N_2+O_2 \rightleftharpoons 2NO$$

The mechanism, predicts nitric oxide concentrations much lower than those measured in internal combustion engines. According to this mechanism the formation process is too slow for NO to reach equilibrium at the peak temperatures and pressures in the cylinders.

5.5 ZELDOVICH CHAIN REACTIONMECHANISM

$$O_2 \rightleftharpoons 2O$$

$$O+ N_2 \rightleftharpoons NO + N$$

$$N +O_2 \rightleftharpoons NO + 0$$

The chain reactions arc- initiated in equation O + N2 $\rightleftharpoons$ NO + N by the atomic oxygen, formed in equation $O_2 \rightleftharpoons$ 2O from the dissociation of oxygen molecules at the high temperatures reached in the combustion process, An oxygen atom reacts with a nitrogen molecule and produces nitric oxide and a nitrogen atom. In equation N+ $O_2 \rightleftharpoons$ NO + O the nitrogen atom reacts with the oxygen molecule and forms nitric oxide and atomic oxygen.

According to this mechanism the nitrogen atoms do not start the chain reaction because a their equilibrium concentration during the combustion process is relatively low compared to that of atomic oxygen. Experiments have shown that equilibrium concentrations of both the oxygen atoms and nitric oxide molecules

increase with temperature and with leaning the mixture. It has also been observed that no decomposition of NO_2 formed at the maximum cycle temperature occurred during the expansion stroke when the gas temperature decreases.

5.6 FORMATION OF CARBON MONOXIDE (CO)EMISSION

Carbon monoxide is a colourless and odorless but a poisonous gas. It is generated in an engine when it is operated with a fuel-rich equivalence ratio. When there is not enough oxygen to convert all carbon to CO_2, Some fuel does not get burned and some carbon ends up as CO. Typically the exhaust of an SI engine will be about 0.2 to 5% carbon monoxide. Not only is CO considered an undesirable emission, but it also represents lost chemical energy. CO is a fuel that can be combusted to supply additional thermal energy

$$CO + ½ O_2 \rightarrow CO, + heat$$

Maximum CO is generated when an, engine runs rich. Rich mixture is required during starting or when accelerating under load. Even when the intake all-fuel mixture is lean some CO will be generated in the engine. Poor mixing local rich regions, and incomplete combustion will also be the source for COemissions.

A well-designed SI engine operating under ideal conditions can have an exhaust mole fraction of CO as low as 0.001.

5.7 FORMATION OF HYDROCARBONEMISSION

Unburned hydrocarbon levels in the exhaust of a spark ignition engine under normal operating conditions are typically in. the range of 1000 - 3000 ppm. This corresponds to about 1 to 2.5 % of the fuel flow into the engine. HC emissions rise rapidly as the mixture becomes substantially ally riches than stoichiometric. When the combustion deteriorates. eg., which very lean mixture, HC emissions, can rise rapidly due to incomplete combustion or misfire in a fraction of the engine's operating cycle. There here are four possible HC emission formation mechanisms for spark ignitionengines.

- Flame quenching at the combustion chamber walls, leaving a layer of unburned air fuel mixture adjacent to thewall.
- The filling of the crevice volumes with unburned mixture which escapes the primary combustion process since the flame quenches at the creviceentrance.

- The largest of these crevice region is the volumes between the piston, piston rings and they cylinder wall. Other crevice volumes are the threads around the spark plug, the space around the plug centre electrode, crevices around the intake and exhaust valve heads and the head gasket crevice. HC emissions can be reduced by moving the top piston ring as close to the crown of the piston as possible, and scaling this ring at top and bottom in its groove with Orings.
- Absorption of -fuel vapour into oil layers on the cylinder wall during intake and compression, followed by desorption of fuel vapour into the cylinder during expansion and exhaust. Some of the desorbed fuel vapour will mix with high temperature combustion products and oxidize. However, desired vapour that remains in the cool boundary layer or that mixes with the cooler bulk gases late in the cycle may escape full oxidation and contribute to unburned HCemissions.
- Incomplete combustion in a fraction of the engines operating cycles. Extremely rich or lean mixtures or exhaust gas dilution in large quantity lead to incomplete combustion. Factors, which leads to incomplete flame propagation and misfire.are:
  - Poor carburetor and mixture preparation - A/F ratio not adequately controlled.
  - Poor ignition system - spark timing improper,Excess exhaust residual. gas within the cylinder - poor scavenging due to impropervalve
  - Poor swirl and turbulence in the combustion.

A part from the above combustion related four mechanisms, another important source of unburned hydrocarbon emission is exhaust scavenging. During scavenging, 15 to 40 % of the entering fresh mixture flows though the cylinder directly into the exhaust and escapes the combustion process completely. This is the main source of hydrocarbon emission particularly in two stroke cycleengines.

Hydrocarbons are emitted into the atmosphere during filling of the -fuel tank, running in urban areas under hot climatic conditions are when a vehicle is stationary following hotrunning.

The mass of fuel evaporated from the fuel tank, depends on the fuel volatility, fuel temperature, area of liquid vapour surface, volume of tank not filled

with fuel, presence of vapour release cap and degree of agitation and duration near maximum temperature.

Based on the above wall all theory. The HC concentration of the exhaust gas from a SI engine could be reducedby:

- Higher temperature of the exhaust gasby
  - Decreasing the compression ratio
  - Retarding the spark timing
  - Increasing the charge and coolant temperatures, the speed and charge pressure
- More oxygen in the exhaustby
  - Leaning I themixture
  - Adding oxygen orair
- Smaller mass in quench envelopeby
  - Decreasing, the area of the combustion chamberwalls
  - Higher volume/surfaceratio
  - Greater displacement per cylinder with fewercylinders
  - Smaller bore/strokeratio
- More time for reactionby
  - Decreasing thespeed
  - More homogenousmixture
    - Higher charge temperature and
    - More volatilefuel.

5.8 CRANK CASE GASES(BREATHERING)

The piston and its rings are designed to form a gas-tight seal between the sliding piston and the cylinder walls. However, in practice some compressed charge and burnt fumes, which manage to escape and enter the crankcase this gases are called blow by gases.

These gases having un burnt air-fuel mixture hydrocarbons or burnt(or partially burnt) products of combustion, carbon dioxide, water or carbon monoxide.

Blow-by takes place between the piston ring gap, piston-ring topiston- groove clearance and the piston ring circumferential shape cannot accurately follow the contour of an oval or bell-mouthed cylinder wall.

Piston blow-by can become a major problem above some critical engine speeds if ring, flutter occurs due to the ring directional movement of the piston. This problem has largely been reduced by decreasing the width of the piston rings (and therefore the weight of each ring) and by increasing ring radial cylinder-wall pressure. Nevertheless, there is one critical speed for each with of piston ring. Fortunately, however, a good design is able to restrict flutter so that is occurs outside the normal speed range of the engine, provided that the ring-to- groove clearance does not becomeexcessive.

The effect of blow by gases it leads to a high concentration of combustible air-fuel mixture which causes an explosion in the crankcase. The air-fuel mixture, partially burnt and fully burnt vapour fumes will condense and contaminate the engine's lubricating oil. This may cause the lubricant's molecular structure to break-down, thereby reducing its oiliness and oxidizing resistance and, at the same time, produce sludge with the result that the bearings are subjected to much higher were rates.

Since it is impossible to eliminate piston blow-by completely, due to convection current circulates the crank-case and rocker or camshaft cover spaces and consequently carries the unwanted fumes out with it. The removal of blow-by gases and vapour fumes from the crankcase is obtained by creating a partial depression at one outlet location so that the blow-by gases under pressure (escaping between the piston and cylinder wall) are attracted towards the lower pressure region of the crankcase, finally expelled the blow by gases.

5.9 VAPORIZATION OF FUEL INTO THE ATMOSPHERIC FORM THE FUEL TANK

The hydrocarbon vapour losses from a fuel tank arise primarily from the evaporation process. Because the tank temperature changes slowly. The evaporation process is nearly an equilibrium one. At night the tank cools and both liquid and vapour contract, thereby allowing ambient air to be inhaled into the vapour space of the tank. During the day, especially during and after severe hot operation of the engine, tank temperatures rise depending on circumstances As a result of such increase in tank temperature, the liquid and vapour increase UI volume and the tank expels some hydrocarbon vapour airmixture.

The basic factors governing Fuel tank losses are:

- The initial and final fueltemperatures
- The volume of the tank not filled withfuel
- The composition of the fuel, especially thelightC4andC5ends
- The area of liquid vapoursurface
- The length of time or degree of agitation of the tank near its maximum temperature
- The presence of a pressure reliefcap.

The fuel generated vapour pressure depends on the presence in the liquid of highly volatile constituents (high vapour pressure) and the amount of each constituent present. If the tank temperature is to be increased, the partial pressures would increase. It is clear that from, the point of view of evaporative emissions, it is undesirable to have fuel components in any significant amount which have high vapour pressures at lowtemperatures.

If the unfilled tank space is increased, more 'fuel must evaporate to increasing the loss. The tank emissions increase linearly as the amount of fuel in the tankdecreases.

The presence of C_4 olefins gives a high vapour (lie evaporation losses. A reduction of these components in the fuel would reduce the evaporative losses. These compounds are highly reactive with smog-forming potential.

Design factors that affect the evaporative losses include the peak tank temperature, the area of the liquid vapour surface, and the amount of agitation. It is obvious that any design change which reduces the peak tank temperature will reduce the 'Lank loss. Such modifications include tank insulation, lower surface to volume ratio of tank, better tank orientation or location for reduce heat pick up from solar radiation or other heat sources such as the exhaustsystem.

The surface area for evaporation and tank agitation are factors which influence the speed with which equilibrium is achieved. Baffles in the tank can reduce losses by maintaining concentration gradients.

5.10 EVAPORATION OF THE FUEL FROM CARBURETOR ARID SPILLAGELOSS

Carburetor hydrocarbon vapour losses arise from Float bowl. Carburetor fuel temperature often reaches 55 ❙❙ C during warm weather engine operation and may raise up to 80❙❙C during a hot soak. During the soak, a significant fraction of the fuel will boil off and a large portion escape into the atmosphere. There is considerable rise in temperature of fuel system during shutdown after a hardrun.

The basic factors governing the Carburetor losses

- ❙❙ Maximum fuel bowltemperature
- ❙❙ Amount of fuel in thebowl
- ❙❙ Amount of after fill,and
- ❙❙ Distillation curve of thefuel

The carburetor bowl volume has a significant effect on evaporative losses. Increase in the volume of the bowl increases the losses linearly. If an insulated spacer is placed between the carburetor and the inlet, losses can be minimized.

5.11 EFFECTS OF IC ENGINE POLLUTION ON HUMANHEALTH

The prime factors affecting the human health care;

- ❙❙ Nature of thepollutants
- ❙❙ Concentration of thepollutants
- ❙❙ Duration of exposure
- ❙❙ State of health ofreceptor
- ❙❙ Age group ofreceptor
- ❙❙ The effect of air pollution is great among infants, elderly and the infirm and chronic disease of lungs and heart. The effect of air pollution on human health is worst during winter season and objectionable odour, visibility reduction, eye irritation and vegetation damage are some of' the effect of airpollution.
- ❙❙ Air born gases, vapours, fumes, mist and dust may cause irritation of membranes of eyes, nose, throat and lungs, digestictrack.

5.12 HEALTHEFFECTS

- Eyeirritating
- Nose and throat irritation
- Irritation of the respiratorytrack
- Gases like hydrogen sulphide ammonia and methane cause odour nuisance even at low concentration.
- Increase in mortality rate and movidity (a diseaserate)
- Carcinogenic (substances producing cancer) agent causecancer
- Dust particles cause respiratory disease like siliconsis, a testosis results from specific dust
- Such as heavy metals 'like lead may enter the body through the lungs and cause poisoning,effect.
- Carbon monoxide combines with hemoglobin in the blood and consequently increase stress on those a suffering from cardiovascular and pulmonaryeffect.
- Hydrogen fluoride cause disease of bone and mottling of teeth (dark softer row)Chronic pulmonary disease like bronchitis and asthrma arc aggravated by high concentration of SO_2, NO_2 particulate matter and photochemicalsmog.

5.13 SPECIFIC POLLUTANTS

CO

- It combines with hemoglobin in blood to -form carboxyl hemoglobin (CO Hb). This reduce the ability of Hb to carry oxygen to the bodyissues
- Co effect the central nerves system and responsible for heart attacks and high mortalityrate.

Oxides of nitrogen (NO_x)

- NO, NO_2 are cause high eyes and nose irritation after exposure to about 15 ppm of NO_2 and pulmonary discomfort after exposure of 25 ppm ofNO_2
- NO_2 from electric arc welding, IC. Engine, manufacturing of nitric acid, fertilizers and mining utilizing nitrogen compound, asexplosives.

Hydrocarbonvapours

- The effect of formaldehyde in primarily irritating natural it is major contributed to eye and respiratory irritation cause by photo chemicalsmoke.

Lead

- In organic lead act as an agent which cause variety of human health problems. The effect include gastro intestinal damage lever, kidney damage, abnorminalities in fertility and pregnancy and metal development ofchildren
- In urban area lead having the concentration1-3 g/m^3

Sulphur Di-oxide

- It is an irritant gas which affects the human body membranes SO_2, SO_3 sulphurous and sulphuric acid are the variousforms.
- Sulphur tri oxide (SO_3) is every strong irritant compare to sulphur dioxide causing severe dronchospasms at relatively low level ofconcentration

CHAPTER 6

EXPERIMENTAL SETUP AND PROCEDURE

6.1 Experimental setup

A Vertical in line TATA NANO engine with MPFI, water cooled, twin cylinders, four stroke, 73.5 mm bore, 73.5 mm stroke, 624 cc displacement 9.5:1 compression ratio with rated speed 2500 rpm, engine is used for the experimental work. The engine is coupled with an Eddy current dynamometer for load measurement. Exhaust emission viz, Hydrocarbons, Carbon monoxide, NO_x were measured by using AVL Di-gas analyzer.

Table 6.1 Specification of the test engine (TATA NANO)

Type	Vertical In-line Engine with MPFI
No.of.Cylinder	2
Displacement	624 cc
Bore	73.5 mm
Stroke	73.5 mm
Compression Ratio	9.5:1
Fuel	Petrol
Cycle	4-Stroke
Max. Engine output	25.74 kW @ 5250 rpm
Max. Torque	48 Nm @ 3000 rpm
Speed	2500 rpm
Orifice Diameter	20 mm
Cooling System	Water
Loading Device	Eddy current Dynamometer

6.2 Loadmeasurement

The test engine is coupled to an eddy current dynamometer. A photo sensor along with a digital rpm indicator is used to measure the speed of the engine. The voltage pulse from the sensor was sent to the digital rpm meter for pulse conversion and display of the engine with an accuracy of one rpm.

6.3 Fuel supplymeasurement

Fuel flow rate was measured on mass basis using a weighing balance and stop watch. Fuel is supplied to the engine from the fuel tank placed above the weighing balance for fuel measured. The fuel is supplied to the engine with the help of electronic fuel injection pump. The fuel flow rate can be obtained by noting the time taken for one minute and repeat the same for three times to take the average of the fuel consumption.

6.4 Measurement of HC, CO and NO_xemission

Exhaust emission of hydrocarbons, carbon monoxide and oxides of nitrogen were measured on the dry basis. AVL Di-gas analyzer is used for the test. The exhaust gas to be evaluated was passes through a cold trap moisture separator and filter element to prevent water vapour and periodically calibrated with standards gas, according to the instruction of the manufacturer. Hydrocarbon and oxides of nitrogen were measure in parts per million (ppm) carbon monoxide in terms of percentage by volume, the specification of the TATA NANO engine is given by table5.1.

6.5 Measurement Procedure

The following tests were conducted on TATA NANO engine, operated by Gasoline and Gasoline blends with bio-additives.

- Performance test
- Emissiontest

6.6 Procedure for performancetest

The experimental setup is shown in Figure 5.1. The level of the fuel and lubricating oil were checked before starting the engine. The eddy current dynamometer control unit panel is switched "ON' to note down the load, speed and temperature from the indicator provided in the panel board.

Then the ignition switch is turned "ON" position. The fuel flowed from the fuel tank through the electronic fuel injection pump and then started the engine at no load condition. The engine was allowed to run with sole fuel at a constant speed of 2500 rpm for nearly 30 minutes to obtain steady state condition. The cooling water temperature reached 50◦C. Fuel consumption was measured by stop watch for one minute of fuel. In the same readings for 20%, 40%, 60%, 80% and full load were observed. After taking the required readings the ignition switch is turned "OFF" position to stop the engine and the eddy current dynamometer control unit panel was also switched "OFF".

6.7 Procedure for emissiontest

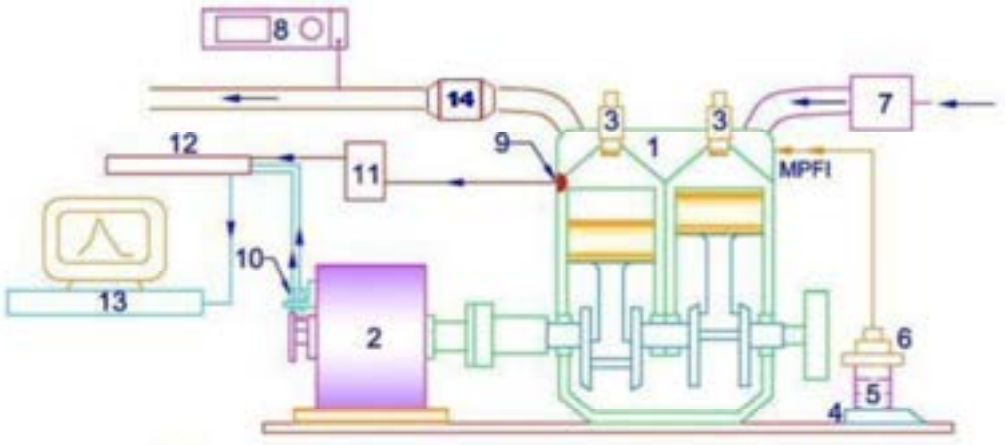
Switch "ON" the exhaust gas down analyzer through the electrical power supply and also allow it to settle down for 15 minutes. Allow the display to settle at zero readings.

- Run the engine as per load testprocedure.
- Hold the sampling probe in the exhaust gas outlet (CO, HC and NO_x). Now digital display will show the readings. These readings start increasing and at the maximum value, the values stand for few seconds and then the reading start reading. Take the minimum value of the reading corresponding to CO, HC and NO_x.
- Take out the sampling probe from exhaust gas outlet and allow the display to settle at zeroreading
- Repeat the same procedure for different loads of different blends offuel.

Table 6.2 Specifications of AVL Di gas analyzer

Make	AVL
Type	AVL Di Gas 444
Power Supply	11...22 voltage ≈ 25 W
Warm up time	≈ 7 min
Connector gas in	≈ 180 l/h, max.over pressure 450 hPa
Response time	T95 ≤ 15s
Operating temperature	5...45 ◦C
Storage temperature	0...50 ◦C
Relative humidity	≤ 95%, non-condensing
Inclination	0...90°∠
Dimension (w x d x h)	270 x 320 x 85 mm^3
Weight	4.5 kg net weight without accessories
Interfaces	RS 232 C, Pick up, oil temperature probe

Figure 6.1 Schematic view of experimental setup (TATA NANO Engine)



1.NanoEngine
2.EddyCurrentDynamometer
3. SparkPlug
4. WeighingBalance
5. FuelTank
6. FuelPump
7. AirFilter
8. Avl Di Gas Analyser
9. PressureTransducer
10. Crank Angle Encoder
11. Charge Amplifier
12. Indimeter
13. Monitor
14. Muffler

Figure 6.2 Photographic view of Experimental setup (TATA NANO Engine)

Sample Calculation

Engine Specification:

Brake Power = 8 kW;

Speed = 2500rpm;

C =9549.3 {Dynomometer Constant}

Load Test Formula:

BP =WN/C in kW

To find maximum Load or T_{max}:

BP =WN/C

Wmax =BP × C ÷ 2500inNm {W_{max} – Maximum Torque}

Wmax = 8 × 9549.3 ÷ 2500 = 169.85Nm

W_{max}= 30.6 Nm

Based on Load (20%, 40%, 60%, 80%, 100%):

% of Load	**T_{max} - Nm**
20% = 0.2×30.6	6.12
40% = 0.4×30.6	12.24
60% = 0.6×30.6	18.36
80% = 0.8×30.6	24.43
100%	30.6

1) FC_1=Vol.Flow rate, CC/g; Density of fuel, kg/CCX3600s/hr

FC_1 = (W1-W2) X 60 kg/hr

FC_1 = (2.500-2.480) × 60 kg/hr

FC_1 = 1.2 kg/hr

20% Brake Power in kW

BP_1= W × N ÷ C kW

BP_1 = 6.12 X 2500 ÷ 9549.3

BP_1=1.6 kW

2) Specific fuel consumption,kg/kW-hr

SFC= FC÷BP

SFC= 1.2 ÷1.6

SFC= 0.75kg/kW-hr

3) Fuel Power(Fu.P) or Heat input, Kw:

FuP_1 =FC1 × C.V÷ 3600 {CV-Calorific value}

FuP1 = 1.2 × 44000÷3600

FuP_1 = 14.66 kW

4) Brake thermal

Efficiency:B.therm η_1 = BP ÷

FuP×100 B.therm η_1 = 1.6 ÷

14.66×100

B.therm η_1 =10.91%

Table 6.3 Result tabulation by using Petrol

Load (%)	Brake Thermal Efficiency (%)	SFC (Kg/kW hr)	CO (% vol)	HC (ppm)	NOx (ppm)
20	11.80	0.7230	0.48	14.5	6
40	16.50	0.5233	0.50	27.2	10
60	20.70	0.3878	0.51	29.1	16
80	22.40	0.3618	0.49	28.2	17
100	22.38	0.3822	0.76	28.4	18

Table 6.4 Result tabulation by using 10% 1,4 Dioxane

Load (%)	Brake Thermal Efficiency (%)	SFC (Kg/Kw hr)	CO (%vol)	HC (ppm)	NOx (ppm)
20	12.40	0.702	0.46	13.0	7
40	16.80	0.521	0.49	25.5	11
60	21.00	0.371	0.49	27.0	16
80	22.70	0.352	0.48	27.0	18
100	22.80	0.367	0.68	26.0	61

Table 6.5 Result tabulation by using 20% 1,4 Dioxane

Load (%)	Brake Thermal Efficiency (%)	SFC Kg/kW hr	CO (% vol)	HC (ppm)	NOx (ppm)
20	12.28	0.676	0.45	12.0	8
40	16.97	0.517	0.48	24.0	13
60	21.28	0.363	0.48	26.0	17
80	23.07	0.342	0.47	26.0	19
100	23.19	0.346	0.63	25.0	65

Table 6.6 Result tabulation by using 30% 1,4 Dioxane

Load (%)	Brake Thermal Efficiency (%)	SFC Kg/kW hr	CO (% vol)	HC (ppm)	NOx (ppm)
20	13.15	0.662	0.45	12	9
40	17.32	0.512	0.47	24	12
60	21.69	0.343	0.47	25	17
80	23.40	0.321	0.46	24	20
100	24.94	0.332	0.61	24	78

CHAPTER 7

RESULT AND DISCUSSION

The experimental investigations were conducted by the alternate fuel such as 1,4 dioxane. The fuels were blended with sole fuel by 10%, 20%, 30%. The investigations were experimentally conducted in twin cylinder, MPFI, TATA NANO gasoline engine by various load conditions and maintained as 2500rpm constant speed of theengine.

a) Brake thermal efficiency

In SI engines the higher the octane number the better brake thermal efficiency is expected, i.e., due to the improved compression ratio, in case of blended fuel. The variations of brake thermal efficiency against load applied for 10% 20%, 30% of 1,4 Dioxane blended gasoline

The blend 30% having higher brake thermal efficiency when compared to that other blend and sole gasoline fuel. The brake thermal efficiency of the blend is 2.09% increased compared to that of sole fuel. Here clearly revealed the increased efficiency due to the incorporation of blends in the Gasoline engine. the brake thermal efficiency increased with the increasing load of theengine.

Main reason for this situation is the decrease in brake specific fuel consumption. It has been reviewed that the use of blends have positive influence on octane rating of the fuel hence it is quoted that increased use of blends have increased the overall brake thermal efficiency of the engine .

b) Specific fuel consumption

The variations of specific fuel consumption against load for 10%,20%, 30% of 1,4 dioxane blend with gasoline fuel . It is noticed that 1,4 dioxane blend 30% shows lower specific fuel consumption compared to all above the percentage.

It indicates the decreased specific fuel consumption of the engine with blended fuel. The SFC is reported as 0.382, 0.322, 0.310kg/kW-hr respectively. Certainly, these downwards in brake specific fuel consumption are normal due to the higher energy content of the dioxane. The increased load also significantly decreases the specific fuelconsumption.

c) Oxides ofnitrogen

The variations of NOx emission against load for 10%,20%, 30% of 1,4 dioxane blend with gasoline fuel .It is noticed that NOx emission is slightly increased for 30% blends compared to sole fuel and other percentage. The blend has 20% increased NOx emission compared to sole fuel.

The NOx emission is 50, 78, 86ppm respectively. It is due to adding 1,4 dioxane in gasoline fuel octane number is increased. Increased octane number for dioxane blends improves the combustion quality which is increase the incylinder temperature.

b) Carbonmonoxide

The variations of CO emission against load for 10%,20%, 30% of 1,4 dioxane blend with gasoline fuel . The blend 30% has lower CO emission which is 22% decreases compared to sole fuel. The CO emission are 0.76, 0.61, 0.59% of volume respectively. Carbon monoxide is a product of incomplete combustion due to an insufficient amount of air in the air– fuelmixture.

When 1,4 dioxane is mixed with gasoline, the combustion of the engine becomes better, and therefore CO emission is reduced. The concentration of CO decreased as the volume percentage of ethanol fuel is increased in the fuel mixture. This is due to the reduction in carbon atoms concentration in the blended fuel and the high molecular diffusivity and high flammability limit which improve the mixing process and hence combustion efficiency.

c) Hydrocarbon

The variations of HC emission against load for 10%,20%, 30% of 1,4 dioxane blend . HC emission is decreases for 1,4 dioxane blends compare to sole fuel. The blend 30% is decreases by means of 22.5% compared with sole fuel. The HC emission are identified by 28, 24, 22 ppm respectively. The HC emission decreased due to better combustion. HC emission is decreases as the oxygen content of 1,4 dioxane causes the reaction to move towards completecombustion.

CHAPTER 8

CONCLUSION

The main conclusions of this study are;

1. The experimental investigations with gasoline fuel blended with 10% 20%, 30% of 1,4 dioxane have been carried out to determine the best fuel blend with various load of theengine.
2. The performance and emission characteristics were investigated on twin cylinder, MPFI, TATA NANO car engine with 1,4 dioxane as alternate fuel.
3. The physical properties of 1,4 dioxane were measured by ASTM standard and compared to that of sole fuel.
4. Among the blends of 1,4 dioxane, 30% shows better performance and emissioncharacteristics.
5. The blend 30% shows increased brake thermal efficiency than that of sole fuel. It has shown an increase of 2.09% when compare to sole gasolinefuel.
6. The blend 30% show significant reduction in CO, HC emission and increases of NO_x emission when compared to that of sole gasoline fuel. The decreases of CO, HC emission is 22%, 23% respectively and increases of NOx emission is20%.

REFERENCES

1. Abdel-Rahman, M.M.Osman, Experimental investigation on varying the compression ratio of SI engine working under different ethanol-gasoline fuel blends, *International Journal of Energy Research,* Vol. 21, pp.31-40,1997.

2. Ananda Srinivasan, C.G. Saravanan, Study of Combustion Characteristics of an SI Engine Fuelled with Ethanol and Oxygenated Fuel Additives, Journal of Sustainable Energy & Environment, Vol.1, pp.85-91,2010.

3. V. Balaji Raman, X. Alexander, Emission and performance test on petrol engine using fuel Modification, International Journal of Emerging Technology and Advanced Engineering, Vol.3, pp.119-123,2018.

4. T. Shanmuga Vadivel, C. G. Saravanan, P. Balashanmugam, Experimental Investigation on the Performance and Combustion Characteristics of a Gasoline Engine run with Ethanol Blend, *International Journal of Engineering Sciences,* Vol(3), pp. 25-32,2018.

5. A.N.Basavaraju, Dr.Joseph Gonsalvis, Dr.B.Yogesha, Performance study of methanol blended petrol in SI engine, *International Journal of Engineering Science Invention,* Vol.2, PP.01-07,2018

6. V. Saikrishnan , A. Karthikeyan , J. Jayaprabakar, Analysis of ethanol blends on spark ignition engines. Taylor and Francis, International Journal of Ambient Energy,2017.

7. Sebastian Verhelst, James WG Turner, Louis Sileghem, Jeroen Vancoillie, Methanol as a fuel for internal combustion engines. Progress in Energy and Combustion Science, Vol.70, pp.43–88,2019.

8. Ashraf Elfasakhany, Investigations on the effects of ethanol-methanol-gasoline blends in a spark-ignition engine: Performance and emissions analysis. International Journal of Engineering Science and Technology, Vol.18, pp.713-719, 2015.

9. Prakhar Chansauria, R. K. Mandloi, Effects of Ethanol Blends on Performance of Spark Ignition Engine-A Review. Materials Today: Proceedings, Vol.5, pp.4066–4077, 2018.

10. Sandip Shyamsundar Gadewad, Pankaj Mishra, Abhishek Bhandari, Performance on spark ignition engine using ethanol and petrol blends. International Journal of Research in Science & Engineering, Volume: 3 Issue: 3, pp.356-362,2017.

ROOM AIR CONDITIONING USING HEAT PIPE

PROJECT WORK (PHASE -II) REPORT

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ABSTRACT

Heat pipes are very flexible systems with regard to effective thermal control. They can easily be implemented as heat exchangers inside sorption and vapour-compression heat pumps, refrigerators and other types of heat transfer devices. Their heat transfer coefficient in the evaporator and condenser zones is 103–105 W/m^2 K, heat pipe thermal resistance is 0.01–0.03 K/W, therefore leading to smaller area and mass of heat exchangers. Miniature and micro heat pipes are welcomed for electronic components cooling and space two-phase thermal control systems. Loop heat pipes, pulsating heat pipes and sorption heat pipes are the novelty for modern heat exchangers. Heat pipe air preheaters are used in thermal power plants to preheat the secondary–primary air required for combustion of fuel in the boiler using the energy available in exhaust gases. Heat pipe solar collectors are promising for domestic use. This paper reviews mainly heat pipe developments in the Former Soviet Union Countries. Some new results obtained in USA and Europe are also included.

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CHAPTER 1

INTRODUCTION

Recent heat pipe (HP) R&D (conventional heat pipes, heat pipe panels, loop heat pipes, vapour-dynamic thermosyphons, micro/miniature heat pipes, sorption heat pipes, etc.), oriented on different industry application is listed in this paper. Sorption technologies with heat pipe thermal control are efficient with an emphasis on implementation and integration of sorption machines in industry, as well as domestic, commercial, administrative buildings and transport for heating, cooling, air-conditioning, heat recovery and use of waste heat. The heat pipe thermal control system is the key element of the heat pump, refrigerator, heat transformer, and gas and energy storage devices.

Sorption machines with heat pipes as heat exchangers have some advantages such as short time cycle, improved compactness of cascading machines (less intermediate elements), increased coefficient of performance (COP) due to intercascaded heat recovery. Sorption machines with heat pipe thermal control can be used combined with solar energy, process heat recovering (waste heat), or a burning fuel as their driving energy source.

In some cases there is a possibility to combine the application of different energy sources (solar/ gas, solar/electricity) in the same prototype of heat pump due to heat pipe application as heat exchangers. Actually an investigation of hydrocarbons boiling heat transfer related to applications of heat pipes and thermosyphons as thermal control systems in refrigeration technology, liquid hydrocarbons gasification, electronic components, fuel cells, etc. is important.

CHAPTER 2

LITERATURE REVIEW

L.L. Vasiliev (1998), "STATE-OF-THE-ART ON HEAT PIPE TECHNOLOGY".

The paper is a review of recent survay of developments on heat pipes and thermosyphons in the former Soviet Union. The paper discussed practical heat pipe applications in space programs, industry, agriculture and is based on commonly available equipment. Heat pipe R&D in Russia, Ukraine, Belarus and other CIS countries is analysed.

R.E. Critoph, (2000),,,,,Heat Pipes, Heat Pumps, Refrigerators"".

Some sorption refrigeration machines (sorption technologies) developed in Belarus are presented in this paper with emphasises on different heat pipes application: conventional heat pipes, heat pipe panels, loop heat pipes, vapour-dynamic thermosyphons, etc. Heat pipes are very flexible systems with regards to the effective thermal control. They can easily be implemented inside sorption refrigerators and other types of refrigerators [1]. Their heat transfer coefficients are typically in the range of 10^3–10^5 W/m^{2}K, therefore lead to smaller area and mass of heat exchangers. Sorption machines are used for more than 50 years, but recently its parameters became competitive with the vapour compression cycles. One of possibilities to improve the sorption machines parameters is heat pipe (HP) application as thermal control systems.

C. Kren, etal., (2002) "Proceedings of the International Sorption Heat Pump Conference".

It has already been shown that efficiency of direct-fired absorption chillers or tri-generation systems (CCHP) can be increased if the hot flue gas - from internal gas burner or from motor engines or gas turbines - is successively utilized in the absorption cycle at several temperature levels. For successful realization of such concepts, however, efficient heat exchanger designs are required. An increase in complexity on the flue gas side of the chiller must not introduce a proportional increase in size, cost, and pressure drop. Thus, the development of a compact and efficient flue gas fired regenerator design with low flue gas pressure drop is a major step towards *COP* increase in direct-fired and exhaust-fired absorption chillers.

B. Spinner, etal., (1996), "Proceedings of the Absorption Heat Pump Conference".

Solid sorption coolers have a good potential to be used in the air-conditioning, electronic thermal control and transport applications. Recently it is focused on the application in a small-scale combined cold, heat and power system, which utilizes the motor waste heat for cold production (tri-generation system).The main feature of this cooler is the innovative adsorbent bed consisting on a heat pipe heat exchanger, in which the finned tubes (heat pipes) are coated with an active carbon fiber "Busofit" layer, saturated with different metal salts. In this way, the advantageous sorption properties of the complex compound ("Busofit" + metal salts) and the good heat transfer quality of the coated heat pipe are joined in an advanced sorption cooler, which can be heated by the low temperature heat source. This cooler ensures availability of two sources of cold.

R.Z. Wang, (2000), ,,,,Heat Pipes, Heat Pumps, Refrigerators"".

Heat pipes are very flexible systems with regard to effective thermal control. They can easily be implemented as heat exchangers inside sorption and vapor-compression heat pumps, refrigerators and other types of heat transfer devices. Heat pipe air pre-heater is used in thermal power plants to preheat the secondary–primary air required for combustion of fuel in the boiler using the energy available. A novel type of heat pipe application for cold energy storage has been proposed and discussed in this paper. The cold storage system is aiming to save electricity for data center cooling. A typical wickless heat pipe - thermo siphon (thermal-diode heat pipe) will be employed in this application. The thermo siphon cold energy storage systems can be designed into several types that are ice storage, cold water storage and pre-cool heat exchanger.

Groll.M. etal.,(1984) Heat recovery units employing reflux heat pipes as components. Commission of the European Communities.

Heat recovery is an important measure to conserve thermal energy. Thermal energy can be recovered e.g. from sewage, waste air and flue gases of households and industrial processes. Examples are heat recovery in apartment and public buildings, hospitals and conference buildings by means of air conditioning installations, heat recovery from drying processes (wood, plastic, paper and textile industries, plant drying installations), furnaces and kilns (foundries, ceramic and glass industries), chemical and petrochemical processes, power stations. There exist various heat recovery methods, and different equipments are used. Heat recovery units employing gravity-assisted heat pipes or closed two-phase thermosyphons ('reflux heat pipes') as components are competing with other regenerators and recouperators. For the discussed temperature range from about ambient temperature up

to about 300/sup 0/C, competing devices are pumped-loop heat exchangers, plate heat exchangers, tubular recuperators (e.g. glass tube units) and rotating heat exchangers.

Deverall,J.E.,(1970) Mercury as a heat pipe fluid American Society of Mechanical Engineers.

In the temperature range of 450-700 K, there are currently no working fluids that have been validated for heat pipes and loop heat pipes, with the exception of water in the lower portion of the range. This paper reviews a number of potential working fluid including several organic fluids, mercury, sulfur/iodine, and halides. Physical property data are used where available, and estimated where unavailable using standard methods. The halide salts appear to possess attractive properties, with good liquid transport factors, and suitable vapor pressures. Where nuclear radiation is not a consideration, other potential working fluids are aniline, naphthalene, toluene, and phenol. The limited available life test data available suggests that toluene, naphthalene, and some of the halides are compatible with stainless steel, while the other fluids have not been tested.

Bienert.W, (1973)Heat pipes for solar energy collectors. 1st International Heat Pipe Conference.

These Several techniques for heat transfer enhancement have been introduced to improve the overall thermal performance of heat exchangers resulting in the reduction of the heat exchanger size and the cost of operation. In general, the heat transfer enhancement techniques can be classified into two methods including active method (requires external power source) and passive method (not requires external power source). The mechanism for improvement of heat transfer performance in the passive method is promoting the turbulence near the tube wall surface to reduce the thermal boundary layer thickness. This turbulence introduces a chaotic fluid mixing which acted by several enhancing modified tubes such as a finned tube, tube with rib, tube with spirally roughened wall, corrugated tube, fluted tube, helical tube, elliptical axis tube and micro-fin tube, etc.

Kemme,J.E., etal.,(1978) Proceedings of the III International Heat Pipe Conference, Palo Alto.

Development activity in heat pipe and thermosyphon technology in the Americas from January 1990 through December 1995 is surveyed. This period was selected because of the lack of a regional report for the Americas at the 8th International Heat Pipe Conference and the high level of activity since 1990. Heat pipe related journal articles and conference papers as well as books by American authors are cited. This report is by no means comprehensive. Only representative citations are given, as their vast number from various sources make selection in every report section mandatory. Because coverage of a

six year period is attempted, a bibliographic form was selected rather than the more customary summary form. Mention is also made of some products developed by commercial heat pipe manufacturers in the US and Canada who do not normally publish their work.

Roesler, A.etal.,(1991) Proceedings of the 7th International Heat Pipe Conference.

These simple looking devices have intriguing thermo-hydrodynamic operational characteristics. In fact, it is rare to find a combination of such events and mechanisms like bubble nucleation and collapse, bubble agglomeration and pumping action, flow regime changes, pressure/ temperature perturbations, dynamic instabilities, metastable non-equilibrium conditions, flooding or bridging etc., all together contributing towards the thermal performance of a device. Recent literature suggests that important milestones have been achieved in characterization of these devices. Yet, the very definition of PHPs is quite vague. The paper addresses this fundamental issue and attempts to define the device in terms of controllable thermo-mechanical boundary conditions. Such an exercise is deemed necessary to benchmark the operational performance limits and to help in system analysis.

CONCLUSION OF LITERATURE SURVEY

Above all, concluded that the overall literature survey for the working of Heat Pipe as a Room Air Conditioning system of our Project work literature survey.

CHAPTER 3

CONSTRUCTION AND DEVELOPMENT

In this chapter we will discuss the main components of heat pipe and the materials used.heat pipes was written the materials and components of heat pipe have remained essentially the same. Never the less life tests have had an opportunity to extend over a further 10-year period and some working fluids have lost their attractiveness. This may be dictated by health and safety consideration or by environmental pressure for example the use of chlorofluorocarbons is now banned and in some countries in Europe the application of hydrofluorocarbons (HFCs) is being phased out in favour of fluids that contribute less to global warming.

The temperature range affected by these trends is principally between 50^0C and 100^0C. This affects products in the electronics thermal control domestic and heat recovery areas as well as (although less important in the context of global warming) spacecraft.

The issue of compatibility and the result of life tests on heat pipe and thermosiphons remain critical aspects of heat pipe design and manufacture. In particular the generation of non-condensable gases that adversely affects the performance of heat pipes in either shorts term or long term must taken particularly seriously in the emerging technology of micro heat pipes and arrays of such units.

An aspect of heat pipes that has always been of interests is the compatibility of water with steel (mild or stainless variants). The superior properties of water and the low cost of some steel together with their strength make the combination of water steel attractive if sometimes elusive.

A considerable quantity of an heat pipe life teste was accumulated in the 1960s-1980s.To many this was the most active period of heat pipe research and development and in many applications heat pipes are now routine components in many terrestrial and space applications .It is therefore important to retain much of the early life test data (often now discarded in paper copies of reports from company libraries etc.) thus apart from examples where the fluids have been discarded due to environmental or other considerations (for example refrigerants such as R11 and R133) the historical data are retained in this new

edition of Heat Pipes The majority of the fluids materials and operating conditions remain the same, so the test data remain valid and should be of not just archival value to those entering the heat pipe field.

However, the importance of the tests at each laboratory, once new designs are made remains great,

The materials required are as follows:

- Thermocol
- Aluminium channels
- Heat pipes
- Submersible pump
- PVC pipes and clamps
- RTD temperature monitor
- Temperature sensor probe

The three basic components of a heat pipe are as follows:

i. The working fluid

ii. The wick or capillary structure

iii. The container

In the selection of a suitable combination of the above inevitably a number of conflicting factors may arise and the principal bases for selection are discussed below

3.1 THE WORKING FLUID

A first consideration in the identification of a suitable working fluid is the operating vapor temperature range and a selection of fluid is shown in Table 3.1 Within the approximate temperature band several possible working fluids may exist and a variety of characteristics must be examined in order to determine the most acceptable of these fluids for the application being considered.

The prime requirements are as follows:

1. Compatibility with wick and wall materials.
2. Good thermal stability.
3. Wettability of wick and wall materials.
4. Vapors pressure not too high or low over the operating temperature range.
5. High latent heat.
6. High thermal conductivity.
7. Low liquid and vapor viscosities.
8. High surface tension acceptable freezing or pour poit.

The selection of the working fluid must also be based on the thermodynamic consedations which are concerned with the various limitations to heat flow occurring within the heat pipe. These were also considering the viscous, sonic, capillary, entertainment and nucleate boiling limitations.

Many of the problems associated with long-life heat pipe operations are a direct consequence of materials incompatibility. This involves all three components of the heat pipes and is discussed fully later. One aspect peculiar to the working fluid, however, is the possibility of the thermal degradations. With certain organic fluids, it is necessary to keep the film temperature below a specific value to prevent the fluid breaking down into different compounds. A good thermal stability is therefore a necessary feature of the working fluids over likely operating temperature range. The surface of a liquid behaves like a stretched skin expect that the tension in the liquid surface is independent of surface area.

Table 3.1 Heat pipe working fluids

Medium	Melting point(°C)	Boiling point at atmospheric press (°C)	Useful range(°C)
Ammonia	-78	-33	-60 to 100
Acetone	-95	57	0 to 120
Methanol	-98	64	10 to 160
Flutec pp2	-50	76	10 to 130
Heptane	-90	98	0 to 150
Water	0	100	30 to 200
Toluene	-95	110	50 to 200
Flutecppg	-70	160	0 to 225
Thermex	12	257	150 to 350
Mercury	-39	361	250 to 650
Cesium	29	670	450 to 900
Potassium	62	774	500 to 1000
sodium	98	892	600 to 1200
Lithium	179	1340	1000 to 1800
Silver	960	2212	1800 to 2300

This surface tension varies with temperature and pressure, but the variation with pressure is frequently small.

The effective value of the surface tension may be considerably altered by the accumulation of foreign matter at the liquid/vapor liquid/liquid or solid surface. In heat pipe design a heat value of surface tension is desirable on order to enable the heat pipe to operate against gravity and to generate a high capillary driving force.

In spite of suggestion that additives can improve the performance of the heat pipes – for example by the addition small amount of a long-chain alcohol to water heat pipe- such as a practice is not generally recommended. Claimed to improve the 'wettability' of surfaces. In two-phase system, additives tend to get left behind when phase change occurs! The vapor pressure over the operating temperature range must be sufficiently great to avoid high vapor velocities which tend to set up a large temperature gradient, entire the refluxing condensation in the countercurrent flow, or cause flow instabilities associated with compressibility. However, the pressure must not be too high because this will necessitate a thick-walled container.

A high latent heat of vaporization is desirable in order to transfer large amount of heat with a minimum fluid flow, and hence to maintain low pressure drops within the heat pipes. The thermal conductivity of the working fluid should also preferably be high in order to minimize the radial temperature gradient and to reduce the possibility of nucleate boiling at the wick/wall interface.

A convenient means for quickly comparing working fluids is provided by the merit number, defined as $Lp1/\mu1$ where 01 is the surface tension, L the latent heat of vaporization, $p1$ the liquid density and $\mu1$ the liquid viscosity. Figure 3.1 gives the merit number at the boiling point for working fluids covering temperature ranges between 200 and 1750k. One obvious feature is the marked superiority of water with its high latent heat and surface tension.

Compared with all organic fluids, such as acetone and the alcohols. The final fluid selected is of course, also based on cost, availability, compatibility, and the other factor listed above. Graphical a tabulated data on merit number of a range of common working fluids are present in.

A high merit number is not the only criterion for the selection of the working fluid, and other factors may, in a particular situation, be of greater important. For Example on grounds of cost, potassium might be chosen rather than cesium or rubidium which is one hundred times more expensive. Also, over the temperature range 1200-1800K, lithium has a higher merit number then most metals, including sodium. However, its use require a container made from an expensive lithium-resistance alloy, whereas sodium can be contained in stainless steel. It may therefore, be cheaper and more convenient to accept a lower performance heat pipe made from sodium/stainless steel.

3.2 THE WICK OR CAPILLARY STRUCTURE

The selection the wick foe a heat pipe depends on many factor, several of which or closely linked to properties of the working fluid. Obviously the prime purpose of the wick is to generate capillary pressure to transport the working fluid from the condenser to the evaporator. It must also be able to distribute the liquid around the evaporator section to any area where heat is likely to be received by the heat pipe. Often these two function require wicks of different from particularly where the condensation has to be written over a distance of, say one meter in zero gravity. Where a wick is retained in 'gravity-assisted' heat pipe, the role may be enhance heat transfer and to circumferentially distribute liquid. The wick permeability, another desirable feature, increase with increase pore size, however. For homogeneous wicks, there an optimum pore size, which is a compromise. There are three main types in this context. Low performance wicks in horizontaland gravity assisted heat pipe should permit maximum liquid flow rate by having a comparatively large pore size, as with 100 or 160 mesh. Where pumping capability is required against gravity small pores are needed. In Space constrains on the size and the general high-power capability needed necessitates the use of non-homogeneous or arterial or wick aided by small pore structure for axial liquid flow.

Another feature of the wick, which must be optimized, is its thickness. The heat transport capability of the heat pipe is raised by this wick thickness. However, the increased radial thermal resistance of the wick created by this would work against increased capability and would lower the allowable maximum evaporator heat flux. The overall thermal resistance at the evaporator also depends on the conductivity of the working fluid in the wick. Other necessary properties of the wick are compatibility with the working fluid and wet ability. It should be easily formed to mould in to the wall shapes of the heat pipe and should preferably be of a form that enables repeatable performance to be obtained. It should be cheep.

A guide to the relative cost of the wick may be given by nothing that the mass-produced heat pipe for electrics applications use sintered copper or woven wire mesh, where aluminium gravity-assisted units can be used(as in solar collectors), extruded grooves are employed. Micro-heat pipes may not need a separate 'wick'. The corners of the pipes(where non-circular) may be generated capillary actions.

3.3 HOMOGENEOUS STRUCTURE

Of the wick forms available, meshes and twills are the most common. These are manufactured in a range of pore size and materials, the latter including stainless, nickel , copper and aluminium.

Table 3.4 shows measured values of pores sizes and permeability for a variety of meshes and twills. Homogeneous wicks fabricated using metal foams and particular felts are becoming increasing useful and by varying the pressure on the felt during assembly, varying pores sizes can be produced. By incorporating removable metals an arterials can also be molded in the felt.

Foams and felts are growing in importance for variety of the transfer duties. As well as incorporating arteries in felts, like foams their structure can be ‘ graded’ to allow the structure to be designed for ‘local’ conditions that may differ from those in other parts of a heat pipe wick(e.g. radially or axially). The research at auburn university in the united states was directed at examining whether the heat transfer limits of heat pipes could be increased by gradation of the pore structure. In particular layouts selected by the auburn research team which resemble composite mesh wick in concept, with different variants, has merit. Fibrous materials have been widely used in heat pipes and generally have small pore size. The main disadvantage is that ceramic fibers have little stiffness and usually requires a continuous support for example by metals mesh. Thus, while the fiber itself may be chemically compatible with the working fluids, supporting materials may cause problem. Semena and nishchik discuss metallic fiber(Andsinter) wick properties in reference.

3.4 ARTERIAL WORK

Arterial wicks are necessary in high-performance heat pipe for spacecraft, where temperature gradients in the heat pipe have to be minimized to counter the adverse effect of what are generally low the thermal conductivity working fluids. An arterials wick develops at IRD. The bore of the heat pipe in this case was only5.25mm. This heat pipe, developed for the European space organization (ESA) was designed to transport 15W over a distance of 1 m with an overall temperature drop not exceeding 6°C . the wall material was aluminum alloy and the working fluid acetone.

The aim of this wick system was to obtain liquid transport along with the minimum pressure drop. A high driving force was achieved by covering he six arteries with a fine screen.

In order to achieve the full heat transport potential of the arterial wick, the artery must be completely shut of from the vapor space. The maximum capillary driving force is thus determined by the pore size of the screen. Thus a high degree of the quality control was required during the manufacturing process to ensure that the artery was successfully closed and the screen undamaged.

A further consideration in the design of arterial heat pipes is that of vapour or gas blockage of the arteries. If a vapor or gas bubble forms within or is vented into the artery, then the transport capability is seriously reduced. Indeed, if the bubble completely blocks the artery then the heat transport capability is dependent on the effective capillary radius of the artery, i.e. there is an effective state of open artery. In order that the artery will reprime following this condition, the heat load must be reduced to a value below the maximum capability associated with the open artery.

The implications of wick design and working fluid properties in arterial heat pipes are as follows:

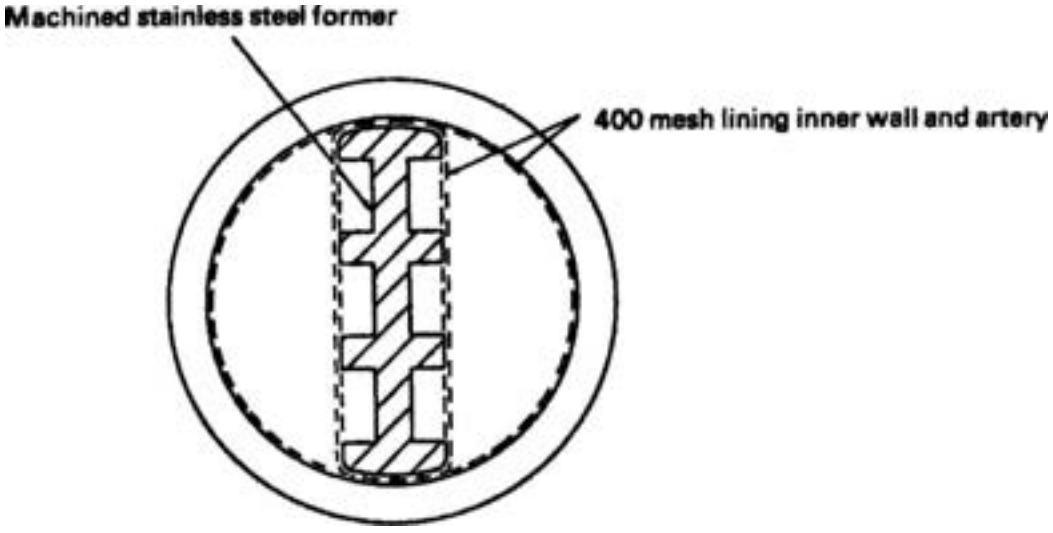

Figure 3.1 Arterial wick developed at NEI-IRD.

(i) The working fluid must be thoroughly degassed prior to filling to minimise the risk of non- condensable gases blocking the artery.

(ii) The artery must not be in contact with the wall to prevent nucleation within it.

(iii) A number of redundant arteries should be provided to allow for some degree of failure.

(iv) Successful priming (i.e. refilling) of the artery, if applied to spacecraft, must be demonstrated in a one 'g' environment, it being expected that priming in a zero 'g' environment will be easier.

As mentioned above, arterial heat pipes have been developed principally to meet the demands of spacecraft thermal control. These demands have increased rapidly over the last decade, and while mechanical pumps can be used in two-phase 'pumped loops', the passive attraction of the heat pipe has spurred the development of several derivatives of 'conventional' arterial heat pipes.

One such derivative is the mono groove heat pipe, shown in Fig. 3.4. This heat pipe comprises two axial channels, one for the vapor and one for the liquid flow. A narrow axial slot between these two channels creates a high capillary pressure difference, while in this particular design circumferential grooves are used for liquid distribution and to maximize the evaporation and condensation heat transfer coefficient. The principal advantage of this design is the separation of the liquid and vapour flows, eliminating the entrainment, or countercurrent flow, limitation.

One feature mentioned in discussions of the desirable properties of both the wick and the working fluid is the thermal conductivity. Expressions are available for predicting the thermal conductivities of saturated wicks of several types, and these are discussed below. The conductivity is an important factor in determining the allowable wick thickness.

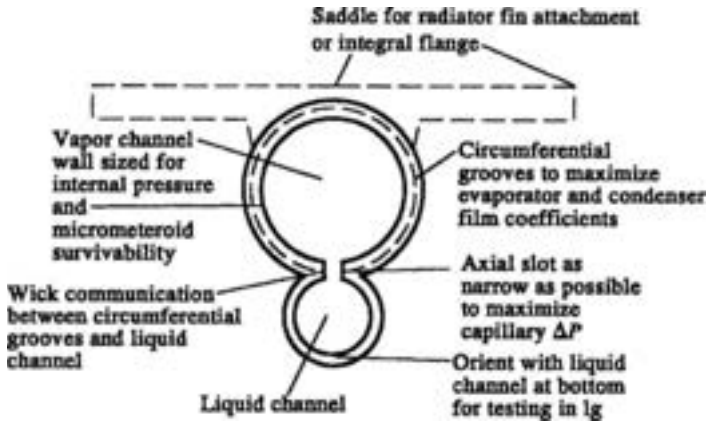

Figure.3.2 Mono groove heat pipe configuration

3.5 SINTERED WICKS

The exact geometric configuration of a sintered wick is unknown because of the random dispersion of the particles and the varying degree of deformation and fusion, which occurs during the sintering process (see Chapter 4). For this reason, it is suggested that the sintered wick be represented by a continuous solid phase containing a random dispersion of randomly sized spheres of liquid.

Maxwell has derived an expression that gives the thermal conductivity of such a heterogeneous material:

$$\frac{k_{eff}}{k_f} = \frac{(k_p + 2k_f) - 2\chi(k_f - k_p)}{(k_p + 2k_f) + \chi(k_f - k_p)}$$

Gorring and Churchill show that this expression agrees reasonably well with experimental

In order to do so, the intermeshing between the screen layers should be taken into account. This can be done by accurately measuring the overall thickness of the wick.

3.6 GROOVED WICKS

The radial thermal resistance of grooves will be radically different in the evaporator, and condenser sections. This occurs because of the differences in the mechanisms of heat transfer. In the evaporator the land or fin tip plays no active part in the heat transfer process. The probable heat flow path is conduction via the fin, conduction, across a liquid film at the meniscus and evaporation at the liquid–vapor interface. In the condenser section, grooves will be flooded and the fin tip plays an active role in the heat transfer process. The buildup of a liquid film at the fin tip will provide the major resistance to heat flow

The thickness of the liquid film is a function of the condensation rate and the wetting characteristics of the working fluid.

The aim of this wick system was to obtain liquid transport along with the minimum pressure drop. A high driving force was achieved by covering he six arteries with a fine screen.

3.7 CONTAINER

The function of the container is to isolate the working fluid from the outside environment. It has, therefore, to be leak-proof, to maintain the pressure differential across its walls and to enable the transfer of heat to take place into and from the working fluid.

Selection of the container material depends on several factors. These are as follows:

- Compatibility (both with working fluid and the external environment).
- Strength-to-weight ratio.
- Thermal conductivity.
- Ease of fabrication, including weldability, machineability and ductility.
- Porosity.
- Wett ability.

Most of these are self-explanatory. A high strength-to-weight ratio is more important in space craft applications, and the material should be non-porous to prevent the diffusion gas into the heat pipe. A high thermal conductivity ensures minimum temperature drop betweenthe heat source and the wick.

Figure 3.3 heat pipe

3.8 COMPATIBILITY

Compatibility has already been discussed in relation to the selection of the working fluid, wick and containment vessel of the heat pipe. However, this feature is of prime importance and warrants particular attention here.

The two major results of incompatibility are corrosion and the generation of non-condensable gas. If the wall or wick material is soluble in the working fluid, mass transfer is likely to occur between the condenser and the evaporator, with solid material being deposited in the latter. This will result either in local hot spots or blocking of the pores of the wick. Non-condensable gas generation is probably the most common indication of heat pipe failure and, as the non- condensables tend to accumulate in the heat pipe condenser section, which gradually becomes blocked, it is easy to identify because of the sharp temperature drop that exists at the gas/vapour interface.

Some compatibility data is of course available in the general scientific publications and from trade literature on chemicals and materials. However, it has become common practice to carry out life tests on representative heat pipes, the main aim of these tests being to estimate long-term materials compatibility under heat pipe operating conditions. At the termination of life tests, gas analyses and metallurgical examinations as well as chemical analysis of the working fluid may be carried out.

Many laboratories have carried out life tests, and a vast quantity of data have been published. However it is important to remember that while life test data obtained by one laboratory may indicate satisfactory compatibility, different assembly procedures at another laboratory, involving, for example a non-standard materials treatment process, may result in a different corrosion or gas generation characteristic. Thus, it is important to obtain compatibility data whenever procedural changes in cleaning or pipe assembly are made.

Stainless steel is a suitable container and wick material for use with working fluids such as acetone, ammonia and liquid metals from the point of view of compatibility. Its low thermal conductivity is a disadvantage, and copper and aluminum are used where this feature is important. The former is particularly attractive for mass- produced units using water as the working fluid. Plastic has been used as the container material, and at very high temperatures ceramic sander factory metals such as tantalum have been given serious consideration.

In order to introduce a degree of flexibility in the heat pipe wall, stainless steel bellows have been used, and in cases where electrical insulation is important, a ceramic or glass-to-metal seal has been incorporated. This must of course be used in conjunction with electrically non- conducting wicks and working fluids.

3.9 HISTORICAL COMPATIBILITY DATA

Long-term life tests on cryogenic heat pipes started a little later than those for higher temperature units. However, there are comprehensive data from European Space Agency sources on stainless steel (container was type 304L and wick type 316) heat pipes using as working fluids methane, ethane, nitrogen or oxygen, arising out of tests extending over a period of up to 13 years. The test units were 1 m in length and either 3.2 or 6.35 mm outside diameter. Heat transport capability was up to 5 Wm (meaning that the pipe transport 5 W over 1m, or, for example, 10 W over 0.5m), and vapour temperatures70–270K. Tests were completed in the mid-1990s.

The main outcomes were as follows:

- All pipes retained maximum heat transport capability.
- All pipes maintained maximum tilt capability (capillary pumping demonstration).
- The evaporator heat transfer coefficient remained constant.

No incompatibility or corrosion was evident in the oxygen and nitrogen pipes.

Slight incompatibility, resulting in non-condensable gas extending over 1 per cent of the heat pipe length and therefore affecting condenser efficiency, was noted in the ethane and methane units.

Unlike the oxygen and nitrogen TIG-welded pipes, the ethane and methane units were hard-brazed, and the implication is that the gas generation was attributed to this. A comprehensive review of material combinations in the intermediate temperature range has been carried out by Basiulis and Filler and is summarized below .Results are given in the paper over a wider range of organic fluids, most produced by Dow Chemicals.

Tests in excess of 8000h with ammonia/aluminium were reported, but only1008h had been achieved at the same time of data compilation with aluminium/acetone. No temperatures were specified by Basiulis for these tests:other worker shave exceeded 16000h with the latter combination.

Later, the life test work at IKE, Stuttgart, was published involving tests on about 40 heat pipes. The tests indicated that copper/water heat pipes could be operated without degradation over long periods (over 20 000 h), but severe gas generation was observed with stainless steel/water heat pipes. IKE had some reservations concerning acetone with copper and stainless steel. While compatible, it was stressed that proper care had to be given to the purity of both the acetone and the metal. The same reservation applied to the use of methanol.

Exhaustive tests on stainless steel/water heat pipes were also carried out at where experiments were conducted with vapour temperatures as high as 250°C.

It was found that neither the variation of the fabrication parameters the addition of a large percentage of oxygen to the gas plug resulted in a drastic reduction of the hydrogen generation at 250°C. Hydrogen was generated within 2 h of start-up in some cases. The stainless steel used was type 316 and such procedures *n*-Pentane: Tested for 750 h at 150 °C.Short-term instabilities noted with random fluctuation in temperature of 0.2. On examination of the capsule, very light brownish areas of discolouration were noted on the interior wall but the screen wick appeared clean. No corrosion evidence was found. The liquid removed from the capsule was found to be slightly brown in colour.*n*-Heptane: Tested for 600 h at160°C. Slight interior resistances noted after 465 h, but on opening the capsule at the end of the tests, the interior, including the screen, was clear, and the working fluid clean. Benzene: Tested for 750 h at 150 °C plus vapour pressure 6.7 bar. Very slight local areas of discolouration found on the wall, the wick was clean, there was no evidence of corrosion and the liquid was clear. It was concluded that benzene was very stable with the chosen aluminium alloy. Toluene: Test run for 600 h at 160 ×C. A gradual decrease in condenser section temperature was noted over the first 200h of testing but no change was noted following this. On opening the capsule, slight discolouration was noted locally on the container wall. This seemed to be a surface deposit, with no signs of attack on the aluminium. The screen material was clean and the working fluid clear at the end of the test. Water: (stainless steel) Tested at 150 °C plus for 750 h. Vapour pressure 6.7 bar.Large concentration of hydrogen was found when analysis of the test pipe was performed. this was attributed in part to poor purging procedure as there was discolouration in the area of the welds, and the authors suggest that oxidation of the surfaces had occurred. A brown precipitate was also found in the test heat pipe.CP-32: Tested for 550 h at 158 °C. A brownish deposit was found locally on interior surfaces. Screen clean, but the working fluid was darkened. Gas generation was noted.

3.10 COMPATIBILITY OF WATER AND STEEL – A DISCUSSION

Water is an ideal working fluid for heat pipes, because of its high latent heat, thus requiring a relatively low inventory, its low cost and its high 'figure of merit'. As shown already in this Chapter, water is compatible with a number of container materials, the most popular being copper. However, ever since heat pipes were first conceived, experimenters have experienced difficulty in operating a water/steel (be it mild, boiler or stainless steel) heat pipe without obtaining the generation of hydrogen in the container. This gas generation always manifests itself as a cold plug of gas at the condenser section of the heat pipe – blocking off surface for heat rejection. There is a sharply defined interface between the water vapour and the non-condensable gas, making the presence readily identifiable. The effect is similar to that when air is present in a conventional domestic radiator system but of course the reasons maybe different.

The earlier description in of the Perkins Tube and its derivatives, which used iron or steel with water as the working fluid, shows that the fluid/wall combination has demonstrated a significant life, although gas generation did occur.

3.11 THE MECHANISM OF HYDROGEN GENERATION AND PROTECTIVE LAYER FORMATION

The reaction responsible for the generation of hydrogen is

$$Fe + 2H_2O \rightarrow Fe(OH)_2 + H_2$$

Corrosion of steel is negligible in the absence of oxygen. Therefore, in a closed system such as a steel heat pipe with water as the working fluid, the corrosion only takes place until all the free oxygen is consumed. When oxygen is deficient, low alloy steels develop a hydrated magnetite layer in neutral solutions, by decomposition of the ferrous hydroxide. Further dehydration, or a chemical reaction of iron with water, occurs $3Fe(OH)_2 \rightarrow Fe_3O_4 + 2H_2O + H_2$

The conversion of $Fe(OH)_2$ leads to a protective layer of Fe_3O_4 especially with mild/carbon steels. In high-temperature water, this Fe_4O_3 layer is responsible for the good corrosion resistance of boiler steels in power generation plant boilers.

3.12 THERMOCOL ROOM AND FRAME SUPPORT

In 1951 the researchers of a German company named BASF successfully restructured chemical bonding of polystyrene (a synthetic petroleum product) molecules and developed a substance named stretch polystyrene. This substance was named Thermocol, which nowadays is manufactured through a simple process. Thermoplastic granules are expanded through application of steam and air. Expanded granules become much larger in size but remain very light. Thermocol acts as a good resistant to cold and heat but since it is a petroleum product it dissolves in any solvent of petroleum.

The thermocol room setup are framed by the aluminium channels for required dimensions. aluminium frame which gives the mechanical support to the room, the room size are 1.28 meters square room of height 2.05 meters.

Figure 3.4 Thermocol and frame

3.13 SUBMERSIBLE PUMP

A **submersible pump** is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped.

Figure 3.5 Submersible pump

A problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps which create a vacuum and rely upon atmospheric pressure. Submersibles are more efficient than jet pumps. Hydraulic submersible pumps (HSP's) use pressurized fluid from the surface to drive a hydraulic motor down hole, rather than an electric motor, and are used in heavy oil applications with heated water as the motive fluid.

3.14 RTD TEMPERATURE MONITOR

Resistance thermometers, called Resistance Temperature Detectors (RTDs), are sensors used to measure temperature. Many RTD elements consist of a length of fine wire wrapped around a ceramic or glass core but other constructions are also used. The RTD wire is a pure material, typically platinum, nickel, or copper. The material has an accurate resistance/temperature relationship which is used to provide an indication of temperature. As RTD elements are fragile, they are often housed in protective probes. RTDs, which have higher accuracy and repeatability, are slowly replacing thermocouples in industrial applications below 600 °C. Common RTD sensing elements constructed of platinum, copper or nickel have a repeatable resistance versus temperature relationship and operating temperature range. The R and T relationship is defined as the amount of resistance change of the sensor per degree of temperature change. The relative change in resistance (temperature coefficient of resistance) varies only slightly over the useful range of the sensor.

The significant characteristic of metals used as resistive elements is the linear approximation of the resistance versus temperature relationship between 0 and 100 °C. This temperature coefficient of resistance is denoted by α and is usually given in units, where

is the resistance of the sensor at 0 °C,

is the resistance of the sensor at 100 °C.

Figure 3.6 RTD sensor probe and Temperature monitor

3.15 MODEL OF ROOM

Figure 3.7 Room layout

CHAPTER 4

WORKING AND MANUFACTURING PROCESS

4.1 HEAT TRANSFER AND FLUID FLOW THEORY

There are many variants of heat pipe but in all cases the working fluid must circulate when a temperature difference exists beween the evaporator and the condenser. In this chapter, the operation of the classical wicked heat pipe is discussed. Various analytical techniques are then outlined in greater detail, these techniques are then applied to the classical heat pipe and gravity-assisted thermosyphon.

4.2 Operation Of Heat Pipes

$$AP_{c,\max} \geq AP_l + AP_v + AP_g \quad (1)$$

If this condition is not met, the wick will dry out is evaporator region and the heat pipe will not operate. The maximum allowable heat flux for holds is referred to as the capillary limit. Methods of evaluating the four terms in will be discussed in details in this chapter. Typically, the capillary limits will determine the maximum heat flux over much of the operating range, however, the designer must check that a heat pipe is not required to function outside the envelope either at design conditions or at start-up.

During start-up and with certain high-temperature liquid metal heat pipes, the vapour velocity may reach sonic values. The sonic velocity sets a limit on the heat pipe performance. At velocities approaching sonic, compressibility effects must be taken into account in the calculation of the vapour pressure drop.

The viscous or vapour pressure limit is also generally the most important at start-up. At low temperature, the vapour pressure of the fluid in the evaporator is very low, and, since the condenser pressure cannot be less than zero, the maximum difference in vapour pressure is insufficient to overcome viscous and gravitational forces, thus preventing satisfactory operation.

At high heat fluxes, the vapour velocity necessarily increases; if this velocity is sufficient to entrain liquid returning to the evaporator, then performance will decline, hence the existence of an entrainment limit.

The above limits relatetoaxial flow through the heatpipe. The final operating limit discussed will be the boiling limit. The radial heat flux in the evaporator is accompanied by a temperature difference that is relatively small until a critical value of heat flux is reached above which vapour blankets the evaporator surface resulting in an excessive temperature difference.

The position of the curves and shape of the operating envelope depends upon the wick material, working fluid and geometry of the heat pipe.

4.3 THERMOSYPHONS

Thermosihon or **thermosyphon** is a method of passive heat exchange based on natural convection, which circulates a fluid without the necessity of a mechanical pump.

The two phase thermosyphon is thermodynamically similar to the wicked hear pipe but relies on gravity to ensure liquid return from the condenser to the evaporator. A wick or wicks may be incorporated in at least part of the units to reduce entrainment and improve liquid distribution within the evaporator.

4.4 LOOP HEAT PIPE AND CAPILLARY PUMPED LOOPS

As will be seen later, the characteristics that produce a wick having the capability to produce a large capillary pressure also lead to high values of pressure drop through a length wick. This problem can be overcome by incorporating a short wick contained within the evaporator section and separating the vaporflow to the condenser from the liquid return.

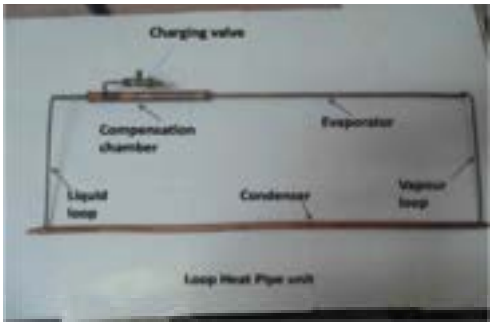

Figure 4.1. The physical view of a LHP unit

4.5 GRAVITATIONAL HEAT

The pressure difference, $AP_{g,}$ due to the hydrostatic heat of liquid may be positive, negative or zero. Depending on the relative positions of the condenser and evaporator. The pressure difference may be determined from:

$$AP\text{g} = p\text{l}\ gl\sin \varnothing$$

Where p1 is the liquid density (kg/m^3),

g the acceleration due to gravity ($9.81 m/s^2$),

L the heat pipe length (m), and

$\varnothing$ theanglebetweentheheat pipeand thehorizontal($\varnothing$ is positivewhenthecondenser is lower thantheevaporator).

4.6 SURFACE TENSION AND CAPILLARITY

4.6.1 Introduction

Molecules in a liquid attract one another. A molecule in a liquid will be attracted by the molecules surrounding it and on average, a molecule in the bulk of the fluid will not experience any resultant force. In the case of a molecule at or near the surface of liquid, the forces of attraction will no longer balance out and the molecule will experience a resultant force in wards. Because of this effect, the liquid will tend to take up a shape having minimum surface area, in the case of a free falling drop in a vacuum this would be a sphere. Due to this spontaneous tendency to contract, a liquid surface behave rather like a rubber membrane under tension. In order to increase the surface area, work must be done on the liquid. The energy associated with this work is known as the symbols. For example, if a soap film is setup on a wire support as in Fig.2.2 a and the area is increased by moving one side a distance dx the work done is equal to and the work done is equal to F dx, hence the increase in surface energy is 2ol l dx. The factor 2 arises since the film has two free surface. Hence, if T is the force per unit length for each of the two surface.

$$2Tl\text{d}x\ 2o\text{l}\ l\text{d}x$$

This force per unit length is known as the surface tension. It is numerically equal to the surface per unit area measured in any consistent set of unit, example N/m. Values for surface tension for a number of common working fluids.

Since latent heat of vaporization, L is a measure of the forces of attraction between the molecules of a liquid, we might expect surface energy or surface tension to be 1 to be related to L. This is found to be the case. Solids also will have a free surface energy, and in magnitude it is found to be similar to the value for the same material in the molten state. When a liquid is in contact with a solid surface, molecules in the liquid adjacent to the solid will experience force form the Molecules of the solid in addition to the forces from the other molecules in the liquid. Depending on whether these solid/liquid forces are attractive or repulsive, the liquid/solid surface will curve upward or downward, as indicated in Fig.2.2 b. The two best examples of attractive and repulsive forces, respectively, are water and mercury. Where the forces are attractive, the liquid is solid to 'wet' the solid. the angle of contact made by the liquid surface with the solid is known as the contact angle, 8. For wetting, 8 will lie between 0 and G/2 rad and for no wetting liquids

The condition for wetting to occur is that the total surface energy is reduced by wetting.

$$o\text{sl} + o\text{lv} < o\text{sv}$$

Where the subscripts,s,1 and v refer to solid, liquid and vapor phases

4.7 PRESSURE DIFFERENCE ACROSS A CURVED SURFACE

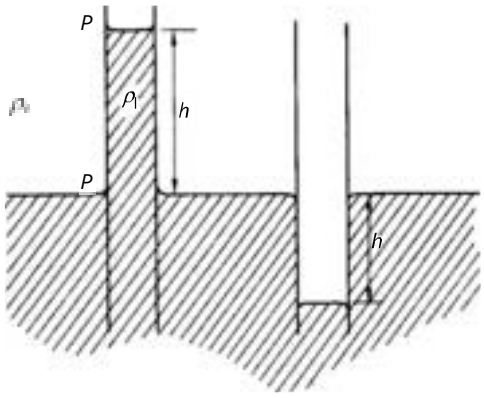

Figure 4.2 Capillary rise in a tube.

A consequence of surface tension is that the pressure on the concave surface is greater than that on the convex surface. this pressure difference AP is related to the surface energy ol

and radius of curvature R of the surface.

The hemispherical surface tension forces acting around the circumference is given by 2GROl and must be balanced by the net force of the surface due to the pressures which is (P1- P2) GR^2 or $APGR^2$.

4.8 FLOW IN WICKS

4.8.1 Pressure Difference In The Liquid Phase

The flow region in the liquid phase is almost always laminar. Since the liquid channels will not in general be straight nor of circular cross section and will often be inter connected, the Hagen-Poiseuille equation must be modified to take account of these differences.

Since mass flow will vary in both the evaporator and the condenser region, an effective length rather than the geometrical length must be used for these regions. If the mass change per unit length is contact, the total mass flow will increase or decrease, linearly along the regions.

We can therefore replace the lengths of the evaporator l_e and the condenser lc by $l_e/2$ and $l_c/2$.

The total effective length for fluid flow will then be L_{eff}.

Tortuosity within the capillary structure must be taken into account separately and is discussed below.

There are three principal capillary geometries

Wick structures consisting of a porous structure made up of inter connecting pores. Gauzes, felts and sintered wicks come under this, these are frequently referred to as homogeneous wicks.

Covered channels consisting of an area for liquid flow closed by a finer mesh capillary structure. Grooved heat pipes with gauze covering the groove and arterial wicks are included in this category. these wicks are sometimes described as composite wicks.

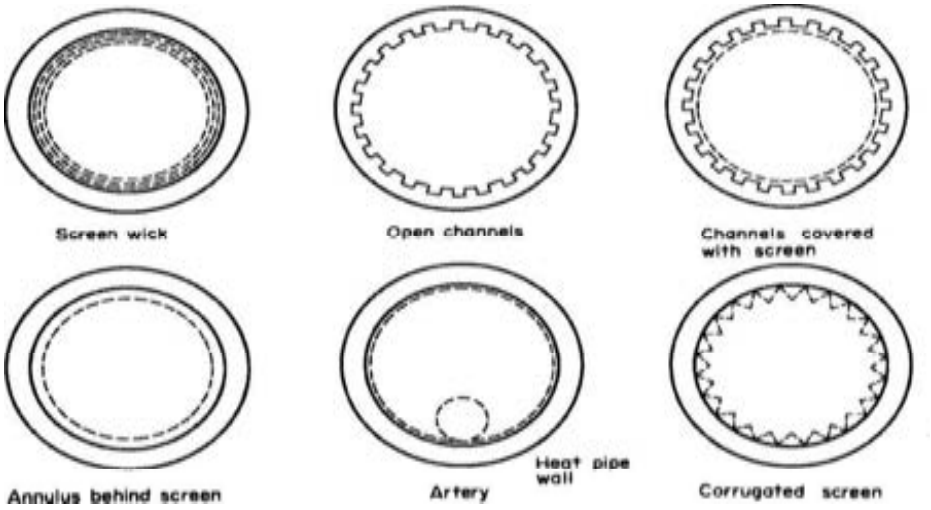

Figure 4.3 A selection of wick sections.

4.9 ENTRAINMENT

In a heat pipe, the vapour flows from the evaporator to the condenser and the liquid is returned by the wick structure. At the interface between the wick surface and the vapour, the latter will exert a shear force on the liquid in the wick. The magnitude of the shear force will depend on the vapour properties and velocity and its action will be entrain droplets of liquid and transport them to the condenser end. This tendency to entrain is resisted by the surface tension in the liquid. Entrainment will prevent the pipe operating and represent one limit to performance. Kemme observed entrainment in a sodium heat pipe and report that the noise of droplets impinging on the condenser end could be heard.

4.10 HEAT TRANSFER AND TEMPERATURE DIFFERENCE

4.10.1 Introduction

Heat can both enter and leave the heat pipe by conduction from or to a heat source/sink by convection or by thermal radiation. The heat pipe may also be heated by eddy current or by electron bombardment and cooled by electron emission. For that temperature drops will occur by thermal conduction through the heat pipe walls at both the evaporator and condenser regions. Th temperature drops through the wicks arise in several ways and are discussed in details later in this section. It is found that a thermal resistance exists at the two vapour liquid surfaces and also in the

vapour column. The processes of evaporation and condensation are examined in some details both in order to determine the effective thermal resistances and also to identify the maximum heat transfer limits in the evaporator and condenser regions. Finally, the results for thermal resistance and heat transfer limits are summarized for the designer.

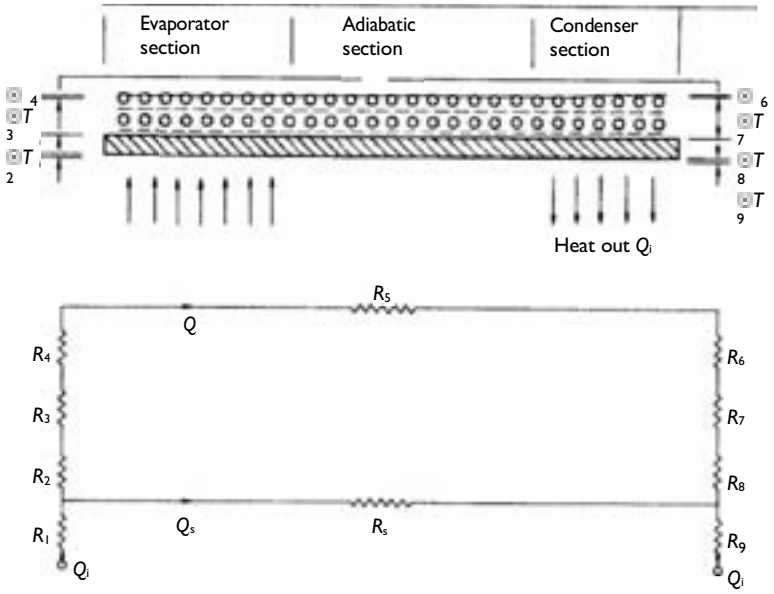

Figure 4.4 Temperature drops and equivalent thermal resistances in a heat pipe.

4.10.2 Heat Transfer In The Evaporator Region

For low values of heat flux, the heat will be transported to the liquid surface partly bt conduction through the wick and liquid and partly by natural convection. Evaporation will be from the liquid surfaces. As the heat flux is increased, the liquid in contact with the wall will become progressively superheated and bubbles will form at nucleation sites. These bubbles will transport will transport some energy to the surface by latent heat of the vaporization and will also greatly increase convective heat transfer. With further increase of flux, a critical value will be reached, burnout, at which the wick will dry out and the heat pipe will cease to operate. Beforce discussing the case of wicked surfaces, the data on heat transfer form plane, un wicked surfaces will be summarized. Experiments on wicked surfaces are then described and correlations given to enable the temperature drop through the wick and the burnout flux to be estimated. The subject is complex and further work is necessary to provide an understanding of the processes in detail.

4.11 EVAPORATION COOLING

In very dry climates, evaporative coolers, sometimes referred to as swamp coolers or desert coolers, are popular for improving coolness during hot weather. An evaporative cooler is a device that draws out side air through a wet pad, such as a large soaked with water. The sensible heat of the incoming air, as measured by a dry blub thermometer is reduced. The temperature of the incoming air is reduced, but it is also more humid, so the total heat is unchanged. Some of the sensible heat of the entering air is converted to latent heat by the evaporation of water in the wet cooler pads. If the entering air is dry enough, the results can be quite substantial.

Evaporative coolers tend to feel as if they are not working during times of high humidity, when there is not much dry air with which the coolers can work to make the air as cool as possible for dwelling occupants. Unlike other types of air conditioners, evaporative coolers rely on the outside air to be channeled through cooler pads that cool the air must be allowed to push the warmer air within the house out through an exhaust opening such as an open door or window. These cooler cost less and are mechanically simple to understand and maintain.

4.12 FREE COOLING

Air conditioning can also be provided by a process called free cooling which uses pumps to circulate a coolant such as air, water or a water-glycol mixture from a cold source, which in turn acts as a heat sink for the energy that is removed from the cooled space. Common storage media are cool outside air, deep aquifers, or a natural underground rock mass accessed via a cluster of small-diameter boreholes. Some systems with small storage capacity are hybrid systems, using free cooling early in the cooling season, and later employing a heat pump to chill the circulation coming from the storage. The heat pump is added because the temperature of the storage gradually increases during the cooling season, there by declining its effectiveness.

4.13 WHAT WE OBSERVED ON WORKING OF HEAT PIPE?

The observations are plotted as a tabulation by comparison of room temperature differences under alternative days are bellow,

DAY:01 Observations TIME: Day Time

Table 4.1 Observed Temperature Differences

S.no	Dew point temperature, (^{0}C)	Time interval, (hrs)	Humidity, (%)	Actual room temperature T, (^{0}C)	Final Temperature, (^{0}C)	
					T2	T1
1	20	10.00, am	49	32	32	32
2	20	11.00, am	42	33	32	32
3	17	12.00, pm	36	34	33	32
4	15	1.00, pm	30	35	32	32
5	15	2.00, pm	27	37	33	32
6	16	3.00, pm	27	38	34	31
7	16	4.00, pm	24	40	33	30
8	17	5.00, pm	28	37	33	31

The above tabulated values are room temperature differences under the hourly bases of the heat pipe at working for room cooling.

To attain temperature differences, by taking 5.00hrs of time intervals to decrease 1^{0}C are observed.

DAY: 01 Observations TIME: Night Time

Table 4.2 Observed Temperature Differences

S.no	Dew point temperature, (^{0}C)	Time interval, (hrs)	Humidity, (%)	Actual room temperature T, (^{0}C)	Final Temperature, (^{0}C)	
					T2	T1
1	16	6.00, pm	49	34	33	32
2	17	7.00, pm	42	33	32	32
3	17	8.00, pm	36	31	33	32
4	18	9.00, pm	30	30	33	32
5	18	10.00, pm	27	29	33	32
6	20	11.00, pm	27	28	33	32
7	20	12.00, am	24	27	33	32
8	21	1.00, am	28	25	33	32

- **Room size are partially reduced**

DAY: 02 Observations TIME: Day Time

Table 4.3 Observed Temperature Differences

S.no	Dew point temperature, (^{0}C)	Time interval, (hrs)	Humidity, (%)	Actual room temperature T, (^{0}C)	Final Temperature, (^{0}C)	
					T2	T1
1	19	10.00, am	49	34	32	32
2	18	11.00, am	42	36	32	32
3	17	12.00, pm	36	39	32	32
4	15	1.00, pm	30	37	33	31
5	17	2.00, pm	38	35	33	31
6	17	3.00, pm	42	34	34	32
7	16	4.00, pm	31	35	34	32
8	17	5.00, pm	34	34	34	32

The above tabulated values are room temperature differences under the hourly bases of the heat pipe at working for room cooling.

To attain temperature differences, by taking 3.30hrs of time intervals to decrease 1^{0}C are observed.

By getting the difference of 1.30hrs time intervals between the Day01 and Day02 observation are by reduced room size partially.

DAY: 02 Observations TIME: Night Time

Table 4.4 Observed Temperature Differences

S.no	Dew point temperature, (^{0}C)	Time interval, (hrs)	Humidity, (%)	Actual room temperature T, (^{0}C)	Final Temperature, (^{0}C)	
					T2	T1
1	18	6.00, pm	34	34	33	31
2	17	7.00, pm	33	33	33	31
3	17	8.00, pm	32	32	32	31
4	18	9.00, pm	31	31	32	32
5	16	10.00, pm	30	30	33	32
6	16	11.00, pm	29	29	32	31
7	17	12.00, am	28	28	33	30
8	18	1.00, am	27	27	33	30

Heat transfer rate of each heat pipe should be approximately, Q = 20-15W.

Total volume of heat pipe are 80ml, working fluid filled by one-third of the heat pipe are 27ml.

CHAPTER 5
APPLICATION OF THE HEAT PIPE

5.1 APPLICATION

In general, the applications come within the number of the broad groups, each of which describes a property of the heat pipe. These groups are:

- Separation of heat source and sink
- Temperature flattening, or iso-thermalisation
- Heat flux transformation
- Temperature control
- Thermal diodes and switches

The high effective thermal conductivity of a heat pipe enables heat to be transferred at high efficiency over considerable distance. In many application where component cooling is required, it may be in convenient or undesirable thermally to dissipate the heat via a heat sink or radiator located immediately adjacent to the component. For example, heat dissipation from a high power device within a module containing other temperature sensitive components would be affected by using heat pipe to connect the component to a remote heat sink located outside the module. Thermal insulation could minimise heat losses from intermediate selection of the heat pipe. Most uses of tubular heat pipes in electronics thermal control are directed at separating the heat source form the sink.

5.2 HEAT PIPES IN ENERGY STORAGE SYSTEM

By their nature, many energy storage system should lose or gain as little heat as possible during 'inactive' periods, while also delivering or taking in heat or 'cool' as predetermined rates, some of which may be rather high, when required to function actively. The nature of chemicals used in some phase change storage media, in particular, such as their low thermal conductivity, gives heat pipes on opportunity to enhance performance. One sensible heat 'store' that has benefited considerably from heat pipes is the ground. Use of the ground as either a heat source or a heat sink well known to heat pump users has been used to device road using heat pipe and ass discussed below as a sensible heat sink for underground train thermal management.

5.3 NUCLEAR REACTORS AND STORAGE FACILITIES

Radio acting waste from nuclear power plants and other facilities may generate modest amounts of heat over very long periods. The waste may be stored in containers or

under water in tanks. The removal of heat from these stores may be done using 'active' methods, or the containers may be finned on their external surfaces, to allow natural convection heat transfer. However, the transfer of heat to the walls of the container suffers from the same thermal conductivity problems as in other stores, and the insertion of heat pipes can improve overall performance, minimising store temperature excursions.

5.4 THE HEAT PIPE IN A PASSIVE COOLING SYSTEM FOR RELIEVING AIR-CONDITIONING LOADS

A system based upon the use of heat pipes to aid heat transfer into and out of PCMs (from and to, respectively, ambient air) has been developed over a number of years at Nottingham University in the United Kingdom by a team led by Dr David Etheridge.

The operation of this system, perfected in conjunction with PCM and heat pipe suppliers and an installer, is comparatively straightforward. During the night, cool air is used to 'freeze' the PCM, and during the day heat is extracted from the room air, which 'melts' the PCM. This cycle is repeated on a daily basis. The crucial process is the transfer of heat between the air and the PCM. Heat transfer coefficients need to be high, because the temperature differences between the air and the PCM are low, typically less than 6 ×C.

As highlighted above, the main problem is achieving sufficient heat transfer into (and out of) a PCM, because the material essentially behaves as a solid and conduction is the only transfer mechanism – in common with most sensible heat stores. Moreover, direct contact between the air and the PCM is undesirable, because of odours and perceived health hazards, and the possibility of this happening should be minimised. The approach adopted was to use a heat pipe to provide an indirect but effective heat transfer path between the air and the PCM, with forced convection on the airside. This allows the PCM to be encased in a rigid sealed container.

5.5 FIELD TRIALS OF THE COOLING UNIT

Field tests were carried out in offices at two sites, the EcoHouse in the University of Nottingham – where heat-pipe-based solar collectors are also used, and the Pinxton premises of Building Product Design Ltd, who were also partners in the project.

5.6 SPACECRAFT

Heat pipes, certainly at vapour temperatures up to 200 ×C, have probably gained more from the developments associated with spacecraft applications than from any other area. The VCHP is a prime example of this 'technological fallout'.

Heat pipes have commonly been used as thermal control components on satellites since the 1970s. A telecommunication satellite can require more than a hundred heat pipes. Most of the heat pipes for space applications have axial grooves and are made of extruded

aluminium 6063, and the most common working fluid is ammonia as its operational temperature is suited to space applications (-40 to 80°C). Axially grooved heat pipes can be fabricated relatively simply and have greater reliability than other wick designs, such as artery heat pipes.

- high thermal conductivity,
- light weight and compact design,
- uniform temperature,
- autonomous and reliable operation with no maintenance required.

The lifetime of these heat pipes is expected to be same as the satellite (15 years minimum).

Around five heat pipe manufacturers which provide heat pipes for satellite sup- pliers can be found worldwide.

Axially grooved heat pipes are flight proven designs. Figure 5.1 shows two types of heat pipe provided by ALCATEL SPACE (a satellite supplier).

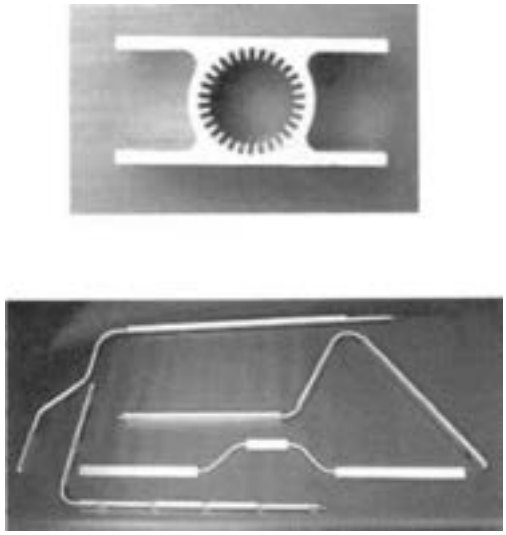

Figure 5.1. *Heat pipe from ALCATEL SPACE (a) Cross-section of 14 mm diameter heat pipe (b) Bent heat pipes*

5.7 HEAT PIPE APPLICATION IN COMPUTER AND ELECTRONICS

Heat pipes and vapor chambers have emerged as the most significant technology and cost-effective thermal solution owing to their excellent heat transfer capabilities, high efficiency and structure simplicity. A selection of the working fluid is based on the operating temperature of the application. In computer applications, the operating temperatures are normally between 50 and 100^{0C}. Within this temperature range water is the best working

fluid. The utilization of heat pipes and vapor chamber to spread and transfer the heat was a key factor for extending the air cooling limit capability for high performance computers.

5.8 ELECTRONIC AND ELECTRICAL EQUIPMENT COOLING

Miniaturization of electronic components is accompanied by increased demands on heat dissipation systems due to the increased density of the components. For example, the digital computer has evolved from a massive system that filled an entire room to a unit which can be stored in a small briefcase. However, the overheating problems associated with the dense packing of heat-generating integrated circuit chips used in the computer (CPU and GPU Cooling) have escalated dramatically. Since the reliability of these and other types of electronic components is sensitive to their operating temperature, steps have been taken to improve heat dissipation by using heat pipes. Other applications to electronic cooling have included rectifiers, thyristors, transistors, traveling wave collectors, audio and RF amplifiers and high density semiconductor packages.

After the introduction of the Pentium processor in 1993, the processor performance and power consumption trend has significantly increased annually. In the year 2000, the heat flux was approximately 10-15 W/cm2, eventually reaching 120-150 W/cm² in 2010. The average power consumption for laptop/notebook computers is currently between 25-50 W, while desktops and servers consume between 80 and 150 W. Regardless of components, power level, or type of computer/processor, as electronics are packed into smaller volumes, it is important to optimize the thermal management components with higher cooling rates.

Presently, almost all laptop/notebook computers use a heat pipe remote heat exchanger (RHE), where a heat pipe is used to transfer heat from the processor to the heat exchanger. Heat pipes have been an important part of laptop/notebook computer cooling systems and will remain so for the foreseeable future. Figure 53 shows a simplified typical layout of a heat pipe remote heat exchanger for laptop/notebook computers, using the heat pipe embedded inside a metal block (CPU case) over the silicon (die). For simplicity, a single heat sink is to illustrate the concept of thermal resistance optimization for personal computers.

CHAPTER 6

WORKING MODEL

6.1 HEAT TRANSFER LIMITATIONS

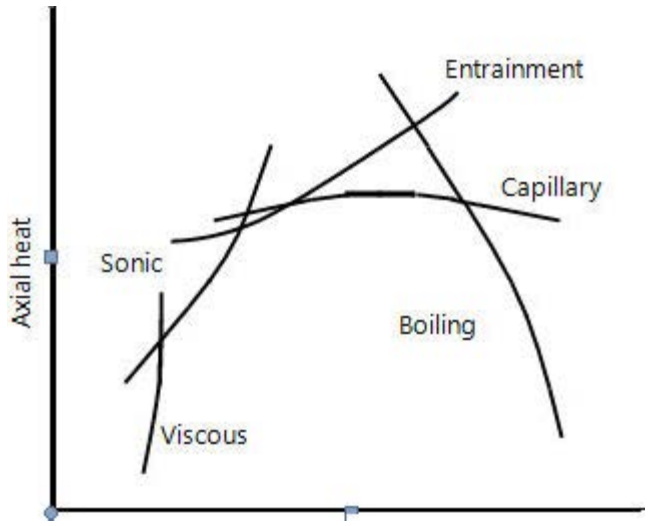

Figure 6.1 limitation to heat transport in a heat pipe.

6.2 DRAWBACKS OBSERVED

- Heat infiltration in the room are high.
- There is no air flow during night time in the room and the room acted as an evacuated chamber.
- Room should not be tightly sealed.
- Water consumption are high because water evaporated due to the ambient room temperature, so rate of condensation decreases slowly.
- Water leakage in the room also a major drawback.

6.3 ADVANTAGES

- May reduce or eliminate the need for reheat
- Allowed cost effective manner to accommodate new ventilation standards

  Requires no mechanical or electrical input are virtually maintenance free

  Provide lower operating cost
- Last a very long time

6.4 DISADVANTAGE

- Add to the first coast and to the fan power to overcome its resistance.
- Increase axial rise in wall temperature pumping power duct to degraded specific heat Increment pumping power due to greater pressure drop
- Inability to sustain flow boiling high cost of Nano particle suspension.

6.5 WORKING MODEL

Figure 6.2 Heat pipe assembly and fixation

Figure 6.3 Temperature monitor

CHAPTER 7

CONCLUSION

It is concluded that all the basic theories of heat and mass transfer to understand the working principle of a heat pipe. On a first look, a heat pipe seems to be a very easy tool to transport heat energy, but if one looks closer it is a very complex heat and mass transfer process that takes place in a heat pipe, convective heat transfer in the condensation and one has convection through evaporation. The second major point is a mass transfer due to vaporization and condensation also through capillary effect, pressure effect and heat conduction effects involved which, create a complex structure of heat transfer is involved. We analyzed and observed the problems during working with the heat pipe and tabulated the readings in a project report additionally we eradicated the minor difficulties and we may reduce the major problems, about our project work as a further study for future improvement in the heat pipe

REFERENCES

1. L.L. Vasiliev, State-of-the-art on heat pipe technology in the Former Soviet Union, Appl. Thermal Eng. 16 (7) (1998) 507–551.

2. R.E. Critoph, The use of thermosyphon heat pipes to improve the performance of a carbon– ammonia adsorption refrigerator, in: Procceedings IV Minsk International Seminar ''Heat Pipes, Heat Pumps, Refrigerators'', 12–15 September 2000, Minsk, Belarus, pp. 35–41.

3. C. Kren, C. Schweigler, F. Ziegler, Efficient Li–Br absorption chillers for the European air conditioning market, in ISHPC'02 Proceedings of the International Sorption Heat Pump Conference, Shanghai, China, 24–27 September 2002, pp. 76–83.

4. B. Spinner, D. Stitou, P.G. Grini, Cascading sorption machines: new concepts for the power control of solid–gas thermochemical systems: towards sustainable technologies, in: Proceedings of the Absorption Heat Pump Conference,Montreal, Canada, vol. 2, 17–20 September, 1996, pp. 531–538.

5. R.Z. Wang, Adsorption refrigeration research in SJTU, in: Proceedings of IV Minsk International Seminar ''Heat Pipes, Heat Pumps, Refrigerators'', Minsk, Belarus, 4–7 September 2000, pp.104–114.

6. Groll,M.etal. Heat recovery units employing reflux heat pipes as components. Final Report, Contract EE-81-133D(B). Commission of the European Communities Report EUR9166EN,1984.

7. Deverall,J.E.Mercury as a heat pipe fluid. ASME Paper 70 HT/Spt-8,American Society of Mechanical Engineers,1970.

8. Bienert,W. Heat pipes for solar energy collectors. 1st International Heat Pipe Conference, Stuttgart, Paper 12–1, October1973.

9. Kemme,J.E., etal., Performance investigations of liquid metal heat pipes for space and terrestrial applications. AIAA Paper 78–431, Proceedings of the III International Heat Pipe Conference, Palo Alto, May1978.

10. Roesler, A. etal. Performance of closed two-phase thermosyphons with high-temperatureorganicworkingfluids.Proceedingsofthe7thInternationalHeatPipe Conference, Minsk, 1990. Hemisphere, New York,1991.

AUTOMATIC TEMPERATURE BASED FAN CONTROLLER USING THERMISTOR

A PROJECT REPORT – PHASE I

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ABSTRACT

Over the last decade, advances in electronics have made devices smaller, cheaper and faster. This project is about how the speed of a fan can be controlled, based on temperature sensor. It is also a part of smart home application where the fan will gradually increase its speed if the temperature is increasing. In general, home appliance fans need to be operated manually with the help of regulators with the variation of temperature, thus requires a repeatedly extra effort for regulating the fan speed which acts to our agony. So as to reduce this extra effort and to add comfort, it is intended in this paper designing an "Automatic Temperature based Fan Controller using Thermistor". In this project the main intension is to control the fan by heating the sensor, i.e. the thermistor, where the speed of the fan is dependent and controlled by any device's temperature like PC. As the temperature of the device increases or decreases, the speed of fan increases or decreases respectively. So it can be used mainly as a cooling device. By modifying the circuit slightly, it can also be used to control the room temperature, depending on the property of thermistor. The thermistor used in the circuit here, decreases its resistance with increasing temperature, hence the electrical conductivity also increases, increasing voltage across it, resulting in an increment in the speed of the fan. Thus, it is possible to control the speed of the fan automatically when the device's temperature varies. Experiment can be followed to evaluate whether this circuit can save energy through the use of temperature sensor and thus promote efficiency.

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LIST OF ABBREVIATIONS AND SYMBOLS

SYMBOLS

V	-	Voltage
cm	-	Centimeter
Ω	-	Ohm
mm	-	Millimeter
W	-	Watt
K	-	Kilo
Hz	-	Hertz
°C	-	Celsius
µF	-	Microfarad

ABBREVIATIONS

PTC	-	Positive Temperature Coefficients
NTC	-	Negative Temperature Coefficients
AC	-	Alternating Current
DC	-	Direct Current
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
RMS	-	Root Mean Square
CRT	-	Cathode Ray Tube
OLED	-	Organic Light Emitting Diode
RGB	-	Red Blue and Green
TFT	-	Thin Film Transistor
TN	-	Twisted Nematic
VAP	-	Vertical Alignment Panels
IPS	-	In Panel Switching
AFFS	-	Advanced Fringe Field Switching
PCB	-	Power Control Box
NRE	-	Non-Recurring Engineering Cost
MOQ	-	Minimum Order Quantities

DVD	-	Digital Versatile Disc
AQUOS	-	Advance Quality Unit Operating System
PDA	-	Personal Digital Assistant
ASV	-	Adaptive Servo Ventilation
CUI	-	Character Oriented User Interface
SPL	-	Sound Pressure Level
PID	-	Positive Identification Device
IC	-	Integrated Circuit
PMDC	-	Permanent Magnet Direct Current
CD	-	Current Density
PWM	-	Pulse Width Modulation
SMD	-	Surface Mount Device

CHAPTER 1

INTRODUCTION

The circuit exploits the property of sensor to operate the DC Fan. A sensor is a type of transducer. In a broader sense, a transducer is sometimes defined as any device that converts energy from one form to another. Besides that, the component that made up the temperature sensor is known as thermistor. Thermistor is a kind of temperature dependent resistor and its resistance varies depending on the temperature in its vicinity. There are two types of Thermistors- Negative Temperature Coefficient Thermistor (NTC) and Positive Temperature Coefficient Thermistor (PTC).

NTC Thermistor decreases its resistance when the temperature increases while PTC Thermistor increases its resistance when the temperature increases. Thermistors are bead like resistors available from 100 ohms to 10K or more values. In this circuit, a 1K (25°C) NTC Thermistor is used. A small DC fan increases or decreases its speed as per the temperature change. When the temperature decreases below a certain level, Fan automatically turns off.

Electronic fan is one of the most post electrical devices due to its cost effectiveness and low power consumption advantages. It is a common circuit and widely used in many applications. It is one of the most sensible solutions to offer a comfortable and energy efficient. In fact the fan has been long used and still usable in the market.

Nowadays, the demand for accurate temperature control and air freshening control has conquered many of industrial domains such as process heat, automotive, industrial places or occupants. One of the most important concern involved in heat area consist in the desired temperature achievement and consumption optimization. So, an automatic temperature control system technology is needed for the controlling purpose in the fan speed according to the temperature changes.

Many researches focusing on automatic temperature control system application in different fields will gain the benefits. For examples, an automatic temperature controller for multi element array hyperthermia systems, multi loop automatic temperature control system design for fluid dynamics. Design of automatic temperature based fan controller using thermistor involved controlling of the fan speed according to the room or any surrounding temperature with our need of suitable conditions.

1.1 Objectives of the Temperature Sensor

- Enable the electric fan to consequently change the rate level as indicated by temperature changes.
- Develop an automatic fan framework that can change the speed level because of the environment temperature changes.
- Apply this method to building a rudimentary on/off heater controller that will maintain a sample at a desired temperature.
- Convert the temperature changes to an equivalent voltage value using sensor.
- Measure RMS / Mean voltage of the captured signal using inbuilt functions of the scope.

1.2 Scope of the Project

- Knowledge about the output voltages from the temperature sensor and how to convert them to byte values.
- The particular formula that will be used to convert the byte values to Centigrade scalar (for LCD display).
- The programming of the Micro-controller and development of the Control Program.
- Driver circuit operation and function of each component.

CHAPTER 2

LITERATURE REVIEW

2.1 An Automatic Room Temperature Control with Security System

Ahmad Faris Bin Zulkifli, 2009, In this paper the author have explained about automatic room temperature control system with an added security system for controlling the temperature in server rooms, especially those that are poorly ventilated and have no cooling units. Finally, if the current temperature reaches lower than desired value, the fan also stops functioning and the LED indicator for cold temperature comes on. Any changes in temperature in the room are continuously displayed on the LCD and the LEDs are used to indicate the current state and range of temperature in the server room.

2.1.1 Conclusion from the Journal

In this journal we have read door lock system and temperature of the room can also be easily controlled automatically by this type sensor systems.

2.2 Temperature Controlled DC Fan using Thermistor

Al Mamun Parvez, 2012, In this paper the author have explained about automatic fan control system based on thermistor for controlling temperature on the room is to allow users to adjust the fan speed automatically. So it can save and streamline the work that is usually done manually which could the work automatically and effective for humans. Fan can be controlled manually by pressing on the switch button where in this method, any change in the temperature will not give any change in the fan speed, except the usage change the speed of the fan which is manually.

2.2.1 Conclusion from the Journal

In this journal we have read that fan can be automatically controlled according to the users need with the any change in the temperature will not give any change in the fan speed, except the usage change the speed of the fan which is manually.

2.3 Temperature Controlled DC Fan using Microcontroller

Ghana Shyam Soren et al., 2010, In this paper the author have explained about the configuration, development, advancement, control and assessment of an automatic switching speed electric fan. This paper shows that the microcontroller base programmed

fan framework introduced in this task to control the electric fan naturally switches the speed as indicated by the environment temperature changes.

2.3.1 Conclusion from the Journal

In this journal we have read development, advancement, control and assessment of an automatic switching the speed of the electric fan.

2.4 Temperature based Fan Control System using Pulse Width Modulation Technique

Vaibhav Bhatia et al., 2013, In this paper the author have explained about the design and simulation of a novel fan speed control system based on room temperature using pulse width modulation technique. This shows the duty cycle is made to vary according to the room temperature and the fan speed is controlled accordingly.

2.4.1 Conclusion from the Journal

In this journal we have read the design and simulation of a novel fan speed control system based on room temperature using pulse width modulation technique.

2.5 Development of Automatic Temperature Control System in Blast Furnace

Choi.W et al., 2006, In this paper the author have explained about the temperature controlled development of automatic temperature control system in blast furnace. This shows the paper is to suggest and propose a low cost wireless sensor network with a low power IR remote sensor to control the distributed air conditioning system and integrated with automatic monitoring system. Due to its advantages, many researches focusing on the automatic temperature control system applications in the different fields will gain the benefits.

2.5.1 Conclusion from the Journal

In this journal we have read the development in the temperature controlling system in blast furnace using low cost wireless sensor network with a low power IR remote sensor to control the distributed air conditioning system and integrated with automatic monitoring system.

2.6 Temperature based Automatic Power Controller for Electrical Devices

SharifulAlam et al., 2014, In this paper the author have explained about the temperature based automatic power controller for electrical devices. This shows a way it can able to control the input voltage as well as power to any load or electrical device not only manually such through the computer but also automatically and based on temperature. The

existing control system can be done manually by supplying the proper manpower which becomes time and cost effective, disgusting and unsuitable as well as main specialty of this researches is to maintain enhanced precision and hysteresis without harmonics in output variation.

2.6.1 Conclusion from the Journal

In this journal we have read the temperature based automatic power controller for electrical devices with the voltage control techniques by the control of the power to the load through maintaining enhanced precision and hysteresis without harmonics in output variation.

CHAPTER 3

DESCRIPTION OF EQUIPMENTS

3.1 Basic Components of the Temperature Control System

There are many electronic components that will be used during the development of temperature controlled fan circuit. There are some that we familiar with and some rarely used components. All components play its important role and interrelated between each other in completing the circuit design. Temperature Control Systems down through the years have been made up of the following five major units:

- The Power Supply Unit: This Unit provides the Temperature Control System with the Electrical Energy that drives it. In this case, the Power Supply Unit consists of a Step down transformer which works based on the principle of induction. The transformer steps down the voltage received from the power outlet from the national rating of 230V to 15V, which is all the voltage needed to drive the system. This voltage is further rectified (using a bridge rectifier) and filtered (using a power capacitor) to give a perfect and undistorted voltage to the system. Of this 15V input voltage, about 5V drives the microcontroller. The rest are needed to drive the other units of the circuit.
- The Sensor Unit: This Module consists of devices (thermometers in traditional systems) that detect the current temperature status. These devices sense the current room/surface temperature, and provide its result to be used as input in the Control unit and in the Display Unit.
- The LCD/Display Unit: This displays the current temperature status of the environment as received from the Sensor Unit. In this case it consists of a 7-bit graphic large-digit display device that reveals the results/reading of the temperature sensor to the external user.
- The Control Unit: The Control unit houses the Controller and related devices (thermostats in automatic systems) that process information to produce effects/action by the system. In this case, this unit houses the microcontroller (and control program/algorithm) that stores the set-point temperature. The control program

receives temperature status from the sensor unit and ensures that it doesn't compromise the set-point by initiating the appropriate sequence of action(s).

- The Menu/Function Unit: This unit consists of input buttons that are used to give commands to the control program and also to program the set-point for the system. In this case, a variable resistor which changes the set-point temperature when its resistance is varied.
- The Alarm Unit: This unit consists of an alarm system that alerts the inhabitants of the environment of a temperature breach. This is an optional component of Temperature Control Systems. It comes mostly with those systems that are built to specifications (custom systems). Most commercial Temperature Control Systems prefer to maintain a silent profile in the environment where they function.

3.2 LCD Display Introduction

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

LCDs were a big leap in terms of the technology they replaced, which include light-emitting diode (LED) and gas-plasma displays. LCDs allowed displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. Where an LED emits light, the liquid crystals in an LCD produces an image using a backlight.

As LCDs have replaced older display technologies, LCDs have begun being replaced by new display technologies such as OLEDs.

3.2.1 LCD Working

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example, a 4K display is made up of 3840 x2160 or 4096x2160 pixels. A pixel is made up of three sub pixels; a red, blue and green commonly called RGB. When the sub pixels in a pixel change color combinations, a different color can be produced. With all the pixels on a display working together, the display can make millions of different colors. When the pixels are rapidly switched on and off, a picture is created.

The way a pixel is controlled is different in each type of display; CRT, LED, LCD and newer types of displays all control pixels differently. In short, LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90 degrees. In between both filters are the liquid crystals, which can be electronically switched on and off.

LCDs are made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.

Some passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same time that it took for one scan in the original technology. However, active matrix is still a superior technology out of the two.

3.2.2 Types of LCDs

- Twisted Nematic (TN) which are inexpensive while having high response times. However, TN displays have low contrast ratios, viewing angles and color contrasts.
- In Panel Switching displays (IPS Panels)- which boast much better contrast ratios, viewing angles and color contrast when compared to TN LCDs.
- Vertical Alignment Panels (VA Panels) which are seen as a medium quality between TN and IPS displays.
- Advanced Fringe Field Switching (AFFS) which is a top performer compared IPS displays in color reproduction range.

3.2.3 Monochrome LCD Display: Segment Display

Segment LCD's, also called static or direct drive are an older technology but are still in heavy use today. These displays are reliable and have been in use for many years. They show no signs of going away anytime soon.

The goal of this display is simplicity. Their only job is to display letters, numbers and icons. There is no 3-D effect or range of brilliant colors and most do not contain

a touch screen or any other type of human interface. They normally are not equipped with a controller/driver chip.

In fact, you could reduce the static/direct drive LCD down to the simple formula of one pin equals one segment. If you need a display that contains a 7 segment number, you need 7 pins. The exception to this is if you increase the number of backplanes and convert this to a multiplex display.

3.2.4 Monochrome LCD Display: Multiplex Display

The formula for a multiplex display is a little more complicated. One pin equals 2 or 4 segments. The advantage of multiplexing is that you reduce the number of pins which, in turn, reduces the cost of the display and the amount of time required to mount the display to a PCB.

One disadvantage of multiplex display over direct drive displays is that the refresh rate is slower and this may allow the segments that are ON to 'fade' or not look as sharp. Some times this is referred to as 'ghosting'. This is not a very common occurrence as the technology has improved since the days of pagers and low cost calculators.

When a customer cannot decided what LCD display type to use we have a general rule: If the total number of segments is 20 or less, we advise a static (direct drive) display since a display with 20 pins is low cost to build and to install on the PCB.

Once the number of segments exceed 20, we recommend multiplex. A display with more than 120 segments becomes cost prohibitive.

If your design exceeds 120 segments we would recommend converting your design to a graphics type of LCD display that makes use of the controller driver chip. The controller driver chip allow the number of connections for multiple segments to be reduced to 14 or 16 pins. This LCD technology is covered later in the article.

3.2.5 Low Power LCD Displays

One key advantage of the monochrome LCD display is that they are not power hungry. They operate with very little current draw. This becomes an ideal choice when the only power you have is a battery. These displays are built to operate at 3.0V, 3.3V (in some case they can operate as low as 1.7V) and 5V. The current draw for a display with no backlight can run slow as 6A per cm. If all you need to display is what time it is, the current temperature, or the number of gallons, and your customer does not wish to pay for vibrant, flashy power-hungry color, then this display will work perfectly for you.

3.2.6 Customizable LCD Displays

The majority of the static or multiplex displays we offer have been customized to meet the customer's requirements. This is a great advantage to consider when choosing one of the LCD display types you will use in your product.

The tooling or NRE (non-recurring engineering cost) of this type of display is much lower than newer technologies and the MOQ (minimum order quantities) are also lower than other types of displays.

If your goal is to display basic information, with a low tooling cost and you need to operate on a low power budget than the best type of LCD Display is a static or multiplex LCD.

3.2.7 LCD Advantages

- Sharpness, Image is perfectly sharp at the native resolution of the panel. LCDs using an analog input require careful adjustment of pixel tracking/phase (see Interference, below).
- Geometric Distortion, Zero geometric distortion at the native resolution of the panel. Minor distortion for other resolutions because the images must be rescaled.
- Brightness, High peak intensity produces very bright images. Best for brightly lit environments.
- Screen Shapes, Screens are perfectly flat.
- Physical, Thin with a small footprint. Consume little electricity and produce little heat.

3.2.8 LCD Disadvantages

- Each panel has a fixed pixel resolution format determined at the time of manufacture that cannot be changed. All other image resolutions require rescaling, which generally results in significant image degradation, particularly for fine text and graphics. For most applications should only be used at the native resolution of the panel. If you need fine text and graphics at more than one resolution do not get an LCD display.
- LCDs using an analog input require careful adjustment of pixel tracking/phase in order to reduce or eliminate digital noise in the image. Automatic pixel tracking/phase controls seldom produce the optimum setting. Timing drift and jitter

may require frequent readjustments during the day. For some displays and video boards you may not be able to entirely eliminate the digital noise.

- Limited viewing angle. Brightness, contrast, gamma and color mixtures vary with the viewing angle. Can lead to contrast and color reversal at large angles. Need to be viewed as close to straight ahead as possible.
- LCDs have difficulty producing black and very dark grays. As a result they generally have lower contrast than CRTs and the color saturation for low intensity colors is also reduced. Not suitable for use in dimly lit and dark environments.
- The bright-end of the LCD intensity scale is easily overloaded, which leads to saturation and compression. When this happens the maximum brightness occurs before reaching the peak of the gray-scale or the brightness increases slowly near the maximum. Requires careful adjustment of the Contrast control.
- The internal Gamma and gray-scale of an LCD is very irregular. Special circuitry attempts to fix it, often with only limited success. LCDs typically produce fewer than 256 discrete intensity levels. For some LCDs portions of the gray-scale may be dithered. Images are pleasing but not accurate because of problems with black-level, gray-scale and Gamma, which affects the accuracy of the gray-scale and color mixtures. Generally not suitable for professional image color balancing.
- LCDs can have many weak or stuck pixels, which are permanently on or off. Some pixels may be improperly connected to adjoining pixels, rows or columns. Also, the panel may not be uniformly illuminated by the backlight resulting in uneven intensity and shading over the screen.
- Slow response times and scan rate conversion result in severe motion artifacts and image degradation for moving or rapidly changing images.
- LCDs have a fixed resolution and aspect ratio. For panels with a resolution of 1280x1024 the aspect ratio is 5:4=1.25, which is noticeably smaller than the 4:3=1.33 aspect ratio for almost all other standard display modes. For some applications may require switching to a letterboxed 1280x960, which has a 4:3 aspect ratio.
- Considerably more expensive than comparable CRTs.

3.2.9 LCD Applications

- Technological improvements to liquid crystal display (LCD) screens have seen them become more popular in the high definition television market. With the improvement

of broadcasting pictures moving quickly from analogue to digital television so too is the television market moving from regular Cathode Ray Tube (CRT) to large flat panel LCD or Plasma screens.

- While liquid crystal display television (LCD TV) is new technology, we have been using liquid crystal display for many years in other household items such as digital clocks, oven timers and home computers.
- LCD technology is not restricted to just large flat screen TVs with LCD projectors available for corporations to display video, images or data in much the same way that the old overhead projector once did.
- LCD technology provides a cheaper alternative to large Plasma screens. Historically the LCD screens have been smaller but new technology is increasing the size of these large flat screen TVs to be more competitive than ever before.
- While the size of LCDs has increased the advantage one has in price comparison with a Plasma screen has seen the LCD screens enjoy their fair share of high definition large flat screen sales in the home entertainment market.
- LCD screens also need less power to function giving the consumers considerable savings on their electricity bills.
- LCD technology is not restricted to just large flat screen TVs with LCD projectors available for corporations to display video, images or data in much the same way that the old overhead projector once did.
- An LCD projector works by sending light from a halogen lamp through three LCD panels (one for red, blue and green). The individual pixels then open to allow light to pass or close to block the light producing our image.
- We also use LCD technology in the world of computers with a LCD computer monitor the most popular display device for computers. An LCD monitor is the popular choice amongst consumers because of the flat panel screen taking up very little space.
- Having replaced the bulky computer monitors the LCD monitor is here to stay with all new computer purchases going hand in hand with a LCD computer monitor. The advantages in buying an LCD monitor is not only restricted to the size but also the savings with LCD monitors using very little of your power supply to work.
- Liquid crystal display television (LCD TV) provides the viewer with a far greater experience watching television. With the LCD TV set you don't have to close the

curtains because the screen is too bright to see the picture properly like you do with a normal CRT television.

Figure 3.1 LCD Display

- One major advantage an LCD screen has is that it is not only a capable of displaying high definition TV, video, DVD or normal television but it can also be used as a computer monitor. Just like your everyday PC monitor you can play games on your LCD screen, you just going to have a bigger, better view of your screen playing on your large screen TV mounted on the wall.
- The new LCD modules combine technology characteristics of the Sharp AQUOS Liquid Crystal TV, referred to as the ASV LCD with Sharp's proprietary small format display technology, referred to as the Advanced-TFT. With this breakthrough, Sharp has attained a new mobile display that is ideally suited for mobile devices, such as camera phones, PDAs, and personal media players, which display streaming video content or color images. The displays achieve excellent visibility in any lighting situation, while offering a wide viewing angle, high contrast ratio, and superior color reproduction.
- The displays are slated for sampling in December of 2003, with volume production to begin next spring.
- "The explosive growth in the use of multi-functional mobile devices has rapidly accelerated the demand for high-resolution color displays that allow users to view a wider range of content," said Joel Pollack, vice president of the Display Business

Unit at Sharp Microelectronics of the Americas. "Sharp's new mobile ASV LCD technology offers design engineers high quality display technology similar to that which is used in our AQUOS LCD TVs. The result is a clear, bright display visible from virtually any angle and under any ambient lighting condition."

- The continued growth in the mobile market is expected to stimulate new demand for the capability to view video and graphic content, including photographic images, scenes from television shows, movies, sports events and news.

3.3 Buzzer Alarm Introduction

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customized with help of other circuits to fit easily in our application.

This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or key stroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play."

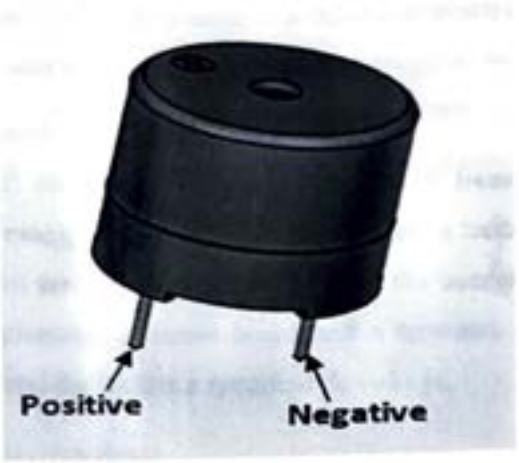

Figure 3.2 Buzzer Alarm

3.3.1 Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

3.3.2 Piezo Buzzer

At the heart of all piezo type buzzers is the piezoelectric element. The piezoelectric piezoelectric effect. Exposure to mechanical strain will cause the material to develop an electric field, and vice versa element is composed of a piezoelectric ceramic and a metal plate held together with adhesive. Both sides of the piezoelectric ceramic plate contain an electrode for electrical conduction. Piezo materials exhibit a specific phenomenon known as the piezoelectric effect and the reverse.

3.3.3 Working of Piezo Buzzer

At the heart of all piezo-type buzzers is the piezoelectric element. The piezoelectric element is composed of a piezoelectric ceramic and a metal plate held together with adhesive. Both sides of the piezoelectric ceramic plate contain an electrode for electrical conduction. Piezo materials exhibit a specific phenomenon known as the piezoelectric effect

and the reverse piezoelectric effect. Exposure to mechanical strain will cause the material to develop an electric field, and vice versa.

3.3.4 Types of Piezo Buzzer

There are two types of piezo buzzers - transducers and indicators. Transducers consist of a casing, a piezoceramic element and a terminal. In order to operate a transducer, the user must send a square wave signal to the buzzer. Indicators consist of a casing, a piezoceramic element, a circuit board and a terminal. In order to operate an indicator, the user must send the buzzer a specified dc voltage.

3.3.5 Piezo Buzzer Characteristics

- Wide operating voltage: 3~250 V
- Lower current consumption: less than 30 mA higher rated frequency
- Larger footprint
- Higher sound pressure level

3.3.6 Piezo Buzzer Feedback

Some CUI Devices piezo buzzers include a feedback line. Driving circuits for buzzers with feedback tend to be simpler than those circuits without. Feedback is accomplished by dividing the piezo element into two, electrically isolated pieces. When the main piezo element is actuated it squeezes the feedback portion, creating a voltage on the feedback line.

A simple way to use feedback is to have the feedback line connected to the base of a transistor. As the piezo element oscillates, the feedback signal will oscillate and the transistor will alternately block or allow current to flow.

- The feedback line provides a voltage that is proportional to the strain on the main piezo element.
- This voltage can be used to create a simple, self-oscillating circuit.

3.3.7 Magnetic Buzzer

This illustration highlights the structure of a typical magnetic buzzer. Like piezo technology, magnetic buzzers are available in transducer and indicator configurations. In a magnetic buzzer, the transistor acts as the driving circuit. Indicators include the transistor, creating a tone when a dc voltage is applied. Transducers lack this transistor, requiring a square wave signal to operate properly.

3.3.8 Magnetic Buzzer Working

The vibrating disk in a magnetic buzzer is attracted to the pole by the magnetic field. When an oscillating signal is moved through the coil, it produces a fluctuating magnetic field which vibrates the disk at a frequency equal to that of the drive signal.

3.3.9 Magnetic Buzzer Characteristics

- Narrow operating voltage: 1~16 V
- Higher current consumption: 30~100 mA
- Lower rated frequency
- Smaller footprint
- Lower sound pressure level

3.3.10 Magnetic Buzzer Types

As mentioned earlier in the presentation, piezo and magnetic indicators have the driving circuitry built into the design, creating a "plug and play" solution. Because of this, engineers do not need to worry about building a complex circuit to drive the buzzer. The disadvantage, however, is that indicators operate on a fixed frequency, reducing the flexibility offered to achieve an alternate frequency as application requirements change. Transducers, on the other hand, do not have the driving circuit built-in, so engineers are offered a greater range of flexibility when designing their circuit. The downside comes in the fact that transducers do require an external driving signal to operate properly, potentially adding complexity and time to the design cycle.

3.3.11 Key Buzzer Specifications

- Frequency Response, How efficiently a buzzer produces sound at a given frequency.
- Sound pressure level, SPL, is the deviation from atmospheric pressure caused by the expressed in decibel Pascal's. It is generally proportional to input voltage and decays by 6 dB when doubling the distance from the buzzer.
- All things have a specific frequency at which they tend to vibrate. This frequency is called the resonant frequency. For buzzers, the resonant frequency is the frequency at which they will be the loudest.
- Electrical impedance is the ratio of applied voltage to current. The electrical impedance varies with frequency.

- In a perfect world all devices would recreate every frequency at the exact same amplitude. In real life every device will have frequencies which it may amplify and frequencies which it will tend to reduce or attenuate. Frequency response curves show how a particular device responds to each frequency. SPL is plotted against frequency to indicate how the device will handle certain frequencies. Note: frequency is plotted on an exponential basis, similar to dB's, it allows the full range of human hearing to be fit in a compact space.
- 20 Hz to 20 kHz tends to be the general range for human ears. This range is reduced with age, especially in males. In older males 13 kHz tends to be the upper end of the audible range. The human ear does not have a flat frequency response over the audible range. Certain frequencies tend to be attenuated while others are magnified. A-weighting attempts to compensate for this by discounting frequencies which the human ear is less sensitive to. It places priority on sounds between 1 kHz and 7 kHz.
- Every system has a particular frequency that it tends to vibrate at. For instance, if you pluck a string on a guitar that string will vibrate very near, or at its resonant frequency. By driving a system at its resonant frequency, very large displacements, relative to the input signal strength can be achieved. Driving a buzzer with an input signal which has the same frequency as the buzzer's resonant frequency, will create the greatest SPL with the least input power.
- CUI Devices has developed an SPL calculator to allow users to convert a buzzer's specified SPL on the datasheet to different real-world conditions, or to compare SPLs between two devices with different specified parameters. This tool makes it quick and easy for designers to specify the proper buzzer for their application.

3.3.12 Advantages of a Buzzer Alarm

There are some advantages of piezoelectric transducer which are given below,

- The piezoelectric transducer is available in desired shape.
- It has rugged construction.
- It is small in size.
- It has good frequency response.
- It has negligible phase shift.

3.3.13 Disadvantages of a Buzzer Alarm

There are some disadvantages of piezoelectric transducer which are given below,

- The piezoelectric transducer is used for dynamic measurement only.
- It has high temperature sensitivity.
- Some crystals are water soluble and get dissolve in high humid environment.

3.3.14 Applications of a Buzzer Alarm

There are some important applications of piezoelectric transducer which are given below,

- The piezoelectric transducer is used in spark ignition engines.
- It can be used in electronic watches.
- It is used in accelerometer.
- It is used in record player.

3.4 DC Motor Fan Introduction

A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

DC motors are rarely utilized in normal applications as a result of all electrical supply firms furnish electrical energy but, for special applications like in steel mills, mines and electric traction, it's advantageous to convert AC into DC so as to use DC motors. The

rational is that the speed/torque characteristics of DC motors are much more superior thereto of AC motors. Therefore, it's not stunning to notice that for industrial drives, DC motors are as common as 3-phase induction motors. Similar to DC generators, DC motors are also classified into 3 kinds; they are series-wound, shunt-wound and compound- wound. The employment of a specific motor depends upon the mechanical load it's to drive.

3.4.1 Principle of DC Motor

A machine which transforms the DC power into mechanical power is called as a DC motor. Its operation relies on the principle that once a current carrying conductor is placed in a very magnetic field, the conductor experiences a mechanical force.

The direction of this force is given by Fleming's left hand rule and magnitude is given by F=BIl newtons.

Fundamentally, there's no constructional distinction between a DC motor and a DC generator. The same DC motor will be run as a generator or motor.

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field.

It will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy.

It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

3.4.2 Types of DC Motor

A DC motor (direct current motor) has a lot of applications in today's field of engineering and technology. From electric shavers to automobiles – DC motors are everywhere. To cater to this wide range of applications – different types of DC motors are used depending on the application.

The types of DC motor includes:

- Permanent Magnet DC Motor (PMDC Motor)
- Separately Excited DC Motor
- Self Excited DC Motor
- Shunt Wound DC Motor
- Series Wound DC Motor

- Compound Wound DC Motor
- Short shunt DC Motor
- Long shunt DC Motor
- Differential Compound DC Motor

3.4.3 Separately Excited DC Motor

As the name suggests, in case of a separately excited DC motor the supply is given separately to the field and armature windings. The main distinguishing fact in these types of DC motor is that, the armature current does not flow through the field windings, as the field winding is energized from a separate external source of DC current as shown in the figure beside.

From the torque equation of DC motor we know $T_g = K_a \varphi I_a$. So the torque in this case can be varied by varying field flux φ, independent of the armature current I_a.

3.4.4 Permanent Magnet DC Motor

The permanent magnet DC motor (also known as a PMDC motor) consists of an armature winding as in case of a usual motor, but does not necessarily contain the field windings. The construction of these types of DC motor are such that, radially magnetized permanent magnets are mounted on the inner periphery of the stator core to produce the field flux.

The rotor on the other hand has a conventional DC armature with commutated segments and brushes. The diagrammatic representation of a permanent magnet DC motor is given below.

The torque equation of DC motor suggests, $T_g = K_a \varphi I_a$

Here φ is always constant, as permanent magnets of required flux density are chosen at the time of construction and there after that can't be changed.

3.4.5 Self Excited DC Motor

In case of self excited DC motor, the field winding is connected either in series or in parallel or partly in series, partly in parallel to the armature winding. Based on this, self-excited DC Motors can be classified as:

- Shunt wound DC motor
- Series wound DC motor
- Compound wound DC motor

3.4.6 Shunt Wound DC Motor

In case of a shunt wound DC motor or more specifically shunt wound self excited DC motor, the field windings are exposed to the entire terminal voltage as they are connected in parallel to the armature winding.

The shunt wound DC motor is a constant speed motor, as the speed does not vary here with the variation of mechanical load on the output.

3.4.7 Series Wound DC Motor

In case of a series wound self excited DC motor or simply series wound DC motor, the entire armature current flows through the field winding as it is connected in series to the armature winding.

In a series wound DC motor, the speed varies with load. And operation wise this is its main difference from a shunt wound DC motor.

3.4.8 Compound Wound DC Motor

The compound excitation characteristic in a DC motor can be obtained by combining the operational characteristic of both the shunt and series excited DC motor. The compound wound self excited DC motor or simply compound wound DC motor essentially contains the field winding connected both in series and in parallel to the armature winding.

The excitation of compound wound DC motor can be of two types depending on the nature of compounding.

3.4.9 Short Shunt DC Motor

If the shunt field winding is only parallel to the armature winding and not the series field winding then it is known as short shunt DC motor or more specifically short shunt type compound wound DC motor.

3.4.10 Long Shunt DC Motor

If the shunt field winding is parallel to both the armature winding and the series field winding then it's known as long shunt type compounded wound DC motor or simply long shunt DC motor.

3.4.11 Working of an DC Motor

Once the terminals of the motor are connected to an external DC supply. Then, the field magnets are excited developing alternate N and S poles. The armature

conductors carry currents. All conductors below N-pole carry currents in one direction whereas all the conductors below S-pole carry currents within the opposite direction.

Assume the conductors below N-pole carry currents into the plane of the paper and those below S-pole carry currents out of the plane of the paper which is shown in Fig. Since each armature conductor is carrying current and is placed within the magnetic field, mechanical force acts on that.

Stating to the Fig and applying Fleming's left hand rule, it's clear that force on every conductor is tending to rotate the armature in anticlockwise direction. All these forces add along to provide a driving torsion that sets the armature rotating. Once the conductor interchanges from one side of a brush to the opposite.

The current in the conductor is reversed and at identical time it comes below the influence of next pole that is of reverse polarity. Accordingly, the direction of force on the conductor rests identical.

A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator.

The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)

The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed.

By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a torque

on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

Different number of stator and armature fields as well as how they are connected provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature.

The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage.

Figure 3.3 12V DC Motor Fan

Since the series-wound DC motor develops its highest torque at low speed, it is often used in traction applications such as electric locomotives, and trams. The DC motor was the mainstay of electric traction drives on both electric and diesel-electric locomotives, street-cars/trams and diesel electric drilling rigs for many years.

The introduction of DC motors and an electrical grid system to run machinery starting in the 1870s started a new second Industrial Revolution. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles and today's hybrid cars and electric cars as well as driving a host of cordless tools.

Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Large DC motors with separately excited fields were generally used with winder drives for mine hoists, for high torque as well as smooth speed control using thyristor drives. These are now replaced with large AC motors with variable frequency drives.

If external mechanical power is applied to a DC motor it acts as a DC generator, a dynamo. This feature is used to slow down and recharge batteries on hybrid and electric cars or to return electricity back to the electric grid used on a street car or electric powered train line when they slow down.

This process is called regenerative braking on hybrid and electric cars. In diesel electric locomotives they also use their DC motors as generators to slow down but dissipate the energy in resistor stacks. Newer designs are adding large battery packs to recapture some of this energy.

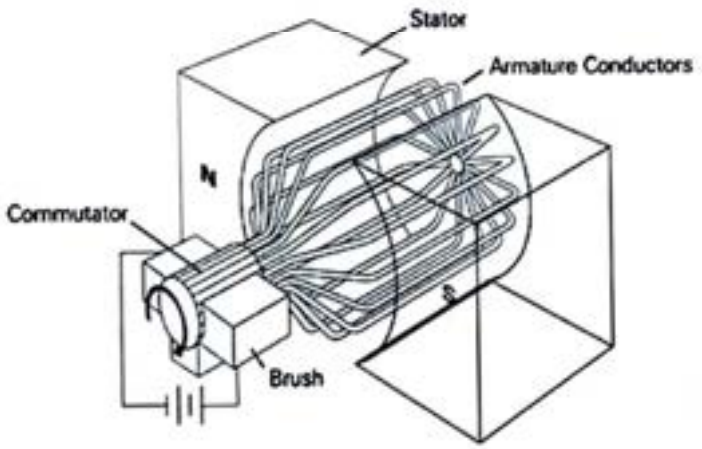

Figure 3.4 DC Motor Structure

3.4.12 DC Motor Advantages

- Starting torque of DC Series motor is comparatively higher than other motors so this kind of motors are widely used for traction applications.
- Series wound motors can use for AC or DC supply so it's also known as universal motors.
- Compare with Shunt Motor DC series motor develop more power for the same construction size.
- Quick start and stop of the motor can do.

- Reversing and acceleration of the motor can do fast.
- Shunt wound motor able to runs at a predetermined speed.
- The power supply of DC motor is any way cheap.

3.4.13 DC Motor Disadvantages

- Speed control and regulation of DC series motor are not good.
- It is necessary to have a load before starting the DC series motors. So Dc Series motors are not good to use where load does not apply to the initial stage.
- Installation of a DC machines is expensive compare with other types of machines.
- Since Shunt motors are constant speed motor, it would be a disadvantage where it's necessary to operate under variable speed.
- DC motors are unreliable at low speeds operations.
- The Size of DC motors is large compared with Alternative Current Motors.
- Operation and maintenance cost of DC motors are expensive.
- DC motors unable to operate in hazard situation where spark occurs at the brush of the motor.
- In generally Every DC motor using brushes so the lifetime of such motors is less compared with AC motors.

3.4.14 DC Motor Applications

- Direct Current series motors are useful traction applications in electrical such as locomotives and trolley cars.
- DC Series Motors are also used for cranes and conveyor belt where higher starting torque is required.
- This motors got great speed controlling characteristics so this type of motors are used in rolling mills.
- Use of lathe machines where constant speed is highly required.
- These motors are also widely used for fans, blowers, reciprocating and centrifugal pumps.
- Compound motors are widely used in applications such as elevators, conveyor belts, air compressors, and punches.
- Can use for variable speed domestic appliances.

3.5 Transformer Introduction

A transformer is one of the most common devices found in electrical system that links the circuits which are operating at different voltages .These are commonly used in applications where there is a need of AC voltage conversion from one voltage level to another.

It is possible either to decrease or increase the voltage and currents by the use of transformer in AC circuits based on the requirements of the electrical equipment or device or load. Various applications use wide variety of transformers including power, instrumentation and pulse transformers.

In a broad, transformers are categorized into two types, namely, electronic transformers and power transformers. Electronic transformers operating voltages are very low and are rated at low power levels. These are used in consumer electronic equipment like televisions, personal computers, CD/DVD players, and other devices.

The term power transformer is referred to the transformers with high power and voltage ratings. These are extensively used in power generation, transmission, distribution and utility systems to increase or decrease the voltage levels. However, the operation involved in these two types of transformers is same. So let us go in detail about the transformers.

3.5.1 Transformer Principle

A transformer is a static device (means that has no moving parts) that consists of one, two or more windings which are magnetically coupled and electrically separated with or without a magnetic core. It transfers the electrical energy from one circuit to the other by electromagnetic induction principle.

The winding connected to the AC main supply is called primary winding and the winding connected to the load or from which energy is drawn out is called as secondary winding. These two windings with proper insulation are wound on a laminated core which provides a magnetic path between windings.

This flux circulates through the core and hence links with the secondary winding. Based on the principle of electromagnetic induction, this magnetic linking induces a voltage in the secondary winding. This is called as mutual induction between two circuits. The secondary voltage depends on the number of turns on the secondary as well as magnetic flux and frequency.

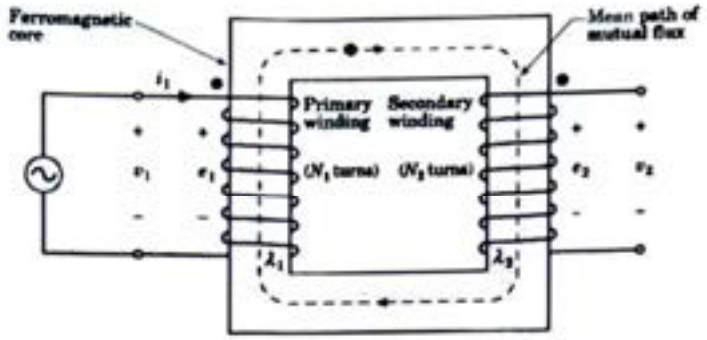

Figure 3.5 Transformer Circuit

3.5.2 Applications of a Transformer

- Step-up or step-down the level of the voltage in power transmission systems like transmission and distribution systems.
- To isolate the low voltage circuits from high voltage circuits in case of substations, control circuitry circuits in industries, etc.
- Instrument transformers like current and potential transformer are used in protection and meter indication systems.
- These are also used for impedance matching.

3.6 Transistor Introduction

- A transistor is a three-terminal electronic device where small current at one terminal is used to control large current at other terminals. Transistors are mainly used for the amplification of the electronic signals.
- Transistor comes with three terminals called emitter, base, and collector which are used for the external connection with electronic circuits.
- Transistors were created with the intention of providing cheap electronics. They are available individually, however, most of the time they are packed together in integrated circuits which are then used for the developments of processors, computer memory chips, and complex ICs.
- A transistor is a combination of two words i.e. transfer and varistor where each layer comes with an ability to transfer current to other layers when a proper biasing voltage is applied across one of the layers.

- Transistor comes with three layers and two PN junctions where an emitter-base junction is forward biased and the collector-base junction is reverse biased.
- Most of the transistors are created using silicon and germanium that are less expensive to vacuum tube and require less power to operate.

Figure 3.6 Transistor

3.6.1 Transistor Types

- Based on the mobility of major charge carriers, transistors are divided into two types NPN and PNP transistors. Both are different in terms of electrical behaviors and physical construction.
- The NPN transistors comes with three layers i.e. two N-doped layers and one P-doped layer. The P-doped layer is sandwiched between two N-doped layers. In NPN transistors, conduction is carried out by both charge carriers i.e. electrons and holes, however, electrons are major charge carriers in NPN transistors.
- Similarly, PNP transistors comes with three layers i.e. two P-doped layers and one N-doped layer. The N-doped layer exists between two P-doped layers. Actually, N-doped layer is responsible for triggering transistor action. When a proper bias voltage is applied at the P-doped layer, it draws current which is then used to control large current at other terminals. Transistors that come in NPN and PNP configurations are nothing but the combinations of two diodes joined back to back.
- In NPN transistor current flows from collector to emitter, while in PNP transistor current flows from emitter to collector.
- The current directions and voltage polarities are always opposite in both transistors. Suppose, if a current is flowing in a clockwise direction in NPN transistor and comes

with positive polarity at the base terminal, it will flow in an anticlockwise direction in a PNP transistor where voltage polarity becomes negative.

- PN junction formed between two semiconductor materials is a building block of the transistor. When PN junction is formed, major charge carriers in N-region (electrons) cross the junction and reach the P-region where they recombine with holes. Similarly, major charge carriers in P-region (holes) cross the junction and reach the N-region where they recombine with electrons.
- The diffusion of electrons and holes depends on the biasing voltage applied across the junction.
- The voltage is said to have forward biased when P-region is connected with positive terminal of the battery and N-region is connected with the negative terminal battery.

3.6.2 Applications of Transistor

- Transistors are mainly used for the amplification of low and high-frequency AC signals.
- No current is produced at the collector terminal unless there is a current at the base terminal. This process allows the transistor to work as a switch. The transistor can be turned ON and OFF by controlling the bias voltage at the base terminal.
- Based on requirements, a transistor can be made to operate in cut-off or saturation region for switching applications.
- Integrated circuits added in the development of the processors are made from transistors.

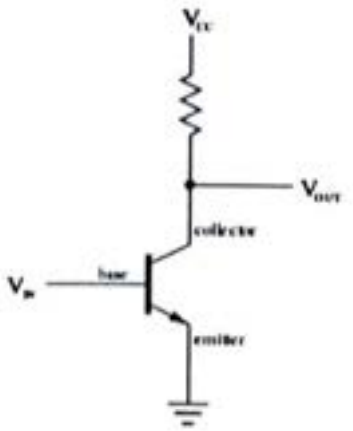

Figure 3.7 Transistor Circuit

- Used in the development of logarithmic converters and logic gates.
- Transistors are widely used in modern electronics especially where signal processing and radio transmission is required.

3.7 LED Introduction

LED is a PN-junction diode that mainly used as a replacement of incandescent lights. It is based on the electroluminescence effect, process where diode converts electric current to light when electrons change their state inside the LED semiconductors.

The PN-junction is nothing but a combination of both N-type and P-type semiconductor materials. The material forming the junction diode is not identical to other mainstream didoes, as it comes with a transparent package, allowing the infrared and visible light to pass through the junction.

The LED contains two terminals known as anode and cathode. The former contains a positive charge on it and comes with the longer lead as compared to other, and later contains negative charge on it.

LED will be working under one condition: the anode terminal should be put at a higher potential than cathode terminal as current flows from anode to cathode (positive to negative). LED won't conduct if the respective terminals are connected in the reverse order.

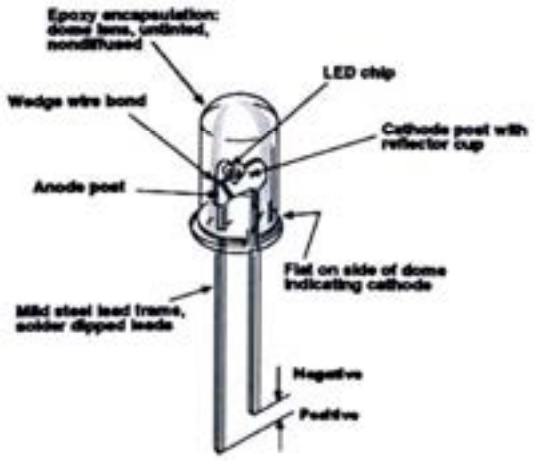

Figure 3.8 LED Structure

3.7.1 LED Working Principle

LED is mainly comprised of four parts known as die, substrate, phosphor, and lens. The die is a semiconductor material containing gallium nitride (GaN) that emits

blue light when the electric current passes through it. In order to provide easy integration of LED, one or two dies are used in combination with the substrate, generating enough power to light up the LED.

The white light is mainly preferred over blue one in general lighting applications where the desired color is produced using phosphor. The blue light, emitting from the die, will generate white light once it hits phosphor particles.

It is important to note that the phosphor can be applied to die material both ways: directly or layered with the lens material that either extracts or directs the light and mainly comes with silicon or glass. The LED, more often than not, generates monochromatic light ranging from red to blue and violet.

Traditional LEDs are formed using inorganic semiconductor materials including aluminum, gallium, silicon, indium, and zinc that produce a different color based on the type of material used: aluminum gallium phosphide produces green color, while aluminum gallium nitride, and aluminum gallium arsenide producing ultraviolet and red light respectively.

The LEDs are also rated with respect to the voltage required to turn them on where red LEDs come with a maximum voltage rating of around 2.2V, while blue LEDs and white LEDs come with a voltage rating of 3.4V and 3.6V respectively.

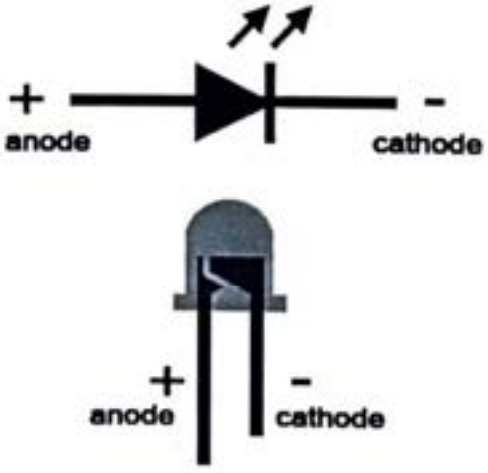

Figure 3.9 LED Circuit Diagram

3.7.2 LED Types

LEDs are available in a variety of types. Some are preferred over others based on the nature of applications. Following are some main types of LEDs.

- **High Power LEDs,** LEDs are known as High Power LEDs if their power rating is greater than or equal to 1 Watt. They are mainly used for generating the maximum brightness. The input power required for these LEDs is very high, making them prone to heat dissipation. Heat sinks are required to keep these LEDs cool and impede from burning. The flashlights, spotlights, and automobile headlamps are some major applications of High Power LEDs.
- **RGB LEDs,** It is widely used in many computer applications and comes with an ability to generate three lights, as the name suggests, red, blue and green. The color of these lights is controlled by using PWM (pulse width modulation). Both the duty cycle of PWM and frequency used for generating the signal per second, prove to be handy for controlling all three colors.
- **SMD LEDs,** SMD LED stands for Surface Mount Device LED. It comes in a special package with the ability to be mounted on the PCB surface. It can be easily categorized based on the physical dimensions. It works both ways: separately or in combination with a compatible device.
- **Thru-hole LEDs,** Thru-hole LED comes with two terminals leads that are embedded into the holes of the printed circuit board. They are available in a variety of different packages and shapes. Most common colors they come with are white, red, blue and green.

3.7.3 LED Applications

- The compact size of the LED makes it stand fit in hard to reach places including ceiling lighting, cove lighting, tray, and cabinet lighting.
- Thanks to the robust nature of LEDs – without them, Landscape lighting would never be so easy and created flawlessly as it has been right now.
- The LEDs play a vital role in generating and optimizing the light beam angle at the desired distance and their ability to disguise any shape as per the nature of the environment they are incorporating in, help them serve a real purpose, adding curated light layered with beauty using a single source.
- Some of the digital clocks are developed using the LED interface. And the 7-segment LED display is widely used student project that incorporates the array of LEDs in an organized manner.

- They are profoundly used in automotive industries, LCD panels, fiber optics data transmission, and remote control devices. While pointing out the sheer advantages of the LEDs, we can't write off their value in advertising.
- They are mainly used to captivate the visitors – when placed in the advertising banner and tree decorated with a number of infrared lights will help in getting the instant attention of the customers.

3.8 Resistor Introduction

A resistor is a two-terminal device that is used to resist the flow of current. It is one of the most commonly used components in electrical circuits.

Resistance of any resister is described in ohms. Ohm is denoted by the Greek letter omega. Each resister has a different value of resistance which tells us how strongly it resists the flow of current. More the value of resistance more is the capability of resisting the current.

Resistance will be considered as one ohm if the potential difference between the two ends of the conductor is 1 V and a current flowing through it is 1 Ampere.

Resistance can be derived from Ohm's law which indicates voltage is directly proportional to the current flowing through the conductor.

Each resistor comes with two wires, also called as leads. Between these two leads there lies a ceramic part which actually resists the flow of current. Resistor consists of three colored strips that indicate the value of resistance.

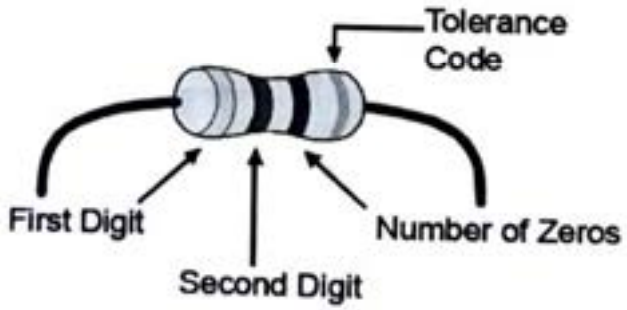

Figure 3.10 Basic Resistor Diagram

Some resistors come with four colored strips. In such case, fourth strip indicates the value of tolerance. Tolerance is the value of the deviation of resistance from its given value on the resistor. Gold color of forth strip indicates tolerance is 5% and silver color indicates tolerance is 10%. Where there is no forth strip, tolerance is considered as 20%. Suppose, if resistance has 50-ohm resistance with no forth strip. Then tolerance of such resistor can be 50 ±20%.

3.8.1 Resistor Applications

Resistors are widely used in many electrical circuits. Following are the main applications of resistors.

- They are used to limit current in order to avoid short circuit.
- They are used to control voltage in order to avoid high spikes at the end of output voltage.
- Used in many electronic industries.
- Temperature can also be controlled using these resistors.
- In home electronic appliances like heater and iron.

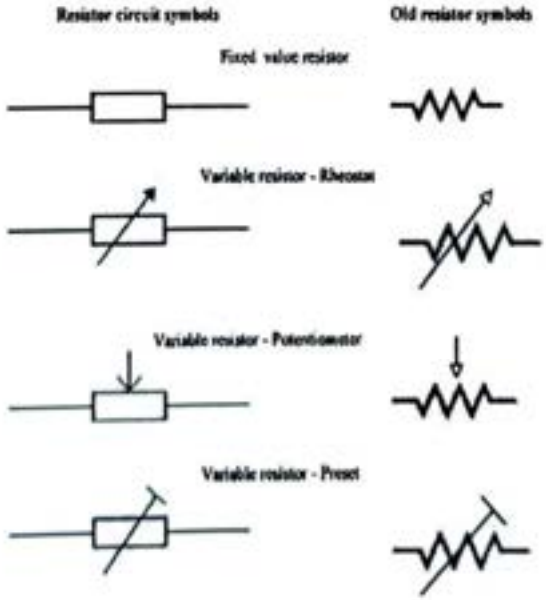

Figure 3.11 Resistor Circuit Symbols

3.9 Diode Introduction

- A diode is an electronic device which allows the current to flow in one direction only and blocks in other direction.

- It is a semiconductor device that comes with two terminals called anode and cathode. An anode is positive while the cathode is negative.
- Most of the diodes are made from silicon because it can afford high temperature, however, germanium is also used for manufacturing where low voltage drop is required.
- A diode is analogous to check valve which is mainly used to carry out ON and OFF operations. This process is used for rectification where AC signal is converted to DC signal. However, diodes are more complicated than simple ON-OFF operation because of a non-linear behavior of current and voltage characteristics of the diode.
- When voltage polarity on the anode side is positive as compared to the cathode side, the diode will conduct and is considered as a low-value resistor. If voltage polarity at the anode side is more negative as compared to the cathode side, the diode is said to have in reverse biased mode and it won't conduct.

Figure 3.12 Diode Diagram

3.9.1 Diode Types

Diodes are divided into two types based on the formation of the junction between the terminals.

- A PN junction diode is made from semiconductors like silicon or germanium where an N-type region is created with the help of negative charge carriers called n-type semiconductor while the P-type region is created with the addition of positive charge carriers called p-type semiconductors.

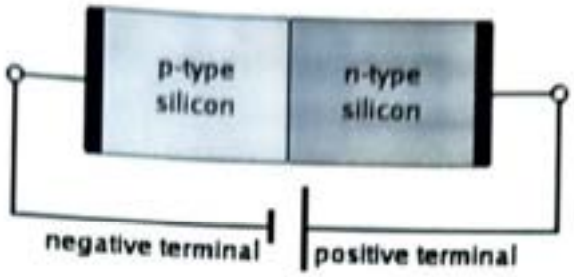

Figure 3.13 PN Junction Diode

- Initially, there is no flow of current between two regions until they are joined together, resulting in a formation of PN junction where movement of electrons starts from N-type semiconductor to P-type semiconductor.
- Schottky diode is another type of junction diode where the junction is formed using metal-semiconductor instead of using p-n junction. It is an ideal choice for the applications where high switching speed is required.

Figure 3.14 Schottky Diode

3.10 Capacitor Introduction

The capacitor is a component which has the ability or "capacity" to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery.

There are many different kinds of capacitors available from very small capacitor beads used in resonance circuits to large power factor correction capacitors, but they all do the same thing, they store charge.

In its basic form, a capacitor consists of two or more parallel conductive (metal) plates which are not connected or touching each other, but are electrically separated either by air or by some form of a good insulating material such as waxed paper, mica, ceramic, plastic or some form of a liquid gel as used in electrolytic capacitors. The insulating layer between a capacitors plates is commonly called the Dielectric.

Figure 3.15 Capacitor

There are two types of electrical charge, positive charge in the form of Protons and negative charge in the form of Electrons. When a DC voltage is placed across a capacitor, the positive (+ve) charge quickly accumulates on one plate while a corresponding and opposite negative (-ve) charge accumulates on the other plate. For every particle of +ve charge that arrives at one plate a charge of the same sign will depart from the -ve plate.

Then the plates remain charge neutral and a potential difference due to this charge is established between the two plates. Once the capacitor reaches its steady state condition an electrical current is unable to flow through the capacitor itself and around the circuit due to the insulating properties of the dielectric used to separate the plates.

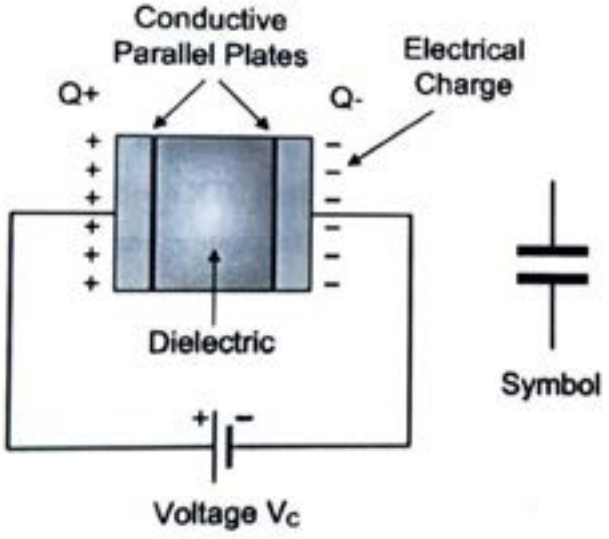

Figure 3.16 Capacitor Symbol

3.11 Thermistor Introduction

A thermistor is a temperature sensing element composed of sintered semiconductor material that exhibits a large change in resistance in proportion to a small change in temperature. A thermistor can operate over a wide temperature range and give temperature value by its resistance change, which is formed by two words: Thermal and resistor. The Positive temperature coefficients (PTC) and the negative temperature

coefficient (NTC) are the two major thermistor types that are used for temperature-sensing applications.

Thermistors are easy to use, inexpensive, and sturdy and respond predictably to a change in temperature. Thermistors are mostly used in digital thermometers and household appliances, such as ovens and refrigerators, and so on. Stability, sensitivity and time constant are the general properties of thermistor that make these thermistors durable, portable, cost-effective, highly sensitive and best for measuring single-point temperature.

Figure 3.17 LM35 Thermistor

3.11.1 Applications of NTC Thermistor

- **Surge Protection:** When a NTC thermistor is turned on, it absorbs the surge current across the equipment and protects it by changing its resistance.
- **Temperature Control and Alarm:** NTC thermistor can be used as a temperature control system or temperature alarm system. When the temperature increases, and the resistance of the thermistor decreases – the current becomes high and gives alarm or switches the heating system on.

CHAPTER 4

WORKING PRINCIPLE

The circuit is an open loop system. In this circuit initially 220V AC is stepped down to 12V AC. Then this AC is converted into DC by a rectifier circuit consisting of 4 diodes D1, D2, D3 and D4. Two electrolytic capacitors C1 and C2 are connected parallel to give more sensitivity to the circuit as they have the ability to smoothen the voltage across them. As the capacitor charges, the rate of change of voltage slows, and charge slows, as the charging current falls thus showing an exponential curve. An LED L1, through a resistance R1 is there across the capacitors to detect the flow of current. Now it is seen that, the thermistor't' and a variable resistor R2 (Potentiometer used here) is divided by R3 resistance of 1K. Initially R2 resistance and that of the Thermistor is almost same and there is no potential difference, so there is no voltage difference thus no current flows though the circuit. Hence the motor does not rotate.

When thermistor senses the temperature, as it is NTC (Negative Temperature Coefficient), its resistance decreases with the increase of temperature. As a result the current and voltage also increase creating a voltage difference across thermistor and the potentiometer R2. Due to this potential difference, a current starts flowing through R3. But this current is not sufficient to start the motor as the rated current of the motor is of high value. In order to amplify the current to a desired value Darlington pair is used. The Darlington transistor (often called a Darlington pair) is a constructed using two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one.

The current output from the Darlington Pair has sufficient high gain to drive the motor. The second LED, L2 is used for the same purpose as L1. Diode D5 is used as a Suppression diode or Fly-back diode, to suppress the sudden voltage spike across the inductive load, i.e. the motor, when the voltage is suddenly increased or decreased.

4.1 Construction and Components

The circuit is designed considering simplicity as the first priority and secondly in an economic way. So the components are also taken as simple as possible, which are very cheap in cost and easily available in the market. The purpose of this circuit is to

vary the speed of a fan related to temperature with a minimum parts counting and avoiding the use of special-purpose ICs, often difficult to obtain.

To do so, first of all, a number of Temperature Sensing Circuits are being developed and their characteristics have been studied. Thermistor as a main component has been chosen for sensing the temperature for designing the circuit. Other components are also there in the circuit design.

Table 4.1 Component Specification

S.NO.	Name of Components	Specifications	No. of Components Used
1.	LCD Display	-	1
2.	Buzzer Alarm	3KHz	1
3.	DC Motor Fan	12V	1
4.	Transformer	220/12V	1
5.	NPN Transistor	BC548C	3
6.	LED Bulb	1.8-2.2V	6
7.	Resistors	2KΩ	4
8.	Diodes	IN4001	3
9.	Capacitor	1000μF	2
10.	Thermistor	1K at 25°C	1
11.	Card Board	Stripped Board	1
12.	Relay	12V	1
13.	Microcontroller	16 Pin	1

4.2 Applications

- **Very low temperature thermometers**: They are used as resistance thermometers in very low-temperature measurements.
- **Digital thermostats**: These thermistors are also commonly used in modern digital thermostats.
- **Battery pack monitors**: NTC thermistors are also used to monitor the temperature of battery packs while charging. As modern batteries such as Li-ion batteries are very sensitive to overcharging, the temperature provides a very good indication of the charging state, and when to terminate the charge cycle.

CHAPTER 5

FUTURE DEVELOPMENT

Artificial Intelligence may be the key to solving the problems/limitations of the PID Controller and making it the perfect method. A little bit of artificial intelligence added to the PID controlled system that would perform an uninformed search with the aim of gaining some prior knowledge of the model of the process would perfect the PID Controller methodology. The major difficulty and defect of the PID Controller is that is acts or performs instinctively and this could sometimes compromise its role because its parameters are constant and precise and hence making it impossible for it to implement knowledge gained of the process because it has no knowledge of the model. Thus, an Artificial Intelligence system would completely remove this defect and perfect the PID Controller methodology.

PID Controller Algorithms are considered the most efficient and effective of all control Algorithms having successfully overcome the limitations of both the On/Off Control and the Proportional Control Algorithms. But even with its efficiency and effectiveness, we can still see some limitations evident in its control structure.

5.1 Scope of the Future Development

- This circuit can be expanded by incorporating a passive infrared sensor along with the temperature sensor. The passive infrared sensor can include a Fresnel lens for sensing a 360° circumference beneath the fan so that the fan can be turned on and off based the motion of persons approaching and leaving a selected area.
- A change over switch can be connected further using which the Fan can be controlled manually as well as automatically.
- This temperature controlled fan with some modifications can further be used in other Heater Circuits to maintain the constant temperature of the device.
- With this circuit, an alarm circuit can be added and used effectively in large equipment where the risk of being overheated and explosions are the serious problems, in various industries.

CHAPTER 6

COST ESTIMATION

Table 6.1 Cost Estimation

S.NO.	TYPE OF COST	Amount(in Rs)
1	Material cost	3500
2	Overhead chargers	600
	Total cost	4100

CHAPTER 7

CONCLUSION

Thus, in our project we have designed a temperature controlled fan using thermistor because of Controlling the temperature is a major problem in our rapidly evolving world and it needs cost-efficient solutions. This Temperature Control System shows a way to get the temperature value and displaying the value on a graphical LCD. In this Project temperature values are measured in analog form, and then it is converted to digital by the Microcontroller. Digital data is used for driving the graphical LCD by the microcontroller unit. The user can configure a set-point temperature value and control an external heating and or cooling device by using the Temperature Control System. The system can be used as the basis for developing custom solutions for networked and standalone data collection and control equipment. It can be centrally powered due to its low current requirement and its small size makes it more portable, allowing it to be placed almost anywhere.

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Automatic Temperature Based Fan Controller using Thermistor

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Abstract: Over the last decade, advances in electronics have made devices smaller, cheaper and faster. This project is about how the speed of a fan can be controlled, based on temperature sensor. It is also a part of smart home application where the fan will gradually increase its speed if the temperature is increasing. In general, home appliance fans need to be operated manually with the help of regulators with the variation of temperature, thus requires a repeatedly extra effort for regulating the fan speed which acts to our agony. So as to reduce this extra effort and to add comfort, it is intended in this paper designing an "Automatic Temperature Controlled Fan". In this project the main intension is to control the fan by heating the sensor, i.e. the thermistor, where the speed of the fan is dependent and controlled by any device's temperature like PC. As the temperature of the device increases or decreases, the speed of fan increases or decreases respectively. So, it can be used mainly as a cooling device. By modifying the circuit slightly, it can also be used to control the room temperature, depending on the property of thermistor. The thermistor used in the circuit here, decreases its resistance with increasing temperature, hence the electrical conductivity also increases, increasing voltage across it, resulting in an increment in the speed of the fan. Thus, it is possible to control the speed of the fan automatically when the device's temperature varies. Experiment can be followed to evaluate whether this circuit can save energy through the use of temperature sensor and thus promote efficiency.

***Keywords*: Temperature controlled fan, Thermistor**

1. Introduction

Electric fan is one of the most popular electrical devices due to its cost effectiveness and low power consumption advantages. It is a common circuit and widely used in many applications. It is also one of the most sensible solutions to offer a comfortable and energy efficient. In fact, the fan has been long used and still available in the market. Fan can be controlled manually by pressing on the switch button. Where in this method, any change in the temperature will not give any change in the fan speed. Except the usage change the speed of the fan which is manually. So, an automatic temperature control system technology is needed for the controlling purpose in the fan speed according to the temperature changes.

2. Methodology

The circuit presents the design, construction, development and control of automatic switching electric fan. The idea is based on the problem occurs in human's life nowadays by improving the existing technology. The Peripheral Interface Controller (PIC) based automatic fan system is applied to upgrade the functionality to embed automation feature. The electric fan will automatically switch on according to the environmental temperature changes. The circuit is using a microcontroller to control the fan according to the temperature variation. The system measures the temperature from the Integrated Circuit (IC) LM35, where it will control the fan according to the setting values in the programming.

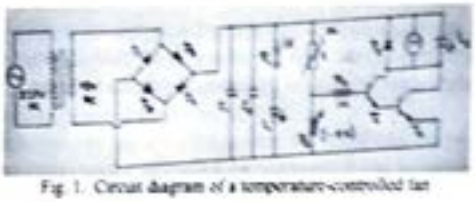

Fig. 1. Circuit diagram of a temperature-controlled fan

3. Fan speed control system components

The Arduino is the heart of the system. It accepts inputs from the temperature sensor, LM35 which allows for the measurement of the current room temperature, then the controller will give the action to maintain the required fan speed. LCD is used to display the fan speed and room temperature. All of these can be summarized in a diagram as shown in Fig. 2.

Fig. 2. Block diagram of fan speed control system

4. Sensor description

A. Thermistor

A thermistor is an electronic component that exhibits a large change in resistance with a change in its body temperature. The word "Thermistor" is actually a contraction of the words "Thermal Resistor".

The thermistors, which are to be described herein are ceramic semiconductors and have either large positive temperature coefficient of resistance (PTC) devices or large negative temperature coefficients of resistance (NTC). Both types of thermistors (PTC and NTC) have definite features and advantages which make them ideal for certain sensor applications.

In this circuit, NTC type Thermistor of 1K at25°C is used.

B. Arduino (Microcontroller)

A microcontroller is a computer control system on a single chip. It has many electronic circuits built into it, which can decode written instructions and convert them to electrical signals. The microcontroller will then step through these instructions and execute them one by one. As an example of this a microcontroller could be used to control the fan speed according to the temperature of the room. There are different types of microcontroller, this project focusses only on the Arduino Uno Microcontroller where its pin diagram is shown in fig. 3.

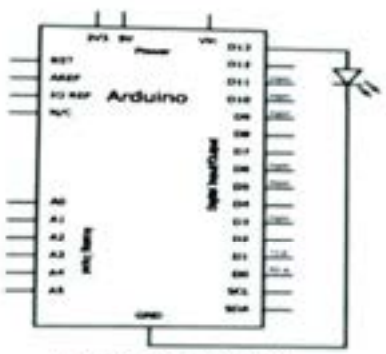

Fig. 3. Pin diagram of Arduino

C. Relay (4 Channel, 5V)

We can control High Voltage electronic devices using relays. A Relay is actually a switch which is electrically operated by an electromagnet. The electromagnet is activated with a low voltage, for example 5 volts from a microcontroller and it pulls a contact to make or break a high voltage circuit.

D. Liquid Crystal Display (LCD)

This component is specifically manufactured to be used with microcontrollers, which means that it cannot be activated by standard IC circuits. It is used for displaying different messages on a miniature liquid crystal display. it can display messages in two lines with 16 characters each. Also, it can display all the letters of alphabet, Greek letters, punctuation marks, mathematical symbols etc. Fig. 3 illustrates LCD (2 x 16 characters) and its connection

E. Algorithm

1. Set T=0, fan Speed=0 and led=off
2. T=getTemp() // Get current temperature from temperature sensor(i.e., LM 35)
3. Now compare the value of T with range of temperatures and set the fanSpeed according to that

a) if T >= 250C and T <=300C
   fan Speed = 25%
b) if T >300C and T <=400C
   fan Speed = 50%
c) if T>400C and T <=450C
   fan Speed = 75%
d) if T >450C
   fan Speed = 100%
   led=On
4. End

The LCD is used to measure and show the changes of temperature value. As working principle, the temperature sensor senses the room temperature and displayed it on the LCD. The speed of the fan is controlled according to the room temperature change.

5. Proposed work

The circuit is designed considering simplicity as the first priority and secondly in an economic way. So the components are also taken as simple as possible, which are very cheap in cost and easily available in the market.

The purpose of this circuit is to vary the speed of a fan related to temperature with a minimum parts counting and avoiding the use of special-purpose ICs, often difficult to obtain.

To do so, first of all, a number of Temperature Sensing Circuits are being developed and their characteristics have been studied.

6. Conclusion

The circuit is very simple and easy to build. This paper elaborates the design and construction of fan speed to control the temperature. Moreover, the fan speed will increase automatically if the temperature will increase. As conclusion, the system which is designed in this work performs very well for any temperature change and can be classified as automatic control.

Acknowledgement

We express our special gratitude to our honourable principle Mr. Premkumar, who gave us an opportunity to work on this project. Being the students of Paavai engineering College, it was our pleasure working on this project and it made us learn lot of new things.

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References

[1] http://www.allaboutcircuits.com
[2] http://en.wikipedia.org/
[3] http://www.howstuffworks.com/
[4] http://www.redcircuits.com
[5] http://www.pc-control.co.uk/
[6] Vaibhav Bhatia and Gavish Bhatia, "Room Temperature based Fan Speed Control System using Pulse Width Modulation Technique," International Journal of Computer Applications, vol. 81, no. 5, November 2013.
[7] Duane, H., Brushless Permanent Magnet Motor Design. University of Maine, Orno, USA, 2nd edition, 2002.
[8] Mustafa Saad, Hossam Abdoalgader, and Muammer Mohamed, "Automatic Fan Speed Control System Using Microcontroller."
[9] Temperature Controlled Relay with Arduino – Tutorial #6 by electronicshematics.com
[10] Automation https://en.wikipedia.org/wiki/Automation

REFERENCES

1. Ahmad Faris Bin Zulkifli, 2019, "An Automatic Room Temperature Control with Security System", International Journal of Recent Technology and Engineering, volume no. 6, pp. 21-24.
2. Al Mamun Parvez, 2012, "Temperature Controlled DC Fan using Thermistor", IOP Conference Series: Materials Science and Engineering, volume no. 420.
3. Ghana Shyam Soren, Zairi Ismael Rizman, Kim Ho Yeap, 2010, "Temperature Controlled DC Fan Using Microcontroller", International Journal of Online and Biomedical Engineering, volume no. 16, pp. 167-169.
4. Vaibah Bhatia and Gavish Bhatia, 2006, "Temperature based Fan Speed Control System using Pulse Width Modulation Technique", International Journal of Computer Applications,volume no. 5, pp. 81-83.
5. W.Choi and W.Yoo, S.Won, 2016, "Development of Automatic Temperature Control System in Blast Furnace", International Journal of Engineering and Science Research, volume no. 24, pp. 55-56.
6. SharifulAlam and Duane, 2009, "Temperature based Automatic Power Controller for Electrical Devices", International Journal of Artificial Intelligence and Applications (IJAIA), volume no. 26, pp. 420-422.

GESTURE CONTROLLED VEHICLE SYSTEM

A PROJECT REPORT – PHASE I

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(AUTONOMOUS)

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ABSTRACT

This paper presents a Hand Gesture Controlled vehicle using Arduino and lily pad, which can be controlled by simple hand gesture. According to the movement of the person hand, the lily pad start moves. It is based on 3axis of accelerometer and vehicle moves in four directions forward, backward, left and right. For sensing Human motion, we use infrared sensor, it is range is 800 mm wavelength from human body. The main goal of this project is to control the movement of the vehicle with hand gesture using accelerometer. This gesture vehicle is very useful for physically challenged people. In previously, the physically challenged people using their wheelchair movement by using joysticks. It creates more pressure and stress in their hands. By using this the movements are very easy to them to operate. In previous gesture devices we are using Arduino UNO. But here by using ARDUINO LILYPAD which senses minor movements in their hands. These wireless communications make the user to interact in a friendlier way.

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LIST OF ABBREVIATIONS AND SYMBOLS

SYMBOLS

V	-	Voltage
C	-	Coulomb
Ω	-	Ohm
mm	-	Millimeter
W	-	Watt
MHz	-	Megahertz
Kb	-	Kilobyte

ABBREVIATIONS

AI	-	Artificial Intelligence
ARM	-	Advanced Risc Machine
HCI	-	Human Computer Interaction
3D	-	3 Dimensional
TV	-	Television
MEMS(or)MEM	-	Micro Electro Mechanical
HMM	-	Hex MICA Module
LED	-	Light Emitting Diode
BX	-	Basic X Free Programmed Language
OSX	-	Operating System X(Ten)
HCL	-	Hydro Chloric Acid Medical
AVR	-	Automatic Voltage Regulator
SRAM	-	Static Random Access Memory
PWM	-	Pulse With Module
IDE	-	Integrated Development Environment
IOT	-	Internet Of Things
I2C	-	Inter Integrated Circuit
SPI	-	Serial Peripheral Interface
USB	-	Universal Serial Bus
SMS	-	Short Message Service

WSN	-	Wisconsin Sports Network
GPS	-	Global Positioning System
PCINT	-	Pin Change Interrupt
ICSP	-	In-Circuit Serial Programming
TX and RX	-	Transmit and Receiver
ADC	-	Analog to Digital Convertor
DC	-	Direct Current
IC	-	Integrated Circuit
VCC	-	Voltage Common Collector
SCL	-	Serial Clock Pin
SDA	-	Serial Data Pin
GND	-	Ground Pin.
XDA	-	Auxiliary Serial Data Pin
IN	-	Interrupt Digital Output Pin.
XCL	-	Auxiliary Serial Clock Pin
SPP	-	Serial Port Protocol
EDR	-	Enhanced Data Rate
CSR	-	Core 04-External Single Chip
CMOS	-	Complementary Metal Oxide Semiconductor
AFH	-	Adaptive Frequency Hopping
AT	-	Attension
NL	-	Next Line
CR	-	Clear
MPU	-	Muss Pick Up
OSC	-	Oscillator Circuit
GPRS	-	General Packet Radio Service
UI	-	User Interface
AR	-	Augmented Reality
VR	-	Virtual Reality
PUI	-	Perceptual User Interface

CHAPTER 1

INTRODUCTION

People would like to regulate everything with their hands, sitting in my chair and dominant things sort of a boss. Thus, I finally came out with a hand gesture recognition automation, which might follow the commands created by hand gestures. Sounds crazy however I promise it is terribly easy. The automaton is split into 2 necessary elements, transmitter and receiver. Here we did like to program the transmitter circuit. Thus, I will be able to be mistreatment Arduino because the programming platform.

To sense the gestures created I will be able to be mistreatment by receiver in the vehicle. Let's see deep part operation of style of Hand Gesture Controlled automation mistreatment Arduino Lily pad and let's see deep operation circuit operating of style of Hand Gesture Controlled automaton mistreatment Arduino Lily pad. In this system, a gesture driven robotic vehicle is developed. in which how the vehicle is moving i.e., control and handling is depending on user gesture. This type of control is mostly used in virtual world compute games. This system makes the physically challenged user to operate the vehicle easily without the help of legs.

1.1 Design Needs to Consider the Following Aspects

- Understanding the gesture recognition technology and implementing it in a robot.
- Designing a proper mechanism.
- Selection of actuators and sensors.
- This robot shall be capable to work on receiving instructions wirelessly.

1.2 Developing Such Kind of Robots Needs

- Proper mechanical arrangement.
- Actuators (motors) of desired speed and power.
- Power supply.
- Programming and logics.

CHAPTER 2

LITERATURE REVIEW

Different types of researches have been made by different researchers in developing this type of project. However, they have a different application and have different technologies implemented.

2.1 Accelerometer Based Hand Gesture with Obstacle Robot

Pankaj Kumar Gautam et al., 2018, In this paper the author have explained about gesture control movement by using micro controller. In this project work we have designed a robot which is to be controlled by hand gesture of human and an accelerometer is used to move robot according to hand movement. In this work the hardware requirements and complexity has been removed because of not using remote control.

2.1.1 Conclusion from the Journal

In this journal we have read most of robots are controlled by wireless connection (like remote or cell phones) or by direct (wired) connection.

2.2 Gesture Control Robot with Arduino

Prem Kumar.CH et al., 2018. In this paper the author have explained about the movement of a robot by using gesture movement of human. A wireless connection is used and helps to connect with robotics and parts of the body. This type is easy to control and use. Arduino Uno is use to Produce a robot commander. The inspector can help you enter a friendly way. We can also increase Productivity production.

2.2.1 Conclusion from the Journal

In this journal we have read advancement of equipment and programming for an automated arm controlled by an accelerometer.

2.3 Hand Motion Controlled Robotic Vehicle

Pooja Pawar et al., 2015, In this paper the author have explained about gesture movement for physically impaired persons. In this work robot can directly contact with people, so we focused on the Manipulation and navigation in the environment and robotic System is used for finding the solution to the requirements.

2.3.1 Conclusion from the Journal

In this journal we have read hand motion controlled robotic vehicle with obstacle identifies trends in technology applications and usability.

2.4 Hand Gesture Recognition

Rafiqul Zaman et al., 2012, In this paper the author have explained about how AI and information technology play a key role in future advancement. In this paper a survey of recent hand gesture recognition systems is presented. Key issues of gesture recognition system are presented with challenges of gesture system. Review methods of recent postures and gestures recognition system presented as well. Summary of research results of hand gesture methods, databases, and comparison between main gesture recognition phases are also given. Advantages and drawbacks of the discussed systems are explained finally.

2.4.1 Conclusion from the Journal

In this journal we have read various methods are discussed for gesture recognition, these methods include neural network, HMM, fuzzy c-means clustering.

2.5 Arm Control Using Gesture and Voice Robot

Suree Pumrin et al., 2017, In this paper the author have explained about gesture to control the overall performance of a smart city. This paper proposes a system to recognize the hand gestures of elderly people using an inexpensive Raspberry Pi. The system can detect six different gestures on both hands in various orientations.

2.5.1 Conclusion from the Journal

In this journal we have read the hand gesture recognition module design for analyzing and classify hand gestures for HCL including glove –based techniques.

2.6 Accelerometer Based Hand Gesture Controlled Robot

Siddharth Rautaray.S et al., 2012, In this paper the author have explained about Human Computer Interaction techniques have become a bottleneck in the effective utilization of the available information flow. Naturalistic and intuitiveness of the hand gesture has been a great motivating factor for the researchers in the area of HCI to put their efforts to research and develop the more promising means of interaction between human and computers. This paper designs a system for gestural interaction between a user and a computer in dynamic environment.

2.6.1 Conclusion from the Journal

In this journal we have read how to use accelerometer and connection circuit with Arduino board.

2.7 Gesture Control Robot

Vijaya Lakshmi, 2016, In this paper the author have explained about gesture control by using raspberry pi. The main objective of this project is to create a hand gesture recognition robot, this robot can be used in both military i.e., in hostage situations which can reduce risk of damage to human life and even for physically handicapped i.e., in the form of wheel chair. This project mainly focuses on Raspberry Pi ARM-11 based processor utilization, image processing. Two motor driver circuits are used which can drive four dc motors combined."

2.7.1 Conclusion from the Journal

In this journal paper we have read and learned to gesture application, human life damage and military usage.

CHAPTER 3

DESCRIPTION OF EQUIPMENTS

3.1 Hand Gesture

A hand gesture is one form of communication in which the movement of the part of bodies especially a hand or head or face to express an idea or meaning. Hand Gestures differ from non-verbal communication which does not communicate some specific messages, like facial expressive displays, or displays of joint attention.

Figure 3.1 Gesture Sign

3.2 Hand Gesture Techniques

For a wide range of applications dynamic, non-contact hand gestures are used. From a selective literature review the following applications have been found; remote crane control; aircraft traffic control; human computer Interaction; virtual environments remote robot manipulation; wearable human computer interfaces, home appliance control, TV control, music; room lighting, hearing aids, weather forecasting, presentation, mobile phone, translation, jukebox and 3D Kiosk. The two common factors in all of the above applications are the use of dynamic and non-contact hand gestures.

Contact and Non-Contact Hand Gestures It is recognized that contact-based hand gestures using a touch pad and expansion of existing handwriting recognition techniques is a possible gesture-based interface for in-vehicle secondary controls which are providing safety benefits. The contact based hand gestures allows a more in-depth analysis of non-contact gesture recognition technologies and possible automotive applications. The three different factors are offers by non-contact gesture recognition.

Firstly, no working in-vehicle non-contact dynamic hand gesture based system could be found maximum research efforts. Secondly, non-contact gestures meant there was no physical interface at all, and thirdly, dynamic noncontact gestures could possibly be used outside the vehicle, although this does not offer any safety benefits, it does offer the opportunity for further experimentation with new ideas and concepts.

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3.2.2 Dynamic and Static Hand Gestures

According to the research, it was understood that for replace existing secondary controls by using static hand gestures, the driver would have to recall potentially hundreds of individual hand gestures each of which would map to a particular in-vehicle secondary control. This static hand gestures create too many problems because drivers are unlikely to work all these gestures and if they did the additional mental workload that providing safety benefit.

Finally, use of dynamic hand gestures appears to be much clearer than static gestures with less ambiguity, only when observing human-to-human communications are present. For these basic common sense reasons, to concentrate on researching dynamic hand gestures only was initially decided.

3.2.3 Gesture Driver Interaction

When reviewing previous research it is interesting and instructive that when gestures are used the differences in different approach with driver interaction is present. In

particular visual reminders, gesture location and system feedback, these are now briefly described.

3.2.4 Gesture Location

It is possible to perform a hand gesture practically anywhere within the drivers reach zone, there are three zones like dynamic, noncontact hand gestures can be performed for in-vehicle controls.

The first is directly in contact with driver in the wind screen area as used by Alpern and Minardo, this would allow hand to be used. The second is in the central windscreen area in the middle of the car, this would just available for use by one of the hands, and the third zone is in the height of the windscreen above the center stack area used by although.

If a specific gesture zone is not to be used and gestures are to be used as a supplementary input method, then it could be argued there is a fourth potential location, namely at or adjacent to the relevant tactile control, this may help users with mental modeling of the gesture and aid recall.

No research has been identified on the best location of hand gestures that would provide maximum safety for in-vehicle applications, ease of use and user acceptability. This lack of research probably explains why there appears to be no agreed standard location. Based on ease of use and the ability to use either hand the first zone immediately in front of the driver is probably the best, however, this may momentarily compromise forward visibility and attract unwanted attention from other motorists or pedestrians.

Since the gesture is hidden from view and there is no obstruction of forward visibility, however, the use of one hand only may be restrictive to some users, perhaps reinforcing the need for the gesture to be a supplementary input modality. The optimum zone to carry out hand gestures is clearly an area of further research.

3.3 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino

programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments.

All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

3.3.1 Needs of Arduino

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments.

Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community. There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems.

programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

- Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

3.4 Arduino Nano

Arduino Nano is a microcontroller board designed by Arduino.cc. The microcontroller used in the Arduino Nano is Atmega328, the same one as used in Arduino UNO. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. So, now let's have a look at its basic features:

Figure 3.2 Arduino Nano

3.4.1 Basic Features of Arduino Nano

Here are few of its basic features which you must know if you are thinking to work on this great microcontroller board:

- It has 22 input/output pins in total.
- 14 of these pins are digital pins.
- Arduino Nano has 8 analogue pins.
- It has 6 PWM pins among the digital pins.
- It has a crystal oscillator of 16MHz.
- It is operating voltage varies from 5V to 12V.
- It also supports different ways of communication.
- Serial Protocol.

- I2C Protocol.
- SPI Protocol.
- It also has a mini USB Pin which is used to upload code.

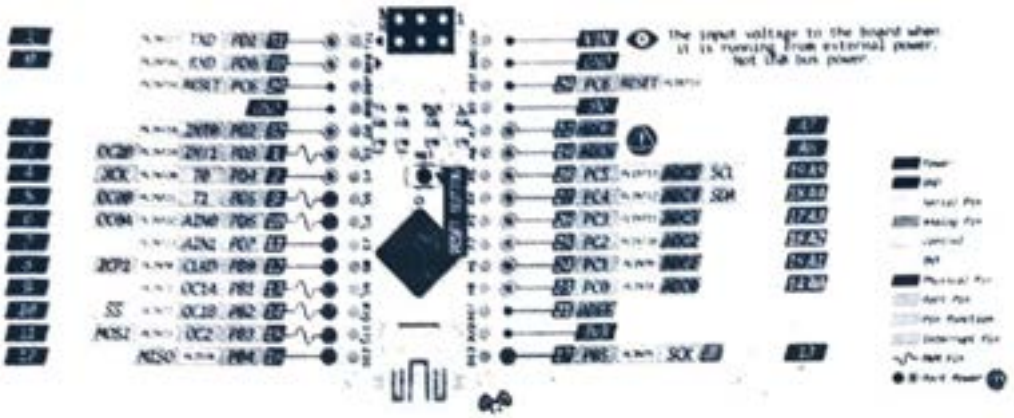

Figure 3.3 Arduino Nano Pin Diagram

- It also has a Reset button on it.
- It has physical pin present in both sides of the module.

3.4.2 Applications of Arduino Nano

Here are few of its application but it has an extensive range which we can't discuss here. So here's the tip of the iceberg:

- Embedded Systems.
- Automation.
- Robotics.
- Control Systems.
- Instrumentation.

3.5 Arduino LilyPad

Over the last decade, it has become much easier to make electronic gadgets. The Arduino revolution has made the microcontrollers easier to use, and at the same time, much more hardware and software has been created. We can now plug a few shields into an Arduino and get a mobile phone, or a GPS navigator with a touchscreen, or, well, almost anything you can imagine. We will discuss the details on Arduino LilyPad.

It is an Arduino Main Board that is based on the ATmega168 or ATmega328 and is introduced by Leah Buechley and SparkFun Electronics. This board is mainly developed for e-textiles and wearable's projects. As per the designed purpose, it can be attached to fabric, sensors, power supplies, and actuators, we may need a conductive thread

for joining this board with the required object. Some applications on wearable devices, smart clothes and embedded e-health system integrated on wearable devices.

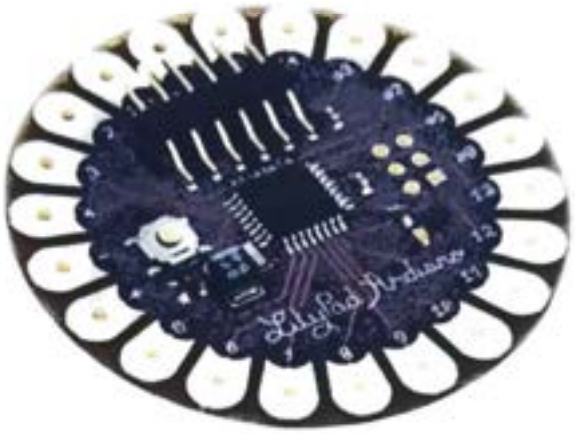

Figure 3.4 Lilypad Arduino

3.5.1 Introduction to Arduino LilyPad

Arduino LilyPad is an Arduino Main Board that is mainly designed for textile's and wearable's projects and is based on ATmega168 or ATmega328. It is nothing but an Arduino-programmed microcontroller and works similar to other Arduino boards available.

It comes in round shape and houses a same number of functionalities what a regular Arduino Board is capable of doing with the intention of performing a number of function on a single chip. However, the ability of this board to be sewn down with the fabric or sensor through conductive thread puts it ahead and stands out of the boards available in the Arduino community.

There are total 22 wide open pin-holes appear around the edge of the whole rounded shape that are mainly used for the connection with the fabric and sensor through a conductive thread.

Out of these 22 pin holes, one is reserved for +5V, and one for ground. Note that, both ATmega328 and Arduino bootloader are incorporated on the board, that help you get rid of the external burner required to burn the code inside the Pad.In order to keep the Pad compact, small and packed in place, the minimum number of external components are required to help design the required operation.

3.5.2 Board Type

The LilyPad has w/ATmega328 Bootloader (a bootloader is like an operating system) on it. Go to Board under Tools and select LilyPad Arduino w/ATmega 328.The LilyPad Arduino incorporates 6 analog inputs that can also be used as digital I/O. They are marked as A0 through A5 on the board, providing 10 bits of resolution.

It is important to note that, the analog inputs measure from ground to 5 volts, however, the upper end of their range can be modified using the analog Reference function. he board contains 14 digital pins that can be employed as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions.

Like other boards in the Arduino, this Pad is programmed by Arduino IDE – an official software mainly used for programming the Arduino Boards, that is developed by Arduino.cc The board comes with a wide voltage range and operates anywhere between 2.7 V to 5.5 V. The pins on the board come with an ability to control and handle the input or output of the attached device.

There are two ways to keep our Pad null and void increase the operating voltage above 5.5 V or plug the power in reverse order. As we mentioned earlier boot loader is used for storing the code and burning it on the board, however, we can also bypass the boot loader and program the ATmega328 using ICSP (In-Circuit Serial Programming) header.

It is important to note that, the analog inputs measure from ground to 5 volts, however, the upper end of their range can be modified using the analogReference() function. He board contains 14 digital pins that can be employed as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. Like other boards in the Arduino.

3.5.3 Pinout for Arduino LilyPad

- There is a candid different between external interrupt pins and PCINT pin. Former is the dedicated hardware pin used for generating the interrupt while later is the interrupt that can be created on any digital I/O pin.
- There are 6 PWM tabs on the board, shown by the dashed lines on the Pinout image above. These PWM pins can also be used as digital I/O pins.

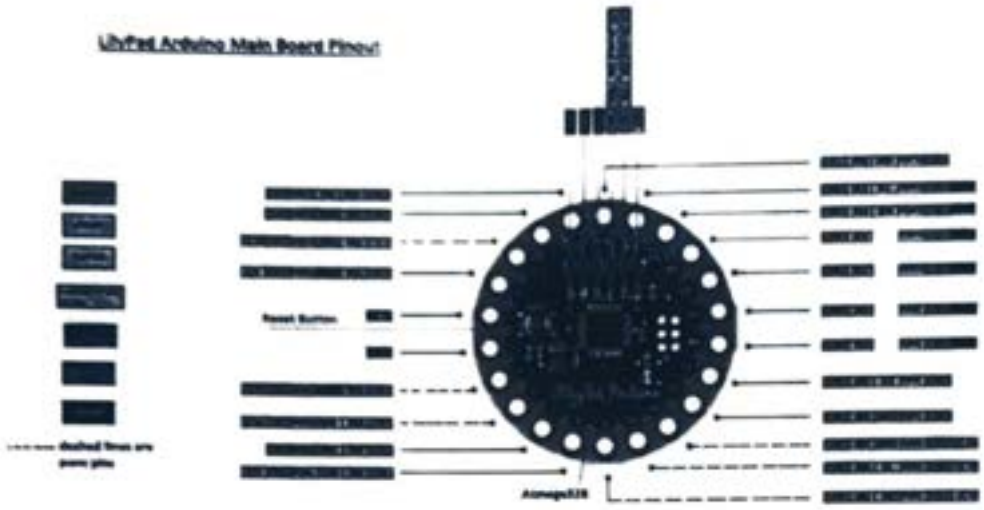

Figure 3.5 Lilypad Main Board Pinout

3.5.4 Arduino Lilypad Connection and Programming

- Be careful while connecting the power and ground pins of the board. The +5V power must be connected to the positive tab on the board and ground tab of the board should be connected to the ground of the power source. The reverse connection can cause a severe damage to the board and in worst case scenario your board may stop working all at once.
- There are two ways to generate regulated +5V power source: Using +5V pin of the Mini USB Adapter or employing another 2.7-5.5V power source using Lithium rechargeable battery. The figure 3.5 shows the LilyPad connection with Mini USB Adapter.

Figure 3.6 Connection Lilypad

- We can see the two circular tabs on the board marked as TX and RX that are mainly used in two ways: For uploading new sketches to the board and establishing a serial communication with other devices.
- Apart from using external power supply, we can also use Mini USB Adapter or Arduino
- Apart from using external power supply, we can also use Mini USB Adapter or Arduino board for connecting the Pad with the computer.

  Following figure shows the connection of the board with LilyPad.

Figure 3.7 Programming Lilypad through Arduino Uno Board

3.5.5 Programming

Using figure4 to connect LilyPad with Arduino Uno board. Programming The LilyPad Arduino can be programmed with the Arduino software (download). *Note*, the LilyPad Arduino should only be programmed with software versions 0010 or higher. You can program it with earlier versions, but all of the time related functions will be off (twice as slow as they should be). The ATmega168V or ATmega328V on the Arduino LilyPad comes returned with a boot loader that allows you to upload new code to it.

3.6 MPU6050 Sensor Module

MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor all in small package. Also, it has additional feature of on-chip Temperature sensor. It has I2C bus interface to communicate with the microcontrollers.

It has Auxiliary I2C bus to communicate with other sensor devices like 3-axis Magnetometer, Pressure sensor etc. If 3-axis Magnetometer is connected to auxiliary I2C bus, then MPU6050 can provide complete 9-axis Motion Fusion output. Let's see MPU6050 inside sensors.

Figure 3.8 MPU6050 Module

3.6.1 3-Axis Gyroscope

The MPU6050 consist of 3-axis Gyroscope with Micro Electro Mechanical System (MEMS) technology. It is used to detect rotational velocity along the X, Y, Z axes as shown in below figure.

Figure 3.9 Axis Gyroscope

- When the gyros are rotated about any of the sense axes, the Carioles Effect causes a vibration that is detected by a MEM inside MPU6050.
- The resulting signal is amplified, demodulated, and filtered to produce a voltage that is proportional to the angular rate.
- This voltage is digitized using 16-bit ADC to sample each axis.

- The full-scale range of output are +/- 250, +/- 500, +/- 1000, +/- 2000.
- It measures the angular velocity along each axis in degree per second unit.

3.6.2 3-Axis Accelerometer

The MPU6050 consist 3-axis Accelerometer with Micro Electro Mechanical (MEMs) technology. It used to detect angle of tilt or inclination along the X, Y and Z axes as shown in below figure.

- Acceleration along the axes deflects the movable mass.
- This displacement of moving plate (mass) unbalances the differential capacitor which results in sensor output. Output amplitude is proportional to acceleration.
- 16-bit ADC is used to get digitized output.
- The full-scale range of acceleration are +/- 2g, +/- 4g, +/- 8g, +/- 16g.
- Acceleration along the axes deflects the movable mass.
- This displacement of moving plate (mass) unbalances the differential capacitor which results in sensor output. Output amplitude is proportional to acceleration

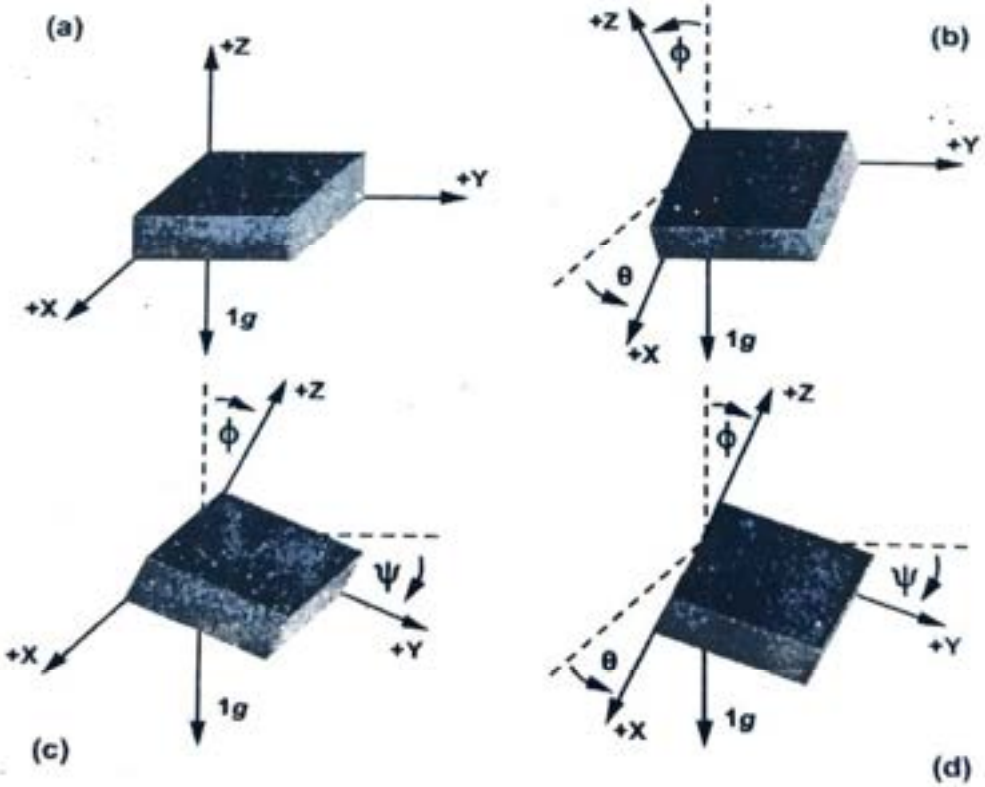

Figure 3.10 Axis Accelerometer

- 16-bit ADC is used to get digitized output.
- The full-scale range of acceleration are +/- 2g, +/- 4g, +/- 8g, +/- 16g.

- It measured in g (gravity force) unit.
- When device placed on flat surface it will measure 0g on X and Y axis and +1g on Z axis.

3.6.3 DMP (Digital Motion Processor)

The embedded Digital Motion Processor is used to compute motion processing algorithms. It takes data from gyroscope, accelerometer and additional 3rd party sensor such as magnetometer and processes the data. It provides motion data like roll, pitch, yaw angles, landscape and portrait sense etc. It minimizes the processes of host in computing motion data. The resulting data can be read from registers.

3.6.4 On - Chip Temperature Sensor

On-Chip Temperature sensor output is digitized using ADC. The reading from temperature sensor can be read from sensor data register.

3.7 MPU-6050 Module

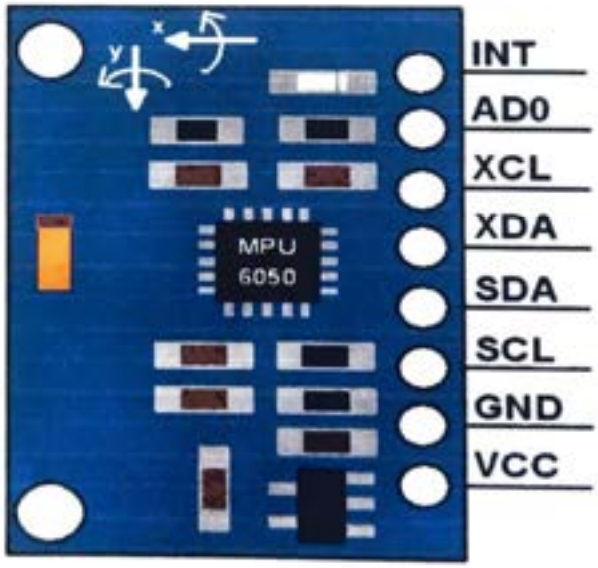

Figure 3.11 MPU-6050 Module

The MPU-6050 module has 8 pins,

INT: Interrupt digital output pin.

AD0:I2C Slave Address LSB pin. This is 0th bit in 7-bit slave address of device. If connected to VCC then it is read as logic one and slave address changes.

XCL: Auxiliary Serial Clock pin. This pin is used to connect other I2C interface enabled sensors SCL pin to MPU-6050.

XDA: Auxiliary Serial Data pin. This pin is used to connect other I2C interface enabled sensors SDA pin to MPU-6050.

SCL: Serial Clock pin. Connect this pin to microcontrollers SCL pin.

SDA: Serial Data pin. Connect this pin to microcontrollers SDA pin.

GND: Ground pin. Connect this pin to ground connection.

VCC: Power supply pin. Connect this pin to +5V DC supply.

MPU-6050 module has Slave address (When AD0 = 0, i.e. it is not connected to Vcc).

Slave Write address (SLA+W): 0 x D0

Slave Read address (SLA+R): 0 x D1

MPU-6050 has various registers to control and configure its mode of operation. So, kindly go through MPU-6050 datasheet and MPU-6050 Register Map.

3.7.1 Calculations

Note that gyroscope and accelerometer sensor data of MPU6050 module consists of 16-bit raw data in 2's complement form. Temperature sensor data of MPU6050 module consists of 16-bit data (not in 2's complement form).

Now suppose we have selected,

- Accelerometer full scale range of +/- 2g with Sensitivity Scale Factor of 16,384 LSB (Count)/g.
- Gyroscope full scale range of +/- 250 °/s with Sensitivity Scale Factor of 131 LSB (Count)/°/then.

To get sensor raw data, we need to first perform 2's complement on sensor data of Accelerometer and gyroscope. After getting sensor raw data we can calculate acceleration and angular velocity by dividing sensor raw data with their sensitivity scale factor as follows,

Accelerometer values in g (g force)

Acceleration along the X axis = (Accelerometer X axis raw data/16384) g.

Acceleration along the Y axis = (Accelerometer Y axis raw data/16384) g.

Acceleration along the Z axis = (Accelerometer Z axis raw data/16384) g.

Gyroscope values in °/S (degree per second)

Angular velocity along the X axis = (Gyroscope X axis raw data/131) °/s.

Angular velocity along the Y axis = (Gyroscope Y axis raw data/131) °/s.

Angular velocity along the Z axis = (Gyroscope Z axis raw data/131) °/s.

Temperature value in °/C (degree per Celsius)

Temperature in degrees C = ((temperature sensor data)/340 + 36.53) °/c.

For example,

Suppose, after 2 complement we get accelerometer X axes raw value = +15454

Then Ax = +15454/16384 = 0.94 g.

3.8 Bluetooth Module HC-05

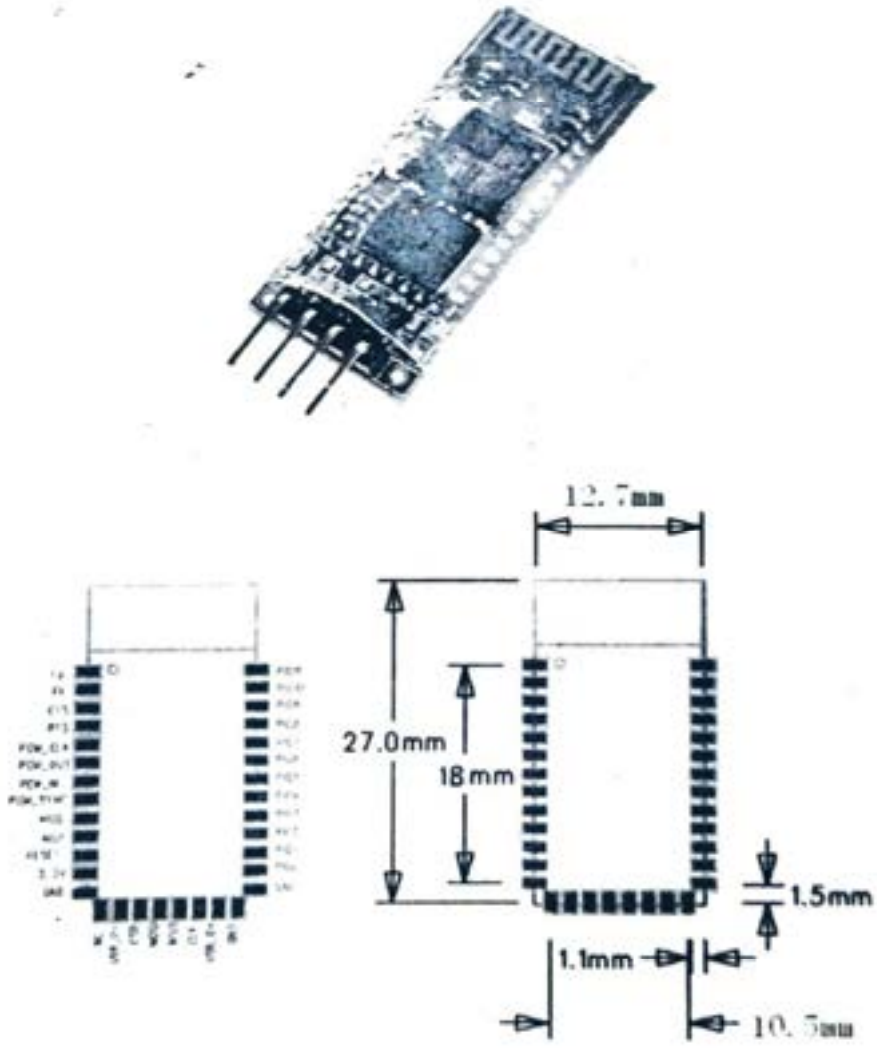

Figure 3.12 Bluetooth Module HC-05 and Dimension

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin.

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0 (+) EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4 GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7 mm x 27 mm. Hope it will simplify your overall design/development cycle.

3.8.1 Hardware Features

- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate

3.8.2 Software Features

- Default Baud rate: 38400, Data bits: 8, Stop bit: 1, Parity: No parity, Data control: has. Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.
- Given a rising pulse in PIO 0, device will be disconnected.
- Status instruction port PIO 1: low-disconnected, high-connected;
- PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default
- Auto-pairing PINCODE:"0000" as default
- Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

3.8.3 Pair Two HC-05 Bluetooth Modules

For this tutorial we need to configure both modules. In order to do that we need to switch to AT Command Mode and here's how we will do that. First we need connect the Bluetooth module to the Arduino as the circuit schematics explained in the previous tutorials. What we need to do additionally is to connect the "EN" pin of the Bluetooth module to 5 volts and also switch the TX and RX pins at the Arduino Board.

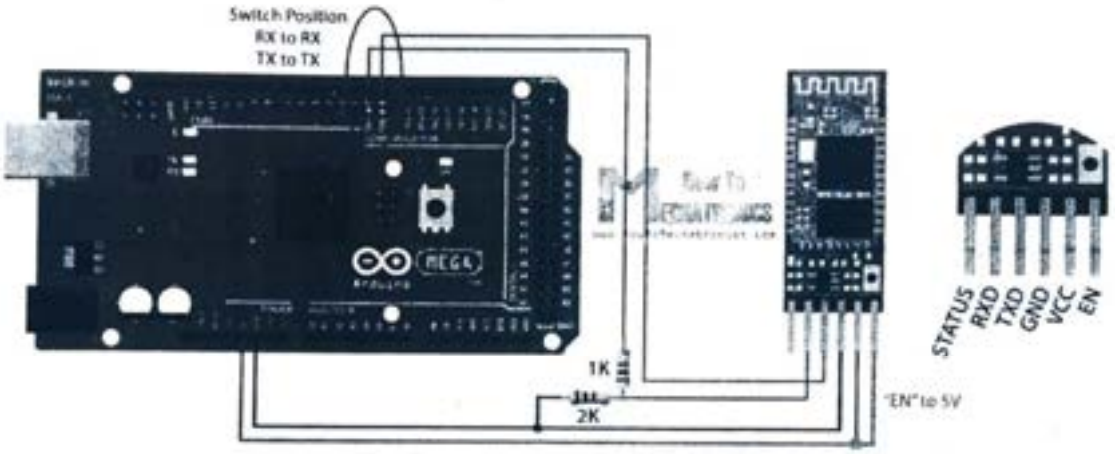

Figure 3.13 Pair Two HC-05 Bluetooth Module Connection

So the RX pin of the Arduino needs to be connected to the RX pin of the Bluetooth module, through the voltage divider, and the TX pin of the Arduino to the TX pin of the Bluetooth module. Now while holding the small button over the "EN" pin we need to power the module and that's how we will enter the command mode. If the Bluetooth module led is flashing every 2 seconds that means that we have successfully entered in the AT command mode. After this we need to upload an empty sketch to the Arduino but don't forget to disconnect the RX and TX lines while uploading. Then we need to run the Serial Monitor and there select "Both NL and CR", as well as, "38400 baud" rate which is the default baud rate of the Bluetooth module. Now we are ready to send commands and their format is as following.

All commands start with "AT", followed by the "+" sign, then a <Parameter Name> and they end either with the "?" sign which returns the current value of the parameter or the "=" sign when we want to enter a new value for that parameter.

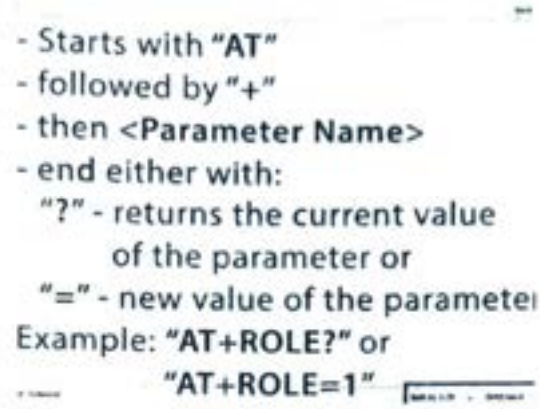

Figure 3.14 Example HC-05 Bluetooth AT Commend

3.8.4 Slave Configuration

So for example, if we type just "AT" which is a test command we should get back the message "OK". Then if we type "AT+UART?" we should get back the massage that shows the default baud rate which is 38400. Then if we type "AT+ROLE?" we will get back a massage "+ROLE=0" which means that the Bluetooth device is in slave mode. If we type "AT+ADDR?" we will get back the address of the Bluetooth module and it should looks something like this: **98d3:34:905d3f.**

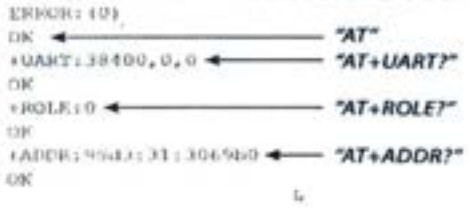

Figure 3.15 Slave HC-05 Bluetooth Module AT Command

Now we need to write down this address as we will need it when configuring the master device. Actually that's all we need when configuring the slave device, to get its address, although we can change many different parameters like its name, baud rate, pairing password and so on, but we won't do that for this example.

3.8.5 Master Configuration

Here Bluetooth module as a master device. First we will check the baud rate to make sure it's the same 38400 as the slave device. Then by typing "AT+ROLE=1" we will set the Bluetooth module as a master device. After this using the "AT+CMODE=0" we will set the connect mode to "fixed address" and using the "AT+BIND=" command we will set the address of the slave device that we previously wrote down.

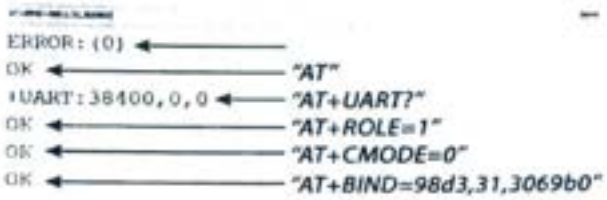

Figure 3.16 Master HC-05 Bluetooth Module AT Command

Note here that when writing the address we need to use commas instead of colons. Also note that we could have skipped the previous step if we entered "1" instead of "0" at the "AT+CMODE" command, which makes the master to connect to any device in its transmission range but that's less secure configuration. Here you can find a complete list of commands and parameters: HC-05 AT.

3.9 L293D Motor Driver – Arduino

The Motor Driver is a module for motors that allows you to control the working speed and direction of two motors simultaneously .This Motor Driver is designed and developed based on L293D IC.

L293D is a 16 Pin Motor Driver IC. This is designed to provide bidirectional drive currents at voltages from 5 V to 36 V.

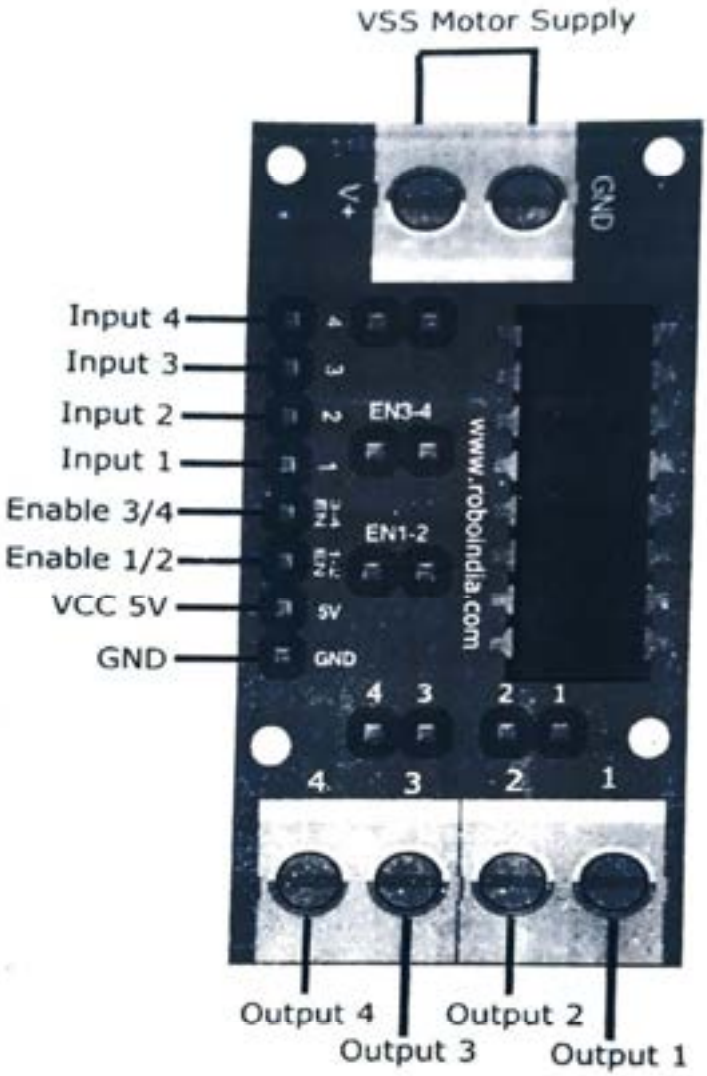

Figure 3.17 Motor Drive L293D

3.9.1 Hardware Required

Table 3.2 Motor Driver Hardware Required

S.NO.	ITEM	QUANTITY
1	Arduino UNO	1
2	Motor Driver	1
3	DC Motor	2
4	Female to Male Jumper wire	8
5	6xAA Battery	1

3.9.2 L293D IC Pin Out

The L293D is a 16 pin IC, with eight pins, on each side, to controlling of two DC motor simultaneously. There are 4 INPUT pins, 4 OUTPUT pins and 2 ENABLE pin for each motor.

Pin 1 : When Enable1/2 is HIGH, Left part of IC will work, i.e motor connected with pin 3 and pin 6 will rotate.

Pin 2 : Input 1, when this pin is HIGH the current will flow though output 1.

Pin 3 : Output 1, this pin is connected with one terminal of motor.

Pin 4/5: GND pins

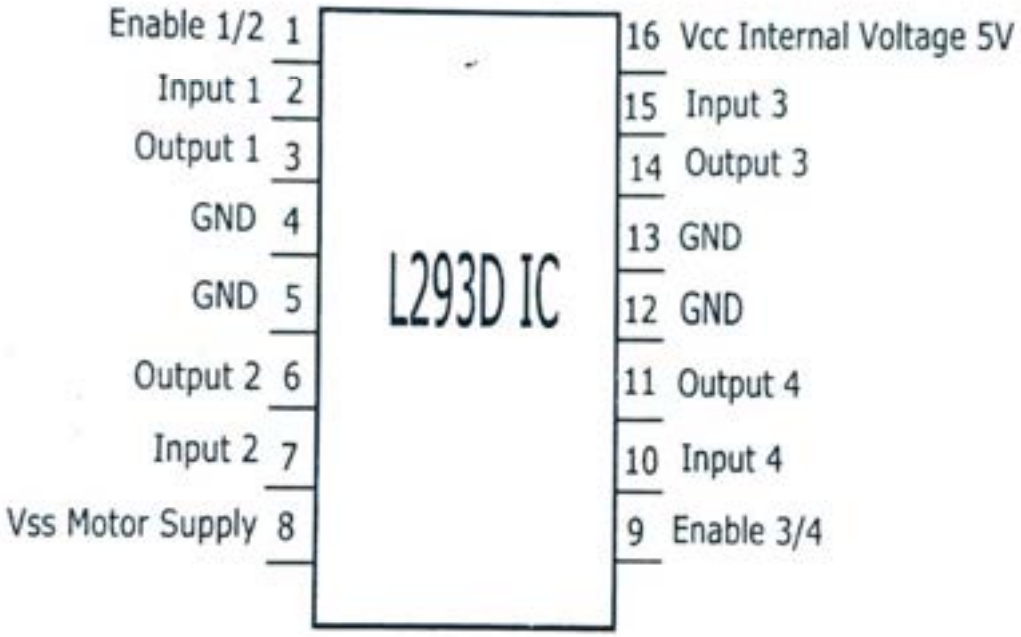

Figure 3.18 L293D IC

Pin 6 : Output 2, this pin is connected with one terminal of motor.

Pin 7 : Input 2, when this pin is HIGH the current will flow though output 2.

Pin 8 : VSS, this pin is used to give power supply to connected motors from 5V to 36V maximum depends on Motor connected.

Pin 9 : When Enable 3/4 is HIGH, Right part of IC will work, i.e. motor connected with pin 11 and pin 14 will rotate.

Pin 10 : Input 4, when this pin is HIGH the current will flow though output 4.

Pin 11 : Output 4, this pin is connected with one terminal of motor.

Pin 12 : GND pins.

Pin 14 : Output 3, this pin is connected with one terminal of motor.

Pin 15 : Input 3, when this pin is HIGH the current will flow though output 3.

Pin 16 : VCC, for supply power to IC i.e. 5V.

3.9.3 Working Mechanism

Rotation of motor depends on Enable Pins. When Enable 1/2 is HIGH, motor connected to left part of IC will rotate according to following manner.

Table 3.3 Working Mechanism of Motor Driver

Input 1	Input 2	Result
0	0	Stop
0	1	Anti-Clockwise
1	0	Clockwise
1	1	Stop

3.10 Arduino - DC Motor

A DC motor (Direct Current motor) is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction.

3.10.1 Different Type of Motors

- DC motor
- Servo motor
- Stepper motor

Figure 3.19 DC motor

3.10.2 Speed Direction Control

To control the direction of the spin of DC motor, without interchanging the leads, you can use a circuit called an H-Bridge. An H-bridge is an electronic circuit that can drive the motor in both directions. H-bridges are used in many different applications. One of the most common application is to control motors in robots. It is called an H-bridge because it uses four transistors connected in such a way that the schematic diagram looks like an "H."

We will be using the L298 H-Bridge IC here. The L298 can control the speed and direction of DC motors and stepper motors, and can control two motors simultaneously. Its current rating is 2A for each motor. At these currents, however, you will need to use heat sinks.

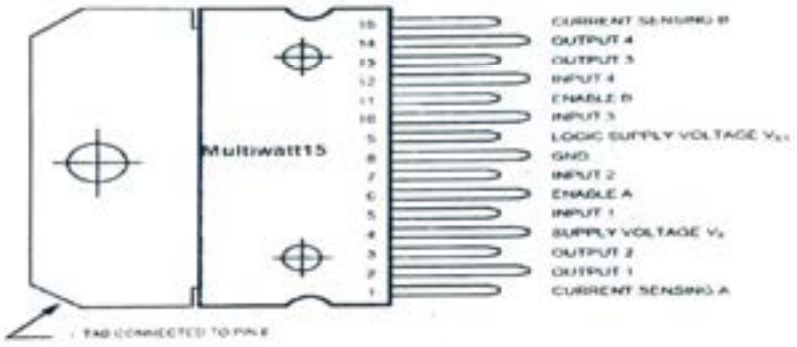

Figure 3.20 Speed Direction Control Multiwatt15

3.11 Power Supply

The nine-volt battery, or 9 volt battery, in its most common form was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in pocket radios, paintball guns, and small electronic devices. They are also used as backup power to keep the time in certain electronic clocks. This format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel cadmium, nickel-metal hydride and lithium-ion. Mercury oxide batteries in this form have not been manufactured in many years due to their mercury content. This type is designated NEDA 1604, IEC 6F22 and "Ever Ready" type PP3 (zinc-carbon) or MN1604 6LR61 (alkaline).Most nine-volt alkaline batteries are constructed of six individual 1.5V LR61 cells enclosed in a wrapper. These cells are slightly smaller than LR8D425 AAAA cells and can be used in their place for some devices, even though they are 3.5 mm shorter.

Figure 3.21 9V Battery

3.12 Arduino IDE

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

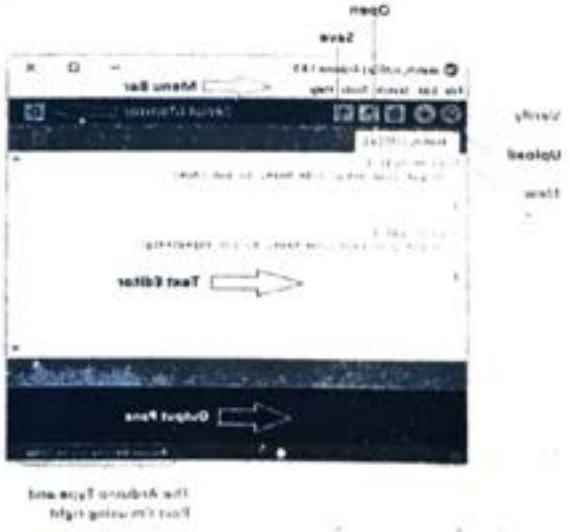

Figure 3.22 Arduino IDE

CHAPTER 4

DESIGN OF EQUIPMENT AND DRAWING

4.1 Mechanical Design

The basic requirement of any robot is its framework or its body on which its complete control circuitry and actuators are to be mounted. In our design our main aim is to move the device according to the hand gestures given by the instructor. So we designed a simple robot which can move forward, backward, turn right and left according to the gestures. The design of the robot is shown in the figure below:

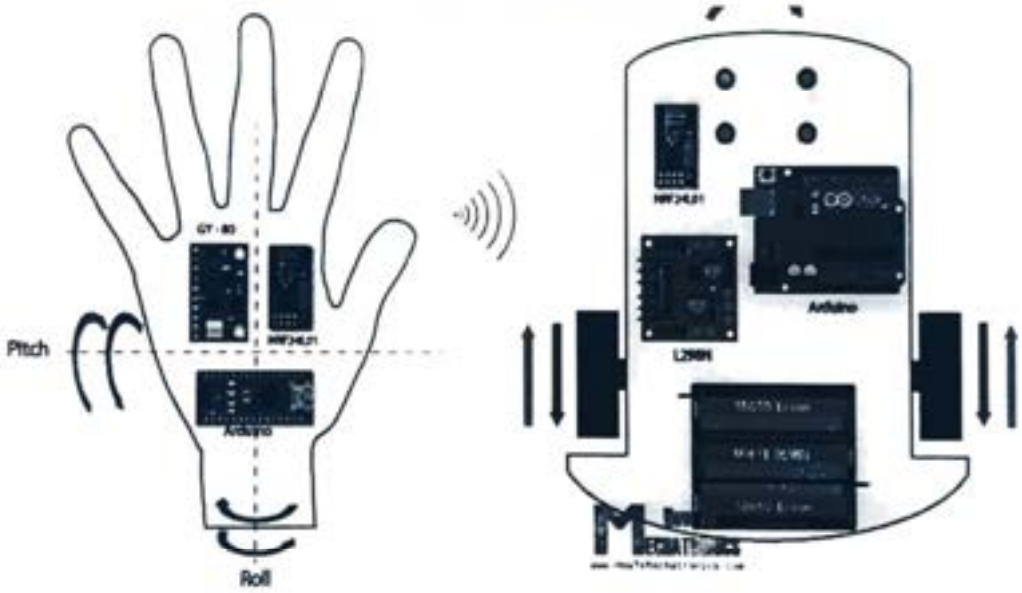

Figure 4.1 Hand Gesture Control Robot

A Robot is an electro-mechanical system that is operated by a computer program. Robots can be autonomous or semi-autonomous. An autonomous robot is not controlled by human and acts on its own decision by sensing its environment. Majority of the industrial robots are autonomous as they are required to operate at high speed and with great accuracy. But some applications require semi-autonomous or human controlled robots.

Some of the most commonly used control systems are voice recognition, tactile or touch controlled and motion controlled. One of the frequently implemented motion controlled robot is a Hand Gesture Controlled Robot. In this project, a hand gesture

controlled robot is developed using MPU6050, which is a 3-axis Accelerometer and 3-axis Gyroscope sensor and the controller part is Arduino Nano.

Instead of using a remote control with buttons or a joystick, the gestures of the hand are used to control the motion of the robot. The project is based on wireless communication, where the data from the hand gestures is transmitted to the robot over RF link (RF Transmitter – Receiver pair).The project is divided into transmitter and receiver section. The circuit diagram and components are explained separately for both transmitter and receiver sections.

4.1.1 Control System

Control system for this robot works using microcontroller and various integrated circuits. The control circuit consists of a Microcontroller (Arduino Uno), Encoder IC (HT12E), Decoder IC (HT12D), Transmitter-Receiver module, Motor driver IC (L293D), and an Accelerometer (ADXL335). The control unit consists of two separate sections.

I. Transmitter section

II. Receiver section

The control system receives data sent from the transmitter section wear by the user. We wear a transmitter module in our hand.

4.1.2 The Transmitting Device

The transmitter section of the robot consists of Arduino Nano board, MPU6050 Sensor, HT-12E Encoder IC and an RF Transmitter. The communication between Arduino and MPU6050 Sensor takes place through I2C Interface. Hence, the SCL and SDA pins of the MPU6050 Sensor are connected to A5 and A4 pins of the Arduino Nano.

Additionally, we will be using the interrupt pin of the MPU6050 and hence,, it is connected to D2 of Arduino Nano.HT-12E is an encoder IC that is often associated with RF Transmitter module. It converts the 12-bit parallel data to serial data. The 12-bit data is divided into address and data bits. A0 to A7 (Pin 1 to Pin8) are the address bits and they are used for secure transmission of the data. These pins can be either left open or connected to ground (Vss). In this circuit, Pin 1 to Pin 9 (A0 – A7 and Vss) of HT-12E are connected to ground. Pins 10 to 13 (AD8, AD9, AD10 and AD11) are the data pins of HT-12E. They receive the 4 word parallel data from external source like a microcontroller (Arduino Nano in this case). They are connected to the pins D12, D11, D10 and D9 of Arduino Nano respectively. TE' is the transmission enable pin and it is an active low pin.

The data is transmitted as long as the TE' is low. Hence, Pin 14 (TE') is also connected to ground.

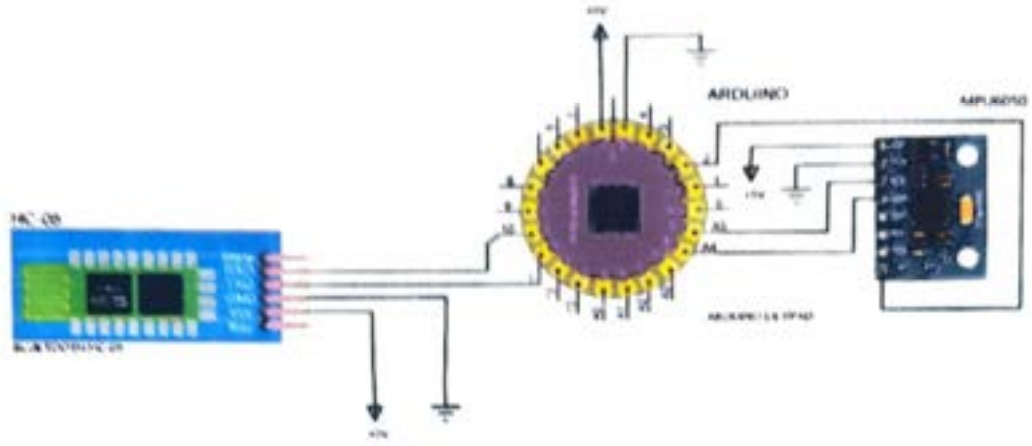

Figure 4.2 Transmitter Connection Part

The encoder IC has an internal oscillator circuit between the pins 16 and 15 (OSC1 and OSC2). A 750kΩ resistor is connected between these pins to enable the oscillator. Out (Pin 17) is the serial data out pin. It is connected to the data in pin of the RF Transmitter. Both Arduino Nano and MPU6050 have 3.3V Regulator. Hence, all the VCC pins are connected to a regulated 5V Supply.

- Accelerometer module (ADXL335) which transmits command to the comparator.
- A microcontroller (Arduino Uno) to receive input from accelerometer and provide output to the Encoder IC.
- An Encoder IC (HT12E) use to encoding the four bit binary data transmitted to the RF Transmitter module
- RF Transmitter module transfers data to the receiver with the help of antenna.

Figure 4.3 Complete Transmitter Part

4.1.3 The Receiver Device

The receiver section of the robot consists of an RF Receiver, HT-12D Decoder IC, L293D Motor Driver IC and a robot chassis with four motors connected to wheels.HT-12D is the decoder IC that is often associated with RF Receiver. It converts the serial data received by the RF link into parallel data. A0 to A7 (Pin 1 to Pin 8) are the address pins and must be matched with the address pins of the encoder.

Since the address pins of encoder (HT-12E) are grounded, the address pins of decoder must also be grounded. Hence, pins 1 to 9 (A0 – A7 and Vss) are connected to ground. The serial data from the RF Receiver is given to Din (Pin 14) of the decoder IC.HT-12D has an internal oscillator and an external resistor of 33KΩ is connected between OSC1 and OSC2 (Pins 16 and 15). Pin 17 (VT) indicates a valid transmission of data and this pin will be high when a valid data is present on the data pins. An LED in series with a 330Ω resistor is connected to this pin to indicate a valid data transmission. Pins 10 to 13 (D8, D9, D10 and D11) of HT-12D are the parallel data out pins. They are connected to the input pins of the L293D motor driver IC (Pins 2, 7, 10 and 15 respectively).L293D motor driver IC is used to provide the necessary current (for both forward and reverse directions) to the motors.

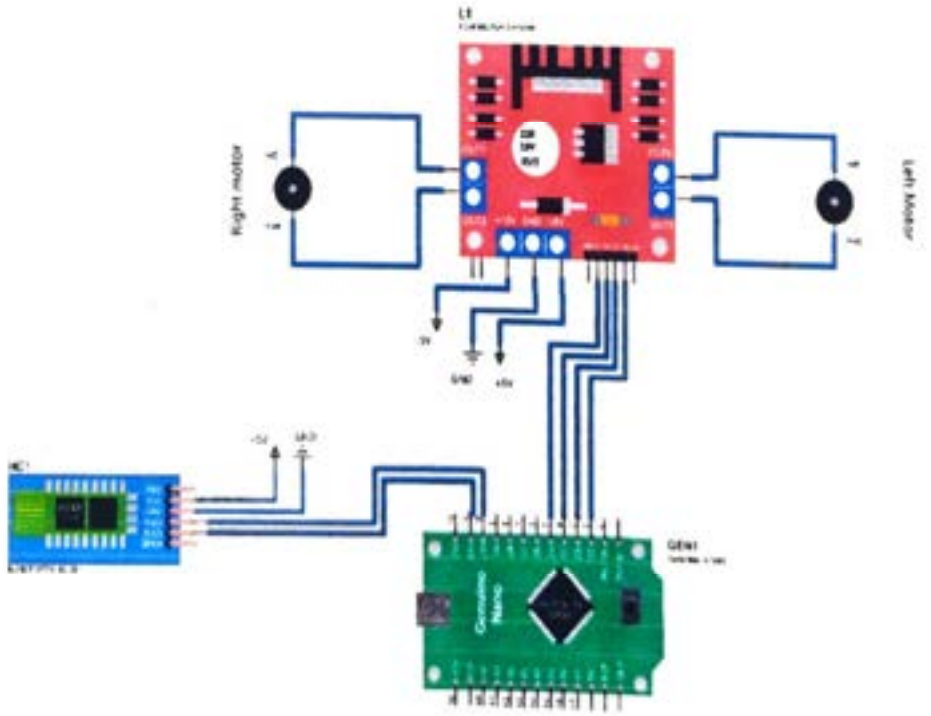

Figure 4.4 Receiver Connection Part

Pins 1 and 9 are the enable pins and are connected to VCC (+5v) along with Pin 16 (which is the logic supply). Pins 3 – 6 and 11 – 14 are the outputs and are connected to the four motors. Pin 8 is the Motor Supply Pin and is connected to a separate power supply. Hence, you will need two batteries in the Receiver Section; one for the Circuit and one for the motors.

- RF Receiver module receives the encoded data with the help of antenna.
- With the help of decoder IC (HT12D) data is decoded.
- According to the data, microcontroller sends commands to the motor driving IC (L293D) for controlling purpose.

Figure 4.5 Complete Receiver Part

CHAPTER 5

WORKING PRINCIPLE

In this project, a robot is controlled by the gestures made by the hand, is designed. The working of the robot is explained here's mentioned earlier, the gesture controlled robot is a wireless operated robot and has two parts: Transmitter and Receiver. When the robot is powered on, the transmitter part, which consists of Arduino, MPU6050, Encoder and RF Transmitter, will continuously monitor the MPU6050 sensor. This data is captured by the Arduino, which then transmits a corresponding data to the Encoder, based on the orientation of the MPU6050 Sensor. The parallel data received by the encoder is converted into serial data and this serial data is transmitted by the RF Transmitter.

At the receiver section, the RF Receiver receives the serial data and transmits it to the Decoder IC. The Decoder will convert the serial data to parallel data and this parallel data is given to the motor driver IC. Based on the data, the movement of the motors, and hence the movement of the robot is defined.

5.1 Test and Procedure

Because of transmitter device wearing on hand and receiver on the robot, the robot starts moving according to the movement of hand gestures. We have explained about the 5 different hand gesture or movement positions i.e. stop condition, forward movement, backward movement, moves towards right and moves towards left.

- Stop Condition The robot can be stopped by making the accelerometer parallel to the horizontal plane; this makes all the output pins of decoder (13, 12, 11, 10) set to high.
- Forward Movement The robot starts moving in forward direction, by making accelerometer tilted to forward direction, this condition sets the two output pin of decoder (13, 11) to low and set high on the other two output pin of decoder (12, 10).
- Backward Movement The robot starts moving in forward direction, by making accelerometer tilted to forward direction (upwards), this condition sets the two output pin of decoder (13, 11) to high and set low on the other two output pin of decoder (12, 10).

- Moves towards Right The robot starts move towards right side by tilting the accelerometer towards right, and this makes the two output pin of decoder (12, 11) low and other two output pin of decoder (13, 10) high.
- Moves towards Left The robot starts move towards left side by tilting the accelerometer towards left, and this makes the two output pin of decoder (12, 11) high and other two output pin of decoder (13, 10) low

5.2 Result

We have seen that physically challenged people are facing many difficulties while travelling they need other's help for their travel. But, by implementing our project to vehicles we can eradicate their difficulty and make their life a trouble free one.

5.3 Applications

- Wireless controlled robots are very useful in many applications like remote surveillance, military etc.
- Hand gesture controlled robot can be used by physically challenged in wheelchairs.
- Hand gesture controlled industrial grade robotic arms can be developed.

5.4 Future Scope

This project can be enhanced using voice circuit in this for deaf and dumb people. Voice circuit converts gestures into voice. With voice circuit implemented this will be useful for Animal Planet, Discovery people for their studies on animals by playing different sounds & for their exploration. Further we can add GPRS and GPS modules for place location.

We can add video camera for live streaming. We can add bomb and metal detectors and can send to place, harmful for a person to go. This type of hand gesture system can be developed for whole body and can be used in military operations.

CHAPTER 6

FUTURE DEVELOPMENT

A few decades ago, touchscreens were impressive, yet clunky pieces of technology reserved for applications that did little more than show off that touchscreens were possible. Today's touchscreens are commonplace and readily accepted as an easy way to interact with an operating system; they're accurate, support multi-touch, are comfortable to use, and can even operate in multiple dimensions (pressing hard).

We may not have perfected touchscreens yet, but we're getting close. Accordingly, engineers and researchers are already speculating about the next phase of UI development, especially for robotics control. So far, the leading candidate is gesture-based control—the use of physical gestures to relay commands.

The major limitation for touchscreens is the fact that they operate only in two dimensions; the third dimension introduced with force touch is extremely limited. Comparatively, hand gestures and physical movements can operate in three dimensions, and depending on how they're designed, could feel more natural than swiping and tapping a smartphone screen.

Demand for three-dimensional gestural control is increasing with the onset of virtual reality (VR) and augmented reality (AR) technology; because the digital world we experience will be moving from two dimensions to three dimensions, the controls we use to manage those experiences will also need to change. With enough sophistication, these systems could provide better feedback to the users in control; rather than merely responding with visual feedback like movement or lights, users could feasibly be immersed with physical feedback like vibration or resistance.

Generally, gestures are classified into two types. Depending on the level of interaction required, different types are used, and it's not always necessary to use one over the other, it does make things simpler to understand though. The two types of gestures.

Online Gestures:

Put simply, these are gestures that control a machine or computer system in real time. Also called direct manipulation gestures, these are the sort that let you interact with objects and impose changes viewable as you do them.

Offline Gestures:

Gestures that are processed after they're done are called offline gestures. In other words, these are the gestures that don't show a real time change. For example, some new smartphones have the option to open a certain application after a specific gesture is made, this is basically an offline gesture. Besides being really functional, it cannot be argued against that gesture control looks really cool. Like in the 2002 hit movie Minority Report, there will probably come a time where everything is controlled by gestures. While it might seem like a technology that will only increase our lethargy, truth is that other than making life easier, it also has a vast array of applications in almost all fields.

Medical Applications:

Advanced robotics systems with gesture recognition can be placed in hospitals or homes to recognize and treat life threatening conditions like heart attacks or strokes.

Alternative Computer Interfaces:

Gesture recognition, along with voice recognition, facial recognition, lip movement recognition and eye tracking combined can be used to create something called a perceptual user interface (PUI), a completely different way to interact with computer systems which will improve usability and creativity by leaps and bounds.

Entertainment Applications:

Most videogames today are played either on game consoles, arcade units, and all require a combination of input devices. Gesture recognition can be used to truly immerse a players in the game world like never before.

Automation Systems:

In homes, offices, transport vehicles and more, gesture recognition can be incorporated to greatly increase usability and reduce the resources necessary to create primary or secondary input systems like remote controls, car entertainment systems with buttons or similar.

An Easier Life for the Disabled:

One of the biggest challenges faced today is providing separate and equally non cumbersome services to the differently abled and handicapped. While there are special provisions around the world, there's still huge room for improvement to bring all lives on

equal footing. Gesture recognition technology can eliminate a lot of manual labor and make life much easier for those who aren't as fortunate as most of us are.

Figure 4.6 Entertainment Application

6.1 Arm Control Based on Human Arm Motion

This paper discusses the development of a robotic arm whereby its motion is controlled based on the movements of the human arm. There are three major components in this project. They are a wearable control device, microcontroller and robotic arm. The wearable control device acts as a sensor to translate the physical movement of the human arm into electrical signals. The translated signals in the form of positional data are sent to the microcontroller unit for processing.

The microcontroller unit processes the signals and outputs it to the robotic arm as physical replicated movements. The wearable control device is capable of sensing six degrees of freedom by the human arm joints movements. This includes rotation of the shoulder, arm, bending of the shoulder, elbow, wrist, and gripping motion. The fabricated robotic arm is able to perform six different motions replicating and mimicking the motions of the human arm.

6.2 Hand Gesture AR.Drone

Parrot AR.Drone is a remote-controlled flying quad-copter helicopter built by the French company Parrot. The controlling system of the drone is based on mobile apps.

Controlling the drone using apps is not comfortable. With this regard, the project proposed is a portable controlling system for the AR.Drone based human gesture.

Figure 4.7 Hand Gesture AR.Drone and Direction

CHAPTER 7

COST ESTIMATION

Table 7.1 Cost Estimation

S. NO.	TYPE OF COST	AMOUNT (in Rs)
1	Materials cost	4000
2	Overhead chargers	500
3	Total cost	4500

CHAPTER 8

CONCLUSION

Thus, in our project we have designed a gesture-controlled vehicle which works on our hand gesture. We have connected an Arduino lily pad in our hand which transmits the signal and it is received by the gyroscope sensor in the vehicle. Our project can be implemented in all vehicle. We have added special features by which our robot can overcome so many problems in industry. If it is further developed then it can be used for military application. A Gesture Controlled robot with Arduino Uno microcontroller has been designed in this work, which can be controlled by human hand gestures. This requires to wear a small transmitting device on our hand included an accelerometer, which transmits particular commands to the robot to move according to the users hand gesture and one receiver at the robot.

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Gesture Controlled Vehicle System

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***Abstract*: This paper presents a Hand Gesture Controlled ehicle using Arduino and lily pad, which can be controlled by mple hand gesture. According to the movement of the person and, the lily pad start moves. It is based on 3axis of accelerometer d vehicle moves in four directions forward, backward, left and ght. For sensing Human motion, we use infrared sensor, it's ange is800nm wavelength from human body. The main goal of is project is to control the movement of the vehicle with hand sture using accelerometer. This gesture vehicle is very useful for hysically challenged people. In previously, the physically hallenged people using their wheelchair movement by using ysticks. It creates more pressure and stress in their hands. By sing this the movements are very easy to them to operate. In revious gesture devices we are using Arduino UNO. But here by sing ARDUINO LILYPAD which senses minor movements in heir hands. These wireless communications make the user to nteract in a friendlier way.**

***Keywords*: Arduino Lily pad, Bluetooth module, IC, Integrated Development Environment, HT12E, HT12D, RF, Transmitter.**

1. Introduction

People would like to regulate everything with my hands! Sitting in my chair and dominant things sort of a BOSS. thus, I inally came out with a hand gesture recognition automation, which might follow the commands created by hand gestures. Sounds crazy however I promise it's terribly easy. The utomaton is split into 2 necessary elements, transmitter and ceiver. Here we'd like to program the transmitter circuit. Thus, I will be able to be mistreatment Arduino because the rogramming platform. To sense the gestures created I will be ble to be mistreatment by receiver in the vehicle. Let's see eep part operation of style of Hand Gesture Controlled utomaton mistreatment Arduino Lily pad and let's see deep peration circuit operating of style of Hand Gesture Controlled utomaton mistreatment Arduino Lily pad.

In this system, a gesture driven robotic vehicle is developed, n which how the vehicle is moving i.e., control and handling is epending on user gesture. This type of control is mostly used virtual world compute games. This system makes the hysically challenged user to operate the vehicle easily without he help of legs.

2. Literature survey

Different types of researches have been made by different researchers in developing this type of project. However, they have a different application and have different technologies implemented. some of those papers are mentioned below stating their technology and application.

[1] Pankaj presented a paper on gesture control movement by using micro controller. In this project work we have designed a robot which is to be controlled by hand gesture of human and an accelerometer is used to move robot according to hand movement. In this work the hardware requirements and complexity has been removed because of not using remote control.

[2] Pooja has proposed on gesture movement for physically impaired persons. In this work robot Can directly contact with people, so we focused on the Manipulation and navigation in the environment and robotic System is used for finding the solution to the requirements

[3] Rafiqul zaman has presented a paper in how AI and information technology play a key role in future advancement. In this paper a survey of recent hand gesture recognition systems is presented. Key issues of gesture recognition system are presented with challenges of gesture system. Review methods of recent postures and gestures recognition system presented as well. Summary of research results of hand gesture methods, databases, and comparison between main gesture recognition phases are also given. Advantages and drawbacks of the discussed systems are explained finally

[4] Vijaya Lakshmi has given a paper on gesture control by using raspberry pi. The main objective of this project is to create a hand gesture recognition robot, this robot can be used in both military i.e., in hostage situations which can reduce risk of damage to human life and even for physically handicapped i.e., in the form of wheel chair. This project mainly focuses on Raspberry Pi ARM-11 based processor utilization, image processing. Pi two motor driver circuits (L298) are used which can drive four dc motors combined.

[5] Pumrin has discussed the use of gesture to control the overall performance of a smart city. This paper proposes a system to recognize the hand gestures of elderly people using an inexpensive Raspberry Pi. The system can detect six different gestures on both hands in various orientations. The experiment showed good results in detecting and classifying their meanings as lingual descriptions.

[6] Siddharth has proposed on Human Computer Interaction techniques have become a bottleneck in the effective utilization of the available information flow. Naturalistic and intuitiveness of the hand gesture has been a great motivating factor for the researchers in the area of HCI to put their efforts to research and develop the more promising means of interaction between human and computers. This paper designs a system for gestural interaction between a user and a computer in dynamic environment.

[7] Prem Kumar has presented on the movement of a robot by using gesture movement of human. A wireless connection is used and helps to connect with robotics and parts of the body. This type is easy to control and use. Arduino Uno is used to produce a robot commander. The inspector can help you enter a friendly way. We can also increase Productivity production.

3. Components

A. Hand gesture

A hand gesture is one form of communication in which the movement of the part of bodies especially a hand or head or face to express an idea or meaning. Hand Gestures differ from non-verbal communication which does not communicate some specific messages, like facial expressive displays, or displays of joint attention.

Fig. 1. Gesture signs

B. Arduino lily pad

Arduino Uno is that the microcontroller board supported the ATmega328p. there are many varieties of Arduino boards however here the sort of board is Arduino Lily pad, even this additionally planning to do an equivalent method however with some distinction, the distinction that is nothing however system voltage, clock speed, digital I/O, analogy inputs and programming interface and additionally the price.

Fig. 2. Arduino lily pad

C. Bluetooth module HC-05

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin.

Fig. 3. Bluetooth module

D. Servo motors

Servomotors are a kind of electromechanical actuators that do not persistently become DC / AC motors. A **servo motor** is an electrical device which rotates an object when current is applied. It works on the principle of PULSE WIDTH MODULATION technique in which variation of current pulses makes the servomotor to rotate. It will make the vehicle to move.

Fig. 4. Servomotors

E. Arduino Nano

Arduino Nano is a small board similar to UNO it is based on AT mega 328p. it is more or less similar to other Arduino but in a separate way. In NANO IIC is used for TWI communication. AREF is to provide reference voltage for input voltage.it has an operating range of 5V. recommended input is 7-12V. It has a flash memory of 32kb.

F. Gyroscopic sensor

MPU-6050 is an 8 pin 6 axis gyro sensor. This kid works on I2C serial communication by default but it can be configured for SPI interface by configuring it register. SCA and SDA lines are present in this module for 12c. it is a multi-functioning sensor but for our project we are using only 12c mode.

Fig. 5. Gyroscopic sensor

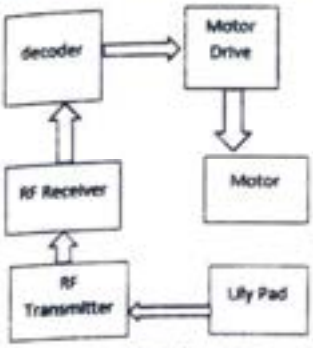

Fig. 6. Block diagram

4. Conclusion

Thus, in our project we have designed a gesture-controlled vehicle which works on our hand gesture. We have connected an Arduino lily pad in our hand which transmits the signal and is received by the gyroscope sensor in the vehicle. Our project can be implemented in all vehicle

5. Result

we have seen that physically challenged people are facing many difficulties while travelling they need other's help for their travel. But, by implementing our project to vehicles we can eradicate their difficulty and make their life a trouble free one.

Acknowledgement

We express our special gratitude to our honourable principle Mr. Prem Kumar, who gave us an opportunity to work on this project. Being the students of Paavai engineering College, it was our pleasure working on this project and it made us learn lot of new things.

I would like to thank our Project guide, Prof. Mr. C. Vibin Stalin, who with her friendly nature helped us to complete this project and guided us continuously. This list would be incomplete without our Head of the Department, Dr. D. R. P. Rajarathnam, who coordinated with us and gave us her valuable time.

References

[1] Pankaj Kumar Gautam, Sudhanshu Pandey, and Vishwajeet Kumar Nanda, "Robot Control by Accelerometer Based Hand Gesture using Arduino Microcontroller," in International Journal of Recent Technology and Engineering, vol. 7, no. 4, pp. 24-27, November 2018.

[2] Dinesh Kumar Bhusare, Shilpa Karale, Pooja Pawar and R. K. Sarawale, "Hand Gesture by Using Robotic Car Control," in International Journal of Advanced Research in Computer Engineering & Technology, vol. 4, no. 3, pp. 830-833, March 2015.

[3] Rafiqul Zaman Khan and Noor Adnan Ibraheem, "Hand Gesture Recognition: A Literature Review," International Journal of Artificial Intelligence & Applications (IJAIA), vol. 3, no. 4, pp.161-174, July 2012.

[4] Vijaya Laxmi, "Image Processing Based Hand Gesture Controlled Robot On Raspberry PI," in International Journal of Engineering & Science Research, vol. 6, no. 3, pp. 49-54, March 2016.

[5] Thinapom Ganokratanaa, and Suree Pumrin, "Hand Gesture Recognition Algorithm for Smart Cities based on Wireless Sensor," International Journal of Online and Biomedical Engineering, vol. 13, no. 6, 2017.

[6] S. Siddharth Rautaray, and Anupam Agrawal, "Real Time Gesture Recognition System for Interaction in Dynamic Environment," in Procedia Technology, vol. 4, pp. 595-599, 2012.

[7] Ch. Prem Kumar and Salumuri Madhu, "Gesture Control Robot with Arduino," IOP Conference Series: Materials Science and Engineering, vol. 455, conference 1, 2018.

REFERENCES

1. Pankaj Kumar Gautam, Sudhasnhu Pandey and Vishwajeet Kumar Nanda, 2018, "Robot Control by Accelerometer Based Hand Gesture using Arduino Microcontroller", International Journal of Recent Technology and Engineering, volume no. 7, pp. 24-27.
2. Prem Kumar Ch and Salumari Madhu, 2018, "Gesture Control Robot with Arduino", IOP Conference Series: Materials Science and Engineering, volume no. 455.
3. Pooja Pawar, Dinesh Kumar Bhusare, Shilpa Karale and R. K. Sarawale, 2015, "Hand Gesture by Using Robotic Car Control", International Journal of Advanced Research in Computer Engineering & Technology, volume no. 4, pp. 830-833.
4. Rafiqul Zaman and Noor Adnan Ibraheem, 2012, "Hand Gesture Recognition: A Literature Review", International Journal of Artificial Intelligence & Applications (IJAIA), volume no. 3, pp.161-174.
5. Suree Pumrin, Thittaporn and Ganokratanaa, 2017, "Hand Gesture Recognition Algorithm for Smart Cities based on Wireless Sensor", International Journal of Online and Biomedical Engineering, volume no. 13.
6. Siddharth Rautaray.S and Anupam Agrawal, 2012, "Real Time Gesture Recognition System for Interaction in Dynamic Environment", Procedia Technology, volume no. 4, pp. 595-599.
7. Vijaya Laxmi, 2016, "Image Processing Based Hand Gesture Controlled Robot on Raspberry PI", International Journal of Engineering & Science Research, volume no. 6, pp. 49-54.

GUESTURE CONTROL CAR CONTROLLING SYSTEM USING PIR SENSOR

A PROJECT REPORT – PHASE I

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ABSTRACT

The goal of gesture recognition in Computer Science field has always been the minimization of the distance between the physical world and the digital world. The way humans interact among themselves could be implemented in communication with the digital world by interpreting gestures via mathematical algorithm. Numerous ways and algorithms have been proposed and implemented to achieve the goal of gesture recognition and its use in communicating with the digital world. Gestures can be tracked using accelerometers. Since modern Smartphone are equipped with an in-built accelerometer, gesture control using Smartphone can be easy to implement, cheap to provide and the output will be more intuitive. This paper deals with the design and implementation of a wireless gesture controlled Robot using Arduino Lily pad processor and an Android operated application to control the gestures with minimal, and cheap hardware requirements.

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LIST OF ABBREVIATION AND SYMBOL

SYMBOL

V	-	Volt
°	-	Degree
MHz	-	Mega Hertz
Rpm	-	Rotational per Meter

ABBREVIATION

USB	-	Universal Serial Bus
IC	-	Integrated Circuit
OS	-	Operating System
DC	-	Direct Current
TCL	-	Transport Layer Security
PIR	-	Passive Infrared Sensor
HSV	-	Herpes Simplex Virus
DWT	-	Dead Weight
ICSP	-	In-Circuit Serial Programming
FTDI	-	Future Technology Devices International
CRF	-	Cortrcotropin Releasing Factor
YCBCR	-	Luminance;Chroma;Blue;Chroma;Red

CHAPTER 1

INTRODUCTION

Humans interact in the physical world by the means of the five senses. However, gestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever. Robots are classified into two types: Autonomous robots like Line sensing or edge sensing robots, and Remote controlled robots like Gestures controlled Robots. Since this paper deals with gestures controlled robot, the primary focus will be on the remotely controlled robots only. Undoubtedly, the output and the functioning of machines will be more intuitive if they are communicated using human gestures. A gesture is a form of communication in a non-verbal manner by using visible body movements or actions conveying messages.

There are several ways to capture human gestures that a machine would be able to understand. The gestures can be captured using a camera, or a data glove. Gestures can also be in infrared waves, Acoustic, Tactile, optical or motion technological means. The embedded systems designed for specific control functions can be optimized to reduce the size and cost of the device, and increase the reliability and performance. The Gestures are equipped with in-built accelerometer which may be used for gestures recognition and such other tasks. Moreover, Android platform is being used in the development of numerous applications for cell phones.

Researchers have shown interest in gestures recognitions and have built several robots and devices that are controlled by human gestures. There is a constant development in the field of gestures controlled devices. Apart from hand gestures recognition, emotional gestures recognition from face is also done in some cases. There are two types of gestures used in gestures recognition: Online gestures and Offline gestures. In Online gesturesahan, direct manipulations like rotation and scaling are done. In Offline gestures, the processing is done only after the user interacts with the object. Gestures technologies are applied in several fields like in Augmented Reality, Socially assistive Robots, recognition of sign

languages, emotion detection from facial expressions, Virtual mouse or keyboard, recognition of sign languages, remote control, etc.

There are various modes of communication between the microcontroller of the robot and the Smartphone. However, the popularly used means of communication is done via RF, Bluetooth or Wi-Fi. Using RF limits the distance from which the robot can be controlled. Using Wi-Fi increases the overall cost for setup. So, the robot has been built with Bluetooth which has intermediate range of distance covered and cost between RF and Wi-Fi. Arduino to detect the direction of movement of the user's hand and move the robot accordingly. The prime aim of the design is that as the user moves his hand in some direction, the robot moves in the same direction as well. In other words, the robot is solely controlled by the hand movements and gestures of the user. The goal of this paper is to develop a method to control and program a robot with gestures and assure high level of abstraction, cheap and minimal hardware and a simplified robot programming.

The automated allow the you to automate task using drag and drop interface that make programming this task easier for beginners automated. Hand gestures recognition system provides us an innovative, natural user friendly way of interaction with computer has a wide a area of application including human machine interaction sign language immersive gain technology.

A gestures controlled robot using an accelerometer is one kind of robot which can be operated by the movement of hand by placing an accelerometer on it. This project is divided into two parts transmitter devices and receiver devices. Where a gestures devices works as a transmitter devices works as a transmitter devices and a robot works as a receiver devices when a transmitting devices is placed on the hand, then it will send signals to the robot for the required operation

The main goal of the of this project is to control the movement of the robot with the hand gestures using a PIR sensor it is used to detect the human body and motion accuracy with the sensing devices

CHAPTER 2

LITERATURE SURVEY

2.1 Study on Hand Gesture Segmentation

BaoHong, et.al., 2010, explains the detects the hand gestures from a monocular video image under complex background using a skin colour detection and background subtraction algorithm. The arm removal and the noise reduction have improved performance of the gestures recognition.

2.2 Bare Hand Gesture Recognition with a Single Colour Camera

Yishen Xu, et.al., 2009, explains the devised a technique for detecting the bare hand without any colour cap. The RGB image is transformed into Hue image. The skin segmentation algorithm is used to localize and segment the hand derived from image and eliminates arm region through using wrist line. Features are extracted to identify the different hand gestures.

2.3 Real-time hand gestures detection and recognition, using boosted classifiers and active learning

H. Francke et.al., 2007, explains proposed a robust, real time method for segmenting and hand gestures identification under dynamic environment hand gestures. To detect and recognize hand gestures extraction of the hand with skin colour detection and adaptive skin colour model, tracing of the hand location based on colour and finally to classify the gestures the boosted classifiers and multi gestures classification tree are used. The classifiers are trained using active learning and bootstrap training techniques, enhancing system performance regarding rate of detection, processing times, and false positives volume.

2.4 A Robust Method for Hand Gestures Segmentation and Recognition Using Forward Spotting Scheme in Conditional Random Fields

Mahmoud Elimezain et.at., 2010 explains the article has put forwarded a forward 6 spotting method for segmentation and recognition simultaneously with less time

delay. A stochastic non-gestures framework utilizing CRF is utilized to identify gestures without requiring data training. The model yields appropriate confidence measures utilized as part of an adaptive threshold to elaborate the initiation and conclusion of effective measures.

2.5 Hand Gestures Recognition based on Shape Parameters

Menak shi Panwar et.at., 2012 explains the approach is based on shape parameters. The shape information is extracted using computer vision techniques. Using the shape based approach hand gestures is matched.

2.6 Hand Segmentation using Skin colour and Background information

Wai wang et.at., 2012 explains the propose a new procedure for segmentation of human hands through adaptive skin colour model and background data with effect to split the image into upturned side to improve performance.

2.7 Stability analysis for tactile pattern based recognition system for hand gestures

Yuichiro Honda et.al., 2007 explains that Has developed a new pattern recognition system for the artificial limb control using the tactile pattern generated in the prosthetic socket due to muscle contraction.

2.8 Ethiopian Sign Language Recognition Using Artificial Neural Network

Yonas Fantahum et.al., 2010 explains and discusses about hand gestures detection and recognition for an Ethiopian sign language by using Garbor filters and PCA for feature extraction and artificial Neural Network for classification of the patterns drawn by the hand.

2.9 Accurate Recognition of Large Number of Hand Gestures

A. Shamaie et.al., 2003 explain and established a hierarchical gestures algorithm to recognize the hand gestures. A very low resolution images are processed. Each input frame of sequence is mapped onto a sequence of resulting in a trajectory. Using PCA, HMM and Graph matching, the reduction in the size of the image and noise removal, for temporal analysis and recognition of gestures are made respectively.

2.10 Gestures Recognition for Human-Computer Interaction Using Neural Networks

Y. Zhang et.al., 2001, explains the process incorporates detection and segmentation, Feature extraction and finally recognition of gestures assigned as control commands. Each stage includes a neural network for skin colour detection, principal component analysis and the clustering encoding for hand gestures.

2.11 Recognizing action at a distance

A. Efros et.al., 2003, explains and focuses on identifying people's action at a far of distance by using new motion identification based over optical flow assessments under spatiotemporal volume for all stable human image, and identical measure to the closest-neighbour structure. Here the optical flow is regarded as a pattern of noise in spatial domain which forms the motion descriptor in spatio- temporal domain. Nearest –neighbour technique is used to classify the actions performed by the person.

2.12 Actions as space-time shapes

M.Blank et.al., 2005, explains and have considered human interactions in 3D figures developed through outlines towards the time and space volume. The solution characteristic of Poisson equation is utilized for the extraction of attributes i.e. shape structure and orientation, action dynamics, local time space saliency. This method is fast; video alignment is not required and is applicable to images with known background.

Segmentation is a procedure of splitting an image into numerous parts. Automatic segmentation of object of interest from its background in video sequences has drawn lot of interest in computer vision. Skin colour is used for detection, recognition and tracking of hand. A review of various skin colour modelling and recognition techniques along with their numerical evaluation results are discussed in "A Survey on Pixel based Skin colour Detection Techniques". [V Sazonova, 2003]

2.13 A real time Face Tracker

Jie Yang et.al., 1996 explains and discusses about tracking the face of person while moving freely. The system is described as three models. Stochastic model is used to characterize skin colour distribution of human faces. The features extracted from this model are used for tracking the face at different angles and possess and can adapt for any

races of human being and for any lighting conditions. The motion based framework is utilized for assessing image motion and to predict the window of search. 8 The camera framework it utilized to forecast and balance out the motion of the camera. This procedure is implementable towards recognition of hand gestures.

2.14 Hand Gestures Segmentation Based on Improved Kalman Filter and TSL Skin Colour Model

Shu Mo et.al., 2011 explains the ponders on the new concept of segmentation which avoids the misclassification of objects with the same skin colour in the environment. A new segmentation concept combined with kalman filtering and TSL colour space provides high accuracy and efficiency. Kalman filter assist in anticipating the hand location so as avoid the interference of non-hand objects of the skin colour. TSL colour model is used to realize the hand region. Morphological executions are utilized for the removal of outlying objects and holes.

2.15 A New Method for Hand Segmentation Using Free-form Skin Colour Model

I Abdullah et.al., 2010 Deals with the extraction of hand pixel and characterized in YCbCr colour space. CbCr space is then transformed into CbCr plane to form the clusters region of skin colour. Edge detection is applied to form free form skin colour model. The concept works well in complex background.

2.16 Statistical colour models with application to skin detection

M. J. Jones et.al., 2002 explains the focuses of the simple histogram learning techniques to build a model for low image characteristics, i.e. colour of the skin. Skin pixel detector is utilized for isolating skin pixels from the contrary using histogram models and its performance is compared with mixture models in skin detection. The histogram model proved more efficient in skin detection.

2.17 Hand Segmentation for Augmented Reality System

Wu Yueming et.al., 2007, explains and focuses towards appearance and colour based procedures for detection of the skin for segmenting the hand and the background. The method does not emphasize on the still camera and a background. It does not depend

upon the intensity variation of the illumination. The performance is high as the appearance model avoids the misclassification of the pixels of the skin.

The hand region is recovered using the 3D reconstruction technologies in the paper "Estimation of the fundamental matrix from un-calibrated stereo hand images for 3D hand gestures recognition",. A method is presented for predicting epipolar geometry amidst two non-calibrated cameras through stereo-based hand images. The hand undergoes segmentation utilizing RCE neural network based over colour algorithm segmentation and finger tips are extracted as features of interest and are matched with topological features of hand. The procedure has been proven over images based from both calibrated and non-calibrated cameras. [Yin X, 2002]

A learning based chromatic matching method is used to find out the skin chroma without the effect of illumination. Coarseness of skin is used to segment the skin accurately. To further increase the accuracy of the segmentation low level geometrical constraints is used. [J-S Lee, 2007]

2.18 Face Detection using Quantised skin colour regions merging and wavelet packet analysis

Arica C et.al., 1999, explains for deals with the detection of human faces in the colour images in a complex background with varying illumination conditions. YCbCr and HSV colour models are applied to form the cluster region of the skin. The face skin quality is assessed using wavelet packet decomposition in the detection of faces. The wavelet coefficients of the band filtered images characterize the face skin texture and the statistical differences extracted results in the feature vectors. The probabilistic metric based on the distance parameter is used for classification of the feature vectors as skin or non-skin areas of the face using the trained data set.

2.19 Enhanced Skin Detection Technique Using Block Matching

Kaabneh et.al., 2007, explains the highlights on a technique to detect the skin region in a static image. This procedure utilizes a model encompassing five faces detection with critical alterations to enhance facial detection rates. The hybrid model detects the face region using the block matching technique.

2.20 Computer monitoring and control with hand movements

R.O. Dogan et.al., 2014, explains the implemented computer controlling and monitoring utilizing hand motions through image and computer vision techniques In proposed study, the face of the user is detected with Harr Classifier and the hand region is detected using YCbCr model. The hand is traced by means Blob 10 Tracking Technique and the features are extracted using Convexity Defect-Hull. Finally, position of mouse is controlled according to features of hand region, and Computer controlling and monitoring using hand movements are implemented by tracking hand gestures.

2.21 Hand gestures recognition with depth images

J. Suarez et.al., 2012, explains and provides an extensive review of the literature based on the usage of depth assessment and identification of gestures. It concentrates towards depth-oriented gestures identification with reference to the methods developed for hand detection and classification of gestures, the implementation of gestures identification and implementation of OpenNI and Kinect software archives over gestures identification. Studies focuses towards OpenNI and Kinect archives for identification of hand gestures exhibit tendency to focus more towards application, as compared to classification or localization procedures, illustrating that OpenNI tracking procedure is the most efficient to the tested scenarios till now. Regardless, limitation factors for Kinect and associated sensors for gestures identification have not yet been assessed over difficult settings and applications.

The executed sign, utilizing glove-worn hands, are illustrated as letters over the screen. The framework is built to allow communication between the receiver and transmitter so that the elaboration of the message is conduced accurately and is fully comprehensible. [El Hayek, 2014]

A molecular modelling for understanding and visualizing chemical structures in 3D spatial domain and in their dynamic behaviour, using an Augmented Reality frameworks for viable interaction with ocular indicator using molecules. When individuals bring forward multiple molecules within single vicinity, prospective bonds are illustrated and molecules uniquely alter their 3D makeup in accordance with the prospective chemical reactions. Gestures-based procedures, proximity and shake based procedures are recommended to overcome the issues potentially arising when individuals are required to

choose one specific bond from amongst a diverse array of prospective bonds whilst utilizing both hands for the alteration of molecules. [Maier, Patrick, 2010]

Author taking into consideration the identical traits found in human hands, i.e. featuring one thumb with four additional fingers, has written "Hand gestures recognition based on shape parameters," with the fundamental goal to provide a realtime framework for identification of hand-based gestures over viable shapes, i.e. finger and thumb status, orientation, mass centre etcetera. The framework presented in this research is based entirely on shape-related factors with the hand committing the gestures. The input sequence of images obtained from a simple web camera with 20 fps and seven mega pixel intensity is pre-processed to remove background noise. Kmean clustering is utilized for segmenting hand from the background. [M. Panwar, 2012]

A Kinect based dynamic gestures trajectory identification method which overcomes the limitation of gestures recognition rate in traditional dynamic gestures track recognition system uses OpenNI, under which palm has been elaborated as Kinect node. The palm position can be quickly and accurately obtained. The HMM technology is used for training the gestures models, therefore leading to enhanced rate of detection. The results demonstrate that these frameworks are faster and efficient with identification rates as compared to the conventional frameworks. [Youwen Wang, 2012]

2.22 Real-Time Hand Gestures Detection and Recognition Using Bag-of-Features and Support Vector Machine Techniques

Dardas, N.H et.al., 2011, explain the presents a hand gestures recognition model that detects and tracks the naked hand under a busy background using detection of skin and position of the hand's outline similarity procedure after deletion of the face. The gestures are recognized using BoF and multi-class Support vector machine. The generated gestures commands are employed to control an application. The features from every trained image are extracted by applying SIFT. A vector quantization procedure mapping features belonging to all trained images into a solitary dimensional histogram vector (BoW) after K-means clustering. The SVM is fed with the histogram to construct a trained classifier. In each input image frame the hand is detected using the algorithm, followed by the feature extraction for all smaller images featuring solely the observed gestures. The

features extracted are entered into group systems to categorize them in a BoW format, which is eventually applied to the multiclass SVM to recognize the action of the hand.

A hand gestures detection algorithm based on DWT and multi- class probability is proposed. Directional features based on Quaternion algebra are extorted utilizing a colour-depth camera. Directional characteristics, i.e. orientation or position which are invariant are utilized. DWT is applied to make speed and size of gestures as invariant, alongside improving the detection capacity. Hierarchical thresholding for deforming distance and gestures probability are utilized for gestures detection. Multi-class estimates are employed for classification of gestures. [Pisharady, P.K, 2013]

A real time model to identify the action of the hands based on wave controller technology is used to simplify the interaction between the human and machines. The presently interfacing devices between the human and computers like mouse, joystick etc suffers from major drawback that have restricted the capability of users, as they are required to respond to computer through the physical contact. Voice recognition cannot be applied where multiple users are present. These mentioned disadvantages are overcome by using hand gestures identification framework. It is also to be extended to the sign language recognition. [Zhengmao Zou, 2010]

A 6° of liberty over virtual mouse hand gestures utilizing a webcam powered through USB is focused in this article. The procedures of hand gestures and tracking constitute the skin colour, finger movement and hand motion. People with disabilities are able to access the computer easily. [Xingfeng Wang, 2010]

An efficacious skin colour detection system utilizing face detection technology to enhance skin model for a précised individual, whilst tracking is gained through a basic data algorithm is proposed. An efficient gestures identification procedure utilizing various extracted data, i.e. hand motion, local features, finger tips, and hand orientation is brought forward. The suggested framework for identification of hand gestures is implemented towards administration of computer mouse and executing computer applications and games. [Nam Vo, 2010]

2.23 A Real Time Vision-Based Hand Gestures Interaction

Yee Yong pang et.al., 2010, explains has focused on vision based gestures recognition. This application necessitates pinpoint identification and detection. Moreover, the clutter and real environment make a significant influence 13 towards the recognition procedure. In this study, a real-time, vision-oriented, hand motion identification system was suggested for administering the desktop cursor, allowing for the navigation through utilizing only gestures of the hand.

A system was proposed for physically challenged people who are powerless to use conventional input systems for communication with computers. In this paper, Computer commands are implemented through hand motion. Dynamic and static movement of hand are obtained by using inertial navigation sensor to administer the mouse cursor, allowing for the opening and usage of computer through motion. Therefore accelerometer profiles are transformed into interactions without wired connection. The tool includes nontactile usage of equipments to alter and administer them as per the provided hand motions.[Dand 2010]

2.24 Advanced mouse pointer control using trajectory-based gestures recognition

Manchanda K et.al., 2010, explains and presents a technique for the administration of the mouse pointer motion utilizing basic gestures from the human hand, utilizing a camera. A real-time algorithm for tracking is implemented over adaptive skin identification and motion assessment. The motion and steering of movement is assessed and then utilized for the identification of a gestures. A section of interest algorithm is suggested, for scaling motion when users are stationed at a far distance from camera. The steering of the pointer is scaled subsequently.

A realistic game system employing a multi-modal user interface is proposed in "A realistic game system using multi-modal user interfaces," The framework utilizes gaze tracking, a hand gestures identification and analysis of bio-signal. In this system, addictive and realism-orientated graphical software is implemented over the Head Mounted Display with an eye ball tracer, hand gestures recognizer and a bio-signal analysis. The grasping and pitching towards a object are executed through the individual's gestures by means of a Hand glove. Based on the measurement and analysis of bio-signals of the user are used to control the difficulty adaptively. [Hwan Heo, 2010]

2.25 A Real-Time Hand Gestures Recognition System for Daily Information Retrieval from Internet

Sheng-Yu et.al., 2011, explains and proposed a system to acquire regular data through the internet, i.e. news, finance news, weather information without requiring interaction with a mouse or keyboard. The daily information's are regained from Internet, using his/her hands' movements. On selection of the function by means of hand gestures the system gives out the information to the users through synthesized speech. The system also provides individual services by identifying the user with the face detection technique. Under this study, a PCA technique is utilized for the identification of facial and hand gestures, and afterwards, gestures are registered into the database for their meaning for further practical applications.

In this paper, the hand gestures captured from the camera provides virtual reality mechanism which can be operated on the entire system in real time. Hand gestures recognition system is composed of three steps namely skin detection, feature extraction and recognition A virtual mouse is designed for moving the cursor up and down. [Aksac A 2011]

The paper elaborates regarding the virtual touchpad, one that is built utilizing a camera and some other identification procedures, generally hand-based. It utilizes a section of a rectangular object as a pad, functioning similar to a conventional touchpad but features an additional array of controls. The pad supports different clicks, and allowing for gestures-based commands based on the hand and finger motions. This pad is capable of identifying and commanding most simple interactions, i.e. V shape, horizontal, vertical etcetera. [Edwin G, 2011: 1-5]

2.26 Gestures Recognition Based Mouse Events

Rachit Puri et.al., 2004, explains and describes an efficient strategy for mouse points and executes several basic operations, i.e. double and single clicking, dragging etc. utilizing identification procedures. Identifying motions can become a difficult tasks, as there are several aspects involved, e.g. modelling of motions, analysis, recognition of patterns, and learning according to machines. Taking into consideration all the critical factors, a framework has been established with the capacity to identify the motion of hands and fingers, fully understanding the meaning behind it. Coloured caps are utilizes in place

of fingers to identify different factors, i.e. skin and background colour. Therefore, identifying the gestures, different events be performed 15 using the cursor. This software was created through MATLAB, and Windows is the supported OS.

The subjects like the fast response time and high-level precision of the systems are conferred with a stress on computer vision techniques, as gestures interaction presents technical problems. This paper presents an updating study of real time applications of the system using hand gestures along with body movements, vision, facial expression and voice recognition in health clinics and supportive technologies, entertainment, disaster management and in robotics. [J. P. Wachs, 2011]

2.27 Model-based 3d hand posture estimation from a single 2d image

C. Chua et.al., 2002, explains has focused on three dimensional hand gestures detection based on a two dimensional image. The hand prototype with 27° of freedom is introduced and its limitations are examined to reduce the 27° to 12° of freedom without any major deterioration of performance. The two dimensional feature points are used to estimate three dimensional hand poses through the algorithm.

The study elaborates on developing efficient gestures of the hand identification framework through the Kinect sensor. To acquire shape of hand acquired from the sensor, FEMD procedure is implemented. FEMD takes into consideration only the fingers, and disregards fingers. Therefore, allowing for the ascertaining of hand shape featuring trivial discrepancies. The long and expansive study illustrates the efficacy, precision, and effectiveness of the gestures identification system. [Z. Ren, 2011]

2.28 Hand gestures estimation and model refinement using monocular camera-ambiguity limitation by inequality

N. Shimada et.al., 1998, explains have proposed a method to find concurrently the shape and gestures of hand from the monocular imaging system without the depth information. The crude gestures is detected by matching the shape of the hand. Using motion detection and shape features the Region of Interest is efficiently reduced and possible crude gestures are developed. The crude gestures with high probability are selected and corresponding features are extracted. The modified Extended Kalman Filter with condensed distribution is used for fine-tuning of a three dimensional shape prototype

and the crude gestures by disparity limitations. The depth uncertainty is 16 restricted with the knowledgeable observations of the images. The ambiguity of the balanced gestures is determined by producing and conserving the several solutions.

A frame work is designed for Bayesian tracking to approximate the posterior distribution at multiple resolutions. To remove least probability cluster and to estimate the distribution to a subjective accuracy, a tree based delineation of distribution is projected in this paper. In tree based depiction, the leaves describe the separation of the Region of Interest with the steady density. This method is used to track three dimensional distinct and flexible motions in a complex environment. The joint angles and the orientation of the hand are estimated in this method. [B. Stenger,1999]

The paper compares the performance of tracking system in kinect sensor camera and the optitrack in optical system in this paper. The data accumulated from the six upper limb Data is used in game based rehabilitation application. The Kinect and optitrack showed equal performance in tracking the movement of the hand. Kinect provides an prevalent accessibility for patients to recover from paralysis stroke and muscle rejuvenation in clinic and home. [C Y Chang, 2012]

CHAPTER 3

WORKING METHODOLOGY

Gestures recognition is the main aim of this work. The user holds an Android operated Smartphone, and moves, or rotates his hand in any direction. The accelerometer within the phone is regulated to generate a maximum and minimum value for the movement of the hand in three dimensional co-ordinates depending upon the external environmental conditions. The android application does the work of sensing the accelerometer calibration and generating the maximum and minimum values from it. Depending upon the values obtained, it sends a determinant value to the microcontroller and moves the robot accordingly. The whole process is under an infinite loop, so it runs as long as the power is supplied. The output depends on the accelerometer inputs directly that can be used to control the robot. The accelerometer input depends on the gestures of the user's hand.The steps stated above are broadly described in this section. The system consists of the following steps to work as mentioned.

3.1 Block Diagram of the system

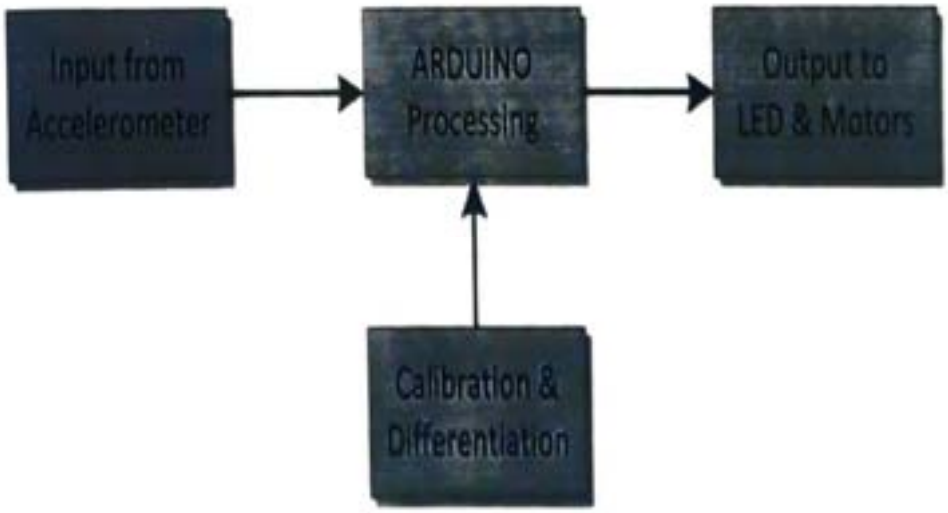

Figure 3.1 Block Diagram of Gesture Controlled Robot.

The data is received from the PIR sensor via HC-05 Bluetooth module on the digital pins of the Arduino microcontroller. It is then processed in Arduino. This processed data is received by the Adafruit motor shield. Based on the data.

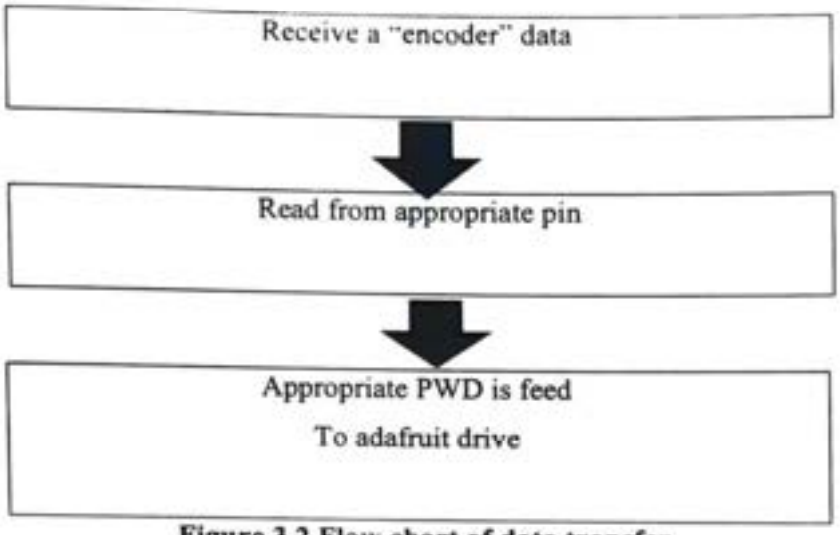

Figure 3.2 Flow chart of data transfer

3.2 Gestures Recognition

The application designed in this retrieves in the value of the accelerometer and sends a determinant value to the microcontroller via Bluetooth. As the user moves his hand, the accelerometer reading changes. It is then retrieved by the application. There are two values: One is maximum value and the other is minimum value. The range is specified using these two values for each function of the robot. If the value retrieved by the application lies between these specified values, then the corresponding determinant is generated. This determinant is sent to the microcontroller, which then receives the determinant value, process it to recognize.

Figure 3.3 Hand recognition

When the user tilts hand forward. The gestures are recognized as the forward movement, and the robot moves in the forward direction. The angle of the tilt or the difference between the angle of tilt of user's hand and the threshold value of forward movement gestures determines the speed of the robot. When the user tilts his hand on the right direction, the gestures is recognized as the right turn, and the robot moves in the right direction. When the user tilts his hand in the left direction, the gestures is recognized as the left turn, and the robot moves in the right direction. The angle of the tilt of user's hand determines whether the left or right turn is a normal turn or a sharp turn. A sharp turn is one in which a car changes direction without slowing down before turning. When the user tilts his hand backwards, the gestures is recognized as the move backward gestures, and the robot moves in the backward direction. If the user's hand is somewhere between the two gestures, i.e., the accelerometer value is somewhere between the threshold of two directions(forward and left turn, left turn and backwards, backwards and right turn, forward and right turn), then the robot moves in that diagonal direction.

3.3 Movement of Motors and Wheels

There are four DC motors used in the design of this robot: one motor for each wheel. The motors are controlled by There are four DC motors used in the design of this robot: one motor for each wheel. The motors are controlled by the Adafruit Motor Shield library gives the flexibility of using the motors just by calling some pre-defined functions as motor1.setSpeed(value) that sets the speed of the motor to 250 rpm, or motor1.run(FORWARD) that makes the motor1 to rotate forward. These functions are

called from the program burnt in the Arduino microcontroller. The signal is sent to the motor shield that runs the motors.

The wheels are connected to the motors. 4 DC motors are used Two for left wheels, and two for right wheels. When the signal received in the motor shield is to move forward, all the four wheels of motors rotate forward, this turns all the four wheels in the forward direction. The robot moves in the forward direction. When the signal received in the motor shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right backward while the left diagonal motors are rotated forwards. This makes the robot turn in the forward right direction.

When the signal in the motor shield is to move backward, both the pairs of the motors are rotated backwards resulting the robot to move backwards. When the signal in the motor shield is to stop the robot, all the motors are made stationary resulting the robot to stop. Similarly, to rotate the robot in backward directions, similar methodology is used. To turn the robot in the backward left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This motors are rotated forwards while the left diagonal motors are rotated backwards. This makes the robot turn in the backward right.

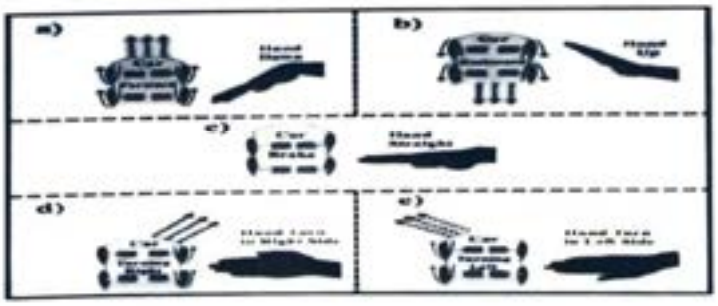

Figure 3.4 Movements of Motors and Wheels

CHAPTER 4

TECHNICAL REQUREMENTS

In this work, there are six fundamental components are required as shown in the figure 4.1. Technical Components used in the work

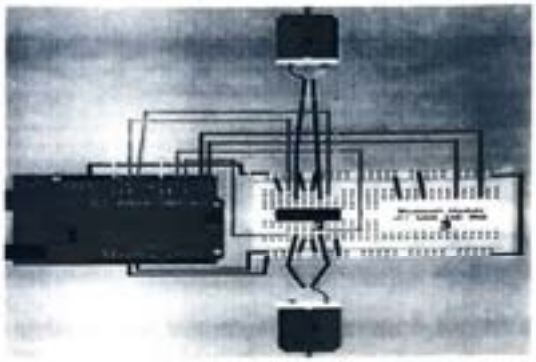

Figure: 4.1 Working Model of Gesture

4.1Microcontroller

The first requirement for the design of the robot is the microcontroller. In this work, Arduino ATMEGA 328 has been used. It is an open-source electronics prototyping platform with 14 digital I/O pins, 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.it is marked with 1.

Figure 4.2 Microcontroller chip

4.2 Mechanical Components

Motor driver is an additional requirement in this work. But to make the output more intuitive, this component is necessary. DC motors are used in this work to rotate the four wheels due to its effectiveness while designing robot with a high gear ratio. The motors are shown in the figure as. The motor shield used here is Adafruit Motor Shield V2.

The chip marked as 2 in the figure is motor shield, though a commercial manufactured motor driver is used to complete the work.

4.3 Arduino Lily pad

Figure 4.3 Arduino Lily pad

It is a designed for wearable application. It works on rechargeable batteries and allows easy connections with sensors and actuator's developed for an easy integration in clothes and fabrics. The Lily pad Arduino USB2 serial interface is the one we recommend, but any standard FTDI compatible interface suitable. The Arduino USB 2 serial interface behaves as an Arduino UNO and shares the same driver.

4.4 Physical Characteristics

The Lily pad Arduino is a circle, approximately 50mm (2") in diameter. The board itself is 0.8mm (1/32") thick (approximately 3mm (1/8") where electronics are attached0) .The operating voltage are 2.7-5.5V and the input voltage is 2.7-5.5V. The digital input pins 14 analog input pins 6 DC current per input pin 40mA flash memory 16KB SRAM 1KB.

4.4.1 PIR Sensor

A passive infrared sensor is an electronic sensor that measure infrared light radiating from objects in its field of view. They are most often used in PIR sensor based motion detectors PIR sensor is commonly used in security alarm and automatic lighting applications. PIR sensor detect general movement.

Figure 4.4 PIR

4.4.2 Accelerometer

Accelerometer is an electro- mechanical devices used to measure acceleration forces such forces may be static like continuous forces of gravity as it case with many mobile devices, dynamic to senses movement or vibration . Acceleration is the measurement of the change the velocity, or speed divided by time.

Figure 4.5 Accelerometer

4.4.3 RF433module

These RF module are very popular among the arduino tinkerers are used on a wide variety of applications requires wireless controls its frequency of range is 433.92Mhz and it have a input voltage of 5V it is works as a transmitter and receiver in arduino.

Figure 4.6 RF433MODULE

4.4.4 HT12D

HT12D is a 2^{12} series decoder integrated circuit for remote control application for manufactured by HOTTEK. It is commonly used for radio frequency. Wireless application by using the paired HT12E encoder and HT12D decoder can transmitter's bits of parallel data serially.

Figure 4.7 HT12D

4.4.5 1293DNE

Its current enhancing integrated circuit has the output from sensor is not able to drive motors itself so 1293DNE is use for this purpose and is 16pin IC having to enables pins which should always be remain high to enables pins which should always be remain high to enables both the H-bridges.

Figure 4.8 1293DNE

CHAPTER 5

DESING OF EQUPMENT AND WORKING

5.1 Components

The major components are used in gestures mode the are used to function in a gestures control car controlling system using PIR sensor.

1. Motor
2. Battery
3. Arduino lily pad
4. RF433 Module
5. HT12D
6. 1293DNE

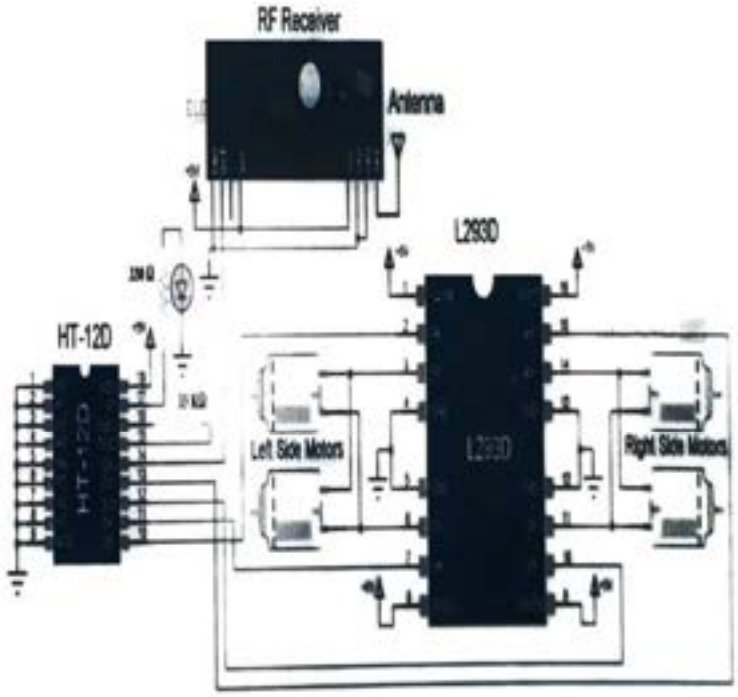

Figure 5.1 Connection of Gesture

5.2 Working Principle

The emergence of robots can be traced back to the 90's with Helpmate Robots and Robot-Caddy. Since then, there is an exponential development in the field of

robotics, and controlling robots through human gestures have been the topic of research for as long time. With the implementation of gestures to control robots, there have been several methodologies to perform the action. Some of the related works are being described in this section:

Our gestures controlled robots works on the principle of accelerometer which records our hand movements and sends that data to be comparator which assigns proper voltage levels to the recorders movements. That information is then transfer to the encoder which makes it ready for RF transmission. On the receiving end. The information is received wirelessly via RF, decoder and then passed on to the microcontroller which takes various decisions are passed to the motor driver in which triggers the motors in different configuration to make the robot moving a specific direction. With help of block diagram to understand the working of the robot.

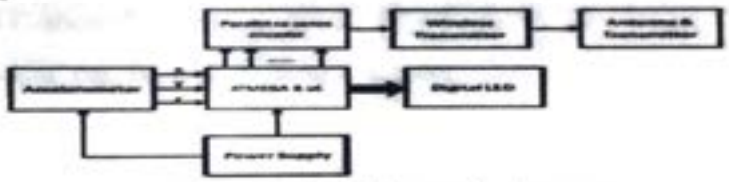

Figure 5.2 Block diagram for Processor

In our project we are have a two type of section which are work as a transmitter and receiver section.

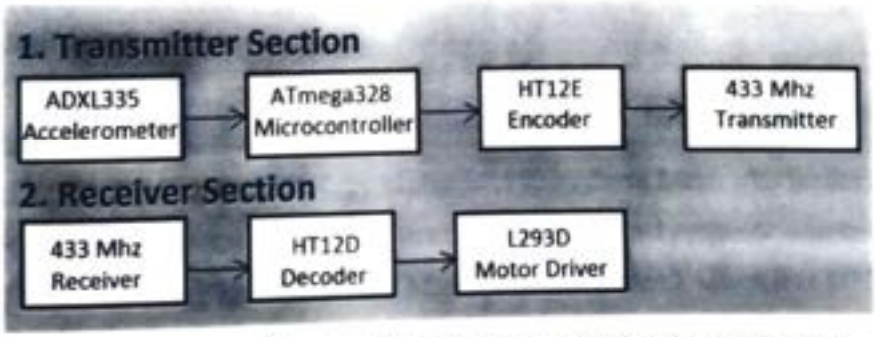

Figure 5.3 Block Diagram of encoder and decoder

5.2.1 Light-based Gesture Recognition

Light or illumination tracking and controlling robots with light sensors are being done in a lot of cases. Such robots are autonomous in nature. Generally, there are some light

sensors associated with the robot. The sensors send some rays of light and track them as they gets absorbed in the surface or reflected back to it. According to this, the robot can be line-sensing robots where it is made to follow a black or a white path autonomously.

5.2.2 Vision-based Gestures Recognition

Several robots are designed to be controlled by vision-based gestures. In such robots, there are, generally, some cameras as the sensor, which also acts as an interface to control the robot with some manipulators. The input gestures can be some patterns, movements of hands, colour tracking, face recognition, finger tracking, or some templates. They are also used in ball tracking and Robo-football games where the robots play the traditional game of football by tracking the movement of the ball. Though it has paved a way for advanced robot operations, but it is affected by factors such as illumination, foggy weather, background lights, etc.

5.2.3 Motion-based Gestures Recognition

The motions can be used to control a robot. This is generally done by incorporating an accelerometer to control the robot wirelessly. This can also be done using sensors. This method is beneficial over other methods in the sense that it can interact with machines naturally without being intruded by the factors that affects the mechanical devices. One important development in this field is done by Sauvik Das et al in 2010, where he designed a spying device yielding location and activities of the user without his/her knowledge.

5.2.4 Sixth Sense Technology

The Sixth sense technology begins in 1990 by Steve Mann who implemented a wearable computing device via neck-projector or head-mounted projector coupled with a camera. Later, following his idea, Pranav Mistry, a young research scientist at MIT at that time came up with new applications of this technology. Pranav Mistry came up with the name „Sixth Sense Technology" and has since been named Wear Ur World (WUW). This technology applies all of the techniques mentioned above and designing applications that give an intuitive output with the connection of internet.

CHAPTER 6

FUTURE DEVELOPMENT

A few decades ago, touchscreens were impressive, yet clunky pieces of technology reserved for applications that did little more than show off that touchscreens were possible. Today's touchscreens are commonplace and readily accepted as an easy way to interact with an operating system; they're accurate, support multi-touch, are comfortable to use, and can even operate in multiple dimensions (pressing hard). We may not have perfected touchscreens yet, but we're getting close. Accordingly, engineers and researchers are already speculating about the next phase of UI development, especially for robotics control. So far, the leading candidate is gesture-based control—the use of physical gestures to relay commands. The major limitation for touchscreens is the fact that they operate only in two dimensions; the third dimension introduced with force touch is extremely limited. Comparatively, hand gestures and physical movements can operate in three dimensions, and depending on how they're designed, could feel more natural than swiping and tapping a smartphone screen. Demand for three-dimensional gestural control is increasing with the onset of virtual reality (VR) and augmented reality (AR) technology; because the digital world we experience will be moving from two dimensions to three dimensions, the controls we use to manage those experiences will also need to change. With enough sophistication, these systems could provide better feedback to the users in control; rather than merely responding with visual feedback like movement or lights, users could feasibly be immersed with physical feedback like vibration or resistance. Generally, gestures are classified into two types. Depending on the level of interaction required,

different types are used, and it's not always necessary to use one over the other, it does make things simpler to understand though.

The Two Types of Gestures:

1. Online gesture
2. Offline gesture

Online Gestures:

Put simply, these are gestures that control a machine or computer system in real time. Also called direct manipulation gestures, these are the sort that let you interact with objects and impose changes viewable as you do them.

Offline Gestures:

Gestures that are processed after they're done are called offline gestures. In other words, these are the gestures that don't show a real time change. For example, some new smartphones have the option to open a certain application after a specific gesture is made, this is basically an offline gesture. Besides being really functional, it cannot be argued against that gesture control looks really cool. Like in the 2002 hit movie Minority Report, there will probably come a time where everything is controlled by gestures. While it might seem like a technology that will only increase our lethargy, truth is that other than making life easier, it also has a vast array of applications in almost all fields.

Medical Applications:

Advanced robotics systems with gesture recognition can be placed in hospitals or homes to recognize and treat life threatening conditions like heart attacks or strokes.

Alternative Computer Interfaces:

Gesture recognition, along with voice recognition, facial recognition, lip movement recognition and eye tracking combined can be used to create something called a perceptual user interface (PUI), a completely different way to interact with computer systems which will improve usability and creativity by leaps and bounds.

Entertainment Applications:

Most videogames today are played either on game consoles, arcade units, and all require a combination of input devices. Gesture recognition can be used to truly immerse players in the game world like never before.

Automation Systems:

In homes, offices, transport vehicles and more, gesture recognition can be incorporated to greatly increase usability and reduce the resources necessary to create primary or secondary input systems like remote controls, car entertainment systems with buttons or similar.

An Easier Life for the Disabled:

One of the biggest challenges faced today is providing separate and equally non cumbersome services to the differently abled and handicapped. While there are special provisions around the world, there's still huge room for improvement to bring all lives on equal footing. Gesture recognition technology can eliminate a lot of manual labor and make life much easier for those who aren't as fortunate as most of us are.

6.1 Arm Control Based on Human Arm Motion

This paper discusses the development of a robotic arm whereby its motion is controlled based on the movements of the human arm. There are three major components in this project. They are a wearable control device, microcontroller and robotic arm. The wearable control device acts as a sensor to translate the physical movement of the human arm into electrical signals. The translated signals in the form of positional. The microcontroller unit processes the signals and outputs it to the robotic arm as physical replicated movements. The wearable control device is capable of sensing six degrees of freedom by the human arm joints movements. This includes rotation of the shoulder, arm, bending of the shoulder, elbow, wrist, and gripping motion. The fabricated robotic arm is able to perform six different motions replicating and mimicking the motions of the human arm.

CHAPTER 7

ADVANTAGES AND APPLICATION

7.1 Advantages

- It Requires Acceptable Speed.
- It Is Sufficient Reliable For Recognition System.
- It Is Performance A Good For Complex Background.
- It Is Successfully Recognized Static and Dynamic Gestures.
- It Is Applied On Mobile Robot Control.
- Simple, Fast and Easy To Implement.
- This Also Can Be Applied For Real System And Play Games.
- It does Not Need Training Is Required.
- Easy To Maintains
- It Is More Complex.
- It Reduces A Man Power.
- Good Performances.
- It Can Be Related To The All Four Wheelers.

7.2 Application

- Image Controlling And Scaling.
- To Control Mouse.
- Sign Language Recognition.
- It Is Support For The Gaming Interface.
- Robot Control.
- Controlling Machines.
- It Can Be Used In Post Offices And Banks.
- It Is Used For Especially Socially Assistive Robotics.

CHAPTER 8

COST ESTIMATION

Table 8.1 Cost Estimation

S.No.	TYPE OF COST	AMOUNT (in Rs)
1	Materials Cost	3500.00
2	Labour Cost	1500.00
3	Overhead Charges	500.00
4	Total cost	5500.00

CHAPTER 9

CONCLUSION

Based on the phase I study the following conclusion are made:

The Gestures controlled robot designed in this work has many future scopes. The robot can be used for surveillance purpose. The robot can be applied in a wheelchair where the wheelchair can be driven by the movements of rider's hand.

Edge sensors can be incorporated to it to prevent the robot from falling from any surface. Some camera can be installed which can record and send data to the nearby computer. It can be implemented on a watch, or in any home appliances like Room heater. Modern ARDUINO chips support Intranet as well as Internet connections which can be utilized to a greater extent.

This robotic car can be enhanced to work in the military surveillance where it can be sent to some enemy camps and track it's activities via Internet. With a mind full of creation, the possibilities are endless. In this paper, the design and implementation of Gestures Controlled Robot is presented and developed using Arduino microcontroller. An algorithm has been provided and its working is detailed thoroughly. Since the updating possibilities are endless, updating the system has been kept as a future scope. The built device is cheap, and is easy to carry from one place to another.

The addition of the some additional sensors or camera will make it more productive. The limitation of the hardware being associated with a system has been reduced to a great extent. As an end thought, the system will allow the user to control it in a way that reduces the gap between the physical world and the digital world with an output more intuitive.

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REFERENCES

1. Pankaj Kumar Gautam, Sudhasnhu Pandey and Vishwajeet Kumar Nanda, 2018, "Robot Control by Accelerometer Based Hand Gesture using Arduino Microcontroller", International Journal of Recent Technology and Engineering, volume no. 7, pp. 24-27.
2. Prem Kumar.Ch and Salumari Madhu, 2018, "Gesture Control Robot with Arduino", IOP Conference Series: Materials Science and Engineering, volume no. 455.
3. Pooja Pawar, Dinesh Kumar Bhusare, Shilpa Karale and R. K. Sarawale, 2015, "Hand Gesture by Using Robotic Car Control", International Journal of Advanced Research in Computer Engineering & Technology, volume no. 4, pp. 830-833.
4. Rafiqul Zaman and Noor Adnan Ibraheem, 2012, "Hand Gesture Recognition: A Literature Review", International Journal of Artificial Intelligence & Applications (IJAIA), volume no. 3, pp.161-174.
5. Suree Pumrin, Thittaporn and Ganokratanaa, 2017, "Hand Gesture Recognition Algorithm for Smart Cities based on Wireless Sensor", International Journal of Online and Biomedical Engineering, volume no. 13.
6. Siddharth Rautaray.S and Anupam Agrawal, 2012, "Real Time Gesture Recognition System for Interaction in Dynamic Environment", Procedia Technology, volume no. 4, pp. 595-599.
7. Vijaya Laxmi, 2016, "Image Processing Based Hand Gesture Controlled Robot on Raspberry PI", International Journal of Engineering & Science Research, volume no. 6, pp. 49-54.

GUESTURE CONTROL CAR CONTROLING SYSTEM USING PIR SENSOR

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Abstract—The goal of gesture recognition in Computer Science field has always been the minimization of the distance between the physical world and the digital world. The way humans interact among themselves could be implemented in communication with the digital world by interpreting gestures via mathematical algorithm. Numerous ways and algorithms have been proposed and implemented to achieve the goal of gesture recognition and its use in communicating with the digital world. Gestures can be tracked using accelerometers. Since modern Smartphone are equipped with an in-built accelerometer, gesture control using Smartphone can be easy to implement, cheap to provide and the output will be more intuitive. This paper deals with the design and implementation of a wireless gesture controlled Robot using Arduino Lilypad processor and an Android operated application to control the gestures with minimal, and cheap hardware requirements. The system can be broadly classified into two components: The Hardware part consisting of Arduino Microcontroller, the Adafruit motor Shield, HC-05 Bluetooth module, and the Android Smartphone, and the software part consists of a Java based application run on android.

Keywords—Microcontroller, Accelerometer, Gesture recognition, Embedded Systems, Android, Module, Motor driver, Co-ordinates, Robot.

I. INTRODUCTION

Humans interact in the physical world by the means of the five senses. However, gestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever. Robots are classified into two types: Autonomous robots like Line sensing or edge sensing robots, and Remote controlled robots like Gesture controlled Robots. Since this paper deals with gesture controlled robot, the primary focus will be on the remotely controlled robots only.

Undoubtedly, the output and the functioning of machines will be more intuitive if they are communicated using human gestures. A gesture is a form of communication in a non-verbal manner by using visible body movements or actions conveying messages.

There are several ways to capture a human gesture that a machine would be able to understand. The gesture can be captured using a camera, or a data glove. Gestures can also be in infrared waves, Acoustic, Tactile, optical or motion technological means [1]. The embedded systems designed for specific control functions can be optimized to reduce the size and cost of the device, and increase the reliability and performance. The Gesture are equipped with in-built accelerometer which may be used for gesture recognition and such other tasks. Moreover, Android platform is being used in the development of numerous applications for cellphones.

Researchers have shown interest in gesture recognitions and have built several robots and devices that are controlled by human gestures. There is a constant development in the field of gesture controlled devices. Apart from hand gesture recognition, emotional gesture recognition from face is also done in some cases. There are two types of gestures used in gesture recognition Online gestures and Offline gestures. In Online

gestures, direct manipulations like rotation and scaling are done. In Offline gestures, the processing is done only after the user interacts with the object. Gesture technologies are applied in several fields like in Augmented Reality, Socially assistive Robots, recognition of sign languages, emotion detection from facial expressions, Virtual mouse or keyboard, recognition of sign languages, remote control, etc.

There are various modes of communication between the microcontroller of the robot and the Smartphone. However, the popularly used means of communication is done via RF, Bluetooth or Wi-Fi. Using RF limits the distance from which the robot can be controlled. Using Wi-Fi increases the overall cost for setup. So, the robot has been built with Bluetooth which has intermediate range of distance covered and cost between RF and Wi-Fi. Arduino to detect the direction of movement of the user's hand and move the robot accordingly. The prime aim of the design is that as the user moves his hand in some direction, the robot moves in the same direction as well. In other words, the robot is solely controlled by the hand movements and gestures of the user. The goal of this paper is to develop a method to control and program a robot with gestures and assure high level of abstraction, cheap and minimal hardware and a simplified robot programming.

II. working

The emergence of robots can be traced back to the 90"s with Helpmate Robots and Robot-Caddy [1] Since then, there is an exponential development in the field of robotics, and controlling robots through human gestures have been the topic of research for as long time. With the implementation of gestures to control robots, there have been several methodologies to perform the action. Some of the related works are being described in this section:

A. Light-based Gesture Recognition

Light or illumination tracking and controlling robots with light sensors are being done in a lot of cases. Such robots are autonomous in nature. Generally, there are some light sensors associated with the robot. The sensors send some rays of light and track them as they gets absorbed in the surface or reflected back to it. According to this, the robot can be line-sensing robots where it is made to follow a black or a white path autonomously.

B. Vision-based Gesture Recognition [7]

Several robots are designed to be controlled by vision-based gestures. In such robots, there are, generally, some cameras as the sensor, which also acts as an interface to control the robot with some manipulators. The input gesture can be some patterns, movements of hands, color tracking, face recognition, finger tracking, or some templates. They are also used in ball tracking and Robo-football games where the robots play the traditional game of football by tracking the movement of the ball. Though it has paved a way for advanced robot operations, but it is affected by factors such as illumination, foggy weather, background lights, etc. [2]

C. Motion-based Gesture Recognition

The motions can be used to control a robot. This is generally done by incorporating an accelerometer to control the robot wirelessly. This can also be done using sensors. This method is beneficial over other methods in the sense that it can interact with machines naturally without being intruded by the factors that affects the mechanical devices [3]. One important development in this field is done by Sauvik Das et al in 2010, where he designed a spying device yielding location and activities of the user without his/her knowledge [4].

D. Sixth Sense Technology

The Sixth sense technology begins in 1990 by Steve Mann who implemented a wearable computing device via neck-projector or head-mounted projector coupled with a camera. Later, following his idea, Pranav Mistry, a young research scientist at MIT at that time came up with new applications of this technology. Pranav Mistry came up with the name „Sixth Sense Technology" and has since been named Wear Ur World (WUW). This technology applies all of the techniques mentioned above and designing applications that give an intuitive output with the connection of internet.

III. TECHNICAL REQUIREMENTS

In this work, there are six fundamental components are required as shown in the figure 1. Figure 1 Technical Components used in the work

A. Microcontroller

The first requirement for the design of the robot is the microcontroller. In this work, Arduino ATMEGA 328 has been used. It is an open-source electronics prototyping platform with 14 digital I/O pins, 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.it is marked with 1

B. Mechanical Components

Motor driver is an additional requirement in this work. But to make the output more intuitive, this component is necessary. DC motors are used in this work to rotate the four wheels due to its effectiveness while designing robot with a high gear ratio. The motors are shown in the figure as 4. The motor shield used here is Adafruit Motor Shield V2. The chip marked as 2 in the figure is motor shield, though a commercial manufactured motor driver is used to complete the work.

C. Arduino Lilypad

It is a designed for wearable application. It works on rechargeable batteries and allows easy connections with sensors and actuator's developed for an easy integration in clothes and fabrics. The Lilypad Arduino USB2 serial interface is the one we recommend, but any standard FTDI compatible interface suitable. The Arduino USB 2 serial interface behaves as an arduino UNO and shares the same driver.

D. Physical Characteristics

The Lilypad Arduino is a circle, approximately 50mm (2") in diameter. The board itself is 0.8mm (1/32") thick (approximately 3mm (1/8") where electronics are attached0) .The operating voltage are 2.7-5.5v

And the input voltage is 2.7-5.5v. The digital input pins 14 analog input pins 6 DC current per input pin 40mA flash memory 16KB SRAM 1KB

IV. SYSTEM DESCRIPTION

Gesture recognition is the main aim of this work. The user holds an Android operated Smartphone, and moves, or rotates his hand in any direction. The accelerometer within the phone is regulated to generate a maximum and minimum value for the movement of the hand in three dimensional co-ordinates depending upon the external environmental conditions. The android application does the work of sensing the accelerometer calibration and generating the maximum and minimum values from it. Depending upon the values obtained, it sends a determinant value to the microcontroller. The module receives data and transmits it to Arduino where it checks the determinant value and moves the robot accordingly. The whole process is under an infinite loop, so it runs as long as the power is supplied. The output depends on the accelerometer inputs directly that can be used to control the robot. The accelerometer input depends on the gestures of the user"s hand. The steps stated above are broadly described in this section. The system consists of the following steps to work as mentioned

A. Block Diagram of the system

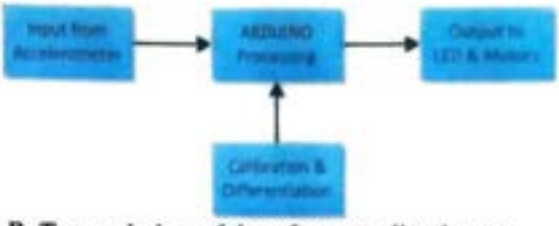

Figure 2 Block diagram of the system

B. Transmission of data from application to Motor driver

The input to the application is the direction of movement of hand of the user given by the accelerometer. This is analog in nature. The signal goes to the digital pins of the Arduino board, which has an inbuilt AD/DA converter of 8 bit. The processer the received data. Based on the data received, appropriate signal is transmitted to the motor driver to rotate the motor in such a way that the robot moves in the direction of movement of the user"s hand.

C. Gesture Recognition

The application designed in this work retrieves the value of the accelerometer and sends a determinant value to the microcontroller via transmitter. As the user moves his hand, the accelerometer reading changes. It is then retrieved by the application. There are two values: One is maximum value and the other is minimum value. The range is specified using these two values for each function of the robot. If the value retrieved by the application lies between these specified values, then the corresponding determinant is generated. This determinant is sent to the microcontroller, which then receives the determinant value, process it to recognize the corresponding gesture, and sends signals to move the robot accordingly. Gestures for movement of the robot Figure 5 shows the gestures to control the movement of the robot. When the user tilts his hand forward, the gesture is recognized as the forward movement, and the robot moves in the forward direction. The angle of the tilt or the difference between the angle of tilt of user"s hand and the threshold value of forward movement gesture determines the speed of the robot. When the user tilts his hand on the right direction, the gesture is recognized as the right turn, and the robot moves in the right direction. When the user tilts his hand in the left direction, the gesture is recognized as the left turn, and the robot moves in the right direction. The angle of the tilt of user"s hand determines whether the left or right turn is a normal turn or a sharp turn. A sharp turn is one in which a car changes direction without slowing down before turning. When the user tilts his hand backwards, the gesture is recognized as the move backward gesture, and the robot moves in the backward direction. If the user"s hand is somewhere between the two gestures, i.e , the accelerometer value is somewhere between the threshold of two directions(forward and left turn, left turn and backwards, backwards and right turn, forward and

right turn), then the robot moves in that diagonal direction

D. Movement of Motors and Wheels

run 4 DC motors. Installing the Adafruit Motor Shield library gives the flexibility of using the motors just by calling some pre-defined functions as motor1.setSpeed(value) that sets the speed of the motor to 250 rpm, or
motor1.run(FORWARD) that makes the motor1 to rotate forward [10]. These functions are called from the program burnt in the Arduino microcontroller. The signal is sent to the motor shield that runs the motors.
The wheels are connected to the motors. 4 DC motors are used Two for left wheels, and two for right wheels. When the signal received in the motor shield is to move forward, all the four wheels of motors rotate forward, this turns all the four wheels in the forward direction. The robot moves in the forward direction. When the signal received in the motor shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right diagonal motors are made rotated forwards. This makes the robot turn in the forward left direction. When the signal received in the motor shield is to turn the robot in the forward right direction, the right diagonal motors are rotated. Backward while the left diagonal motors are rotated forwards. This makes the robot turn in the forward right direction. When the signal in the motor shield is to move backward, both the pairs of the motors are rotated backwards resulting the robot to move backwards. When the signal in the motor shield is to stop the robot, all the motors are made stationary resulting the robot to stop. Similarly, to rotate the robot in backward directions, similar methodology is used. To turn the robot in the backward left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This makes the robot turn in the backward left direction. To turn the robot in the backward right direction, the right diagonal motors are rotated forwards while the left diagonal motors are rotated backwards. This makes the robot turn in the backward right direction...Movement of the Motors and Wheels

E. Designing the Android Application

The Android application is the key to control the robot using hand gestures. The application reads the accelerometer state and X, Y, and Z values are obtained in the application. There are two threshold values assigned for each movement - one is the MAX_THRESHOLD, and the other is the MIN_THRESHOLD. If the obtained value lies between these thresholds of a certain movement, then the character assigned to denote that movement, which is called the DET or

There are four DC motors used in the design of this robot - one motor for each wheel. The motors are controlled by the Adafruit motor shield. The shield is stacked on top of Arduino. Every shield stacked can

determinant is sent to the robot via Bluetooth. The application continuously sense this until the application is ON. A graphical user interface has been designed for the comfort of the user. The application abstracts the calculations and accelerometer values, but the user interface shows the direction of movement of the hand so that the user is aware of wrong turns in the bot.

V. ALGORITHM FOR GESTURE CONTROLLED ROBOT

A. Main Module

Step 1: Initialize the frequencies of the motors. **Step 2:** Initialize SERIAL 9600 **Step 3:** Set the speed for the motors in rpm. **Step 4:** While (1) do 1. DETcheck(); 2. While DET == F, move the robot forward Call check (); End While 3. While DET == B, move the robot backwards Call check (); End While 4. While DET == L, move the wheels left Call check (); End While 5. While DET == R, move the wheels right Call check (); End While 6. While DET == I, move the wheels right forward Call check (); End While 7. While DET == J, move the wheels right backward Call check(); End While 8. While DET == G, move the wheels left forward Call check (); End While 9. While DET == H, move the wheels left backward Call check (); End While End While

B. Function check()

Step 1: Initialize DATAIN S **Step 2:** Initialize VELOCITY 0 **Step 2:** If data on the serial lines > 0 then
1. DATAIN Character sent by the phone
2. If DATAIN == F, then DET F
3. If DATAIN == B, then DET B
4. If DATAIN == L, then DET L
5. If DATAIN == R, then DET R
6. If DATAIN == I, then DET I
7. If DATAIN == J, then DET J
8. If DATAIN == G, then DET G
9. If DATAIN == H, then DET H
10. If DATAIN == S, then DET S

End If **Step 3:** Set the velocity based on the data received in the multiples of 25. Set VELOCITY U, if no valid value for velocity is received. **Step 4:** Return DET

VI. ALGORITHM FOR THE ANDROID APPLICATION

Step 1: Connect to the Bluetooth Module **Step 2:** Set THRESHOLD_MAX and THRESHOLD_MIN values for each direction forward, backward, Left and Right **Step 3:** Get the state of the accelerometer I State of the accelerometer **Step 4:** VALUE I into X, Y, Z coordinate values **Step 5:** If VALUE is in

between THRESHOLD_MAX and THRESHOLD_MIN for a direction, then set DATAOUT as the direction of VALUE

VII. EXPERIMENTAL RESULTS

Figure 8: The robot moves in the direction of the movement of the user"s hand: forward-left Figure 9: The robot moves in the direction of the movement of the user"s hand: back Figure 10: The robot moves in the direction of the movement of the user"s hand: forward -right

VIII. FUTURE SCOPE AND CONCLUSION

The Gesture controlled robot designed in this work has many future scopes. The robot can be used for surveillance purpose. The robot can be applied in a wheelchair where the wheelchair can be driven by the movements of rider's hand. Edge sensors can be incorporated to it to prevent the robot from falling from any surface. Some camera can be installed which can record and send data to the nearby computer. It can be implemented on a watch, or in any home appliances like Room heater. Modern ARDUINO chips support Intranet as well as Internet connections which can be utilized to a greater extent. This robotic car can be enhanced to work in the military surveillance where it can be sent to some enemy camps and track it's activities via Internet. With a mind full of creation, the possibilities are endless. In this paper, the design and implementation of Gesture Controlled Robot is presented and developed using Arduino microcontroller. An algorithm has been provided and its working is detailed thoroughly. Since the updating possibilities are endless, updating the system has been kept as a future scope. The built device is cheap, and is easy to carry from one place to another. The addition of the some additional sensors or camera will make it more productive. The limitation of the hardware being associated with a system has been reduced to a great extent. As an end thought, the system will allow the user to control it in a way that reduces the gap between the physical world and the digital world with an output more intuitive.

REFERENCES

[1] Monika Jain, Aditi, Ashwani Lohiya, Mohammad Fahad Khan, Abhishek Maurya "Wireless Gesture Control Rbot: An Analysis" Available at http://www.ijarcce.com/upload/december/22-WIRELESS%20GESTURE.pdf

[2] Wang, B., and Yuan, T., "Traffic Police Gesture Recognition using Accelerometer", IEEE SENSORS Conference, Lecce-Italy,pp. 1080-1083,Oct. 2008

[3] Cannan, J. and Hu, H., "Human-Machine Interaction (HMI): A Survey" [Online] Available: http://www.dces.essex.ac.uk/staff/hhu/Papers/CE-508%20HMI-Survey.pdf

[4] Song, M., Kim, B., Ryu, Y., Kim, Y., and Kim, S., "A design of real time control robot system using android Smartphone" The 7th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI), Busan- Korea, Nov. 2010. [5] K. Brahmani, K. S. Roy, Mahaboob Ali, April 2013, "Arm 7 Based Robotic Arm Control by Electronic Gesture Recognition Unit Using Mems", International Journal of Engineering Trends and Technology, Vol. 4 Issue 4 Available at: http://www.ijettjournal.org/volume-4/issue-4/IJETT-V4I4P347.pdf

[7] S. Waldherr, R. Romero and S. Thrun, 2000, "A gesture based interface for human-robot interaction", In Autonomous Robots in Springer, vol. 9, Issue 2, pp. 151-173Available at http://www.cs.cmu.edu/~thrun/papers/waldherr.gestures-journal.pdf

MASK 2ND GENERATION

A PROJECT REPORT PHASE- I

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

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(AUTONOMOUS)

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ABSTRACT

The Masks are used as a protection devices but it is not highly efficiency to protect a person from the dust, pollution, gases, etc. By this project mask-2 nd generation the protection of a person's life from dust, pollution, gases can be increased, by this increment in protection leads a person to healthy life from pollution and other form of dust, gases that affects the human health. This mask gives fresh air to breath were the breathing problems are reduced and the person may have a cure.

This mask is categorizing into two types based on the filters used in it: uni- functional filter and multi-functional filters. The filters play a major role in this mask which is the heart of the mask. The airflow is maintained by the motors which are in the form of 2:2 rations where 2- motors for suction and 2-motors for exhaustion. These motors and connecting tubes used in this mask act as nerves. The air flow is the important thing to be maintained to get a good air for breathing.

The technology used here is the compression/minimization of large industrial technologies like Electro Static Precipitator (ESP), filters. It is a device used to collect carbon particles from the polluted atmospheric air. This is minimized into a pocket device where the high voltage supply is to be given for that ESP-process.

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LIST OF ABBREVATIONS

ABBREVATIONS

PM	-	Particulate Matter
BC	-	Black Carbon
FFP	-	F ce Filtering Piece
EPA	-	Environmental Protection Agency
TIL	-	Total Inward Leakage
NIOSH	-	National Institute for Occupational Safety and Health
RNA	-	Ribonucleic Acid
CPE	-	Cyto Pathic Effect
CFU	-	Colony Forming Units
PFU	-	Plaque Forming Units
FLTF	-	Faceseal-Leakage-to-Filter
CFD	-	Computational Fluid Dynamics
ESP	-	Electro-Static Precipitator
CM	-	Centi Meter
KV	-	Kilo Volt

CHAPTER 1

INTRODUCTION

The Masks are used as a protection devices but it is not highly efficiency to protect a perso ı from the dust, pollution, gases, etc. By this project mask-2 nd generation the protection of a person's life from dust, pollution, gases can be increased, by this increment in protection leads a person to healthy life from pollution and other form of dust, gases that affects the human health. This mask gives fresh air to breath were the breathing problems are reduced and the person may have a cure.

This mask is categorising into two types based on the filters used in it: uni-functional filter and multi-functional filters. The filters play a major role in this mask which is the heart of the mask. The airflow is maintained by the motors which is in the form of 2:2 ration where 2- motors for suction and 2- motors for exhaustion. These motors and connecting tubes used in this mask act as nerves. The air flow is the important thing to be maintained to get a good air for breathing.

The technology used here is the compression/minimisation of large industrial technologies like Electro Static Precipitator (ESP), filters. It is a device used to collect carbon particles from the polluted atmospheric air. This is minimized into a pocket device where the high voltage supply is to be given for that ESP-process.

CHAPTER 2

LITERATURE REVIEW

John W Cherrie et.al, - Many residents in Beijing use disposable face masks in an attempt to protect their health from high particulate matter (PM) concentrations. Retail masks may be certified to local or international standards, but their real-life performance may not confer the exposure reduction potential that is marketed. This study aimed to evaluate the effectiveness of a range of face masks that are commercially available in China.

S. Steve Zhou1 et.al, - Prevention of infection with airborne pathogens and exposure to airborne particulates and aerosols (environmental pollutants and allergens) can be facilitated through use of disposable face masks. The effectiveness of such masks for excluding pathogens and pollutants is dependent on the intrinsic ability of the masks to resist penetration by airborne contaminants. This study evaluated the relative contributions of a mask, valve, and Micro Ventilator on aerosol filtration efficiency of a new N95 respiratory face mask.

Xingzhou Li et.al - This system is based on making a vehicle which is moved automatically by the signals of the ultrasonic sensor, controlled by the arduino Uno processor and its software commands. If any obstacle is detected then the movement of the vehicle will be stopped. This helps to move the vehicle automatically and safe without striking to any object and avoiding accidents.

CHAPTER 3

CAPSULE

3.1 CAPSULE OPERATION

The capsule consists of filters such as glass fibre filter, carbon filter, macro and sterilized filter. This unit purifies the dust and other particles from the air .The diagram and image of the capsule is shown below in figure 1. The capsule is of two types' they are as follows:-

- Primary capsule
- Secondary capsule / filter tube

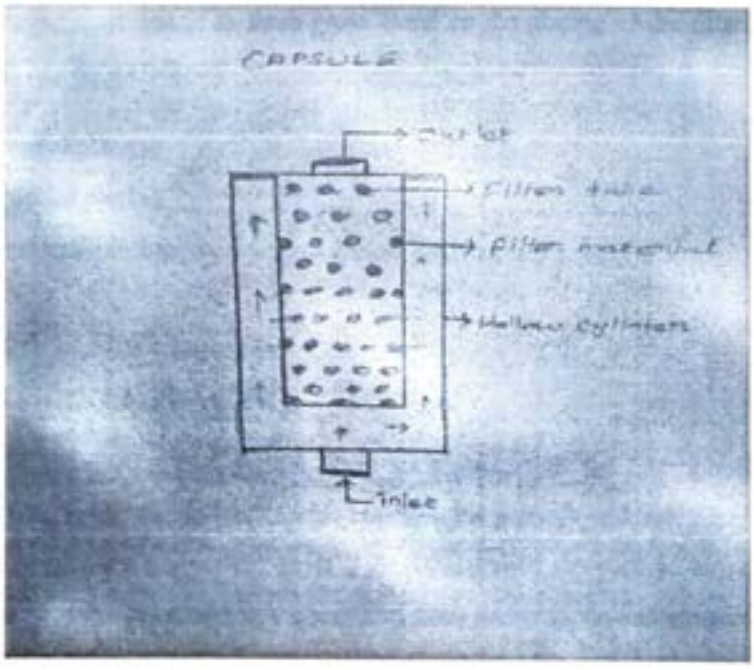

Figure 1 Capsule

3.2 PRIMARY CAPSULE:

It is a external tube which protects the filter material and secondary capsule and also acts as a Support structure. The two ends of the capsule is closed and a valves for air flow is fixed on that end caps, Where the top end cap is fixed to the secondary filter, where the fresh filtered air flows through the top valve Where the bottom end cap is free from secondary capsule in this the dust air flows through it.

3.3 SECONDARY CAPSULE

It is a internal tube which covers by the filter material and secondary capsule and also acts as a Support structure. The two ends of the capsule is closed and a valves for air flow is fixed on that end caps, Where the top end cap is fixed to the secondary filter, where the fresh filtered air flows through the top valve Where the bottom end cap is covered by the filters, where to filter the dust.

The filters are classified in to three types based on the placing of the filter in to the capsules .They are as follows:

- Internal placing
- External placing
- Universal placing

3.3.1 INTERNAL PLACING:

In this internal placing, the filters are placed inside the filter tube/secondary capsule. This holds the un-purified air between the primary and secondary capsule. Where the space for un-purified air is high compared to the purified air, hence this makes the air stabilisation less in the breathing area. The diagram and image of internal placing is shown below in figure 2(a) and 2(b).

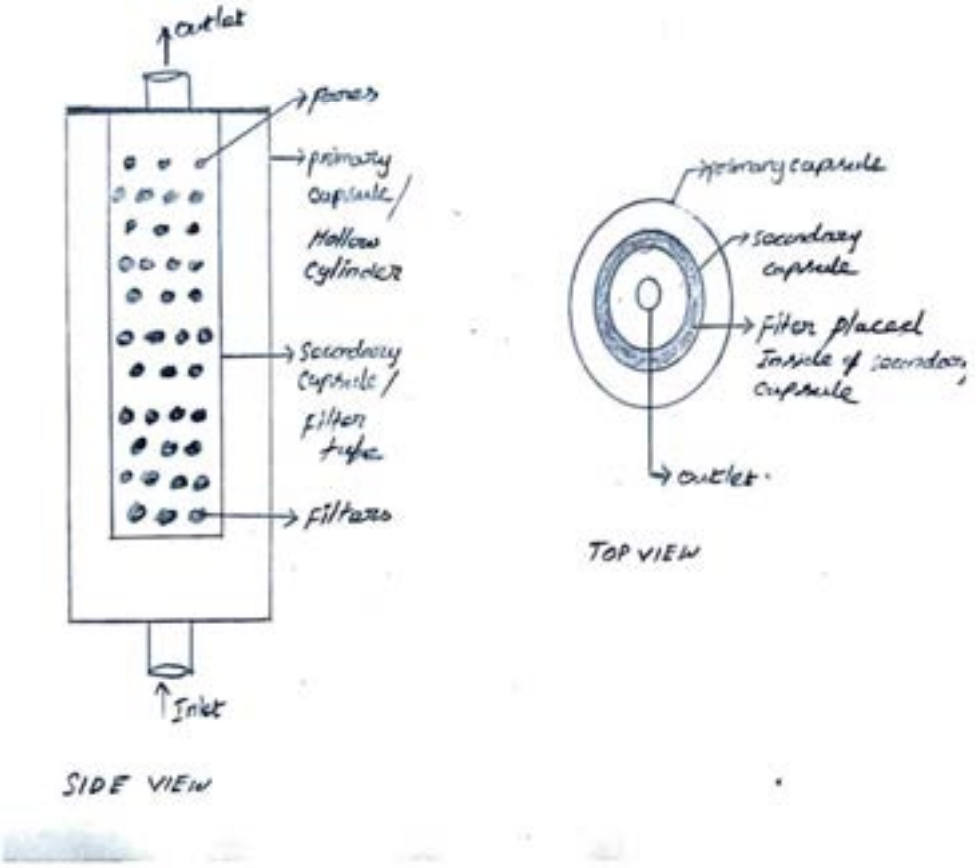

Figure 2(a) Side View and 2(b) Top View (Internal Placing)

3.3.2 EXTERNAL PLACING:

In this external placing, the filters are placed outside of the filter tube/secondary capsule, where in-between the primary and secondary capsule. The efficiency and air holding capacity is high in external placing compared to the internal placing. Here the air holds inside the secondary capsule, which also acts as an additional storage for breathing. Hence this type is mostly preferred then the internal placing. The diagram and image of the external placing is shown below on 3(a) and 3(b).

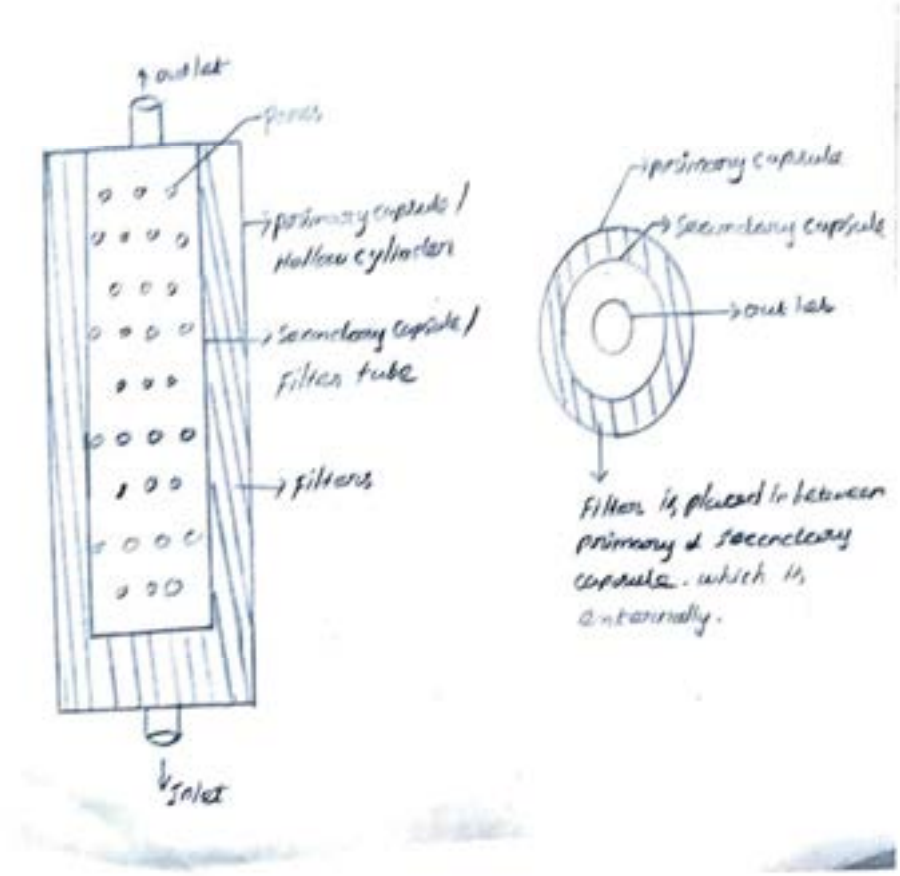

Figure 3(a) Side View and 3(b) Top View (External Placing)

3.4 POLYMERIC NANOFIBER GAUZE MASK TO PREVENT INHALING PM2.5 PARTICLES FROM HAZE POLLUTION

PM2.5 (particulate matter with diameter of 2.5micronor less) in polluted air can directly go through the lung alveolar to cause many diseases including asthma. Recently, many Chinese cities are covered by haze air. The heavy metals adhered on PM2.5 particles may even lead to severe chronic health problems such as cancer after long-term exposure under the particles contained environment. In order to prevent inhaling PM2.5 in haze, people wear regular gauze masks. Most of those masks are made of non-woven fabric, activated carbon, or cotton which has fiber diameter of

several micrometres. They have significant shortcoming of poor PM2.5 rejection and low air permeability. In this paper, a novel polymeric nanofiber masks were synthesized by electro spinning. Such masks based on nanofiber\ are expected to well prevent the PM2.5 particles and maintain a good air permeability. These nanofiber can be potentially developed to high efficiency and low cost mask product.

3.4.1. EXPERIMENT MATERIALS:

Polysulfone, acetone, polyethylene oxide, and dimethyl acetamide were purchased from Beijing Chemical Factory, China. Medical clinic masks, medical operating room masks, ITO PM2.5 masks, N95 respirator, and R95 masks were purchased from Tianjin Youkang medical and health care products factory. All chemicals were of analytical grade and were used without further purification.

3.4.2. PROCEDURE FOR ELECTRO SPINNING:

Polysulfone solution was prepared at a concentration of 18wt% by dissolving in DMAc/acetone (9 : 1) with vigorous stirring. The prepared solution was kept overnight without stirring under room temperature to remove air bubbles. For the electro spinning, the 18wt% Polysulfone solutions were filled into a syringe with a metal needle connected with a high-voltage power supply (Tianjin Dongwen High Voltage Co., China). The voltage is 13KV and the distance between the needle and the aluminium foil is 13cm. The polymer solution was fed at a constant rate of 0.4mL/h by using a syringe pump. The nanofiber were collected on the surface of a non-woven PP on the grounded aluminium foil. The collective time of nanofiber was 15, 30, and 60min.

3.4.3. MORPHOLOGY OBSERVATION:

The membranes were dried in vacuo and sputtered gold before observation. The morphology of nanofiber membranes was imaged by scanning electron microscopy (SEM, Hitachi T-1000, Japan).

3.4.4. PERMEABILITY SIMULATION TEST:

Permeability simulation test device mainly includes a pump, a pressure differential gauge, a meter, and bronchus. The nanofiber matts and the commercial masks as control group were clamped by a well sealed testing chamber, which was connected with a syringe at top, install a pressure meter at the side exit.Thebottomside of the chamber was open to the ambient air. Counterweights were placed on the syringe to adjust the pressure inside the testing chamber. The resulti g pressure above the nanofiber matts was measured by the pressure meter.

3.4.5. INTERCEPT RATE TEST:

Intercept experimental equipment was conducted in a nuclear particle counter (Model of CPC 3772 made in TSI Company). That counter can measure the concentration of particles (diameter between 10 and 2500 nm) in the air. The particle concentration in air represented the PM2.5 intercept rate of the filtration material.

3.4.6. DATA ANALYSIS:

All data were mean SD from three independent experiments. Comparisons between multiple groups were performed with the ANOVA test by SPSS. *P* values less than 0.05 were considered statistically significant. 15 min 30 min 60 min : Nano masks on non-woven fabrics.

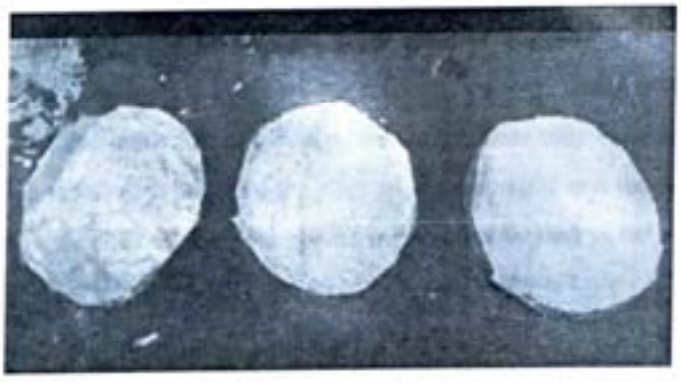

Figure 4 Nano masks on Non-woven Fabrics.

3.4.7 FACE MASKS USED TO PARTICULATE AIR POLLUTION

In China, air pollution causes around 1.6 million premature deaths each year and the loss of around 31 million disability-adjusted life years. Annual average particulate matter of aerodynamic diameter 2.5 micrometres (PM2.5) concentrations in Chinese megacities well exceed the WHO's guideline of 10 μg/m3, and corresponding black carbon (BC) concentrations are around 5 μg/m3. Beijing PM2.5 concentrations often reach unhealthy levels during the winter and near busy streets.

Chinese residents now have access to air quality information and can take measures to protect themselves in the short term. Studies in China have found that wearing face masks can have positive impacts on\ short-term health outcomes such as blood pressure and heart rate variability, although it is unclear what level of exposure reduction was associated with these impacts, given that only ambient particulate concentrations were measured.

In occupational health, the term 'respirator' includes a range of personal respiratory protection products, including disposable filtering face piece (FFP) respirators, sometimes referred to as 'dust masks' or 'face masks', particularly in lay parlance. In this manuscript, we use the latter term (or abbreviate to 'mask"), as we are evaluating these devices for use in non-occupational air pollution settings. Respirators remove particles from the inhaled airstream by filtration, through gravitational settling, inertial impaction, interception, diffusion and electrostatic deposition.

Filtration efficiency depends on particle size, charge, concentration and flow rate through the filter material. In practice, the contaminant may bypass the filter, by passing through small gaps between the edge of the respirator and the face, so-called 'edge-seal leakage'. The extent of leakage depends on factors such as the size and shape of the face, facial hair, the respirator design and the way that it is worn.

Disposable particulate respirators sold for use in workplaces are generally tested to ensure compliance with appropriate international or national standards, but face

masks sold for public protection against air pollution may not need to comply with any standards, and so may not be suitable. In November 2016, the Chinese National Institute of Standardization issued a new guideline to recommend testing of protection levels for 'daily protective masks'.

This guideline (GB/T 32 610–2016) categorises masks based on their filtration efficiency. Unlike GB2626-2006 (the Chinese standard for occupational masks) and other regulatory standards, it is not compulsory that 'daily protective masks' fulfil these testing guidelines. The tests in this study were carried out before the introduction of this guideline.

There is limited information about the performance of face masks against diesel exhaust particulate, which may play an important role in the health impacts of ambient particulate matter (PM). Studies often test the filtration efficiency of a section of the mask filter material in a sample holder or on mannequin heads, usually sealing the mask to the mannequin's face. One study investigated the filtration efficiency of mask filter material complying with the N95 criteria (filtering ≥95% particulate), finding that between <0.5% and 4.3% of the diesel aerosol, measured as elemental carbon, passed through the filters. Languish *et al*demonstrated that several mask materials allowed <5% of a diesel exhaust challenge through the material.

A study of the filtration efficiency of masks mounted on a mannequin head with mask sealed to the head found penetration of diesel aerosol mass between 11% and 15% for FFP2 masks and 13%–24% for FFP3 masks. These studies, however, did not account for inward leakage around the seal between the mask and face on humans.

Previous work on face masks used by the public has indicated poor performance, with masks often being poorly designed and ill-fitting. The Shanghai Municipal Bureau of Quality and Technical Supervision and China Consumers Association tested the filtration efficiency of several commercially available face masks.

The methods are not described in the reports, but few of the masks passed the requirements. We have found no direct measurements of the effectiveness of masks against diesel exhaust particulate or ambient particulate pollution when worn by people. Masks mounted on mannequins provide only partially realistic tests. Therefore, the aim of this study was to test the filtration efficiency of a range of masks sold to consumers in Beijing and, for the best performing masks, to assess mask effectiveness in reducing exposure to diesel :xhaust particulates when worn by volunteers.

3.4.8 MASK MATERIAL PENETRATION:

The surface area of each mask was estimated using image editing software (Paint. Net V.4.013, dotPDN LLC, 2016) from a scanned image. A circular area was cut from each mask and fitted to a sample holder (15.9 cm^2). Masks were tested in a chamber for 30 min under flow rates equivalent to 40 L/min and 80 L/ min through the whole mask but scaled to the area of the mask in the sampler. These rates were chosen to reflect high intensity breathing rates, which would be expected to draw more particles through the filter material and therefore mimic a worst case scenario (eg, cycling or running through traffic). The US Environmental Protection Agency (EPA)'s Exposure Factors Handbook, suggests the mean high activity breathing rate for males and females aged 21–<31 years old is 50 L/min (95^{th} percentile 76 L/min). The testing order of the masks was randomised. The target challenge BC concentration was 50µg/m3. A MicroAeth AE51 (Aethlabs, San Francisco, USA) measured BC, and a Sidepak AM510 (TSI) measured PM2.5. The Sidepak was not calibrated for diesel exhaust, because we were examining the relative change in filtration, rather than absolute concentrations.

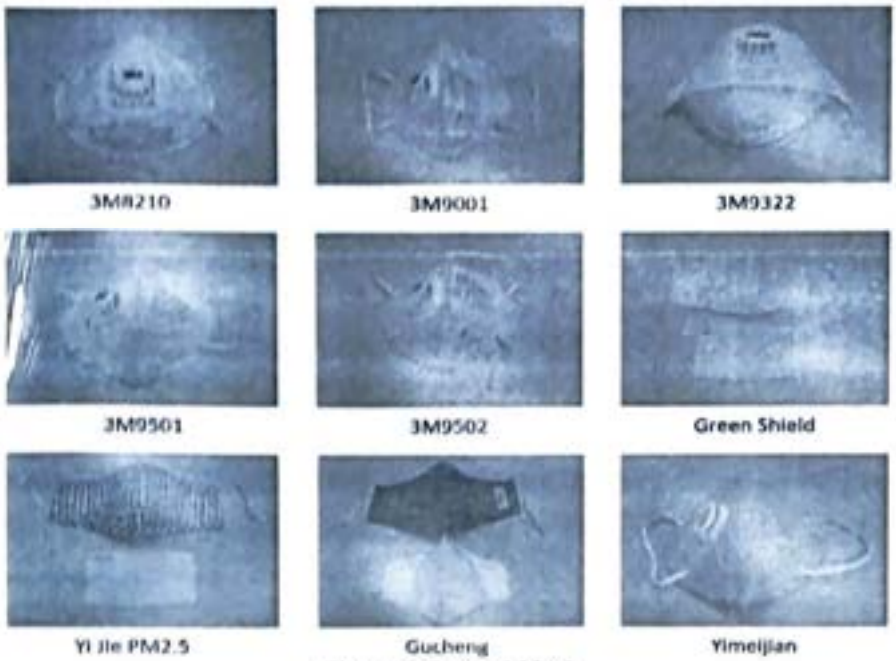

Figure 5 General Mask

3.4.9 VOLUNTEER TESTS:

Four masks for the volunteer tests were selected based on performance in the material penetration tests and mask design, including how the masks would seal against the face and method of attaching the mask to the head. Volunteers were recruited via word of mouth, social media and a local marketplace website. Volunteers were screened to ensure they had no underlying health problems. The original design was to have eight volunteers (four male, four female), each wearing all four masks, with two tests per mask (one standing and one sitting). However, the first two female volunteers dropped out after testing two masks, and two other female volunteers were recruited to test the remaining two masks. The total number of volunteers, therefore, was 10 (4 male, 6 females). Four facial dimensions were measured using anthropometric callipers: lip length, distance from chin to nasal root (menton– sellion length), facial width (bizygomatic width) and tragion (ear) to the tip of the nose. One individual measured all of the volunteers to reduce any variability in the measurement method. A Latin square design was employed to randomise the order in which the masks were tested by the volunteers. Additional information on the mask and sampling equipment donning are available in online supplementary information. The tests were conducted in an exposure

chamber supplied with air from a mixing chamber connected to a small diesel engine with the target average BC concentration of $50\mu g/m^3$.

3.4.10 SIMULATION TESTS:

Volunteers performed two simulation tests, designed to reflect everyday activities: (1) sitting (sedentary) and (2) standing and walking on the spot (active). All simulations had subtasks breathing normally (5 min), deep breathing (2 min), moving the head up and down (2 min), moving the head side to side (2 min), talking (2 min), bending over (2 min) and breathing normally (2 min). BC was measured simultaneously inside the mask (penetration concentration) and in the exposure chamber (challenge concentration).

3.4.11 DATA ANALYSIS:

The per cent penetration for each mask's filter material was calculated by dividing the penetration concentration by the challenge concentration at each time point, for BC and PM2.5. Agreement between the penetration percentages from the MicroAeth and Sidepak readings were assessed using a Spearman correlation. For the simulation study, the total inward leakage (TIL) percentage of BC was calculated by dividing the concentration measured inside each mask by the concentration in the exposure chamber for each time point. The unadjusted mean, median and interquartile range (IQR) of TILs were generated for each mask. Autocorrelation for time-series data, where values are influenced by previous time points, was assessed with the Durbin-Watson statistic. A Cochrane-Orcutt first-order autoregression model was developed to adjust TILs by the following covariates: mask type, time, gender, face size and activity. Covariates were included in the model using a likelihood ratio test significant at $P<0.05$. Goodness of fit of a log-linear model was compared using the Bayesian information criterion. For categorical variables, the level contributing the smallest incremental increase in TIL was used as the reference.

3.5 ACTIVITIES OF TESTS

The activities undertaken during the tests were grouped if volunteers were (1) sitting or standing/walking, (2) moving their head, (3) remaining stationary, (4) talking, (5) breathing deeply or (6) bending. Volunteers were classified as either small/ medium or large face sizes by National Institute for Occupational Safety and Health (NIOSH) guidelines based on face length and width and through the assessment of lip length and face depth. Data analysis was performed using the 'prais' command in Stat V.13.1.μ.

3.6 MASK MATERIAL PENETRATION:

Overall agreement of penetration between the two instruments was very good (rho=0.84, P<0.001). In the 40 L/min flow rate scenario, eight of the nine masks demonstrated median rates of penetration below 9% for both PM2.5 and BC . The median penetration of BC ranged from 0.2% (IQR: 0.2%–0.3%) to 20.7% (IQR: 19.6%–22.1%) with the lowest value being for the 'Yimeijian' mask and the highest being for the 'Gucheng Professional AntiHaze W&G' ('Gucheng') mask. Values were similar, but slightly higher, using 80 L/min, ranging from (IQR: 0.4%–1.0%) to 32.8% (IQR: 21.1%–35.3%) with the same masks performing best/worst. Penetration of PM2.5 was typically greater than for BC: the Yimeijian mask exhibited the lowest median penetration at 0.3% (IQR: 0.2%–0.3%) for the 40 L/min flow, with the highest corresponding penetration seen for the Gucheng, with a median of 29.3% (IQR: 27.7%–30.3%). The median range for 80 L/min tests extended from 0.8% (IQR: 0.7%–1.1%) for Yimeijian to 41.4% (IQR: 33.9%–50.2%) for Gucheng.

3.7 VOLUNTEER STUDY:

The 3M9322, 3M9502, Yi Jie PM2.5 mask and the Yimeijian mask were selected for the volunteer trials. There was relatively little variability in face size among volunteers, with the exception of two, which were classified as large. The eight other volunteers were classified as having 'Small' or 'Medium' faces. provides the TIL ranges for the four masks tested in the volunteer studies, in the same order shown in.

TIL values in excess of 100% are possible where there is a very poor facial seal; in this instance, TIL values would largely represent fluctuations of similar concentration levels inside and outside the mask. A number of high outliers are evident in the TIL values for both 3M masks; the TIL values exceeding 30% occurred for a single subject for each 3M mask, although the volunteers differed between masks. There was clear variation in the unadjusted median TILs across the four masks tested, spanning from 1.8% (IQR: 0.6%–4.7%) for 3M9322 to 67.3% (IQR: 56.6%–75.2%) for the Yi Jie PM2.5 mask.

There was apparent variation in the TIL across volunteers, time and activities. The Durbin-Watson statistic was 0.12 from a simple regression model with mask type as the dependent variable, indicating positive autocorrelation. The transformed value produced in a Cochrane-Orcutt regression was close to 2.00 (1.85), suggesting autocorrelation had been sufficiently addressed. Only mask type and activity were significant in the model at $P<0.05$. Face size, sitting/standing and elapsed time had no measureable effect on TIL.

A log-linear model was deemed a better fit than a linear model according to the Bayesian information criterion difference. After adjustment for covariates, the 3M9322 mask was significantly better than the three other masks, which increased leakage by a factor of 2.0 (95% CI 1.2 to 3.3) to 26.7 (95% CI 16.4 to 43.5). Compared with talking, only bending and head moving contributed to higher TIL, ranging from 1.1 (95% CI 1.0 to 1.3) to 1.2 (95% CI 1.1 to 1.3) times greater than the reference category of talking, respectively. After adjustment for autocorrelation, the regression model explained 11% of the variation in the TIL data.

We assessed the real-life effectiveness of masks worn by Beijing residents, to protect against urban air pollution. We demonstrate that a mask with highly efficient particle filtering material may confer little protection when worn. Facial fit and movement have a large impact on the actual protection. In spite of the generally good filtration efficiency of the tested mask materials, two of the masks performed poorly when worn because of inadequate fit to the face. These included a reusable mask with disposable filters (PM2.5) and a single-fold disposable mask . The reusable mask cloth was loose, and the filters did not cover the whole surface area of the mask. These masks

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used elasticated ear loops to hold them onto the face rather than head straps. Even for the better-performing masks (3M9502 and 3M9322), some volunteers' results indicated that the fit was not sufficient to ensure maximal performance of the mask.

Our first-order auto regression model suggested the presence of large differences in the efficacy of the tested masks, and that activities, namely, bending and head moving, adversely affected the fit. The best performing mask had an estimated mean leakage of 2.3%, which corresponds to a protection factor of 43 (protection factor being the inverse of the leakage, or TIL). The poorest performing mask had a mean leakage of 61% (protection factor 1.6). The face size of the volunteer or the duration did not have a detectable effect on leakage; however, the tests were conducted over a short time, and we cannot be certain of the effect of longer duration wear.

Our results correspond with findings from van der Sande *etal*, who tested an FFP2 mask versus a surgical mask and a home-made tea cloth mask against sodium chloride (NaCl) particles <1 μm diameter on volunteers. They found differences between protection factors for volunteers within a single mask type, with children much less protected compared with adults. Variation of protection by activity was Boxplots of the per cent penetration of each mask assessed for black carbon (MicroAeth) and PM2.5 (Sidepak) monitors. Boxes indicate the 25th–75th percentiles (the IQR), and the lines inside the boxes indicate the median (50th percentile). The whiskers indicate values within 1.5 times the IQR, and the dots are the outliers. Boxplot showing the total inward leakage for each mask tested in the volunteer trial. Boxes indicate the 25th–75th percentiles (the IQR), and the lines inside the boxes indicate the median (50th percentile). The whiskers indicate values within 1.5 times the IQR, and the dots are the outliers.

3.8 DISCUSSION ABOUT THE MASK:

We assessed the real-life effectiveness of masks worn by Beijing residents, to protect against urban air pollution. We demonstrate that a mask with highly efficient particle filtering material may confer little protection when worn. Facial fit and movement have a large impact on the actual protection. In spite of the generally good filtration efficiency of the tested mask materials, two of the masks performed poorly when worn because of inadequate fit to the face. These included a reusable mask with disposable filters (PM2.5) and a single-fold disposable mask. The reusable mask cloth was loose, and the filters did not cover the whole surface area of the mask. These masks used elasticated ear loops to hold them onto the face rather than head straps. Even for the better-performing masks (3M9502 and 3M9322), some volunteers' results indicated that the fit was not sufficient to ensure maximal performance of the mask.

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In this study, a novel nanofiber mask was synthesized by electro spinning for preventing the PM2.5 from haze air. That nanofiber mask showed better performance than the commercial Masks in both air permeability and PM2.5 rejection. To make a clear comparison, the advantages and disadvantages of commercial masks have been summarized in. Most of the masks were made of non-woven fabric microfibers with large diameters of several micro meters.

The thin microfiber mask such as the disposable non-woven mask, though showed excellent air permeability, performed poor rejection on PM2.5 due to the insufficient thickness of fibers and larger inter fiber space. In contrast, the thick microfiber masks of Ito PM2.5 and N95 improved the rejecting ratio of PM2.5 to >80% which is enough for daily use. But they both had high resistance on air permeability which led to uncomfortable breathability in use. The R95 mask, which is commonly used in medical purpose, could well protect the doctors from virus infection. However, it was not suitable for preventing air pollution in daily use because of the extremely poor air permeability.

The Nano fiber mask with 15 min electro spinning had a high PM2.5 rejection of 90% and acceptable air permeability. Therefore, it is a good mask raw material for preventing haze air pollution. The requirement on air permeability and PM2.5 rejection is a contradiction. That means the high air permeability usually reduces the particle rejection of PM2.5 and vice versa. As shown in Figure 3, the nanofiber mask (15min) displayed the largest difference between air permeability and PM2.5 rejection among these masks. We attribute that unique feature to the nano scaled fiber size. At the same porosity, which indicates air permeability, the smaller fiber required higher quantity to achieve the same coverage as that of the bigger fiber. More fibers in the same area result in smaller inter fiber space. when the fiber scale is down to submicron, the inter fiber space between the nano fibers is also reduced to micron scale, which is smaller than the PM2.5 size, consequently rejecting the PM2.5 passing efficiently.

3.9 ASSESSMENT OF INFLUENZA A VIRUS AND RHINOVIRUS TYPE 14 PENETRATION

An aerosol filtration test apparatus assembled at Microbac per modified ASTM F2101-14 was used for the influenza and rhinovirus penetration study. Test masks (the mask with operating Micro Ventilator, the mask with operating Smart Valve but without Micro Ventilator, or the mask with the Smart Valve covered/sealed) were placed between upstream and downstream chambers. The virus filtration efficiency test was performed in triplicate (N=3). For each run, a six-jet Collison nebulizer (Mesa Labs, Butler, USA) was filled with a measured amount of virus suspended in 0.1× Minimum Essential Medium (MEM) and the virus was aerosolized and delivered into the upstream chamber using high-pressure air. A downstream vacuum was turned on to create an air flow (28.3 L/min) through the mask that was intended to mimic human breathing. After the delivery of the aerosol, the upstream air pressure was turned off and the downstream vacuum pump was left on for another minute to pull residual aerosol from the chambers into the one-stage Andersen sampler. Virus aerosol that passed through the mask was captured on a Petri dish containing semi-solid medium (5% gelatin/minimal essential medium). The collected sample was liquefied at 36±2 °C for approximately 10 min. The resulting samples were divided into separate portions for ribonucleic acid (RNA) extraction and for infectivity assays.

Viral infectivity was measured on the basis of cytopathic effect (CPE) generated in MDCK cells (for influenza virus) and H1-HeLa cells (for rhinovirus). For the infectivity assay, a ten-fold dilution series of the samples collected as described above was prepared in a dilution medium. The sample dilutions were then inoculated onto the host cells. After 4–9 days of incubation, the CPE was scored under a phase-contrast light microscope. Viral titers were calculated in units of log10 50% tissue culture infectious doses (TCID50) per mL.

For the qRT-PCR assay, RNA was extracted using a Qiagen QIAamp® Viral RNA Mini kit following the manufacturer's instructions. The RNA was analyzed using primers and probes specific to each virus. For influenza H1N1 virus, the forward primer was 5'-GAC CRA TCC TGT CAC CTC TGA C, the reverse primer was 5'-AGG GCA

TTY TGG ACA AAC GTC TAA, and the probe was 5'-(FAM) TGC AGT CCT CGC TCA CTG GGC ACG (BHQ). For rhinovirus 14, the forward primer was 5'-GAG GTG TGC TGT GTG CTA CT and the reverse primer was 5'-GAC TTG GTT GGC GTG TTG AC.

3.10 ASSESSMENT OF S. AUREUS AND BACTERIOPHAGE ΦX174 PENETRATION

Bacterial and phage filtration efficiencies for the masks without Micro Ventilator were determined at Nelson Laboratories per EN 14683:2014 and ASTM F2101-07, respectively. The purpose of this testing was to assess the filtration efficiency of the filter material used in the test mask.

The bacterial filtration efficiency test compared the upstream bacterial control counts to downstream counts (i.e., counts attributed to passage of bacteria through the face mask). A suspension of *S. aureus* was aerosolized using a six-jet Collison nebulizer and delivered to the face mask (N=5 replicate measurements) at a constant flow rate (28.3 L/min) and challenge delivery [1.7–2.7×103 colony forming units (CFU)] with a mean particle size (MPS) of 3.0±0.3 µm. The aerosolized droplets were drawn through a six-stage Andersen sampler for collection.

The viral filtration efficiency test compared the upstream bacteriophage control counts to downstream counts (i.e., counts attributed to passage of bacteriophage through the face mask). A suspension of bacteriophage ΦX174 was aerosolized using a six-jet Collison nebulizer and delivered to the face mask (N=5 replicate measurements) at a constant flow rate (28.3 L/min) and challenge delivery [1.1–3.3×103 plaque forming units (PFU)] with a MPS of 3.0±0.3 µm. The aerosolized droplets were drawn through a six-stage Andersen sampler for collection.

CHAPTER 4

REPIRATORY PROTECTION

A study of respiratory protection against volcanic ash also found that industry-certified n95 or n99 equi·alent masks performed best in volunteer til tests compared with masks made from ‹ ther materials with similar filtering abilities. similarly, grin shpun *et al* found that 70% of total variability in the faceseal-leakage-to-filter (fltf) ratio was associated with subject characteristics, compared with 30% due to how the subject put on the respirator.

They also found that movement exercises resulted in larger fltf ratios and that the ratio increased as particle size increased (from 0.04 to 1 μm). Conversely, lee *et al* did not find a particle-dependent protection relationship in a similar size range, and shakya *et al* found variable results with regard to filtration efficiency and particle size (all below 1 μm). These size-dependent effects may be due to submicron-sized particles being more likely to deposit by diffusion. Diesel exhaust particulate primarily consists of the ultrafine fraction of the aerosol, which can be breathed deep into the alveolar region of the lung and may then cross into the bloodstream.

The use of a diesel exhaust challenge, rather than sodium chloride, provides a scenario that is closer to real-world exposures, particularly near busy roads, where people are more likely to wear masks. Gao *et al* found that N95 filters did not perform as well compared with R95 or P95 filters when exposed to combustion source aerosol (wood, paper and plastic) compared with NaCl, although all these filters did filter at least 95% of the aerosol. None of the masks tested in our study were certified to the Chinese guidelines for 'daily protective masks' (GB/T 32 610–2016), because the guidelines were introduced after our study was conducted, but six of the nine masks we tested were reportedly certified to GB2626-2006, or an international equivalent. One of these (Yi Jie) performed poorly in the volunteer trial. While respirators for workplace use are required to be tested to a rigorous standard, including TIL, respirators for the consumer market are not.

An analysis of internet purchases of face masks in urban areas across China found that a 100-point increase in the Air Quality Index resulted in a 70% increase in sales of masks marketed as 'anti-PM2.5' and a 54% increase in all mask purchases, indicating that this is a popular method of protection used by people in China. To ensure that the general public are able to effectively protect themselves, all consumer air pollution masks should be required to fulfil the same standards as workplace masks, and sales of non-compliant models should be restricted.

Consumers in China also need better information about the type of masks that should be used, the actual TIL that might be achieved with face masks and how to wear the masks to achieve a good fit. Consumers should know that, although surgical masks may have reasonable filtration efficiency, the design generally confers poor facial fit and high TIL with regards to air pollution. In addition to consumer applications, our study has implications for research studies that investigate health benefits of mask-wearing to protect against air pollution. While studies have shown some reduction in blood pressure and increases in heart rate variability from wearing a respirator over a few hours, there was no assessment of the exposure reduction while the respirators were being worn in any of these studies. That there may be considerable inter individual and intra individual variation in TIL, even with relatively well-constructed respirators, and there are potentially large, systematic differences among respirator brands.

4.1 RESEARCH IN MASK:

Our study was not a comprehensive survey of air pollution face masks, but rather, provides preliminary results. We selected a convenience sample of masks from retail outlets based on accessibility and design type. There are a wide variety of masks on the market, and we were not able to test all of them. We also had a relatively small sample size of volunteers, and not all volunteers wore all four masks that were being tested; therefore, we cannot draw conclusions about the fit across all tested masks for a

given face shape. We had more small/medium face types than large and did not have sufficient volunteers to distinguish small from medium.

We had similar numbers of males and females but, due to small numbers, this was not a representative sample, nor were the subjects exclusively Chinese. Another potential uncertainty in our study relates to the response of the instruments to the aerosol concentration. If the response is not linear across the range of concentrations, we may be underestimating or overestimating the filtration efficiency. We have previously evaluated the MicroAeth AE51 in the field versus a reference aethelometer (AE22) and found a consistently linear relationship across the range of concentrations tested in this study (unpublished data).

Although we do not have a reference comparison for the Sidepak for PM2.5, the relationship between the penetration ratios for each instrument is linear, implying that the Sidepak should have a similar response across the range of concentrations in the study.

In future work, we suggest that a comprehensive survey of the different face mask types available and of their popularity of use be conducted. A larger, more representative population sample should be recruited for testing, and a wider variety of face mask types should be tested for TIL. In day-to-day use, respirators will not be constantly worn, and this will inevitably reduce the overall protection offered although, to our knowledge, there are no extensive study data available on wearing behaviour of consumers in China.

To assess the exposure-reduction potential of real-world face mask use in the public, it is necessary to understand wearing patterns and to assess the effect of constant donning and doffing of masks by the general public. In future studies of the public health benefits of wearing respiratory protection, we recommend the researchers monitor particulate concentrations inside the face piece and take these data into account in analysis of the association between exposure to particulate pollution and health

markers. This would provide a more accurate assessment of particulate exposure change and more robustness to the evaluation of the exposure–response relationship.

4.2 RESEARCH IN PROTECTION ON ENVIRONMENT:

Protection of individuals from environmental pollutants, including pathogens, allergens, and fine particulates (PM2.5), can be achieved, in part, through use of personal protective devices such as respiratory face masks. The use of face masks for this purpose is more common in certain geographical regions, such as China and India, where population densities are higher, and the residents are more likely to be chronically exposed to PM2.5 levels exceeding annual World Health Organization Air Quality Guidelines (<10 μg/m3).

The compliance of use of respiratory face masks should be facilitated by features such as the Smart Valve and operational Micro Ventilator, which are designed to aid in the evacuation of exhaled gases from the interior of the mask. The enhancement of user comfort may be measured quantitatively through assessment of gas content in the dead space of the mask and systemic and facial thermoregulation.

A randomised clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children found, in a clinical study in children aged 7–14 years, that wearing this test mask without Micro Ventilator increased the end-tidal CO_2 ($ETCO_2$) and fractional concentration of inspired CO_2 ($FICO_2$), compared to children without masks at rest and during brisk walking. In contrast, wearing the mask with operational Micro Ventilator brought $FICO_2$ levels for both activities closer to baseline levels obtained in children not wearing the mask.

Computational Fluid Dynamics (CFD) simulation experiments conducted in adult subjects have demonstrated that the introduction of a ventilation fan to the N95 mask is a feasible option for reducing CO_2 accumulation in the dead space of the mask and also for controlling the temperature of the air within the dead space.

A randomised clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children. confirmed the earlier CFD studies indicating reduction of CO_2 in the dead space of the mask with operational ventilator fan. Furthermore, CFD studies performed in adult subjects have demonstrated reduction in heat, CO_2, and moisture build-up within N95 masks configured with operational ventilator fans. Moisture build-up in N95 masks used in high humidity atmospheres has been shown to reduce filtration efficiency of the masks for Ebola-Makona virus .

Mask inhalation and exhalation breathing requirements were met by the test mask with operational Smart Valve and Micro Ventilator fan. Additional evidence that the Smart Valve and Micro Ventilator fan results in a mask that provides acceptable breathing resistance characteristics (inhalation and exhalation) is the fact that the test mask was awarded an N95 rating by NIOSH. Testing for satisfaction of this rating includes evaluation of inhalation and exhalation resistance. The use of respiratory face masks with operational ventilation fans is therefore useful both from a comfort-enhancement perspective as well as for providing optimal filtration efficiency.

Ideally, any features added to a respiratory protective device solely for the purpose of enhancing wearer comfort should not adversely impact the primary function of the device, which is to filter airborne particulates and infectious agents from the contaminated air. In the present study, we have assessed the efficiency of the test mask for filtration of surrogate pathogens (bacteria and respiratory viruses) and pollutants. Various configurations of the mask were challenged, including the mask with operating Micro Ventilator, the mask with operating Smart Valve but without Micro Ventilator, and the mask with the Smart Valve covered/sealed. The latter configuration would be considered "best case" for excluding experimentally aerosolized contaminants [surrogate pathogens/particulates such as PM2.5], while the fully operational Micro Ventilator would be considered "worst case" for this purpose. For instance, a poorly functioning Smart Valve may allow environmental contaminants into the interior of the mask, defeating the purpose of the mask as a filtration device

CHAPTER 5

HARDWARE DESCRIPTION

5.1 COMPONENTS USED

- Active carbon filters
- Glass fibres as filters
- Metal sheets
- Mini motor with propeller
- Cylinder
- Adult oxygen mask
- Tubes
- Electro static precipitator(ESP)
- Connectors

5.2 ACTIVE CARBON FILTERS:

Activated carbon filters are generally employed in the process of removing organic compounds. In air purification systems, activated carbon filters can be used in conjugation with HEPA filters to trap known allergens and impurities like dust, mould spores, carbon dust, etc. the image at figure 6(a) and 6(b) is how the carbon filter tube looks.

Figure 6(a) Carbon Filter

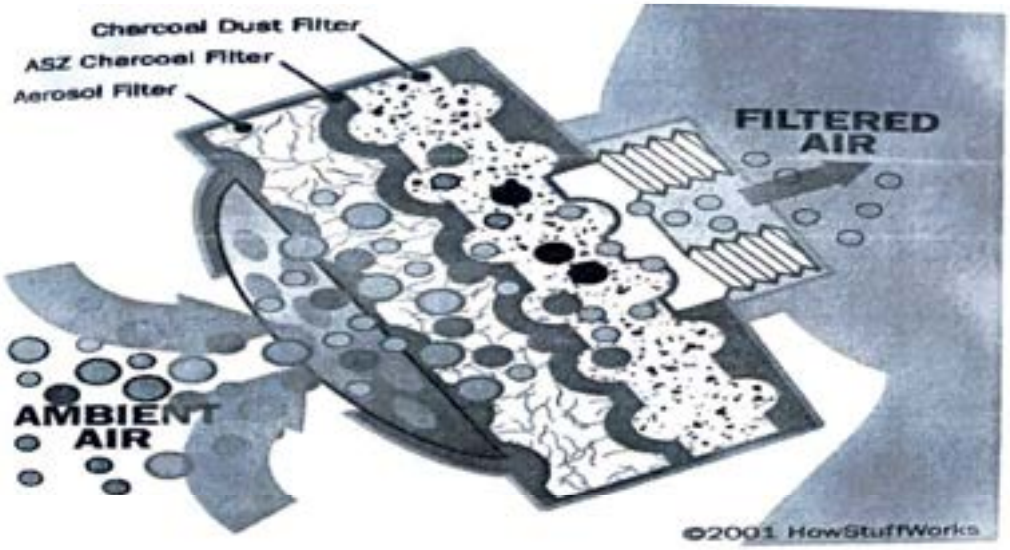

Figure 6(b) Carbon Filter in Gas Mask

5.3 GLASS FIBRES AS FILTERS:

The low cost filters are commonly referred to as depth filters. They are ideal for general gravimetric air sampling and analysis. Suitable when no other analysis than weighting is required binder and additive free. Available un-weighed and pre-weighed. Glass filter is shown in figure 7.

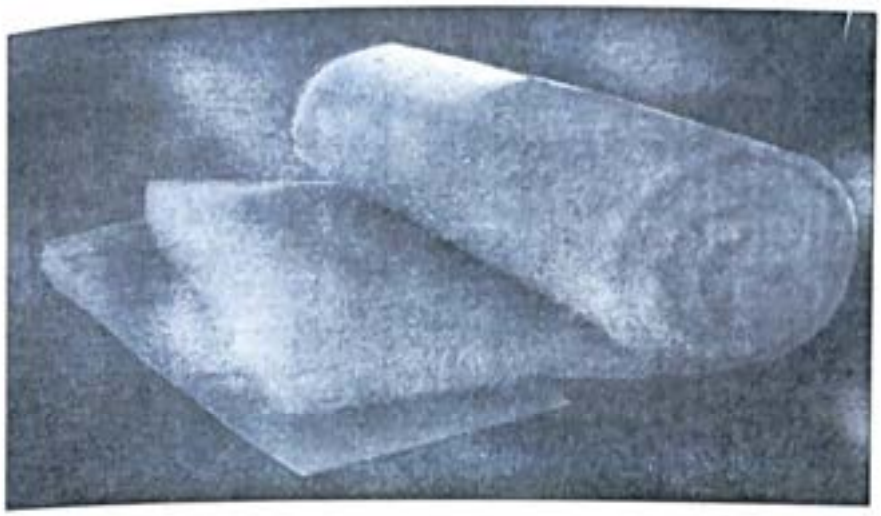

Figure 7 Glass Fibre

5.4 METAL SHEETS:

The metal sheets are used to get strong shape and structure of the mask. This is supportive to internal and external design

5.5 MOTOR WITH PROPPELER:

The motor with propeller is used as a suction unit to suck the air from atmosphere for breathing which pass through the filters.

5.6 ELECTRO STATIC PRECIPITATOR:

A device that removes suspended dust particles from a gas or exhaust by applying a high-voltage electrostatic charge and collecting the particles on charged plates. It is of various types based on the shapes we use here is plates and cylindrical type as shown in the figure 8(a) and 8(b).

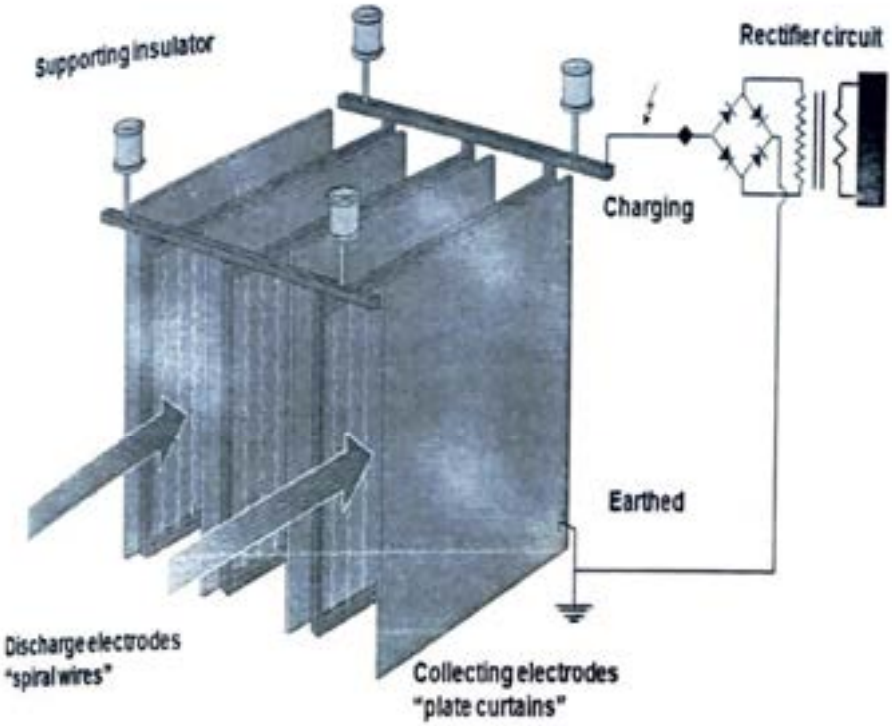

Figure 8(a) Plates Type ESP

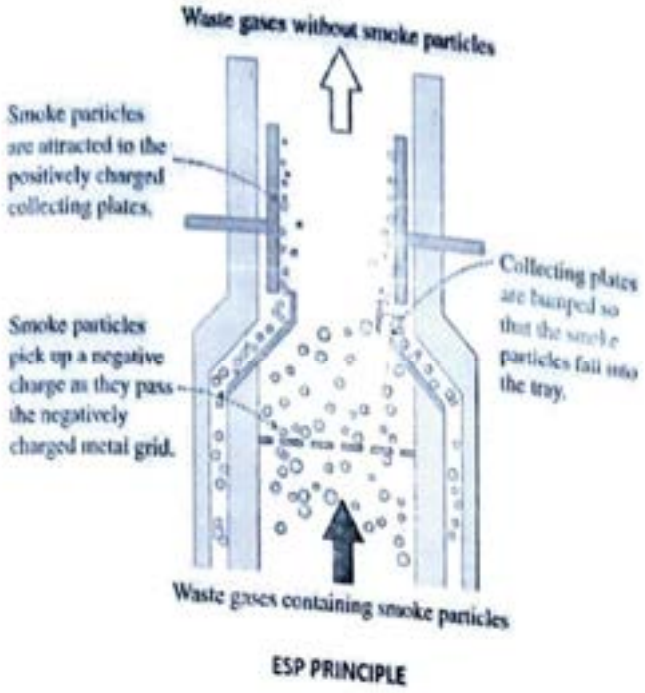

Figure 8(b) Cylindrical Type ESP

5.7 TUBES AND CONNECTORS:

The tubes and connector's are used to connect the devices end to end. Where the fresh air can be send for breathing and the exhaust air flows out with the help of motors.

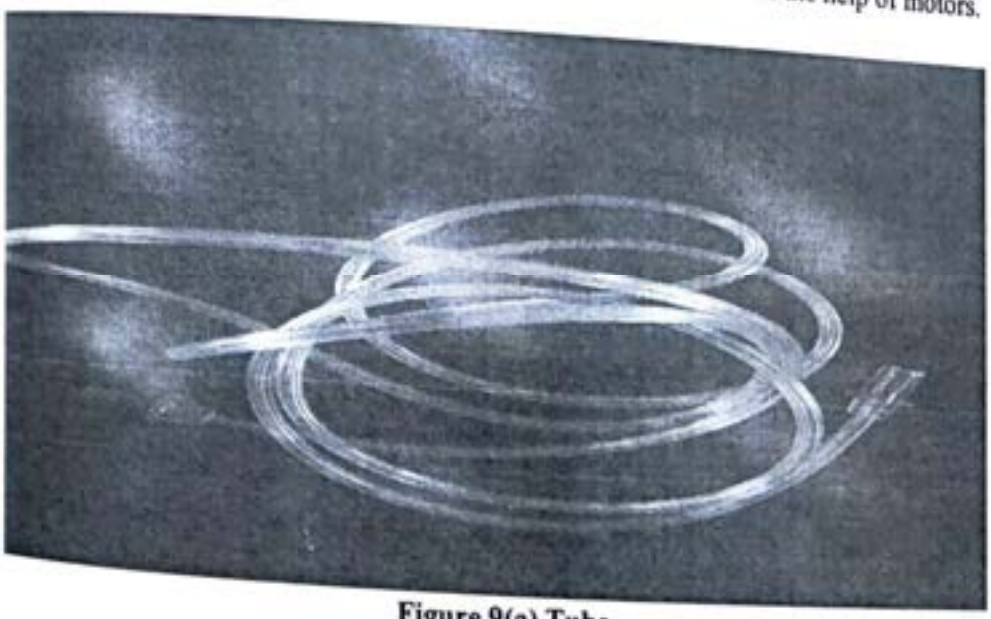

Figure 9(a) Tube

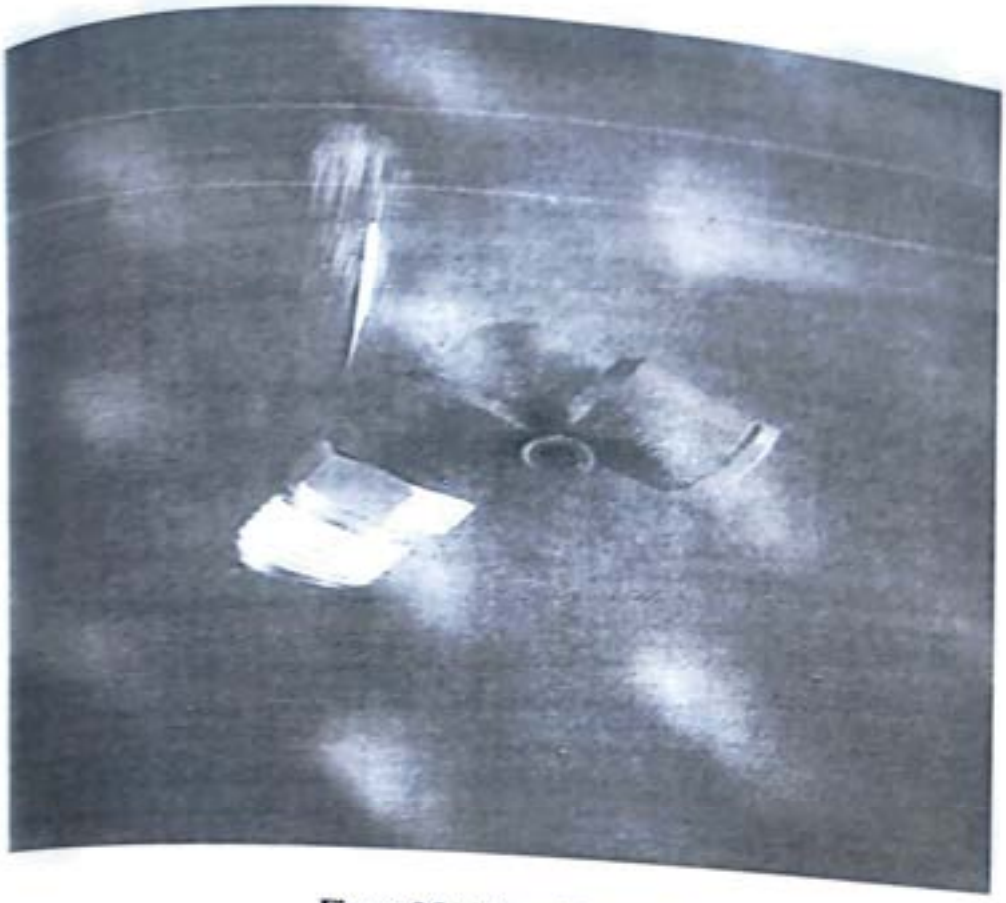

Figure 9(b) Elbow Connector

CHAPTER 6

ADVANTAGES

- Used as multi-purpose device.
- It can be altered based on customers design.
- The filte s can be replaced with new one.
- It gives us pure air to breath.
- The disease due to air pollution is reduced.
- It provides high safety to the people who are all having asthma, vising, and other breathing problems.
- It also gives protection to the face from obstacles which is suspended in air.
- The metal-sheet frame gives protection to face and jaws.

CHAPTER 7

COST ESTIMATION

Table 1 Cost Estimation.

Sl.No	Description	Quantity	Price
1	Active carbon filters	1	3700
2	Glass fibres as filters	1	2750
3	Metal sheets	2	500
4	Mini motor with propeller	1	100
5	Adult oxygen mask	1	250
6	Tubes	25	200
7	Connectors	2	1000
8	Electro static precipitator(ESP)	1	3000
Total			11,500

CHAPTER 8

CONCLUSION

This project is designed to reduce the breathing problems due to dust and carbon dust polluted areas such as roads, desert storms in desert regions. Here the tech used is electrostatic precipitation and filters as in regular masks. It consists of two units' suction unit and exhaustion unit, it is powered by mini motors. To power up the electric components, tritium is used or by regular batteries with solar power can also be used. This provides high safety and pure clean air to breath.

REFERENCES

1. John W Cherrie, Andrew Apsley, Hilary Cowie, Susanne Steinle, William Mueller, Chun Lin, Claire J Horwell, Anne Sleeuwenhoek, Miranda Loh" Effectiveness of face masks used to protect Beijing residents against particulate air pollution".

2. S. Steve Zhou, Salimatu Lukula, Cory Chiossone, Raymond W. Nims, Donna B. Suchmann, M. Khalid Ijaz," Assessment of a respiratory face mask for capturing air pollutants and pathogens including human influenza and rhinoviruses".

3. Xingzhou Li and Yan Gong" Design of Polymeric Nanofiber Gauze Mask to Prevent Inhaling PM2.5 Particles from Haze Pollution".

SEMI-AUTOMATED TROLLEY FOR SUPERMARKETS WITH ULTRASONIC SENSOR AND RFID

A PROJECT REPORT PHASE - I

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

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DEPARTMENT OF MECHATRONICS ENGINEERING

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ABSTRACT

Consider any shopping mall we have to wait much time for billing even though you purchase little things and we are not aware of cost of the product that we wanted to purchase. With the help of this project we reduce the billing time and customers can know the exact cost of the products that they purchased before billing so that they can do their shopping within their budget. The objective of this project is to improve the speed of purchase by using RFID. This project is designed to use the RFID based security system application in the shopping trolley. This project is used in shopping complex for purchase the products.

In this project RFID Key fob is used as security access for product. If the product is put in to the trolley means it will shows the amount and also the total amount. But in this project RFID Key fob with 13.6 MHZ is used for accessing the products. So this project improves the security performance and also the speed. In this project RFID Key fob is used as security access. So each product has the individual RFID fob which represents the product name. RFID reader is interfaced with micro controller. Here the micro controller is the flash type re-programmable micro controller in which we already programmed with card number. RFID transceivers can only detect with minimum range so ultrasonic sensors ac be used within the area in order to improve the security performance at cheap price.

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LIST OF ABBREVIATIONS AND SYMBOLS

SYMBOLS

mV	-	Millivolts
ms	-	Milliseconds
e	-	10^{-6}
mW	-	milliWatts
MHz	-	Megahertz
kHz	-	kilohertz
mm	-	millimeter
V	-	Volts
mA	-	milliamps

ABBREVIATIONS

ABI	-	Allied Business Intelligence
AC	-	Alternating Current
ADC	-	Analog to Digital Convertor
COM	-	Common
CPU	-	Central Processing Unit
DC	-	Direct Current
HF	-	High Frequency
ISO	-	International Standards Organization
LCD	-	Liquid Crystal Display

LED	-	Light Emitting Diode
LF	-	Low Frequency
NC	-	Normally Closed
NO	-	Normally Opened
PIR	-	Passive Infrared
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFID	-	Radio Frequency Identity
RO	-	Read Only
ROM	-	Read Only Memory
RW	-	Read Write
TN	-	Twisted Nematic
TFT	-	Thin Film Transistor
WQRM	-	Write Once Read Many

CHAPTER 1

INTRODUCTION

RFID is the special type wireless card which has inbuilt the embedded chip along with loop antenna. The inbuilt embedded chip represents the 12 digit card number. RFID reader is the circuit which generates 125 kHz magnetic signal. This magnetic signal is transmitted by the loop antenna connected along with this circuit which is used to read the RFID card number.

In this project RFID card is used as security access card. So each product has the individual RFID card which represents the product name. RFID reader is interfaced with microcontroller. Here the microcontroller is the flash type reprogrammable microcontroller in which we already programmed with card number. The microcontroller is interfaced with keypad.

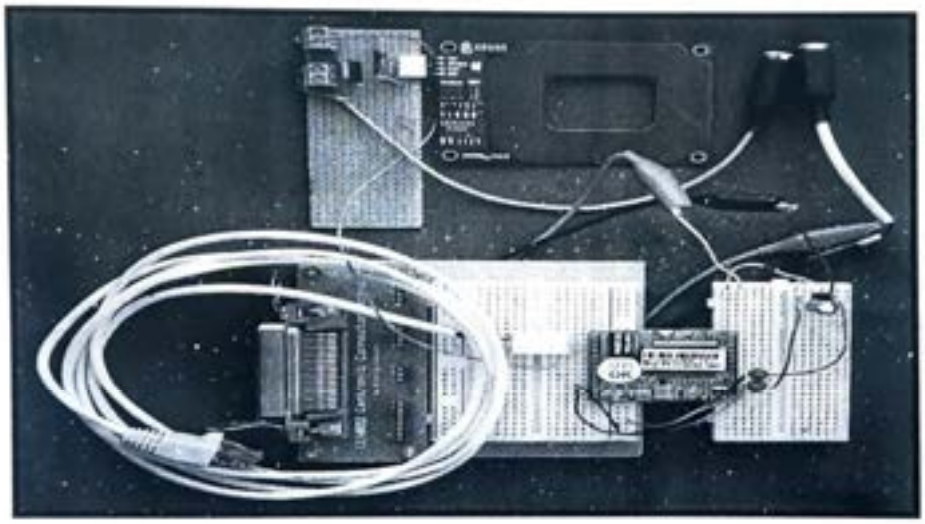

Figure 1.1 RFID Connection

This project is designed with

- RFID tag
- RFID reader
- Microcontroller
- Driver circuit
- Alarm
- Relay

1.1 Introduction to RIFD

Libraries began using RFID systems to replace their electro-magnetic and bar code systems in the late 1990s. Approximately 130 libraries in North America are using RFID systems, but hundreds more are considering it (Molnar, Wagner, 2004). The primary cost impediment is the price of each individual tag. Today, tags cost approximately seventy-five cents but prices continue to fall. However, privacy concerns associated with item-level tagging is another significant Impediment to library use of RFID tags. The problem with today's library RFID systems is that the tags contain static information that can be relatively easily read by unauthorized tag readers. This allows for privacy issues described as "tracking" and "hot listing." Tracking refers to the ability track the movement of a book (or person carrying the book) by "correlating multiple observations of the book's bar code" (Molnar and Wagner, 2004) or RFID tag. Hot listing refers to process of building a database of books and their associated tag numbers (the holist) and then using an unauthorized reader to determine, who is checking out items on the hot list.

Current standards (ISO 15693) apply to container-level tagging used in supply chain applications, and do not address problems of tracking and hot listing. Next generation tags (ISO 18000) are designed for item-level tagging. The newer tags are capable of resolving many of privacy problems of today's tags. However, no library RFID products are currently available using the new standard. Libraries implementing RFID systems today are using tags unsuited for item-level tagging and the cost of upgrading to newer tags when they become available is well beyond the reach of most library budgets. This chapter addresses many of the specific issues and privacy concerns associated with RFID technology in libraries, and suggest best RFID-implementation practices for librarians. Finally, we explore the larger responsibilities of libraries in regards to RFID, public policy, privacy and the changing world of technology.

1.2 Application

Once the reader reads the tag, the information is passed on to an "application" that makes use of the information. Examples of applications and their uses fall into at least six categories:

1. Access control (keyless entry)
2. Asset tracking (self-check-in and self-check-out)
3. Asset tagging and identification (inventory and shelving)
4. Authentication (counterfeit prevention)
5. Point-of-sale (POS) (Fast Track)

6. Supply chain management (SCM) (tracking of containers, pallets or individual items from manufacturer to retailer).

RFID is most pervasive in the SCM market. ABI (2002) reports that by 2007, SCM and asset management applications will account for more than 70% of all transponder (tag) shipments. In the SCM market, items are tracked by pallet or container, not by individual item. Once the individual items are removed from the pallet, they are no longer tagged. In contrast, library applications require that each individual item contain a tag that uniquely identifies the item (book, CD, DVD, etc.). The tag contains some amount of static data (bar code number, manufacturer ID number) that is permanently affixed to the library item. This information is conveyed, via reader, to the library's security, circulation and inventory applications.

1.3 RFID Tags

RFID tags come in three general varieties:- passive, active, or semi-passive (also known as battery-assisted or semi-active) and beacon types. Passive tags require no internal power source, thus being pure passive devices (they are only active when a reader is nearby to power them by wireless illumination), whereas semi-passive and active tags require a power source, usually a small battery. Beacon tags transmit autonomously with a certain blink pattern and do not respond to interrogation. To communicate, tags respond to queries generating signals that must not create interference with the readers, as arriving signals can be very weak and must be differentiated. Besides backscattering, load modulation techniques can be used to manipulate the reader's field. Typically, backscatter is used in the far field, whereas load modulation applies in the near field, within a few wavelengths from the reader.

1.3.1 Passive RFID

Passive RFID tags have no internal power supply. The minute electrical current induced in the antenna by the incoming radio frequency signal provides just enough power for the CMOS integrated circuit in the tag to power up and transmit a response. Most passive tags signal by backscattering the carrier wave from the reader. This means that the antenna has to be designed both to collect power from the incoming signal and also to transmit the outbound backscatter signal. The response of a passive RFID tag is not necessarily just an ID number; the tag chip can contain non-volatile data, possibly writable EEPROM for storing data.

Passive tags have practical read distances ranging from about 11 cm (4 in) with near-field (ISO 14443), up to approximately 10 meters (33 feet) with far-field (ISO 18000-6) and can reach up to 183 meters (600 feet) when combined with a phased array. Basically, the reading and writing depend on the chosen radio frequency and the antenna design/size. Due to their simplicity in design they are also suitable for manufacture with a printing process for the antennas. The lack of an onboard power supply means that the device can be quite small: commercially available products exist that can be embedded in a sticker, or under the skin in the case of low frequency (Low FID) RFID tags.

In 2007, the Danish Company RFID sec developed a passive RFID with privacy enhancing technologies built-in including built-in firewall access controls, communication encryption and a silent mode ensuring that the consumer at point of sales can get exclusive control of the key to control the RFID. The RFID will not respond unless the consumer authorizes it, the consumer can validate presence of a specific RFID without leaking identifiers and therefore the consumer can make use of the RFID without being traceable or otherwise leak information that represents a threat to consumer privacy. IN 2006, Hitachi, Ltd. developed a passive device called the μ-Chip measuring 0.15×0.15 mm (not including the antenna), and thinner than a sheet of paper (7.5 micrometers).

Silicon on Insulator (Sol) technology is used to achieve this level of integration. The Hitachi μ-Chip can wirelessly transmit a 128-bit unique ID number which is hard-coded into the chip as part of the manufacturing process. The unique ID in the chip cannot be altered, providing a high level of authenticity to the chip and ultimately to the items the chip may be permanently attached or embedded into. The Hitachi μ-Chip has a typical maximum read range of 30 cm (1 ft). In February 2007 Hitachi unveiled an even smaller RFID device measuring 0.05×0.05 mm, and thin enough to be embedded in a sheet of paper. The new chips can store as much data as the older μ-chips, and the data contained on them can be extracted from as far away as a few hundred meters. The ongoing problems with all RFIDs are that they need an external antenna which is 80 times bigger than the chip in the best version thus far developed. Further, the present costs of manufacturing the inlays for tags have inhibited broader adoption. As silicon prices are reduced and new more economic methods for manufacturing inlays and tags are perfected in the industry, broader adoption and item level tagging along with economies of scale production scenarios; it is expected to make RFID both innocuous and commonplace much like barcodes are presently.

Alien Technology's Fluidic Self Assembly and HiSam machines, Smart code's Flexible Area Synchronized Transfer (FAST) and Symbol Technologies' PICA process are alleged to potentially further reduce tag costs by massively parallel production. Alien Technology and Smart Code are currently using the processes to manufacture tags while Symbol Technologies' PICA process is still in the development phase. Symbol was acquired by Motorola in 2006. Motorola however has since made agreements with Avery Dennison for supply of tags, meaning their own tag production and PICA process may have been abandoned.[9] Alternative methods of production such as FAST, FSA, HiSam and possibly PICA could potentially reduce tag costs dramatically, and due to volume capacities achievable, in turn be able to also drive the economies of scale models for various silicon fabricators as well. Some passive RFID vendors believe that industry benchmarks for tag costs can be achieved eventually as new low-cost volume production systems are implemented more broadly. On-silicon tags made from polymer semiconductors are currently being developed by several companies globally. Simple laboratory-printed polymer tags operating at 13.56 MHz were demonstrated in 2005 by both PolyIC (Germany) and Philips (The Netherlands). If successfully commercialized, polymer tags will be roll-printable, like a magazine, and much less expensive than silicon-based tags. The end game for most item-level tagging over the next few decades may be that RFID tags will be wholly printed – the same way that a barcode is today and be virtually free, like a barcode. However, substantial technical and economic hurdles must be surmounted to accomplish such an end: hundreds of billions of dollars have been invested over the last three decades in silicon processing, resulting in a per feature cost which is actually less than that of conventional printing.

1.3.2 Active RFID

Unlike passive RFID tags, active RFID tags have their own internal power source, which is used to power the integrated circuits and to broadcast the response signal to the reader. Communications from active tags to readers is typically much more reliable (i.e. fewer errors) than those from passive tags due to the ability for active tags to conduct a "session" with a reader.

Active tags, due to their onboard power supply, also may transmit at higher power levels than passive tags, allowing them to be more robust in "RF challenged" environments with humidity and spray or with RF-dampening targets (including humans and cattle, which contain mostly water), reflective targets from metal (shipping containers, vehicles), or at longer distances. In turn, active tags can be larger (due to battery size) and more expensive to

manufacture (due to price of the battery). However, the potential shelf life of an active tag can be many years. Many active tags today have operational ranges of hundreds of meters, and a battery life from several months to 10 years. Active tags may include larger memories than passive tags, and may include the ability to store additional information received from the reader.

Special active RFID tags may include specialized sensors. For example, a temperature sensor can be used to record the temperature profile during the transportation and storage of perishable goods. Other sensor types used include humidity, shock/vibration, light, nuclear radiation, pressure and concentrations of gases such as ethylene. Increasingly, active tags on the market today are internationally standardized according to the ISO 18000-7 air interface standard, which operates at the 433 MHz frequency. In addition, active tags that are sold in the form of an electronic seal are standardized according to the ISO 18185 standard. The United States Department of Defense (DoD) has successfully used active tags to reduce search and loss in logistics and to improve supply chain visibility for more than 15 years (concept of in-transit-visibility, ITV). The DoD is increasingly relying on active tags to monitor the environmental status of assets and material using onboard sensors.

CHAPTER 2

LITERATURE REVIEW

2.1 Multitasking Shopping Trolley Based On RFID Technology

Satish Kamble et al., 2014, In RFID (radiofrequency identification) technology offers the ability to provide many new services and conveniences in the retail environment. An innovative product with societal acceptance is the one that aids the comfort, convenience and efficiency in everyday life. Purchasing and shopping at big malls is becoming daily activity in various cities. We can see big rush at these malls on holidays and weekends. People purchase different items and put them in trolley. After completion of purchases, one needs to go to billing counter for payments. At billing counter the cashier prepare the bill using bar code reader which is very time consuming process and results in long queue at billing counter. In this paper, we discuss a product "Developing a Multitasking Shopping Trolley Based On RFID Technology" being developed to assist a person in everyday shopping in terms of reduced time spent while purchasing. The main objective of proposed system is to provide a technology oriented, low-cost, easily scalable, and rugged system for assisting shopping in person. The developed system consists of 3 key components/modules (a) Server Communication component (SCC) (b) User Interface and display component (UIDC), and (c) Automatic billing component (ABC). SCC establishes and maintains the connection of the shopping cart with the main server. UIDC provides the user interface and ABC handles the billing in association with the SCC. These 3 modules are integrated into an embedded system and are tested to satisfy the functionality. Smart shopping carts with electronic displays, in communication with a computer system, can display an overall description with cost details associated with a Shopping list Databases. Smart cart, also equipped with RFID tags, can also verify the Purchase of the items as they are placed in the cart and, if desired, communicate with a billing system to automatically bill the shopper for the purchases .

The intended objectives were successfully achieved in the prototype model developed. The developed product is easy to use, low-cost and does not need any special training. This project report reviews and exploits the existing developments and Different types of radio frequency identification technologies which are used for product identification, billing,

etc. We have also learned the architecture of the system that can be used in the shopping systems for intelligent and easy shopping in the malls to save time, energy and money of the consumers. Present trends point towards the fast growth of RFID in the next decade. With around 600 million RFID tags sold in the year 2005 alone, value of market including systems, services and hardware is likely to grow by factor of 10 between years 2006 -2016. It is expected that total number of RFID tags delivered in the year 2016 will be around 450 times as compared to the ones delivered in the year 2006.

This project reviews and exploits the existing developments and Different types of radio frequency identification technologies which are used for product identification, billing, etc. Thus the survey paper studies and evaluates research insight in Radio Frequency Identification systems from a big picture first. We have studied in detail about the business model, technological model and all related work and applications in the domain of RFID based systems that make ease of identification. We have also learned the architecture of the system that can be used in the shopping systems for intelligent and easy shopping in the malls to save time, energy and money of the consumers. Thus RFID has a wide scope in the supply chain management. In the future, if all studies are favorable, we will advance with the implementation of a prototype for proposed architecture for testing in a real hypermarket scenario because RFID is a technology that has the potential to improve our lives to a very great extent.

The RFID technology will be considered not just simple accomplishment of some research, but an efficient solution for companies, which will determine visibility on developing the business processes in a correct manner and of complete transparency. The intelligent shopping system can significantly change the manner in which shopping is performed, thus easing the life of buyers, always confronting with time. The retail supermarkets of the future will present significantly less checking queues, with a view to develop the own services and those of the staff, within steps of efficient performing of activities specific to shopping. An RFID implementation that assumes for the time being large expenses will become approachable in the future. In many applications, the great cost of RFID technology will be balanced out by the achievement of the best solution and results of problems.

2.2 Waiting time influence on the satisfaction-loyalty relationship

Fre´de´ric Bielen et al., 2007, Identified many service companies worry about the length of their queues because customer waiting time is considered as having a negative influence on consumer service perception. Time is valued by both partners. On the one hand, service companies may lose transactions if waiting time is too long; and on the other, consumers consider waiting time as a sacrifice to get the service. It is one of the reasons that more and more

service customer-oriented company's position their offer on time advantage for consumers. Lovelock and Gummesson (2004) insist on the central role played by time in most services and recommend paying more attention to improving the understanding of how customers perceive, budget, consume and value time. Several research studies focus on the relationship between waiting time and satisfaction (Hui and Tse, 1996; Pruyn and Smidts, 1998). Many other studies. Very few studies focus on the influence of waiting time satisfaction on loyalty and that is confined to the fast food industry (Law et al., 2004). To the best of our knowledge, no study has yet evaluated the influence of waiting time or waiting time satisfaction on the satisfaction-loyalty relationship. The objective of this research is threefold. We look into the determinants of waiting time satisfaction and examine the mediating role of the latter variable between these determinants and the service satisfaction. We also investigate the influence of customer waiting time satisfaction on the existing relationship between customer satisfaction and loyalty. A major contribution to this research is the consideration of waiting time satisfaction as a factor that, in addition to being a determinant of customer satisfaction, may also moderate the satisfaction-loyalty relationship. Stockman predicted that "considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and before the field of useful applications is explored."

Managers should be aware of the importance of waiting time satisfaction. The latter not only influences the service satisfaction but also plays a moderating role on the service satisfaction-loyalty relationship. Therefore, service providers expecting to establish customer loyalty must enhance the waiting time satisfaction in addition to service satisfaction. To improve the former, service providers may work on customer satisfaction with the information provided in case of delays and with the waiting environment in addition to decreasing the perceived waiting time.The waiting environment influences not only waiting time satisfaction, but also the overall evaluation of the service. Unfortunately, many waiting areas are both inappropriate and uncomfortable places in which to wait. Managers need to distinguish between waiting areas and other places that customers use in the service process; they need to pay more attention to the design, layout and fittings in designated waiting areas. Satisfaction with the information provided in the case of delays influence waiting time satisfaction more than waiting environment satisfaction. Therefore, investment in improving services might be better spent on information and communication rather than on physical facilities. For instance in airports, it might be valuable for travelers to know how long they will have to wait before picking up their luggage by looking at information boards that indicate waiting time. Developing waiting time guarantees can

also be considered as a means of informing customers of their expected waiting time. Such guarantees can increase customer satisfaction or decrease the likelihood of premature termination of waiting experiences by customers (Kumar et al., 1997). Our results suggest that if companies have difficulties in reducing their customer waiting time, they could manage the other elements that make waiting time more pleasant. The waiting time evaluation is associated with environmental variables which minimize subjective waste of time. These obviously include distractions such as television and newspapers; and information such as documentation about services. Such distractions while waiting intend to minimize this subjective waste of time and make the wait more enjoyable (Katz et al., 1991). Not enough research has been devoted to other time valorization devices in service situations such as learning or entertainment. For instance, we suggested converting a standard waiting room, which accommodated outpatients after a radiological examination before being taken back to their rooms into a "Rest room". This modification has transformed customers' perceptions of time while they were waiting for staff to take them back to their room. Furthermore, this question of time valorization has to be considered in a different way according to the specific characteristics of the customers. Time valorization strategies should be conditioned by the customers' activity, their enthusiasm and motivation, their time sensitivity and socio-cultural variables as much as emotional variables such as anxiety level with the service or their impatience of benefiting from it.

2.3 RFID Based Automatic Shopping Cart

Ankit Anil Agarwal et al., 2011, Large grocery stores are nowadays used by millions of people for the acquisition of an enlarging number of products. Product acquisition represents a complex process that comprises time spent in corridors, product location and checkout queues. On the other hand, it is becoming increasingly difficult for retailers to keep their clients loyal and to predict their needs due to the influence of competition and the lack of tools that discriminate consumption patterns. In this article it is presented the proposal of an architecture and solution of an innovative system for the acquisition of products in grocery stores (Intelligent Cart). The Intelligent Cart explores emerging mobile technologies and automatic identification technologies (such as RFID) as a way to improve the quality of services provided by retailers and to augment the consumer value thus allowing to save time and money. Consumer perceptions of privacy, security and trust in ubiquitous commerce" mentioned that the proliferation of electronic commerce technologies has utterly transformed the way business is conducted. Causes range from the introduction of new mobile technologies and ubiquitous computing, to the recognition by business of the strategic benefits offered by the implementation of communication and ubiquitous computing structures, to the emergence of new business

models made possible due to the new technologies and to the development of new economies that can be used to understand and value the ubiquitous commerce activity. The challenges and opportunities created by electronic business in the supply chain have caused the sharing of information between business partners to improve operational performance, consumer service and solution development. Businesses have evolved from the sharing and coordination of information to the sharing of knowledge and advanced cooperation practices.

This paper reviews and exploits the existing developments and Different types of radio frequency identification technologies which are used for product identification, billing, etc. Thus the survey paper studies and evaluates research insight in Radio Frequency Identification systems from a big picture first. We have studied in detail Control Theory and Informatics about the business model, technological model and all related work and applications in the domain of RFID based systems that make ease of identification. We have also learned the architecture of the system that can be used in the shopping systems for intelligent and easy shopping in the malls to save time, energy and money of the consumers. Thus RFID has a wide scope in the supply chain management. In the future, if all studies are favourable, we will advance with the implementation of a prototype for proposed architecture for testing in a real hypermarket scenario because RFID is a technology that has the potential to improve our lives to a very great extent.

CHAPTER 3

METHODOLOGY

3.1 Block Diagram

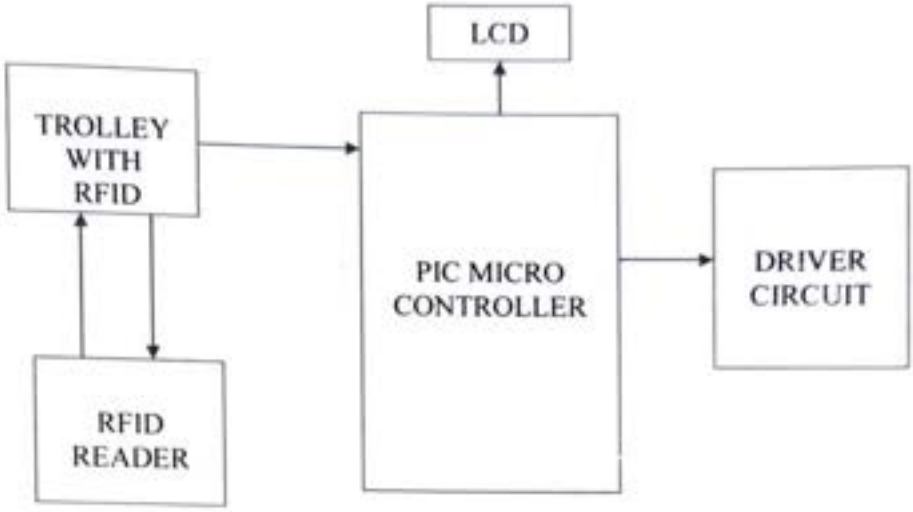

Figure 3.1 Block Diagram

3.2 Circuit Diagram

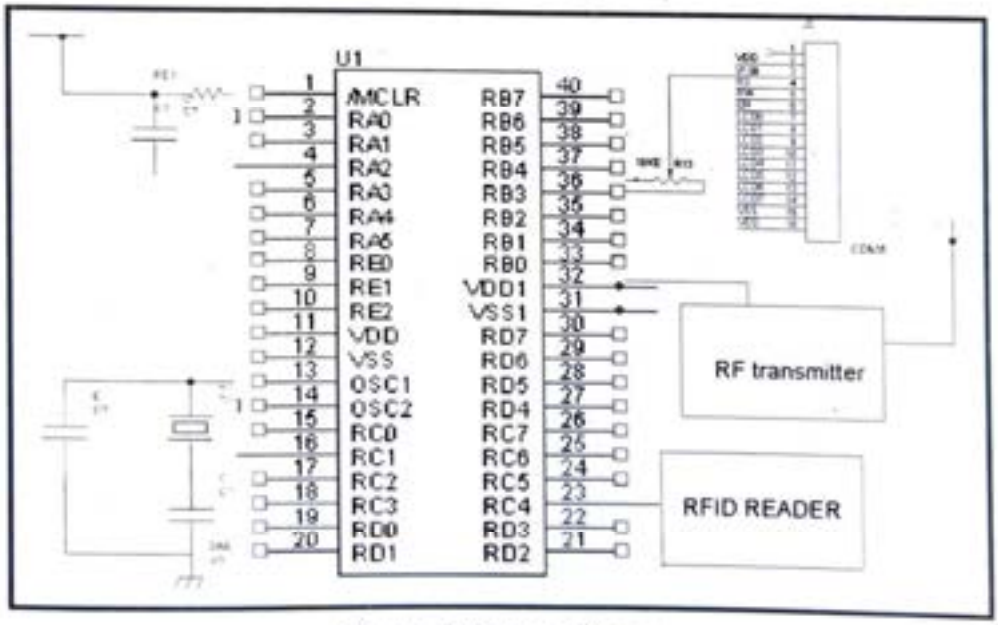

Figure 3.2 Circuit Diagram

3.3 Concepts of Microcontroller

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer.

A microcontroller combines on to the same microchip:

1. CPU core
2. Memory(both ROM and RAM)
3. Some parallel digital I/O

Microcontrollers combined with other devices such as:

1. A timer module to allow the microcontroller to perform tasks for certain time periods.
2. A serial I/O port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.
3. An ADC to allow the microcontroller to accept analogue input data for processing.

Microcontrollers are:

1. Smaller in size
2. Consumes less power
3. Inexpensive

Micro controller is a standalone unit, which can perform functions on its own without any requirement for additional hardware like I/O ports and external memory.

The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on an 8-bit microprocessor unit. For example Motorola uses a basic 6800 microprocessor core in their 6805/6808 microcontroller devices. In the recent years, microcontrollers have been developed around specifically designed CPU cores, for example the microchip PIC range of microcontrollers and Arduino chips are being used to make embedded systems without any complex conditions.

3.4 Introduction to Arduino

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

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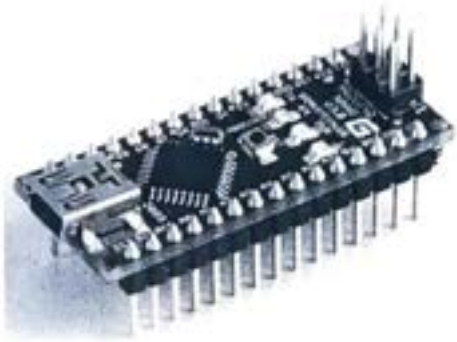

Figure 3.3 Arduino Nano

The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source. The FTDI FT232RL chip on the Nano is only powered if the board is being powered over USB. As a result, when running on external (non-USB) power, the 3.3V output (which is supplied by the FTDI chip) is not available and the RX and TX LEDs will flicker if digital pins 0 or 1 are high. The ATmega168 has 16 KB of flash memory for storing code (of which 2 KB is used for the boot loader); the ATmega328 has 32 KB, (also with 2 KB used for the boot loader).

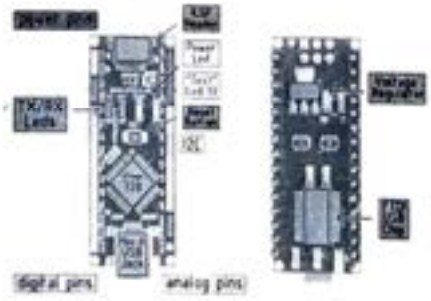

Figure 3.4 Arduino Pins

The ATmega168 has 1 KB of SRAM and 512 bytes of EEPROM (which can be read and written with the EEPROM library); the ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

Specialized functions:

• Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.

- External Interrupts: 2 and 3.These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11.Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).

  These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED 13: There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

3.4.1 Memory Organisation

There are three memory blocks in each of the PIC16f877 MUCs. The program memory and Data Memory have separate buses so that concurrent access can occur.

3.4.2 Program Memory Organization

The PIC16f877 devices have a 13-bit program counter capable of addressing . 8K x 14 words of FLASH program memory.

Accessing a location above the physically implemented address will cause a wraparound. The RESET vector is at 0000h and the interrupt vector is at 0004h.

3.4.3 Data Memory Organization

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions Registers.

Bits RP1 (STATUS<6) and RP0 (STATYUS<5>) are the bank selected bits. Each bank extends up to 7Fh (1238 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM.

All implemented banks contain special function registers. Some frequently used special function registers from one banks may be mirrored in another bank for code reduction and quicker access.

Table 3.1 Memory Allocation

RP1: RP0	Banks
00	0
01	1
10	2
11	3

3.4.4 General Purpose Register File

The register file can be accessed either directly or indirectly through the File Selected Register (FSR).

3.4.5 Instruction Set Summary

Each Arduino instruction is a 14-bit word, divided into an OPCODE which specifies the instruction type and one or more operand which further specify the operation of the instruction.

For byte-oriented instructions, 'f' represents a file register designator and 'd' represents a destination designator. The file register designator specifies which file register is to be used by the instruction. The destination designator specified where the result of the operation is to be placed. If 'd' is zero, the result is placed in the w register. If 'd' is one, the result is placed in the file register specified in the instruction.

For bit-oriented instructions, 'b' represents a bit field designator which selects the number of the bit affected by the operation, which 'f' represents the address of the file in which the bits is located.

For literal and control operations, 'k' represents an eight or eleven bit constant or literal value.

3.4.6 Opcode Field Descriptions

The instruction set is highly orthogonal and is grouped into three basic categories:

- **Byte-oriented** operations
- **Bit-oriented** operations
- **Literal and control** operations

- All instructions are executed within one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction.

- In this case, the execution takes two instruction cycles with the second cycle executed as a +NOP.
- One instruction cycle consists of four oscillator periods.
- Thus, for an oscillator frequency of 4 MHz, the normal instruction execution time is 1 milliseconds.

Field	Description
f	Register file address (0x00 to 0x7F)
W	Working register (accumulator)
b	Bit address within an 8-bit file register
k	Literal field, constant data or label
x	Don't care location (= 0 or 1) The assembler will generate code with x = 0. It is the recommended form of use for compatibility with all Microchip software tools.
d	Destination select; d = 0: store result in W, d = 1: store result in file register f. Default is d = 1
PC	Program Counter
$\overline{TO}$	Time-out bit
$\overline{PD}$	Power-down bit

Figure 3.5 **OPCode Field Description**

- If a conditional test is true or the program counter is changed as a result of an instruction, the instruction execution time is 2 milliseconds.

3.4.7 General Format for Instructions

Figure 3.6 **General Format for Instruction**

3.5 ULTRASONIC SENSOR

Arduino Ultrasonic Range Detection Sensor with Arduino in order to calculate distances from objects. In this case I'm also altering the output of an LED with PWM according to how close an object is to the sensor. So the nearer you are the brighter the LED. So if we start with the Arduino Ultrasonic Range Detection Sensor, it's an IC that works by sending an ultrasound pulse at around 40 KHz with a good ranging frequency. It then waits and listens for the pulse to echo back, calculating the time taken in microseconds (1 microsecond = 1.0 × 10-6 seconds). You can trigger a pulse as fast as 20 times a second and it can determine objects up to 3 meters away and as near as 3cm. It needs a 5V power supply to run. Adding the Arduino Ultrasonic Range Detection Sensor to the Arduino is very easy, only 4 pin to worry about. Power, ground, trigger and echo. Since it needs 5V and Arduino provides 5V I'm obviously going to use this to power it. Below is a diagram of my Arduino Ultrasonic Range Detection Sensor, showing the pins.

Figure 3.7 Ultrasonic Sensor

An ultrasonic transducer is a device used to convert some other type of energy into an ultrasonic vibration. There are several basic types, classified by the energy source and by the medium into which the waves are being generated.

Mechanical devices include gas-driven, or pneumatic, transducers such as whistles as well as liquid-driven transducers such as hydrodynamic oscillators and vibrating blades. These devices, limited to low ultrasonic frequencies, have a number of industrial applications, including drying, ultrasonic cleaning, and injection of fuel oil into burners. Electromechanical transducers are far more versatile and include piezoelectric and magnetostrictive devices.

A Magnetostrictive transducer makes use of a type of magnetic material in which an applied oscillating magnetic field squeezes the atoms of the material together, creating a periodic change in the length of the material and thus producing a high-frequency mechanical vibration. Magnetostrictive transducers are used primarily in the lower frequency ranges and are common in ultrasonic cleaners and ultrasonic machining applications.

3.6 RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.

The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

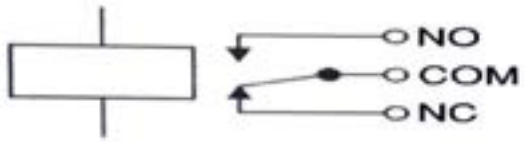

Figure 3.8 Relay

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30Ma for a 12V relay, but it can be as much as 100 Ma for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200 Ma so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further information about switch contacts and the terms used to describe them please see the page on switches. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and IC's in the circuit. To prevent damage you must connect a protection diode across the relay coil.

The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.

The relay's switch connections are usually labeled COM, NC and NO:

COM - Common, always connect to this; it is the moving part of the switch.

NC - Normally Closed, COM is connected to this when the relay coil is off.

NO - Normally Open, COM is connected to this when the relay coil is on.

Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.

Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

3.6.1 Consideration of Choosing Relay

You need to consider several features when choosing a relay:

1. **Physical size and pin arrangement**

   If you are choosing a relay for an existing PCB you will need to ensure that its dimensions and pin arrangement are suitable. You should find this information in the supplier's catalogue.

2. **Coil voltage**

   The relay's coil voltage rating and resistance must suit the circuit powering the relay coil. Many relays have a coil rated for a 12V supply but 5V and 24V relays are also readily available. Some relays operate perfectly well with a supply voltage which is a little lower than their rated value.

3. **Coil**

   The circuit must be able to supply the current required by the relay coil. You can use Ohm's law to calculate the current:

$$\text{Relay coil current} = \frac{\text{supply voltage}}{\text{coil resistance}}$$

For example: A 12V supply relay with a coil resistance of 400 passes a current of 30mA. This is OK for a 555 timer IC (maximum output current 200mA), but it is too much for most ICs and they will require a transistor to amplify the current.

4. **Switch ratings (voltage and current)**

   The relay's switch contacts must be suitable for the circuit they are to control. You will need to check the voltage and current ratings. Note that the voltage rating is usually higher for AC, for example: "5A at 24V DC or 125VAC".

5. **Switch contact arrangement** (SPDT, DPDT etc.)

   Most relays are SPDT or DPDT which are often described as "single pole changeover" (SPCO) or "double pole changeover" (DPCO). For further information please see the page on switches.

3.6.2 Protection Diodes for Relays

Transistors and ICs (chips) must be protected from the brief high voltage 'spike' produced when the relay coil is switched off. The diagram shows how a signal diode (eg: 1N4148) is connected across the relay coil to provide this protection. Note that the diode is connected 'backwards' so that it will normally not conduct. Conduction only occurs when the relay coil is switched off, at this moment current tries to continue flowing through the coil and it is harmlessly diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing.

3.6.3 Advantages of Relays

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch high voltages, transistors cannot.
- Relays are a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once.

3.6.4 Disadvantages of Relays

Relays are bulkier than transistors for switching small currents.

3.7 LCD Display

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizers are pasted outside the two glass panels. These polarizers would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating / highlighting the desired characters. The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCD does don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications. LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for

consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

LCDs were a big leap in terms of the technology they replaced, which include light-emitting diode (LED) and gas-plasma displays. LCDs allowed displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. Where an LED emits light, the liquid crystals in an LCD produces an image using a backlight.

As LCDs have replaced older display technologies, LCDs have begun being replaced by new display technologies such as OLEDs.

Working of LCD

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example, a 4K display is made up of 3840 x 2160 or 4096x2160 pixels. A pixel is made up of three subpixels; a red, blue and green commonly called RGB. When the subpixels in a pixel change color combinations, a different color can be produced. With all the pixels on a display working together, the display can make millions of different colors. When the pixels are rapidly switched on and off, a picture is created.

The way a pixel is controlled is different in each type of display; CRT, LED, LCD and newer types of displays all control pixels differently. In short, LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90 degrees. In between both filters are the liquid crystals, which can be electronically switched on and off.

LCDs are made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a Thin Film Transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.

Some passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same time that it took for one scan in the original technology. However, active matrix is still a superior technology out of the two.

Types of LCD

Twisted Nematic (TN): which are inexpensive while having high response times. However, TN displays have low contrast ratios, viewing angles and color contrasts.

In Panel Switching displays (IPS Panels): which boast much better contrast ratios, viewing angles and color contrast when compared to TN LCDs.

Vertical Alignment Panels (VA Panels): which are seen as a medium quality between TN and IPS display.

Advanced Fringe Field Switching (AFFS): which is a top performer compared IPS displays in color reproduction range.

3.8 RCM2034R

The RCM2034R is a reflective TN type liquid crystal module with a built-in controller / driver LSI and a display capacity of 16 characters 1 line.

Applications:

Personal computers, word processors, facsimiles, telephones, etc.

Features:

1) Wide viewing angle and high contrast.
2) 5 x 7 dot character matrix with cursor.
3) Interfaces with 4-bit or 8-bit MPUs.
4) Displays up to 226 characters and special symbols.
5) Custom character patterns are displayed with the character RAM.
6) Abundant instruction set including clear display, cursor on /off, and character blinking.
7) Compact and light weight for easy assembly to the host instrument.
8) Operable on single 5 V power supply.
9) Low power consumption.

3.9 Oscillator

The majority of clock sources for microcontrollers can be grouped into two types: those based on mechanical resonant devices, such as crystals and ceramic resonators, and those based on electrical phase-shift circuits such as RC (resistor, capacitor) oscillators. Silicon oscillators are typically a fully integrated version of the RC oscillator with the added benefits of current sources, matched resistors and capacitors, and temperature-compensation circuits for

increased stability. Two examples of clock sources are illustrated. Pierce oscillator configuration suitable for use with mechanical resonant devices like crystals and ceramic resonators, while the other shows a simple RC feedback oscillator. Primary Differences between Mechanical Resonators and RC Oscillators Crystal and ceramic resonator-based oscillators (mechanical) typically provide very high initial accuracy and a moderately low temperature coefficient. RC oscillators, in contrast, provide fast startup and low cost, but generally suffer from poor accuracy over temperature and supply voltage, and show variations from 5% to 50% of nominal output frequency. While the circuits illustrated can produce clean reliable clock signals, their performance will be heavily influenced by environmental conditions, circuit component choice, and the layout of the oscillator circuit.

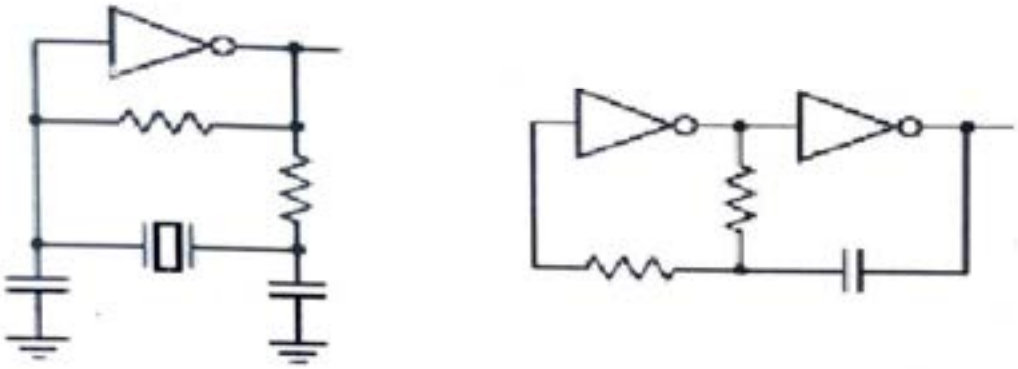

Figure 3.9 Oscillators

Ceramic resonators and their associated load capacitance values must be optimized for operation with particular logic families.

Crystals, with their higher Q, are not as sensitive to amplifier selection but are susceptible to frequency shifts (and even damage) when overdriven.

Environmental factors like electromagnetic interference (EMI), mechanical vibration and shock, humidity, and temperature affect oscillator operation.

These environmental factors can cause output frequency changes, increased jitter, and in severe cases, can cause the oscillator to stop functioning.

3.9.1 Oscillator Modules

Many of the considerations described above can be avoided through use of oscillator modules. These modules contain all oscillator circuit components and provide clock signal as a low-impedance square-wave output. Operation is guaranteed over a range of conditions. Crystal oscillator modules and fully integrated silicon oscillators are most common.

Crystal oscillator modules provide accuracy similar to discrete component circuits using crystals. Silicon oscillators are more precise than discrete component RC oscillator circuits, and many provide comparable accuracy to ceramic resonator-based oscillators.

3.10 Power Consumption

Power consumption is another important consideration of oscillator selection. The power consumption of discrete component crystal-oscillator circuits is primarily determined by the feedback-amplifier supply current and by the in-circuit capacitance values used. The power consumption of amplifiers fabricated in CMOS is largely proportional to the operating frequency and can be expressed as a power-dissipation capacitance value. The power-dissipation capacitance value of an HC04 inverter gate used as an inverting amplifier, for example, is typically 90 pF. For operation at 4MHz from a 5V supply, this equates to a supply current of 1.8 mA. The discrete component crystal oscillator circuit will typically include an additional load capacitance value of 20pF, and the total supply current becomes 2.2 mA. Ceramic resonator circuits typically specify larger load capacitance values than crystal circuits, and draw still more current than the crystal circuit using the same amplifier. By comparison, crystal oscillator modules typically draw between 10 mA and 60 mA of supply current because of the temperature compensation and control functions included. The supply current for silicon oscillators depends on type and function, and can range from a few micro-amps for low frequency (fixed) devices to tens of mille-amps for programmable-frequency parts. A low-power silicon oscillator, such as the MAX7375, draws less than 2mA when operating at 4MHz.Summary the optimal clock source for a particular microcontroller application is determined by a combination of factors including accuracy, cost, power consumption, and environmental requirements. The following table summarizes the common oscillator circuit types discussed here, together with their strengths and weaknesses. LCD is Stands for liquid crystal display. It is used to display the data's which is came from PIC. It contains the 16 pin. 8 pin is used for data communication, read, write, enable, Brightness control and 4 pins for power supply.

FIGURE 3.10 Power Consumption

3.11 Potential Transformer

Potential Transformer is designed for monitoring single-phase and three-phase power line voltages in power metering applications. The primary terminals can be connected either in line-to-line or in line-to-neutral configuration. Fused transformer models are designated by a suffix of "F" for one fuse or "FF" for two fuses. A Potential Transformer is a special type of transformer that allows meters to take readings from electrical service connections with higher voltage (potential) than the meter is normally capable of handling without at potential transformer.

3.11.1 Power Supplies

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an AC voltage, a steady DC voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage.

The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit is shown .

The ac voltage, typically 120 V RMS, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output.

A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes.

This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

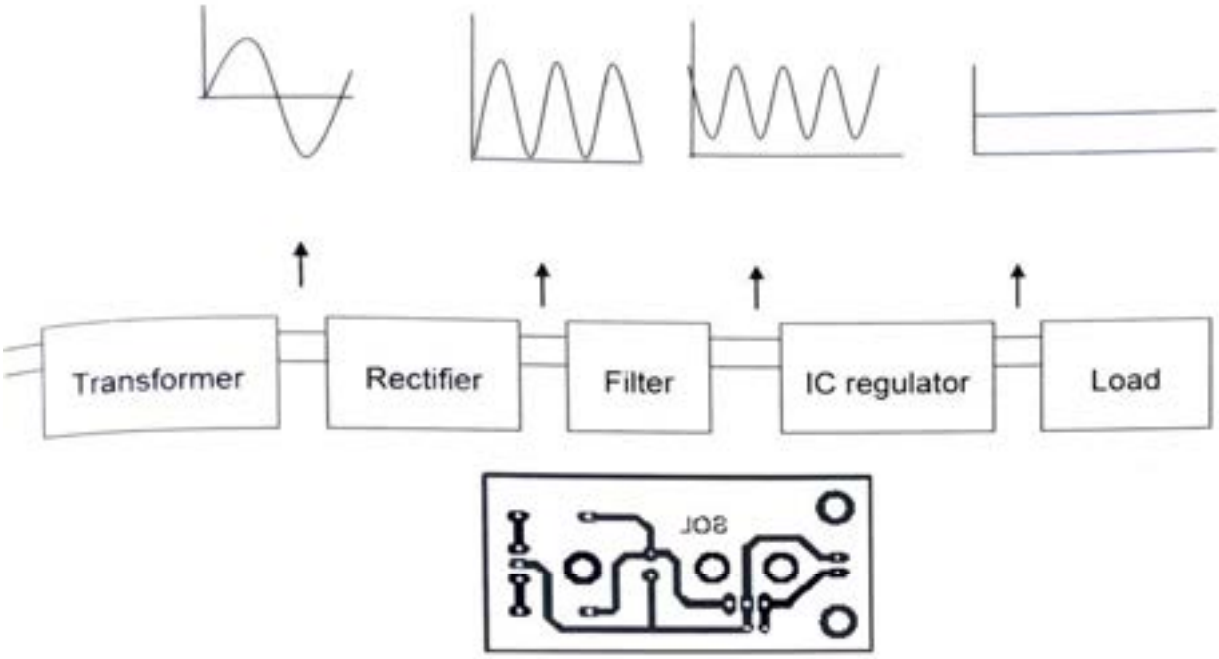

Figure 3.11 Power Supplies

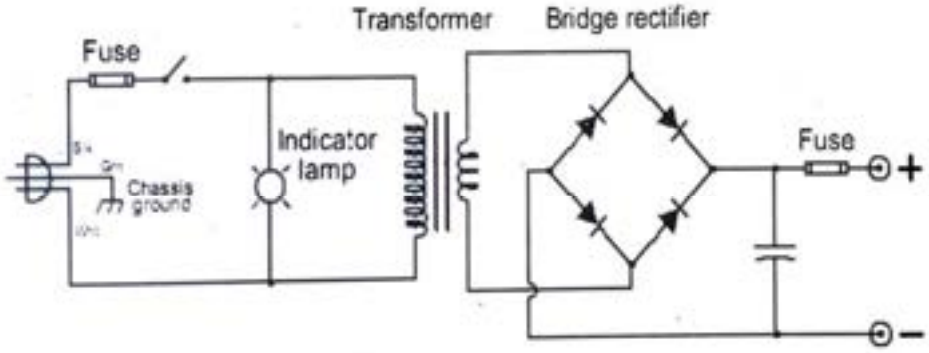

Figure 3.12 Circuit Diagram

3.11.2 IC Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage.

A power supply can be built using a transformer connected to the ac supply line to step the ac voltage to desired amplitude, then rectifying that ac voltage, filtering with a capacitor and RC filter, if desired, and finally regulating the dc voltage using an IC regulator. The regulators can be selected for operation with load currents from hundreds of milliamps' to tens of amperes, corresponding to power ratings from milliwatts to tens of watts. A simple voltage/current regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine. Since the forward voltage of a diode is small, this kind of voltage regulator is only suitable for low voltage regulated output. When higher voltage output is needed, a zener diode or series of zener diodes may be employed. Zener diode regulators make use of the zener diode's fixed reverse voltage, which can be quite large.

Feedback voltage regulators operate by comparing the actual output voltage to some fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability. (Stability is avoidance of oscillation, or ringing, during step changes.) There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point. to produce a higher output voltage–by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection, so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range f the mechanical regulator design is sensitive to small voltage fluctuations, the motion of the solenoid core can be used to move a selector switch across a range of resistances or transformer windings to gradually step the output voltage up or down, or to rotate the position of a moving-coil AC regulator.

Early automobile generators and alternators had a mechanical voltage regulator using one, two, or three relays and various resistors to stabilize the generator's output at slightly more than 6 or 12 V, independent of the engine's rpm or the varying load on the vehicle's electrical system. Essentially, the relay(s) employed pulse width modulation to regulate the

output of the generator, controlling the field current reaching the generator (or alternator) and in this way controlling the output voltage producing back into the generator and attempting to run it as a motor. The rectifier diodes in an alternator automatically perform this function so that a specific relay is not required; this appreciably simplified the regulator design.More modern designs now use solid state technology (transistors) to perform the same function that the relays perform in electromechanical regulators.

3.11.3 Three-Terminal Voltage Regulators

The basic connection of a three-terminal voltage regulates IC to a load. The fixed voltage regulator has an unregulated dc input voltage, VI, applied to one input terminal, a regulated output dc voltage, VO, from a second terminal, with the third terminal connected to ground. For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current. The specifications also list the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

3.11.4 Fixed Positive Voltage Regulators

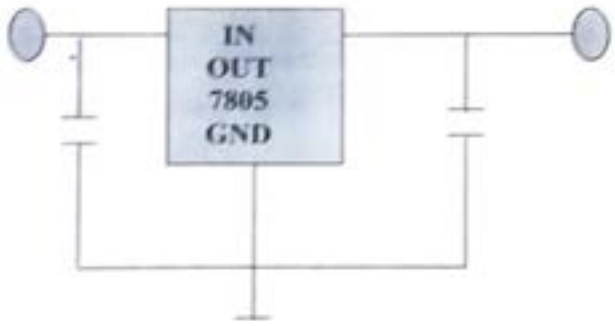

Figure 3.13 Voltage Regulators (fixed)

1. LCD

LCD Stands for liquid crystal display. It is used to display the data's which is came from PIC. It contains the 16 pin. 8 pin is used for data communication, read, write, enable, Brightness control and 4 pins for power supply.

2. Power Supply

Power supply is used to give the 5V to the controller. 5V can be received from IC voltage regulator. Inside the power supply rectifier, filter is present.

3. RFID Reader

RFID reader is used to read the data's present in the RFID tag. RFID readers or receivers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency (RF) communication. Many also include an interface that communicates with an application. Readers can be hand-held or mounted in strategic locations so as to ensure they are able to read the tags as the tags pass through an "interrogation zone."

4. PIC

PIC is used to receive the signal which is come from RFID receiver. For the LCD display the data's can be sent through PIC.

5. RF Transmitter

RF transmitter is used to transmit the signal from the RFID receiver. Inside the transmitter the encoder is present. Data's can be sent after the encoding. At the receiver section the DECODING process takes place for getting the original signal.

Advantage:

- Low power consumption dvantage
- We can access vary easily.
- Improves security performance in the security places because we cannot make the duplicate RFID card.

Application:

We can use RFID based security system in highly secured areas such as

1. RFID based Bank security system.
2. RFID based door opening and closing
3. RFID based production security system

3.12 Microsoft Visual Studio

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as

Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a code profiler, forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level including adding support for source control systems (like Subversion and Git) and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle (like the Azure DevOps client: Team Explorer).

Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#.[8] JavaScript, TypeScript, XML, XSLT, HTML, and CSS. Support for other languages such as Python.[9] Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past. Visual Studio includes a debugger that works both as a source-level debugger and as a machine-level debugger. It works with both managed code as well as native code and can be used for debugging applications written in any language supported by Visual Studio. In addition, it can also attach to running processes, monitor, and debug those processes. If source code for the running process is available, it displays the code as it is being run. If source code is not available, it can show the disassembly. The Visual Studio debugger can also create memory dumps as well as load them later for debugging. Multi-threaded programs are also supported. The debugger can be configured to be launched when an application running outside the Visual Studio environment crashes.

The debugger allows setting breakpoints (which allow execution to be stopped temporarily at a certain position) and watches (which monitor the values of variables as the execution progresses). Breakpoints can be conditional, meaning they get triggered when the condition is met. Code can be stepped over, i.e., run one line (of source code) at a time.[30] It can either step into functions to debug inside it, or step over it, i.e., the execution of the function body isn't available for manual inspection. The debugger supports Edit and Continue, i.e., it allows code to be edited as it is being debugged. When debugging, if the mouse pointer hovers over any variable, its current value is displayed in a tooltip ("data tooltips"), where it can also be modified if desired. During coding, the Visual Studio debugger lets certain functions be invoked

manually from the Immediate tool window. The parameters to the method are supplied at the Immediate window.

3.13 XAMPP

XAMPP is an Apache distribution containing MySQL, PHP, Perl, Mercury (mail server), PHPMyAdmin and Tomcat. Its acronymous name also suggests this, as mentioned below.The philosophy behind XAMPP is to build an easy to install distribution for developers to get into the world of Apache and easy local web hosting on one's own computer. XAMPP is a compilation of free software. It is compatible with Windows, Linux, Mac and Solaris. It's, also, free of charge and it's free to copy under the terms of the GNU General Public License. There are addon packages called BitNami for XAMPP that are able to install some popular applications, easily, into your working XAMPP packages such as Word press, Joomla, Drupal, etc. The name "XAMPP" is an abbreviation for: X (cross) means cross-platform with Apache, MySQL, PHP, Perl.

3.14 MY SQL

MySQL is written in C and C++. Its SQL parser is written in yacc, but it uses a home-brewed lexical analyzer.MySQL works on many system platforms, including AIX, BSDi, FreeBSD, HP-UX, eComStation, i5/OS, IRIX, Linux, macOS, Microsoft Windows, NetBSD, Novell NetWare, OpenBSD, OpenSolaris, OS/2 Warp, QNX, Oracle Solaris, Symbian, SunOS, SCO OpenServer, SCO UnixWare, Sanos and Tru64. A port of MySQL to OpenVMS also exists.

The MySQL server software itself and the client libraries use dual-licensing distribution. They are offered under GPL version 2, or a proprietary license.

Support can be obtained from the official manual. Free support additionally is available in different IRC channels and forums. Oracle offers paid support via its MySQL Enterprise products. They differ in the scope of services and in price. Additionally, a number of third party organisations exist to provide support and services, including MariaDB and Percona. MySQL has received positive reviews, and reviewers noticed it "performs extremely well in the average case" and that the "developer interfaces are there, and the documentation (not to mention feedback in the real world via Web sites and the like) is very, very good". It has also been tested to be a "fast, stable and true multi-user, multi-threaded sql database server".

CHAPTER 4

WORKING PRINCIPLE

4.1 Working

Radio frequency identification (commonly abbreviated to RFID) is so-named because it relates to the identification of objects using EM radiation at radio frequencies. In Table 2 we saw that a large range of frequencies within the EM spectrum are referred to as Radiofrequencies (RF), which results in a number of different forms of RFID. Once again, RFID systems may be categorized based on the band of the EM spectrum that they operate in. RFID systems in the same band will generally display similar characteristics; those in other bands may well operate very differently and therefore be more or less suitable for a given application. An RFID system comprises two components an RFID reader and an RFID tag. Despite its name, the RFID reader is really the transmitter in an RFID system. The electronics in the reader uses an external power source to generate the signal that drives the reader's antenna and which in turn creates the appropriate radio wave. This radio wave may be received by an RFID tag, which in turn 'reflects' some of the energy it receives in a particular way (based on the identity of the tag). Whilst this reflection is going on, the RFID reader is also acting as a radio receiver, so that it can detect and decode the reflected signal in order to identify the tag.

An RFID system is specifically designed to be asymmetric the reader is big, expensive and power hungry compared to the RFID tag.

Figure 4.1 Principle of Operation of RFID

There are a number of different types of RFID system, but one basic categorization is based on the power source used by the tag

1. Passive tag RFID systems require no power source at the tag – there is no battery. Instead, the tag uses the energy of the radio wave to power its operation, much like a crystal radio. This results in the lowest tag cost, but at the expense of performance.

2. Semi-passive tag RFID systems rely on a battery built into the tag in order to achieve better performance (typically in terms of operating range). The battery powers the internal circuitry of the tag during communication, but is not used to generate radio waves.

3. Active tag systems use batteries for their entire operation, and can therefore generate radio waves proactively, even in the absence of an RFID reader.

Passive tag RFID systems are the most common type, and are often referred to simply as 'RFID systems'.

4.2 Range of RFID Systems

With an RFID system, the term range naturally refers to the maximum operating distance between the reader antenna and the tag, and the field of the reader is the specific operating area. The frequency of operation used for an RFID system has a big effect on the operating range. Analysis of the physics of RFID communications shows that the optimum frequency is around 400-500MHz. Such analysis cannot be made generically - there are a number of factors to take into account and these will have different effects based on the intended application. Example factors that will be affected by the choice of frequency include: size of tag antenna, ease of power delivery to the tag, ease of communication of tag back to reader, cost and speed of communication.

The range of RFID systems operating in the UHF band is governed largely by the principles outlined. This means that the ability of the reader to power and communicate to the tag is based on the inverse square law (1/r), as will the return path of reflected signals from the tag to the reader. Operation will also be affected by environmental conditions and interference from other radio sources at the same frequency. RFID systems that operate in the HF band of the spectrum work in a very different way to those using the UHF band and it is useful to understand this fundamental difference and the effect it has on operating range. If communication occurs over a short distance, relative to the wavelength of the radio wave, this is said to be near-field operation. Since HF (3-30MHz) RFID systems use waves with a wavelength of around10-100m.

if the distance of the communication is much less than this (which is the case in RFID) then this is a near-field communication. Near-field communication is based on a magnetic field effect, which has an inverse sixth power ($1/r$) relationship with range.

CHAPTER 5

CONCLUSION

The progress in science & technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. This project is used in shopping complex for purchase the products. In this project RFID card is used as security access for product. If the product is put in to the trolley means it will shows the amount and also the total amount. But in this project RFID card is used for accessing the products. So this project improves the security performance and also the speed.

The principle of the development of science is that

"NOTHING

IS

IMPOSSIBLE"

So we shall look forward to a bright & sophisticated world.

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REFERENCES

1. Satish Kamble, Sachin Meshram, Rahul Thokal and Roshan Gakre, 2014 International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-6.

2. Ankit Anil Agarwal, Saurabh Kumar Sultania, Gourav Jaiswal and Prateek Jain, 2011 Control Theory and Informatics ISSN 2224-5774 (print) ISSN 2225-0492 (online) Vol 1, No.1.

3. F. Bielen, and N. Demoulin, 2007 "Waiting time influence on the satisfaction-loyalty relationship in services," Managing Service Quality: An International Journal., vol. 17, no. 2, pp. 174-193.

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Semi-Automated Trolley for Supermarkets with Ultrasonic Sensor and RFID

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Abstract: **Considering shopping mall, we have to wait much time for billing even though you purchase little things and we are not aware of cost of the product that we wanted to purchase. With the help of this project we reduce the billing time and customers can know the exact cost of the products that they purchased before billing so that they can do their shopping within their budget. The objective of this project is to improve the speed of purchase by using RFID. This project is designed to use the RFID based security system application in the shopping trolley. In this project RFID Key fob is used as security access for product. RFID Key fob with 13.6 MHZ is used for accessing the products. So this project improves the security performance and also the speed. each product has the individual RFID fobs which represent the product name. RFID reader is interfaced with micro controller. Here the micro controller is the flash type re-programmable micro controller in which we already programmed with card number. RFID transceivers can only detect with minimum range so ultrasonic sensors are collectively used with RFID in order to improve the security performance at cheap price.**

Keywords: **RFID, Key fobs, Frequency identification, Object detection, Object counting.**

1. Introduction

Waiting to pay at the checkouts at hypermarkets is very tiresome as people lead very busy lives. Therefore, waiting time should be managed and controlled. Checkout management is the next big technology for retailers in the modern world with less time spent queueing and better customer care. As customers hate long queues which leads to customer dissatisfaction in retailing. This arises whenever a shared facility needs to be accessed for service by a large number of customers. The expectation of short checkout queues is key ways to build customer loyalty and encourage spending. Historical Checkout Management systems were all about getting the customer in and out of your business as quick as possible in an orderly fashion. Today, Checkout Management systems can offer a lot more with the aid of advanced technology and development. This can help to improve business process and the overall customer experience. People are quite sensitive to wait times. There is no doubt that using a modern queue management system will bring improved efficiencies into the organization, through better understanding of customer expectations, greater opportunity to persuade customer to buy more products, better understanding of staff activity and better visibility of the business. The proposed solution for this problem is an intelligent queue management system which serves customer as well as the supermarket with minimum waiting time by managing the related resources such as staff, customers and checkouts efficiently and effectively.

2. Literature review

Intelligent Retail Checkout Management System can be compared with other related products or systems which are available today, such as Nextiva Queue Management [1], Qtech Queueing system [2], EQMS [3], Qmatic [10], Irisys [9] and AQMS-I6 [11]. Irisys basically uses non-instructive infrared sensors at store entrance and above the checkout lanes to monitor customer numbers and queuing behavior. The system is able to automate the capture of accurate data and calculate in real time the average queue length, average wait times, cashier idle times and overall transaction service time. Qmatic [10] helps to organize the queues by providing visitors with virtual and linear queuing solutions, booked appointments or more sophisticated methods like mobile apps and SMS messages. AQMS-I6 [11] is basically a token management system. According to customer tokens and service counters the system manage waiting and reduce rush in counters. AQMS's goal is to reduce real and apparent waiting time, speeds up service delivery, improves service quality and increases customer satisfaction. In Qtech Queueing System [2] a keypad will be placed at the counter to facilitate the calling of the queue number by the counter staff which can be called in a sequential or random manner. Display panel shows both queue numbers and its corresponding counter number either with or without directional arrows. E-QMS is a method of queue management which is characterized by the use of electronic devices to manage the flow of customers or persons waiting in line to be served. A major feature of this type of queue management system is that, there is always an audio and/or flash light alert to let the next person know that he/she is ready to be served. Most of the above mentioned systems are recognized as token management systems where their goal is to manage waiting and reduce rush in counters.

3. Methodology

In the proposed system, after selecting the goods the customer will be requested to place his/her trolley in the trolley volume detection stall, the system calculates the number of goods in the trolley approximately. Mean time system will keep track of the real time rush in each checkout. Then the system will decide the best checkout with minimum waiting time for each trolley and it will display to the relevant customer at the trolley volume detection stall. By analyzing the real time rush in checkout area, system calculates the average waiting time and displays it outside to attract more customers to the supermarket. In the entrance system tracks the number of customers entered and left the supermarket which calculates the current number of people inside the supermarket. In order to manage the staff efficiently, the system will provide predictions for future cashier formations and monthly reports which will be used to predict future sales. There by saving the time and improving the shopping experience of the customers. The Block diagram is mentioned in fig. 1, represents the postulated method.

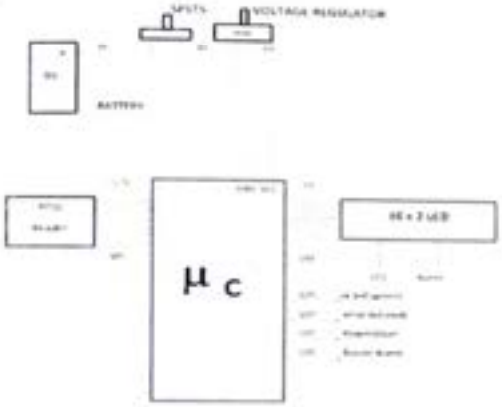

Fig. 1. Trolley system block diagram

A. Components required

1) Arduino 3.0

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

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Unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source. The FTDI FT232RL chip on the Nano is only powered if the board is being powered over USB. As a result, when running on external (non-USB) power, the 3.3V output (which is supplied by the FTDI chip) is not available and the RX and TX LEDs will flicker if digital pins 0 or 1 are high.

Fig. 2. Arduino Nano

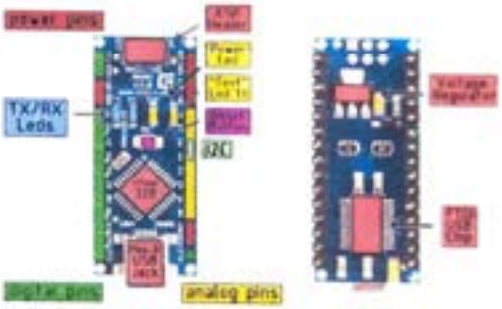

Fig. 3. Arduino Nano 3.0 with AT mega 328 processor

The ATmega168 has 16 KB of flash memory for storing code (of which 2 KB is used for the boot loader); the ATmega328 has 32 KB, (also with 2 KB used for the boot loader). The ATmega168 has 1 KB of SRAM and512 bytes of EEPROM (which can be read and written with the EEPROM library); the ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

Specialized functions:

- Serial: 0 (RX) and 1 (TX). These are used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or change in value. See the attach Interrupt () function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

- LED 13 - There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is On, when the pin is LOW, it's off.

2) MFRC-522 RFID NFC reader with card and tag

The module is based on RF module RC522 (near field communication module). With the operating frequency of 13.66 MHz you can read and write a tag. This is compatible in all gizDuino/Arduino Microcontroller boards. RFID tags support a larger set of unique IDs than bar codes and can incorporate additional data such as manufacturer, product type and even measure environmental factors such as temperature. Furthermore, RFID systems can discern many different tags located in the same general area without human assistance.

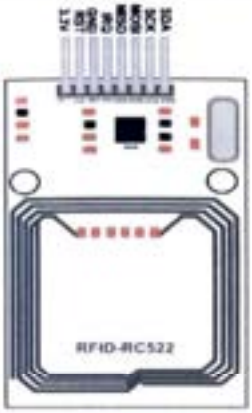

Fig. 4. Sectional view of RFID transceiver

Fig. 5. RFID receiver and tag

The general specifications of the RFID tag:

- Input Supply Voltage: 3.3 VDC
- Working Current: 13 to 26mA
- Part /number: MF522-ED
- Card reading distance: 0 to 60mm
- Interface: SPI communication
- Data Communication speed 10Mbit/s Max.
- Operating Frequency: 13.56Mhz
- Supported card types: Mifare1 S50, Milfare1 S70, Mifare Ultra Ligh, Mifare Pro, Mifare Desfire
- Weight: 8g
- Dimensions: 60mm x 40mm

3) Ultrasonic Sensor

Arduino Ultrasonic Range Detection Sensor with Arduino in order to calculate distances from objects. In this case I'm also altering the output of an LED with PWM according to how close an object is to the sensor. So the nearer you are the brighter the LED. So if we start with the Arduino Ultrasonic Range Detection Sensor, it's an IC that works by sending an ultrasound pulse at around 40Khz with a good ranging frequency.

Fig. 6. Ultrasonic sensor

It then waits and listens for the pulse to echo back, calculating the time taken in microseconds (1 microsecond = 1.0 × 10-6 seconds). It can trigger a pulse as fast as 20 times a second and it can determine objects up to 3 meters away and as near as 3cm. It needs a 5V power supply to run. Adding the Arduino Ultrasonic Range Detection Sensor to the Arduino is very easy, only 4 pin to worry about. Power, ground, trigger and echo. Since it needs 5V and Arduino provides 5V.

4) Voltage regulator:

The MC78XX/LM78XX/MC78XXA series of three terminals positive regulators are available in the TO-220/D-PAK package and with several fixed output voltage which will make them useful in a wide range of applications. Each type employs internal current limiting, Thermal shut down and safe operating area protection, making it essentially indestructible.

If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

1. Input 2. GND 3. Output

Fig. 7. Voltage regulator

Features of the regulator are listed as follows,

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

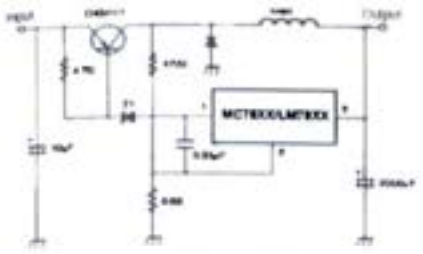

Fig. 8. Voltage Regulator

5) Buzzer

This is an active buzzer so it's easy in use. You just apply voltage to the buzzer and it makes sound. Disadvantage is that you can't determine the frequency of the sounds, for this you need a passive buzzer.

Schematic:

- Module pin - = GND Module pin S = +5V
- Connection to Arduino 0 to digital pin 8 --> Module pin S Arduino GND --> Module pin

Fig. 9. Buzzer

6) LCD

LCD (Liquid Crystal Display a screen is an electronic display module and finds a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), an imitations and so on.

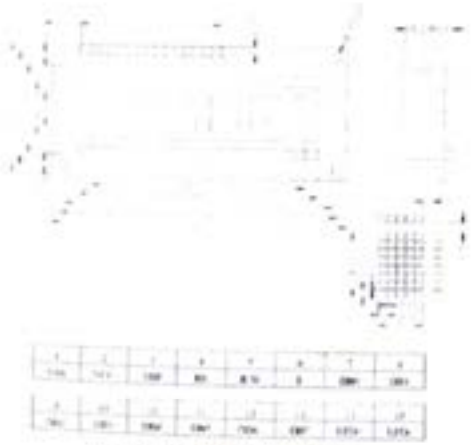

Fig. 10. 16x2 LCD pin diagram

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

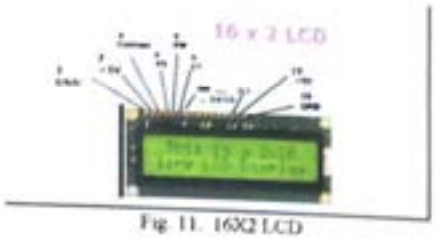

Fig. 11. 16X2 LCD

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

B. Procedure

1) Object detection

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a frame to receive tag data from things passing through the transceiver required, a sensor device can activate the field. When an RFID tag Passes through the electromagnetic zone, it detects the reader's activation signal.

2) RFID transceiver

The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing. The majority of RFID tags contain at least an integrated circuit for modulating and demodulating radio frequency and an antenna for transmitting and receiving signals. Frequency ranges vary from low frequencies of 125 to 134 kHz and 140 to 148.5 kHz, and high frequencies of 850 to 950 MHz and 2.4 to 2.5 GHz. Wavelengths in the 2.4 GHz range are limited because they can be absorbed by water.

3) Tag reader

RFID reader is used to read the data present in the RFID tag. RFID readers or receivers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency (RF) communication. Many also include an interface that communicates with an application. Readers can be hand held or mounted in strategic locations so as to ensure they are able to read the tags as the tags pass through an "interrogation zone." RFID systems can be classified by the type of tag and reader. A Passive Reader Active Tag (PRAT) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only).

i) Power supply

Power supply is used to give the 5V to the controller. 5V can be received from IC voltage regulator. Inside supply rectifier, filter is present.

j) Data reading

This library makes it easy to use a Graphical LCD with Arduino this is an extensive modification of the ks0108 library that has higher performance, more features, supports more Arduino boards and is easier to integrate with different panels. Sketches written for the old library should work with little or no modification. The configuration mechanism has been changed to facilitate use with a broad and ATmega Controllers, See the section on sketch migration for details on modifications for the new library

4. Purpose of the project

The objective of this project is to improve the speed of purchase by using RFID. This project is designed to use the RFID based security system application in the shopping trolley. This project is used in shopping complex shows the amount and also the total amount. But in this project RFID card is used for accessing the products. So this project improves the security performance and also the speed. The trolley developed will also have the provision to take out the printout the bill of the purchased materials which will be designed using .net graphical user interface with Access database. It will overcome the Barcode technology which gets lots of problems that will recover in this technology such as the barcode method is so slow and some time it will creating error at the reading the barcode if in case of damaged the barcode it won't be recognized the barcode tag by barcode reader. Since RFID has only a minimum frequency range an ultrasonic sensor can be used within the circumference area of the trolley. If not detected by the RFID the ultrasonic sensor senses the object within the area and buzzer a red light. Indicating that the customer or buyer is trying to steal the product.

5. Conclusion

The intended objectives were successfully achieved in the prototype model developed. The developed product is easy to use, low-cost and does not need any special training. This project report reviews and exploits the existing developments and Different types of radio frequency identification technologies which are used for product identification, billing, etc. We have also learned the architecture of the system that can be used in the shopping systems for intelligent and easy shopping in the malls to save time, energy and money of the consumers. Present trends point towards the fast growth of RFID in the next decade. With around 600 million RFID tags sold in the year 2005 alone, value of market including systems, services and hardware is likely to grow by factor of 10 between years 2006 -2016. It is expected that total number of RFID tags delivered in the year 2016 will be around 45% times as compared to the ones delivered in the year 2006. This project reviews and exploits the existing developments and Different types of radio frequency identification technologies which are used for product identification, billing, etc. Thus the survey paper studies and evaluates research insight in Radio Frequency Identification systems from a big picture first. We have studied in detail about the business model, technological model and all related work and applications in the domain of RFID.

Abbreviations and Acronyms

RFID: - Radio Frequency Identification
DoD: - Department of Defense
EAS: - Electronic Article Surveillance
EPC: - Electronic Product Code
ISO: - Indian Standard of Organization
[ARPT: - Active Reader Passive Tag
LCD: - Liquid Crystal Display
PCB: - Printed Circuit Board
BAP: - Battery Assisted Passive
PRAT: - Passive Reader Active Tag
IDE: - Integrated Development Environment

References

[1] www.verint.com/solutions/videosituationintelligence/products/videosituationintelligence/activeqmanagementleader
[2] Qtech Queueing System. [Online]. Available: http://www.qmanagementsystem.com/submit-an article/our-featuredproducts.html
[3] FQMS, http://www.academia.edu/7012630/
[4] Satish Kamble, Sachin Meshram, Rahul Thokal, Roshan Wakde "Developing a Multitasking Shopping Trolley Based On RFID Technology," International Journal of Soft Computing and Engineering, vol. 3, no. 6, pp. 179-183, January 2014
[5] Ankit Anil Agarwal, Saurabh Kumar Sultania, Gourav Jaiswal, and Prateek Jain, "RFID Based Automatic Shopping Cart," in Control Theory and Informatics, vol. 1, no. 1, 2011.
[6] Aayush, Otabeck Atajanov, and Hamad Alajanam. "RFID Shopping System Senior Design," Cloud State University
www.slideshare.net/arttuladhar/rfid-shopping-system
[7] Mikro Elektronika
http://www.mikroe.com/add-on-boards/display/easytft/5.LPC2140datasheethttp://www.nxp.com/documents/data_sheet/LPC2141_42_44_46_48.pdf
[8] F. Bielen, and N. Demoulin, "Waiting time influence on the satisfaction-loyalty relationship in services." Managing Service Quality: An International Journal , vol. 17, no. 2, pp. 174-193, 2007
[9] Irisys. http://www.irisys.net/queuemanagement. Kotas, G. (1992).
[10] Qmatic for the queue management in the super markets. Available http://www.qmatic.com/solutions/businesssolutions/queue-managementsystems/
[11] AQMS-16 system for queuing
http://www.databytcindia.com/queuemanagement.html
[12] D. Tseng and C. Chang, "Color segmentation using perceptual attributes," *Proceedings, 11th IAPR International Conference on Pattern Recognition. Vol. III. Conference C: Image, Speech and Signal Analysis*, The Hague, Netherlands, 1992, pp. 228-231
[13] H. Chen, S. Chang, "Learning Algorithms and Applications of Principal Component Analysis ", Image Processing and Pattern Recognition, Chapter 1, C. T. Leondes, Academic Press, 1998

A NOVEL SECURITY ENABLED SYSTEM FOR VEHICLES USING WIRELESS TECHNOLOGY

A PROJECT REPORT

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ABSTRACT

Nowdays most of the accidents are occurred due to non licence drivers careless driving.So here a system is introduced that will avoid accidents to a particular level. a vehicle on road is that a system is introduced that will avoid accidents to a particular level. A vehicle on road is that the person should be a licence holder,Which the permission is issued by he government to drive a vehicle. So to check that firstly an RFID card is provided to licence holders and the details are checked.The authorized licence holder can access every vehicle by using digital RFID licence and can switch on the engine also.

The system also detects alcohol concentration on the breath, Just like common breath analyzer.the alcohol sensor used in this embedded system is to determine wheather the driver is drunk or not.The system also provide safety measures for limiting the speed of the vehicle.For that a hall effect sensor is used.It is one of the magnetic field sensor which are used to calculate the speed of the vehicle .The system is inbuilt in a vehicle and the trackin system works on GPS and GSM\GPRS.The embedded device will send all current information to android phone by using Bluetooth communication.The informations contains liceence number ,vehicle speed and alcohol status.

The GSM\GPRS module attatched in smartphone is used to transmit and update the vehicle location to a database.A smart phone application is also developed for continuously monitoring the vehicle location.A voltage converter IC (MAX232) is used to convert the voltage level and system can connected to the PC.The PC is used to store the details of the licence holder

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LIST OF SYMBOLS

ACRONYMS	ABBREVATIONS
RFID	RADIO VREQUENCY IDENTIFICATION DEVICE
GPS	GLOBAL POSITIUONING SYSTEM
GSM	GLOBAL SYSTEM FOR MOBILE COMMUNICATION
GPRS	GENERAL PACKET RADIO SERVICE
LED	LIGHT EMITTING DIODE
ADC	ANALOG/DIGITAL CONVERTER
AC	ALTERNATING CURRENT
DC	DIRECT CURRENT
GUI	GRAPHICAL USER INTERFACE
PTH	PLATED THROUGH HOLES
PCB	PRINTED CIRCUIT BOARD
PIC	PERIPHERAL INTERFACE CONRTROLLER
USART	UNIVERSAL SYNCHRANOUS ASYNCHRONOUS RECIEVER TRANSMITTER
RAM	RANDOM ACCESS MEMORY
ROM	READ ONLY MEMORY
GND	GROUND
RXD	RECIVE DATA
RST	RESET
AAPT	ANDROID ASSET PACKAGING TOOL
ADT	ANDROID DEVELOPMENT TOOL

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CHAPTER 1

INTRODUCTION

An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of a popular technology that combines a Smartphone application with a microcontroller. This will be easy to make and inexpensive compared to others. The designed in-vehicle device works using Global Positioning System (GPS) and Global system for mobile communication /General Packet Radio Service (GSM/GPRS) technology that is one of the most common ways for vehicle tracking.

The digital license is used in this project. An authorized license holder can access every vehicle by using digital RFID license and can switch on the engine also. Unauthorized person cannot use vehicle. An alcohol sensor used in this embedded region to determine whether the driver is drunken or not. Hall Effect sensor is the one of the magnetic field sensor was used here to calculate the speed of the vehicle. The embedded devise will send all current information to android phone by using Bluetooth communication. The information's contains license number, vehicle speed and alcohol status.

The android device is embedded inside a vehicle whose position is to be determined and tracked in real-time. The vehicle tracking system uses the GPS module that attached in smart phone to get geographic coordinates at regular time intervals. The GSM/GPRS module attached in smart phone is used to transmit and update the vehicle location to a database. A Smartphone application is also developed for continuously monitoring the vehicle location. The Google Maps API is used to display the vehicle on the map in the Smartphone application. Thus, users will be able to continuously monitor a moving vehicle on demand using the Smartphone application and determine the status of vehicles. In order to show the feasibility and effectiveness of the system, experimental results are presented for the vehicle tracking system and some experiences on practical implementations.

CHAPTER 2

LITERATURE REVIEW

Bhumi Bhatt, et. al [1]presents an automotive localization system using GPS and GSM services. The system permits localization of the automobile and transmitting the position to the owner on his /her mobile phone as a short message (SMS) at his/her request. In case of vehicle theft situations, the owner can know the vehicles current location and based on that he/she can stop the vehicle by sending a predefined SMS message to this system. After receiving SMS message from owner this system automatically stops the ignition system hence the vehicle will not function any more.

John and Rose Mary [2] said that, the usage of vehicles has been drastically increased in these days which also cause the steep rise in the number of accidents so that lots of people lose their lives. Only 28 countries, covering 7% of the world's population have comprehensive road safety laws on some risk factors such as drinking and driving, speeding and failing to use the motor helmets, seat belts and child restraints. Alcoholic drivers are one of the major causes of such accidents. This paper gives a solution to these accidents. If a rider consumes alcohol and tries to start the vehicle the ignition system will not be ignited and also if he is not wearing helmet, the vehicle will not get started. Also that the pressure sensor is attached to the helmet which is used to detect the pressure experienced when the person undergoes any accident. If it so, the information is sent to the nearby hospital or family with the help of GSM module. Vehicle ownership comes with its fair share of paperwork.

CHAPTER 3

BLOCK DIAGRAM DESCRIPTION

Block diagram of 'A NOVEL SECURITY ENABLED SPEED MONITORING SYSTEM', shows the components and designing parts of the project. Figure 2.1 shows the detailed block diagram

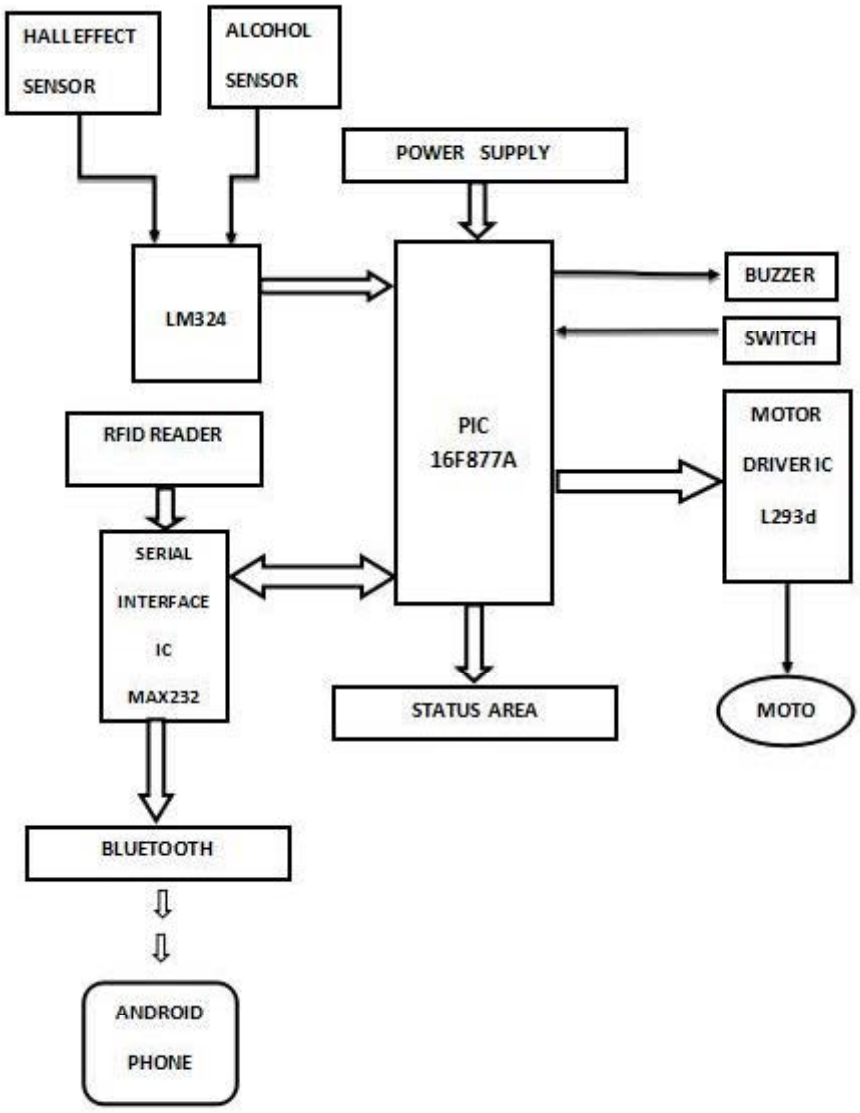


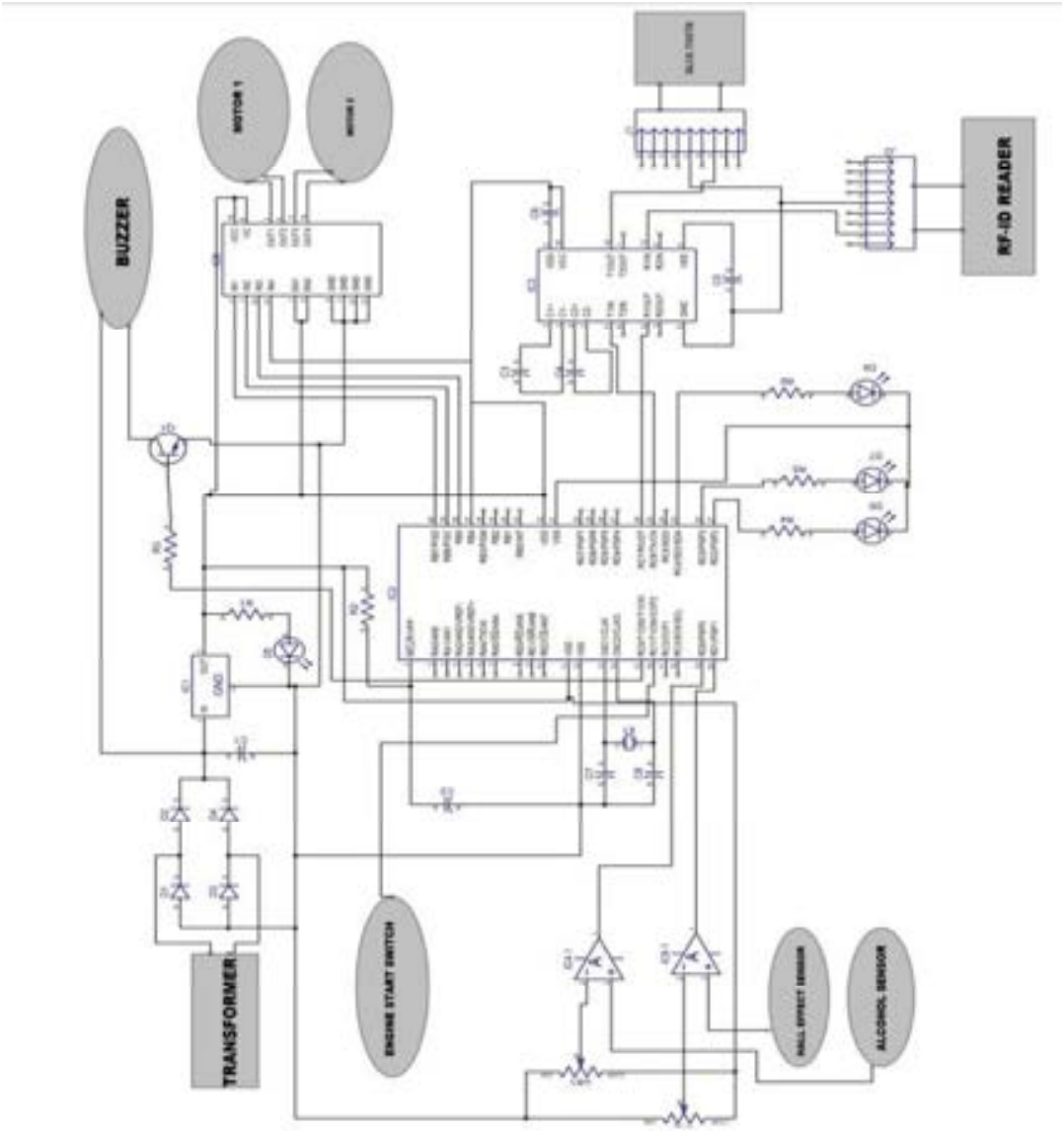
Fig. 3.1: Block diagram

The 12 V supply is converted to 5V by using a voltage regulator. The microcontroller, which used here, is PIC16F877A. It consists of 5 i/o ports: port a, port b, port c, port d, port e. Remaining pins are CLK, &MCLR. The microcontroller accepts and gives the output in digital

form. The gear motor indicates the rotation of the vehicle in several directions. Motor driver IC L293D is used to prevent the back EMF and to drive the corresponding motor, which have mainly 3 pins Enable, input1&input2 by changing the input values the motor works. If the input values are same, the motor will not work. The IC used to drive the motor is L293D. The alcohol sensor used here is suitable for detecting alcohol concentration on breath of the alcoholic driver. It has high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The driver circuit is very simple as it needed only one resistor. A Hall Effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall Effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications. The collected information from both the sensors is given to LM324 IC. Bluetooth Module is a drop in replacement for wired serial connections, transparent usage. This is a Slave mode Bluetooth device.MAX 232 is an IC used to serial communication that converts signals from RS 232 logic to TTL logic. It also converts TTL logic to RS-232. LM324 is a 14pin IC consisting of four independent operational amplifiers compensated in a single package. The output voltage is many times higher than the voltage difference between input terminals of an op amp. Buzzer is an electronic device which is used to indicate character reading from the RFID card. Android is an operating system based on the Linux kernel and designed primarily for touch screen mobile devices such as smart phones and tablet computers. Status area is used for LED Indication. It denotes the working Status of power supply, data transfer and program execution. Engine start button is used to start the engine of the vehicle. A dc motor is used to drive the vehicle. The L293D used to drive the motor.

CHAPTER 4

CIRCUIT DIAGRAM DESCRIPTIION



IC 1: LM 7805

IC 2: PIC 16F877A MICROCONTROLLER

IC 3: MAX 232

IC 4: LM 324

IC 5: L293D

The core part of the circuit is PIC16F877A of low voltage, low cost, wide availability 8-bit ADC and 40 pin micro controller which is build using Harvard architecture. It has five ports which are port A, port B, port C, port D and port E having 6,8,8,8 and 3 pins respectively. It has dual power supply of 5 V and 12 V for equal power distribution to all pins. The 11th and 32nd pins are connected to 5 V VCC and the 12th and 31stpins are connected to the ground. To set the operating frequency 4MHz a crystal oscillator is connected to 13thand 14th pin of the PIC. The 25th and 26th pins are used for the transmission and reception and which are connected to the RC6 and RC7 pins of port C. The PIC has an in build ADC in port A and port E. All others ports are purely digital. The circuit consists of five input units which are the power supply section, alcohol sensor, Hall Effect sensor, accelerometer and RFID. The output units are the status area, Bluetooth and GSM. The Hall Effect sensor is connected to 2ndpin RA1of PORTA, and is used to measure the speed of the vehicle. The alcohol content is measured by using alcohol sensor (MQn3) and is connected to 3rd pin RA1 of port A. All the sensors used are connected to the controller through LM324. A diode rectifier then provides a full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. The MCLR is directly connected with 5V (series with resistor) but it is unable to reset if goes wrong. Also it uses a RESET switch to reset the PIC. When pressing the reset button, the Reset pin of PIC read 0V at MCLR pin and it will reset the program. The other important pin is13 and 14. Those pin was named as OSC1 and OSC2.The crystal oscillator from various frequencies can also be connected. Pulse generated from the oscillator will some time have the noise. A capacitor of value 33pF is used here. 12 V DC supply is given as supply. Microcontroller needs only 5 V for the working. Using LM7805 it is converted to 5 V. RFID reader is used for reading RFID tag. A MAX 232 IC is used to connect the RFID reader and Bluetooth module to the PIC Microcontroller. MAX 232 IC converts TTL logic into RS 232 logic and vice versa. Alcohol sensor senses whether the driver is alcoholic or not. Using engine start button vehicle is started. While running, Hall Effect sensor senses the speed of the vehicle. LM 324 IC is used as comparator IC, for comparing the output of Hall Effect sensor and alcoholic sensor. The output of the IC is given to PIC Microcontroller. This recorded information is transferred to the android device using Bluetooth module. Location of the vehicle is tracked using GPS which is already installed in the android application. Using .NET these data is shared to the server. The police can get the information of any vehicle with the help of another android application. Status area

is used for LED Indication. It denotes the working Status of power supply, data transfer and program execution

CHAPTER 5

SOFTWARE SECTION

The actions in the software part is mainly performed by using MPLAB, .NET and DIPTRACE. Circuit used in the project is developed on MPLAB. The functioning of computer is controlled by programs in .NET. DIPTRACE software is used for designing schematic diagrams and printed circuit boards.

5.1Basic actions in MPLab

MPLAB IDE is an integrated development environment that provides flexibility to develop and debug firmware for various Microchip devices. The circuit used in 'a novel security based speed monitoring system' is designed using this software. MPLAB IDE is a windows based integrated development environment for the microchip technology incorporated PIC microcontroller and PIC digital signal controller families. In the MPLAB IDE,it is possible to create source code using the built in editor. Assemble, compile and link source code using various language tools. An assembler, linker and librarian come with MPLAB IDE. It debugs the executable logic by watching program flow with a simulator, such as MPLAB SIM, or in real time with an emulator, such as MPLAB ICE. Third party emulators that work with MPLAB IDE are also available and make timing measurements.

5.2 Introduction to .NET

Here functioning of the computer is under the control of a program in high level language loaded in it. .NET is used for this purpose. The .NET Framework is a new computing platform that simplifies application development in the highly distributed environment of the Internet.

The developer experience consistency across various types of applications, and Web based application, all communication on industry standards to ensure that code based on the .NET Framework can integrate with any other code. The .NET Framework has two main components: The Common Language Run Time and the .NET Framework Class Library. The Common Language Run Time is the foundation of the .NET Framework. In fact, the concept of code management is a fundamental principle of the run time. Code that targets the run time is known as managed code, while code that does not target the run time is known as unmanaged code.

The Class Library, the other main component of the .NET Framework, is a comprehensive, object oriented collection of reusable types that you can use to develop applications ranging from traditional command line or Graphical User Interface (GUI) applications.

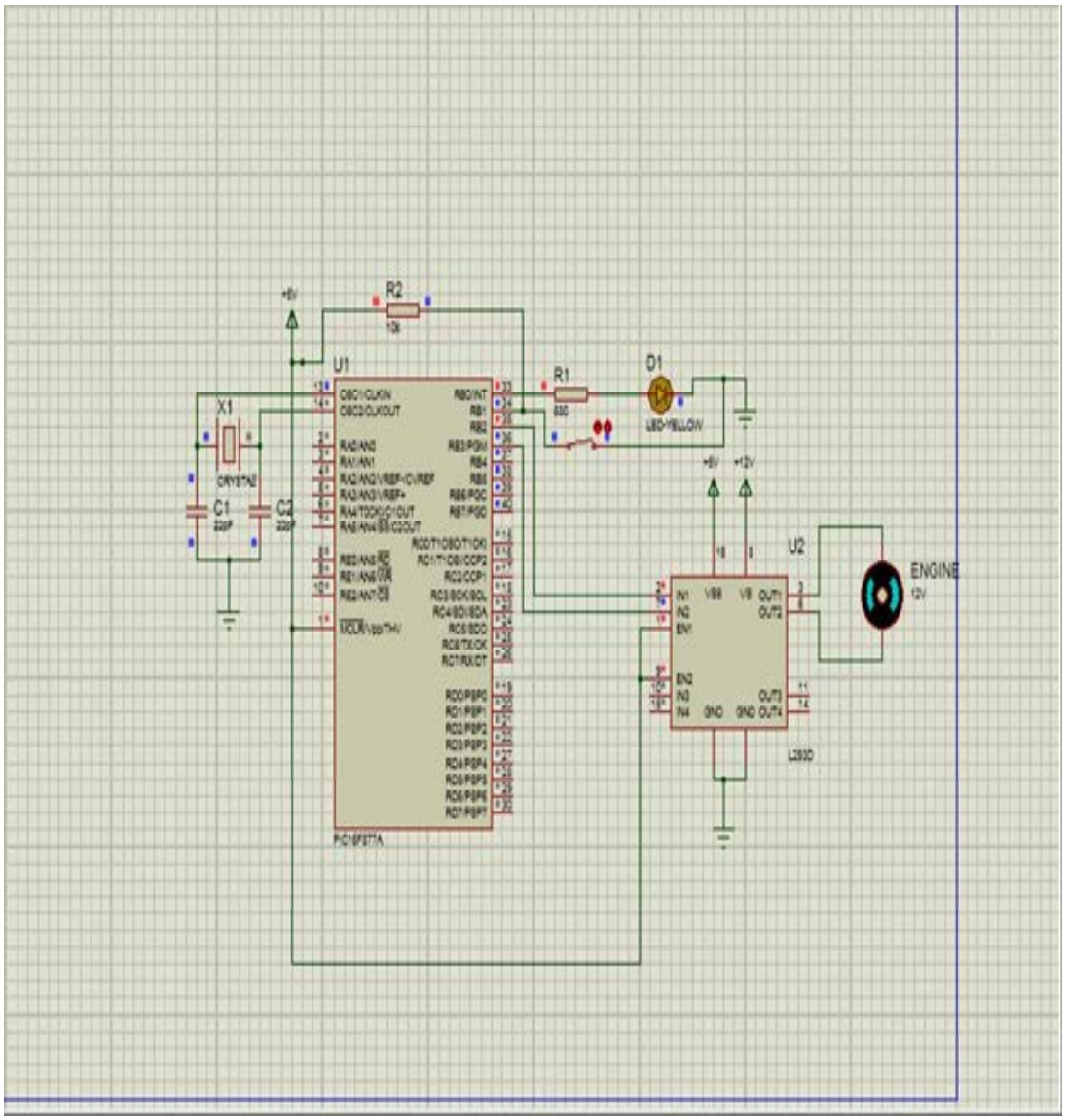
Diptrace Software

DipTrace is EDA/CAD software is used for creating schematic diagrams and printed circuit boards. The developers provide multi lingual interface and tutorials. DipTrace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built in shape based auto router and 3D Preview & Export, Component Editor, and Pattern Editor.

DipTrace is an advanced PCB design software application that consists of 4 modules PCB Layout with efficient auto router and auto placer, schematic capture, component and pattern editors that allow you to design your own component libraries. DipTrace has a powerful automatic router, superior to many routers included in other PCB layout packages. It can route a single layer and multilayer circuit boards. DipTrace also provides with external auto router support. Smart manual routing tools allow users to finalize the design and to get the results they want in a blink of an eye. There are number of verification features that allow controlling accuracy of the project. DipTrace modules allow exchanging schematics, layouts and libraries with other EDA and CAD packages. Output formats are DXF, Gerber, Drill and G code. Standard libraries contain more than 98,000 components. It has simple UI. It has Multi sheet and hierarchical schematics. Diptrace is a high speed shape-based auto router and smart manual routing tools.

5.4 Simulation results

The Proteus design suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit board



5.1: Simulation Results

CHAPTER 6

HARDWARE SECTION

6.1 PCB design

Forming a printed circuit board is essential and the most prominent step in the formation of one electronic device. For a device to work properly the components are planned to use should be well placed in a PCB. The design of a PCB can be considered as the last step in electronic circuit designing.

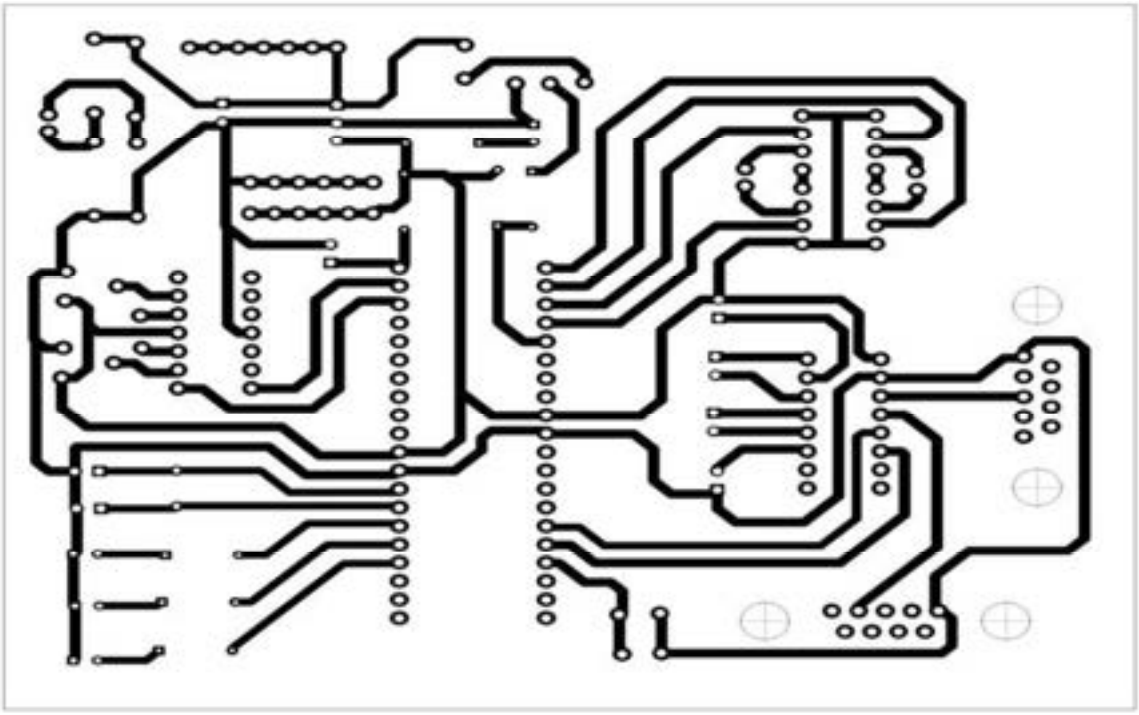


Fig 6.1: PCB Layout

In the electronic circuit performance and reliability depends on the productivity of PCB. Assembling and servicing ability also depends on the design. A proper PCB ensures that various components are interconnected as per the circuit diagram. Double sided PCBs, multiplayer PCBs with Plated Through Holes (PTH), flexible PCBs, etc are some of the developments made recently. Manufacturing of PCB involves the following steps.

- Print and etch
- Print, plate and etch

The single sided PCBs are usually using the print and etch method and the double sided plates through hole boards are made by print, plate and etch method. Both the technique are used in the production of multiplayer boards.

- **Penalization**

The schematic or the artwork of the circuit is transformed to working positive or negative films. The circuit is repeated conveniently to accommodate as many circuits as possible in a panel, which can be operated in every sequent steps in the PCBs process. This is called penalization.

- **Drilling**

This is the state of the art operation. Very small holes are drilled with a high speed CMC drilling machine.

- **Plating**

The heart of the PCB manufacturing process lies in the electrolytic plating process. The holes drilled are treated both mechanically and chemically before depositing the copper by the electrolytic copper plating process.

- **Etching**

Once a multiplayer board is drilled and electro less copper is deposited the image available in the form of a firm is transferred on to the outside by photo printing process. The boards are then coated with copper and tin. This is called etching.

- **Solder mask**

Since PCB design may call for very close spacing conductors, a solder mask has to be applied on both sides of the circuit to avoid bridging of conductors. This ink is applied by screening. This is dried, exposed to UV, developed in a mild alkaline solution and finally treated by both UV and thermal energy.

- **Hot air leveling**

After the abovementioned process, the circuit pads are soldered using hot air leveling process while removing the board from solder path, hot air blown on both the sides of the board through air knives in the machine leaving the board soldered and leveled.

- **Fabrication of demonstration unit**

The total circuit diagram and list of components are prepared and procurement of the components is done. The components layout and interconnection track diagram are prepared and hole drilling as per the size of the components is done. To remove the unwanted copper

other than the track part the board is etched and it is washed with plenty of water and is dried well.

6.2 Hardware setup

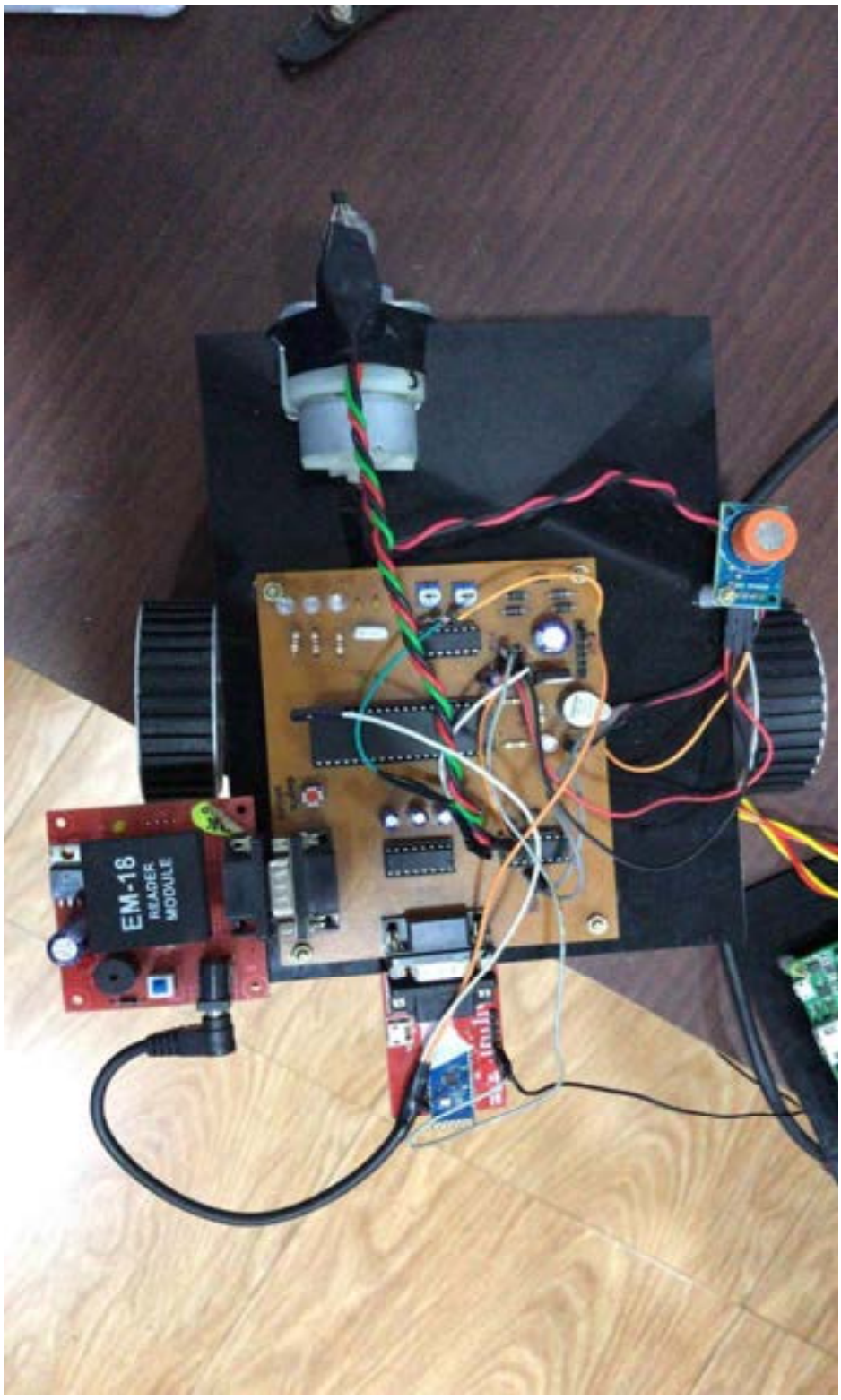


Fig 6.2: Hardware setup

The main parts used for designing are the following:

- POWER SUPPLY
- MICROCONTROLLER
- MOTOR
- MOTOR DRIVER IC L293D
- ALCOHOL SENSOR
- HALL EFFECT SENSOR
- BLUETOOTH MODULE
- MAX232
- LM324
- RFID READER
- BUZZER
- ANDROID PHONE
- STATUS AREA
- ENGINE START BUTTON (SWITCH)

6.3 Power supply

A 12V battery provides the power supply for the whole system. The microcontroller needs 5V. 12 V is converted to 5 V using 7805 regulators. Capacitor is used in the circuit to filter ripples produced during ac to dc conversion. The microcontroller and other devices get power supply from AC to DC adapter through 7805 regulators. The adapter output will be 12V DC Non-regulated.

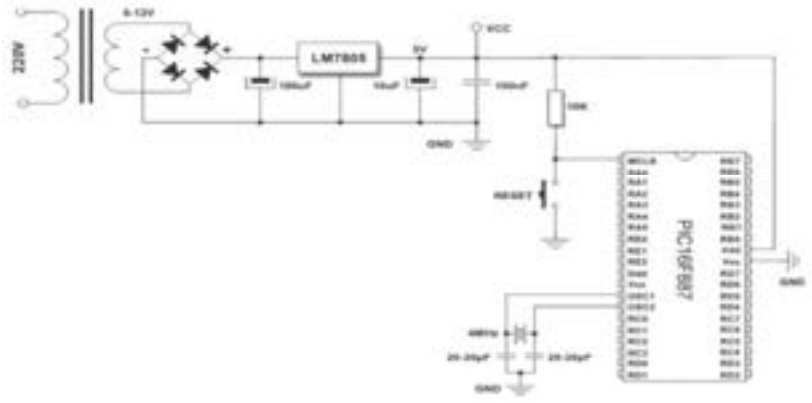


Fig 6.3: Power supply

6.4 MICROCONTROLLER

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory is in the form of flash or OTP ROM, as well as typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

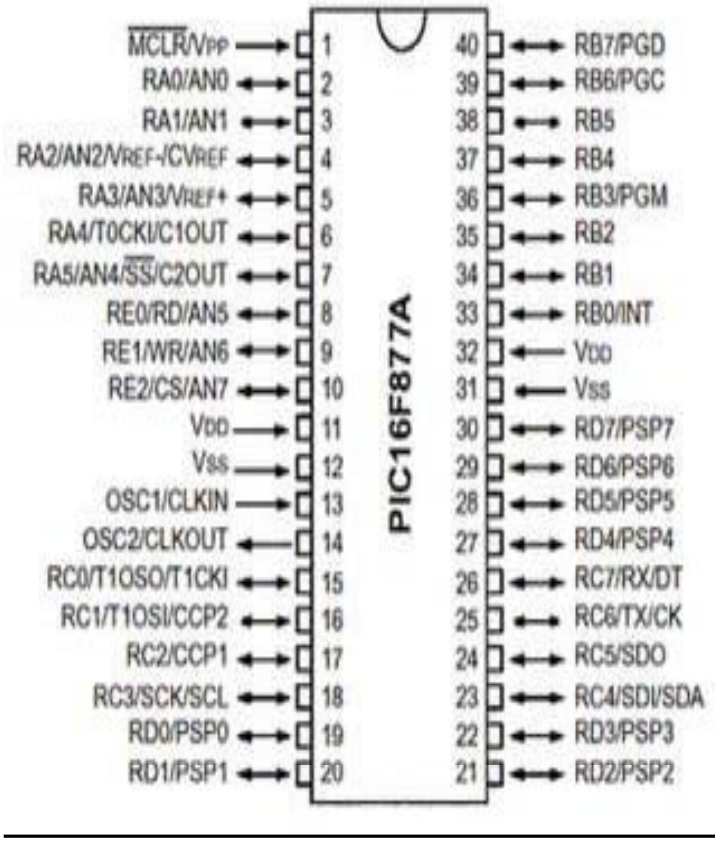


Fig 6.4 pic microcontroller

Peripheral Interface Controllers (PIC) is one of the advanced microcontrollers developed by microchip technologies. These microcontrollers are widely used in modern electronics applications. A PIC controller integrates all type of advanced interfacing ports and memory

modules. PIC is used to control the electronic devices through Bluetooth module. USART module is used for serial communication between PIC and Voice phone.

Available now our exciting new range of inexpensive controller boards, ideal for standard embedded applications and incorporating into machinery, control systems . Our new PIC16F877A Controller board features the powerful Microchip PIC16F877A Microcontroller, one of the most popular microcontrollers on the market, Combined into an easy to use and ready to run board complete with all the necessary components for plugging directly into your system. The PIC16F877A Microcontroller includes 8kb of internal flash Program Memory, together with a large RAM area and an internal EEPROM. An 8-channel 10-bit A/D convertor is also included within the microcontroller, making it ideal for real-time systems and monitoring applications. All port connectors are brought out to standard headers for easy connect and disconnect. Microcontroller PIC16F877A is one of the PIC Micro Family Microcontroller. It is popular for beginner because it is easy to use and it has FLASH memory technology that can be writing

And erase until thousand times. The superiority this RISC Microcontroller compared to another is at the speed and code compression. This PIC16F877A have 40 pins by 33 path of I/O.

6.5 Motor

300 RPM Centre Shaft Economy Series DC Motor is high quality low cost DC geared motor. It has steel gears and pinions to ensure longer life and better wear and tear properties. The gears are fixed on hardened steel spindles polished to a mirror finish. The output shaft rotates in a plastic bushing. The whole assembly is covered with plastic ring. Gear box is sealed and lubricated with lithium grease and require no maintenance. The motor is screwed to the gear box from inside

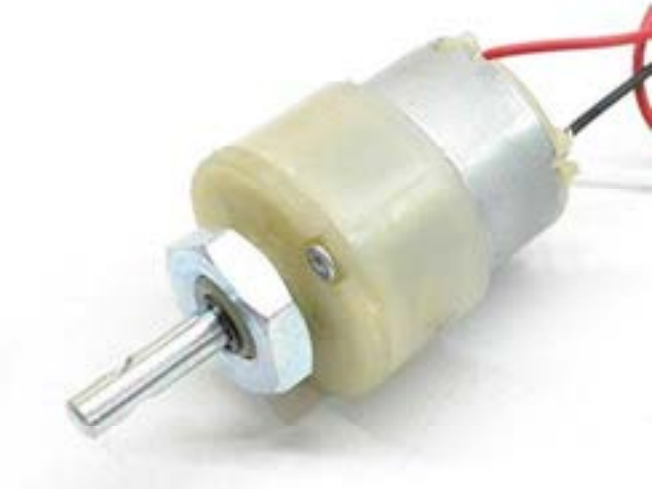


Fig 6.5 gear motor

Although motor gives 300 rpm at 12 V but motor runs smoothly from 4 V to 12 V and gives wide range of RPM and Torque you can also mount this motor on the chassis using motor mount for center shaft economy series DC Motor.

6.6 Motor driver IC L293D

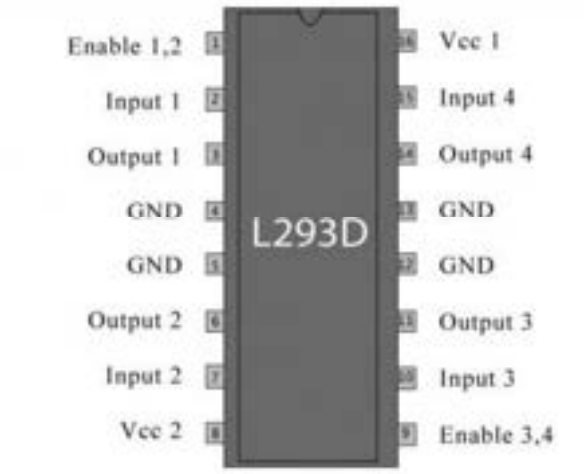


Fig 6.6: Motor driver IC

The PIC processor output is not sufficient to drive the DC motors, a high voltage and high current drivers are required. It prevents the back emf produced by the motor. The L293D is a quadruple high current half H- driver designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5 V to 36 V. It will become easier to drive DC motors with such drivers. Drivers are enabled in pairs with drivers 1 and 2 enabled by 1, 2 EN and drivers 3 and 4

are enabled by 3, 4 EN. When an enable input is high, the associated drivers are enabled, their outputs are active and in phase with their inputs.

6.7 Alcohol sensor

Sensor has a high sensitivity to alcohol with quick response speed. This model is suitable for alcohol detection such as portable breath alcohol checker or ignition locking system in automobiles.

- High sensitivity
- Low power consumption
- Miniature-size

When the target alcohol gas exist, The sensor's conductivity is more higher along with the gas concentration rising. The sensor could be used to detect alcohol with different concentration.

Fig 6.7 Alcohol sensor

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like common breath analyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple; all it needs is one resistor. A simple interface could be 03.3 V ADC.

Some of its major features and dimensions are:

- 5V DC or AC circuit
- Requires heater voltage
- Operation Temperature: -10 to 70 degrees C

- Heater consumption: less than 750mW
- 16.8 mm diameter
- 9.3 mm height without the pins

6.8Hall effect sensor

The Hall Effect is an ideal sensing technology. The Hall element is constructed from a thin sheet of conductive material with output connections perpendicular to the direction of current flow. When subjected to a magnetic field, it responds with an output voltage proportional to the magnetic field strength. The voltage output is very small (μV) and requires additional electronics to achieve useful voltage levels. When the Hall element is combined with the associated electronics, it forms a Hall Effect sensor.

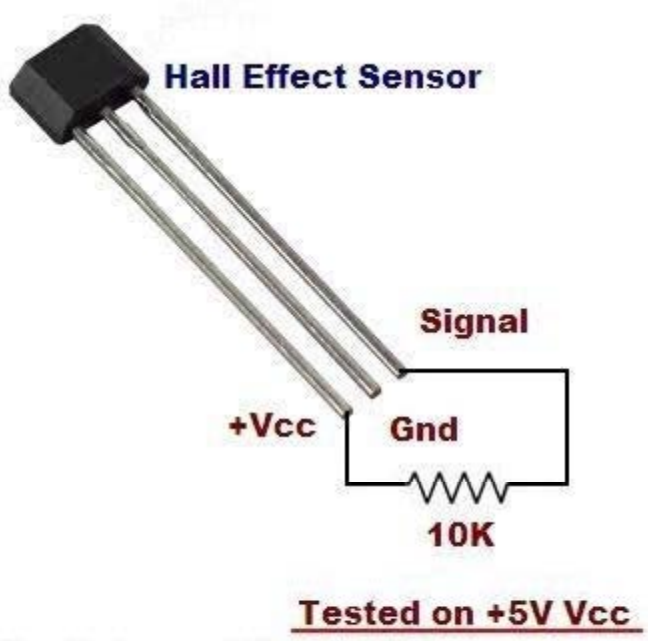


Fig 6.8 Hall effect sensor

A Hall Effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall Effect sensors are used for proximity switching, positioning, speed detection, and current sensing application.

In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced.

Frequently, a Hall sensor is combined with circuitry that allows the device to act in a digital (ON/OFF) mode, and may be called a switch in this configuration. Commonly seen in industrial applications such as the pictured pneumatic cylinder, they are also used in consumer equipment,

for example some computer printers use them to detect missing paper and open covers. When high reliability is required, they are used in keyboards.

Hall sensors are commonly used to time the speed of wheels and shafts, such as for internal combustion engine ignition timing, Tachometer Antilock breaking systems. They are used in brushless DC electric motors to detect the position of the permanent magnet, the voltage from the sensor will peak twice for each revolution. This arrangement is commonly used to regulate the speed of disk drives.

6.9 Bluetooth module

HC 05 is a compact Bluetooth Module (5V Serial TTL). The module has built in Voltage regulator and 3 V to 5 V level converters that can be used to interface with 5V Microcontrollers. The module has only 5 pins (Standard 2.54mm berg strip) VCC, GND, TX, RX and RESET. The module is factory configured in Transparent Mode and hence there is no command required for normal operation.

The HC 05 is a Drop in replacement for wired serial connections, transparent usage. We can use it simply for serial port replacement to establish connection between MCU and GPS, PC to our embedded project / Robot etc. Any serial stream from 9600 to 115200 bps can be passed seamlessly from your PC/PDA/MOBILE to your target board.

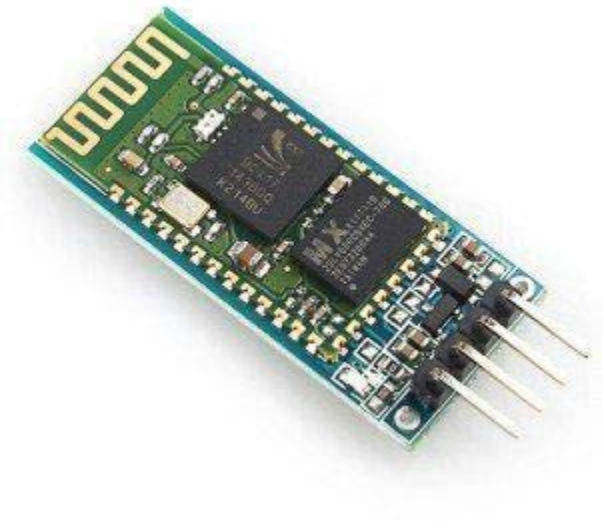


Fig 6.9 Bluetooth module

Some of its major features and dimensions are:

- Support Master & Slave Mode
- Bluetooth core V 2.0 compliant
- Support UART interface to host system
- Serial communications @ 9600-115200bps
- No Setup/Initial command required
- Breadboard Compatible
- Onboard Status and Power LED
- Encrypted connection
- Frequency: 2.4~2.524 GHz
- Built-in Chip antenna
- Power Supply: +5V

  Pin out for the module are:

- GND Ground- Ground Level of Power supply,
- V Power Supply pin for Power Supply Input (5V)
- RXD Receive Pin for Data Reception
- TXD Transmit Pin for Data Transmission
- RST Reset- Reset Input (Internally Pulled-Up)

6.10 MAX 232

The MAX 232 is an IC created in 1987 by Maxim Integrated Products. That converts signals from an RS232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX 232 is a dual driver/receiver and typically converts the RX, TX, CTS, and RTS signals.

The drivers provide RS-232 voltage level outputs (approx. +7.5 V) from a single +5 V supply Via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltage outside the 0 V to +5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as +25 V), to standard 5 V TTL Levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V it is a line driver used to convert the TTL signal to RS-232 and vice versa. This system needed for MAX 232 IC for interfacing GSM modem, GPS and Zigbee with PIC microcontroller.

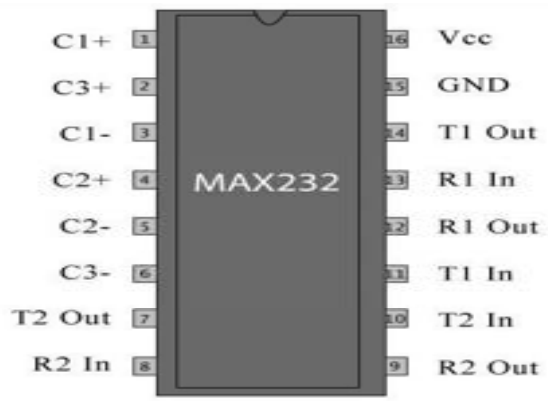


Fig6.10 MAX232 RC

6.11 LM324

LM324 is a 14 pin IC consisting of four independent operational amplifiers (op amps) compensated in a single package. Op amps are high gain electronic voltage amplifier with differential input and, usually, a single-ended output. The output voltage is many times higher than the voltage difference between input terminals of an op amp. These op amps are operated by a single power supply LM324 and need for a dual supply is eliminated. They can be used as amplifiers, comparators, oscillators, rectifiers etc. The conventional op amp applications can be more easily implemented with LM324.

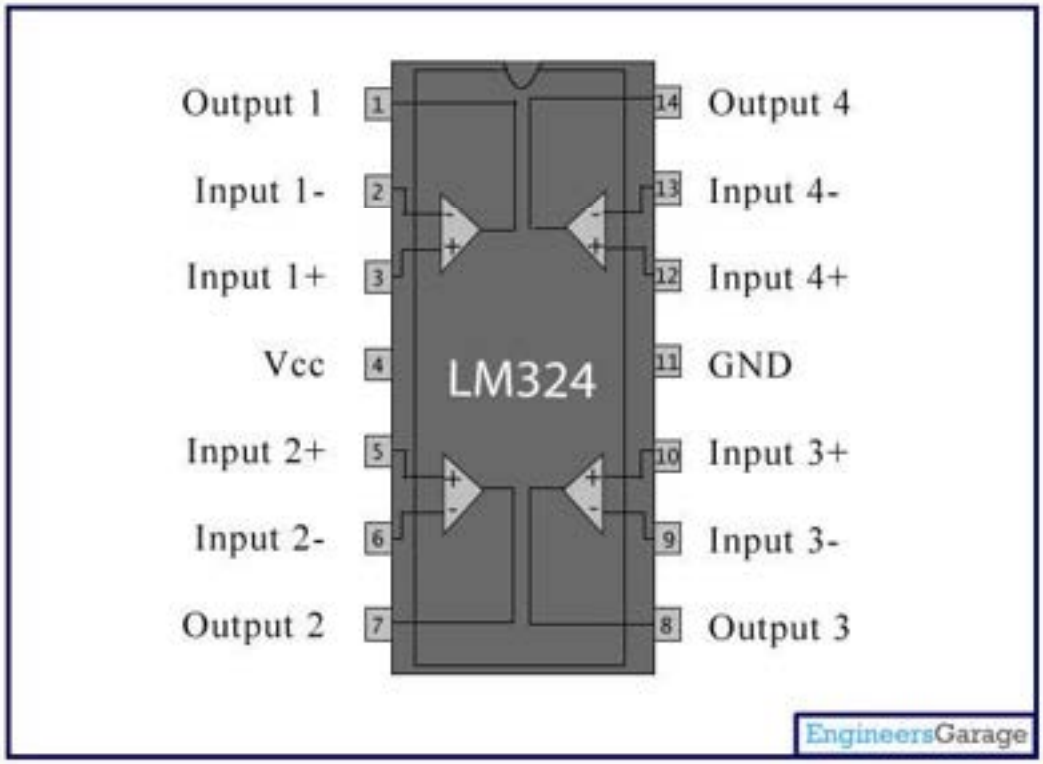


Fig 6.11 LM324 IC

6.12 RFID Reader

RFID is a wireless link to uniquely identify tags. These systems communicate via radio signals that carry data either unidirectional or bidirectional. The tag is energized by a time varying electromagnetic Radio Frequency (RF) wave that is transmitted by the reader. This RF signal is called carrier signal. When tag is energized the information stored in the tag is transmitted back to the reader. This is often called back scattering. By detecting the back scattering signal, the information stored in the tag can be fully identified.

RFID systems use data strings stored inside RFID tags to uniquely identify people or objects when they are scanned by an RFID reader. These types of systems are found in many applications such as passport protection, animal identification, inventory control systems, secure access control systems, robotics, navigation, inventory tracking, payment systems, and car immobilization. The distance over which the RFID tag is usable is affected by such things as the tag shape and size, materials being used in the area near the reader, and the orientation of the

reader and tag in respect to each other and in their operating

environment

Fig6.12 RFID Reader

Some of its major features are:

- Low-cost method for reading passive RFID EM4100 family transponder tags
- Reading Distance 10-15CM of the reader (Depend card shape)
- 125kHz read frequency
- 9600 baud RS232 serial interface
- Standard 2.54mm Pitch Berg strip connector
- Bread Board compatible
- Low power Requirement 7-9V @ 100mA
- Small Size
- Built in Antenna
- No components at PCB bottom side (easy to stick to any surface like wood, glass etc.)
- Status LED for card detection
- On-Board Power LED

6.13 Buzzer

A buzzer or beeper is a signaling device, usually electronics, typically used in automobiles, household appliances such as a microwave oven etc.

Fig 6.13 Buzzer

It most commonly consists of a number of switches or sensors connected to a control unit that determines which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8 ohm speaker. Nowadays, it is more popular to use a ceramic based piezoelectric sounder like a Sonalert which makes a high pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

The word "buzzer" come from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep. Some system, such as the one used on Jeopardy!, make no noise at all, instead using light.

6.14 Android

It is an operating system based on the Linux kernel and designed primarily for touch screen mobile devices such as smart phones and tablet computers. Initially developed by Android, Inc., which Google backed financially and later bought in 2005 Android was unveiled in 2007 along with the founding of the Open Handset Alliance a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first publicly available Smartphone running Android, the HTC Dream, was released on October 22, 2008. Android applications are packed into an .apk file by the program "aapt" (Android Asset Packaging Tool) to simplify development Google provides the Android Development Tools (ADT) for Eclipse. The ADT performs automatically the conversion from class to doc files and creates the apk during deployment

Fig 6.14 Android device

Android supports 2D and 3D graphics using the OpenGL libraries and supports data storage in a SQLite database.

Every Android applications runs in its own process and under its own user id which is generated automatically by the Android system during deployment. Therefore the application is isolated from other running applications and a misbehaving application cannot easily harm other Android applications.

6.15 Status area

Used to denotes the working Status of power supply, data transfer and program execution.

- When the module is successfully powered up, the LED on the reader (PWR) will be ON and the LED on the reader (STS) will blink two times.

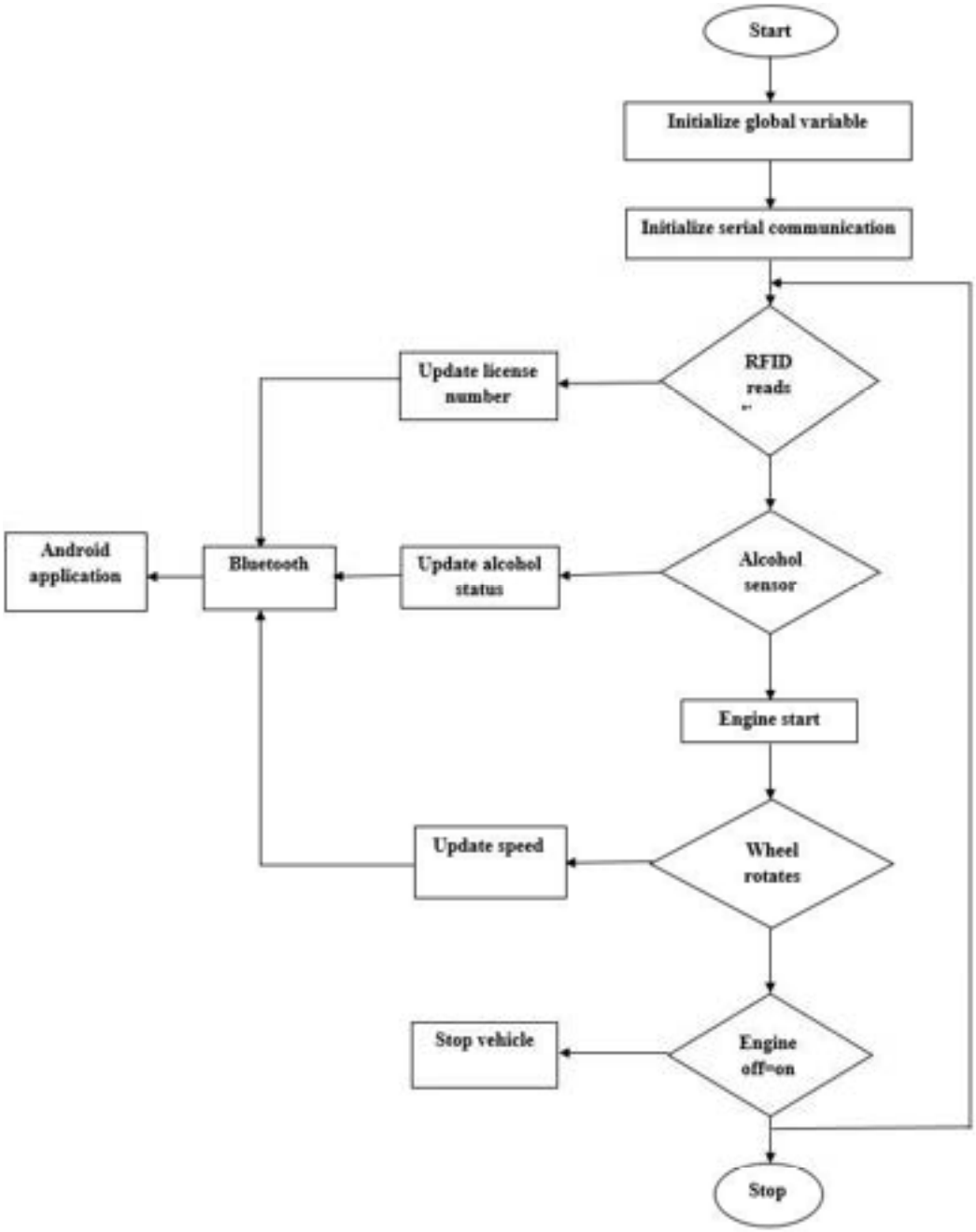
- When RFID Reader(125Khz) – RS232 detect the RFID tag, the LED on the reader (STS) "blinks" to indicate the presence of passive tag.

6.16 Engine start button (switch)

The start button is used to start the engine of the vehicle. A dc motor is used to the engine of the motor. The L293D used to drive the motor.

CHAPTER 7

7.1 Flow chart



7.2 Program

```
#include<pic.h>
#define _XTAL_FREQ  20000000
#define BAUDRATE 9600 //bps
#define stat_led RC2
#define trans_led RC1
```

```
#define data_led RC0
#define buzer RB3

#define rotation RD4
#define alco RD6
#define engine RD2
#define acc1 RD7
#define acc2 RD5

#define mot_fwd RB7
#define mot_rev RB6
void delay(unsigned int k);
unsigned int count1,count2,count3,i,x,j,y,speed,round_count,round;
unsigned char alco_status,count4,acc_status1,acc_status2;
unsigned char count,rec_data,value[12],send[20],p=0,q,m,n    ;
unsigned intcnt;
unsigned char lic[]="ABCDEFGFGHIJ";
bit rfid_flag,flag1,flag2,onflag,engine_flag,send_flag,flag3;

//__CONFIG(0X1932);
__CONFIG(FOSC_HS&WDTE_OFF&PWRTE_ON&CP_OFF&BOREN_ON&LVP_OFF&CP
D_OFF&DEBUG_OFF);

void delay(unsigned int k)
{
for(i=0;i<=k;i++)
{
for(j=0;j<=1000;j++)
{
}
}
}

void InitTimer0(void)
```

```
{
// Timer0 is 8bit timer, select T0CS and PSA to be zero
OPTION_REG &= 0xC0;     // Make Prescalar 1:2
T0IE = 1;                           // Enable Timer0 interrupt
GIE = 1;                            // Enable global interrupts
}
void interrupt ISR(void)
{
if(T0IF)  //If Timer0 Interrupt
{
count1++;
 count2++;
  count3++;
     if(count1>2000)
     {
stat_led=~stat_led;
        count1=0;
     }

    if(count3>4000)
   {
     count3=0;
     if(++count4>30)
     {
      count4=0;
round_count=round;
   round=0;
   speed=round_count;
send_flag=1;
 }
  }
         T0IF = 0;   // Clear the interrupt
}
if(RCIF)  // If UART Rx Interrupt
```

```
{
        if(OERR) // If over run error, then reset the receiver
        {
                CREN = 0;
                CREN = 1;
        }

        rec_data=RCREG;     // Echo back received char

         value[p]=rec_data;
         if(rfid_flag==1)
         {
        if(++p>11)
           {
 p=0;
buzer=1;
data_led=1;
 delay(100);
data_led=0;
buzer=0;
 flag1=1;
        rfid_flag=0;
         }
    }

}
}


void uart_init(void)
{
TRISC6 = 1;                                    // TX Pin
TRISC7 = 1;                                    // RX Pin
SPBRG = ((_XTAL_FREQ/16)/BAUDRATE) - 1;
```

```
BRGH  = 1;              // Fast baudrate
SYNC  = 0;                                  // Asynchronous
SPEN  = 1;                                  // Enable serial port pins
CREN  = 1;                                  // Enable reception
SREN  = 0;                                  // No effect
TXIE  = 0;                                  // Disable tx interrupts
RCIE  = 1;                                  // Enable rx interrupts
TX9   = 0;                                  // 8-bit transmission
RX9   = 0;                                  // 8-bit reception
TXEN  = 0;                                  // Reset transmitter
TXEN  = 1;                                  // Enable the transmitter
}

void main()
{
PORTA=0x00;
TRISA=0x00;
PORTB=0x00;
TRISB=0x00;
PORTC=0x00;
TRISC=0x00;
PORTD=0xff;
  TRISD=0xff

InitTimer0();
uart_init();
buzer=1;
data_led=1;
delay(100);
buzer=0;
data_led=0;
mot_fwd=0;
mot_rev=0;
rfid_flag=1;
```

```
onflag=0;
flag2=0;
unsigned char rec_data=0;
while(1)
{
if(rotation==0)flag3=1;
 if(rotation==1&&flag3==1)
 {
  flag3=0;
 round++;
buzer=1;
   delay(1);
buzer=0;
}
      I f(flag1==1&&flag2==0)
          {
           for(n=0;n<12;n++)
           {
                      delay(1);
          lic[n]=value[n];
                    }
                    flag2=1;
                  }
 if(engine==0)engine_flag=1;
 if(engine==1&&engine_flag==1&&onflag==0)
{
 if(rfid_flag==0)
  {
engine_flag=0;
onflag=1;
buzer=1;
 delay(20);
buzer=0;
  delay(20);
```

```
mot_fwd=1;
mot_rev=0;
}
engine_flag=0;
 }
        if(engine==0)engine_flag=1;
 if(engine==1&&engine_flag==1&&onflag==1)
  {
engine_flag=0;
onflag=0;
buzer=1;
 delay(20);
buzer=0;
 delay(20);
mot_fwd=0;
mot_rev=0;
rfid_flag=1;
         flag2=0;
}
        if(alco==1)
        {
alco_status='Y';
        }
        if(alco==0)
        {
        alco_status='N';
        }


        if(send_flag==1)

        {
 for(x=0;x<12;x++)
                {
```

```
                delay(10);
                TXREG=lic[x];
               }
              delay(10);
               TXREG=',';
 delay(10);
               TXREG=alco_status;
               delay(10);
               TXREG=',';
                delay(10);
               TXREG=speed;
                delay(10);
              TXREG=',';
TXREG=acc_status1;
                delay(10);
 TXREG=',';
                delay(10);
 TXREG=acc_status2;
                delay(10);
               TXREG='*';
               delay(100);
trans_led=1
delay(10);
trans_led=0;
              send_flag=0;

              }
              }
```

CHAPTER 8

ADVANTAGES AND DISADVANTAGES

8.1 Advantages

We are able to minimize the road accidents caused due to the careless driving of non-licensed drivers. People will be aware about the traffic rules and will not be able to violate the rules. Drivers will limit the speed of the vehicle, thus accidents can be reduced. The system tracks the exact location of the vehicle and passes the information to the traffic police force server. Therefore vehicle theft can be easily proven. People will not be able to drive the vehicle by consuming alcohol.

8.2 Disadvantages

RFID card is not an unique identity so it can be misused by someone who is not an authorized license holder. The driver can only start the vehicle after swiping RFID card in the RFID READER and also checking whether he is alcoholic or not so, it is a time consuming process. In weak network area it is difficult to share the data to the data server. In case of emergency the driver is not able to use the vehicle in the absence of RFID tag.

CHAPTER 8
CONCLUSION

The Digital driving license based smart vehicle tracking system was successfully designed and developed according to the requirements and specification. The system used PIC microcontroller as the heart of the project. We introduced this project to reduce the number of accidents occurred due to non-licensed drivers careless driving and due to drink and drive. In

this project an authorized license holder can access every vehicle by using digital RFID license and can switch on the engine. Also we include alcohol sensor, Hall Effect sensor, and accelerometer as a part of road safety. We are proud to express my delight, as the project embarked upon is finished within time.

As we all know nowadays road accidents are mostly occurred due to under aged non licensed drivers, this system is our small attempt to reduce such accidents thus saving human lives. In this case our system will contribute more to our society. This particular application also helps us to reduce careless driving .We can implement this Technology in any vehicle.

REFERENCE

[1] Michael,R.C.(2002).*Smart Card TechnologywithCaseStudies*.Pp.158–159.

[2] Report on Road Accidents in India, Ministry of Road Transport and Highway, Government of

India.

[3] Muji Siti Zarina Mohd,etal."*Simulation of smart card interface with PIC for vehicle security*

system."Computer and Communication Engineering,2008.ICCCE 2008.International Conference on. IEEE, 2008.

[4]John,RoseMary,"*Smart public transport system.* "Embedded Systems (ICES), 2014 International Conference on.IEEE, 2014.

[5]GPS Positioning Guide :A user guide to the Global Positioning System. Natural Resources, Canada.www.geod.nrcan.gc.ca.[Fromthispaper,weunderstoodaboutGPStechnology]

[6]Brian W. Evans, "*Arduino Programming Notebook*".

[7]https://data.gov.in/catalog/stateut-wise-total-numberroad-accidents-persons-killedinjuredfatal-
Accidents.

[8]Computer Science First Edition, 2007.ISSN:2319-7242Volume4Issue6June2015,PageNo. 1250812511.

AUTOMATIC INSPECTION AND WEEDING IN AGRICULTURE USING IoT

A PROJECT REPORT –PHASE II

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ABSTRACT

This inspection strives to develop a robot capable of performing operations like automatic monitoring, inspecting water content according to seed varieties by use of IoT and it automatically weeds the plants which is manually controlled by the user. It checks the level of humidity and informs the farmer. The operating system will be facile even for uneducated peoples. It is user friendly products in which the controls will be facilitate to operate. The monitoring and spraying is been controlled by mobile phone in the basis of IoT. From the initial operation to the final operation, the total control is on phone control.

Hence the advent of robots in agriculture drastically increased the productivity and output of agriculture in several countries. Further, the usage of robots in agriculture reduced the operating costs and lead time of agriculture. The current paper reviews the success stories of robotic agriculture in different areas of agriculture. The work also throws light on the future scope of robotic agriculture especially in developing countries

It may be useful in every form of application in agricultural field in future use. To date we prepared automatic inspection and weeding whether the crop is good and automatic spraying among crops.

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SYMBOLS

Ampere hours	Ah
Area	m^2
Watt	W
Area-Hectare	Ha(100x100m)
Current	A
Distance-meter	m
Efficiency	%
Irradiation	W/m^2
Kilo Watt hours	kWh
Power	W
Temperature	◦C
Time – hour	h
Time – second	sec
Voltage	V

CHAPTER 1

INTRODUCTION

The engineering research in field of agriculture holds a key for sustainable future of mankind. Technological advancement in farming, referred to as agricultural technology as grabbed a massive attention among researchers investors and users.

It focuses on every aspect of farming, starting from crop selection, land preparation, seed selection, sowing until the crop is harvested. Agricultural technology is automation of conventional farming techniques using modern day robots and drones. Development of agricultural equipment has been an extensive process over past many decades and it still continues with intense on robots in agricultural field. In our inspection strives to develop a robot capable of performing operations like automatic monitoring, inspecting water content according to seed varieties by use IoT.

It also automatically weeds the crops by controlling manually by the user. It checks the level of humidity and informs the farmer. The operating system will be facile even for uneducated people. The agricultural robots can also connected to the wireless network will collect the huge amount of information.

1.1. INTERNET OF THINGS

Today, Internet application development demand is very high. So IoT is a major technology by which we can produce various useful internet applications.

Basically, IoT is a network in which all physical objects are connected to the internet through network devices or routers and exchange data. IoT allows objects to be controlled remotely across existing network infrastructure. IoT is a very good and intelligent technique which reduces human effort as well as easy access to physical devices. This technique also has autonomous control feature by which any device can control without any human interaction.

"Things" in the IoT sense, is the mixture of hardware, software, data, and services. "Things" can refer to a wide variety of devices such as DNA analysis devices for environmental monitoring, electric clamps in coastal waters, Arduino chips in home automation and many other. These devices gather useful data with the help of various existing technologies and share that data between other devices. Examples include Home Automation System which uses Wi-Fi or Bluetooth for exchange data between various devices of home.

1.1.1. PRACTICAL APPLICATIONS

The versatility of IoT has become very popular in recent years. There are many advantages to having a device based on IoT. Mckinsey Global Institute reports that IoT business will reach 6.2 trillion in revenue by 2025. There are lots of applications are available in the market in different areas.

1) Personal Field Automation System: Field Automation system is the major example in this area.

WeMo Switch Smart Plug: It is the most useful devices which connected home devices in the Switch, a smart plug. It plugs into a regular outlet, accepts the power cable from any device, and can be used to turn it on and off on hit a button on your smartphone.

2) Enterprise: In the enterprise area many applications are there like environmental monitoring system, smart environment etc.

3) Utilities: smart metering, smart grid, and water monitoring system are the most useful applications in the various utility area.

4) Energy Management: Advanced Metering Infrastructure is the major example in this area.

5) Medical and Health Care: Remote health monitoring and emergency notification system are examples of IOT in the medical field.

Health patch Health Monitor: It can be used for the patient who can't go to doctors, letting them get ECG, heart rate, respiratory rate, skin temperature, body posture, fall detection, and activity readings remotely.

6) Transportation: Electronic toll collection system is the most useful example in this area.

These are the some of the common applications of IoT. But in agricultural field the internet of things plays a role of various applications like ploughing, spraying, seeding, harvesting, purring, composing, plucking etc.

1.2. OPERATING SYSTEM

This is safe to say that the Internet of Things (IoT) is the next big thing in the tech industry. The following are the operating systems used in automation field.

1.2.1 BRILLO

Brillo is an IoT operating introduced by Google which is known as Android-based OS for embedded devices. For extensive secure purposes, Brillo uses the secured boot and signed over-the-air updates. This OS run on constrained devices with at least 128MB of ROM and 32MB of RAM. The following are the intercommunication technologies of Brillo

- Wi-Fi
- Bluetooth
- Thread

1.2.2. ZEPHYR

Zephyr is another real-time IoT operating system like RIOT. This project is initiated collaboratively under Linux Foundation and launched in February 2016. It is available through the Apache 2.0 license. The OS can run on a device with memory as small as 8KB.

The following is the interconnectivity technology of Zephyr

- Bluetooth
- Bluetooth LE

CHAPTER 2

LITERATURE REVIEW

Li Minbo, Chen Guangyu, Zhu Zhu., Internet of Things (IoT) was faced with some difficulties which contained mass data management, various standards of object identification, data fusion of multiple sources, business data management and information service providing. In China, some safety monitoring systems of agricultural product always adopt centralized system architecture in which the data is stored concentratively. These systems could not be connected with or accessed by each other. This paper proposed an information system of agriculture Internet of Things based on distributed architecture. A distributed information service system based on IoT-Information Service, Object Naming Service, Discovery Service is designed to provide public information service including of capturing, standardizing, managing and querying of massive business data of agriculture production. A coding scheme for agricultural product, business location and logistic unit is provided for data identification. A business event model of agriculture IoT is presented for business data management. The whole system realizes the tracking and tracing of agricultural products, and quality monitoring of agriculture production. The implementation of this information service system is introduced.

S. Lachure, A. Bhagat, J. Lachure., Internet of Things (IoT) is a network of sensors and connectivity to enable application like agriculture optimum irrigation. Wireless sensor network (WSN) and Wireless Moisture Sensor Network (WMSN) are components of IoT. One of the important processes in agriculture is irrigation. Improper irrigation will result in waste of water. Proper irrigation system could be achieved by using WSN technology. Monitoring and control applications have been tremendously improved by using WSN technology. It enabled efficient communication with many sensors. WMSN is a WSN with moisture sensors. In this study, Precision Agriculture (PA) used WMSN to enable efficient irrigation. In this paper, we describe about IoT and WMSN in agriculture applications particularly in greenhouse environment. This paper explained and proved the efficiency of feedback control method in greenhouse crop irrigation. A test was conducted to see the

different these two methods. The methods are irrigation by schedule or feedback based irrigation. Irrigation by schedule is to supply water to the plant at specific time periods. Feedback based irrigation is to irrigate plant when the moisture or level of media wetness reached predefined value. The test shows that there is an average savings of 1,500 ml per day per tree.

Joseph Haule, Kisangiri Michael, The Internet of things (IOT) is remodeling the agriculture enabling the farmers with the wide range of techniques such as precision and sustainable agriculture to face challenges in the field. IOT technology helps in collecting information about conditions like weather, moisture, temperature and fertility of soil, Crop online monitoring enables detection of weed, level of water, pest detection, animal intrusion in to the field, crop growth, agriculture. IOT leverages farmers to get connected to his farm from anywhere and anytime. Wireless sensor networks are used for monitoring the farm conditions and micro controllers are used to control and automate the farm processes. To view remotely the conditions in the form of image and video, wireless cameras have been used. A smart phone empowers farmer to keep updated with the ongoing conditions of his agricultural land using IOT at any time and any part of the world. IOT technology can reduce the cost and enhance the productivity of traditional farming.

S. Vijayakumar, J. Nelson Rosario Agriculture plays vital role in the development of agricultural country. In India about 70% of population depends upon farming and one third of the nation's capital comes from farming. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence the project aims at making agriculture smart using automation and IoT technologies. The highlighting features of this project includes smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly it includes smart irrigation with smart control and intelligent decision making based on accurate real time field data. Thirdly, smart warehouse management which includes temperature maintenance, humidity maintenance and theft detection in the warehouse. Controlling of all these operations will be through any remote smart device or computer connected to Internet and the operations will be performed by interfacing sensors

L Atzori, A Iera, G. Morabito As a new emerging and fast growing technology, Internet of Things (loT) has been widely applied in many areas, such as health care, intelligent transportation and agriculture. However, in manufacturing, the IoT-based product lifecycle energy management (PLEM), which is still at its infant stage, has not caught enough attention yet. In order to better promote the development in this field, the framework and the potential applications of IoT-based PLEM are put forward in this paper, which aims at providing a roadmap to direct and guide the related research works in the future

Conclusion

Internet of Things has enables the automatic inspection in agricultural field easy and efficient to enhance the productivity of the crop and hence profits for the farmer. Wireless sensor network and sensors of different types are used to collect the information of crop conditions and environmental changes and these information is transmitted through network to the farmer/devices that initiates corrective actions. Farmers are connected and aware of the conditions of the agricultural field at anytime and anywhere in the world. Some disadvantages in communication must be overcome by advancing the technology to consume less energy and also by making user interfaceeaseofuse.

CHAPTER 3

COMPENENTS SPECIFICATIONS.

After going through all the selected paper the related to various function of inspection in agriculture, this is most unique and simple method for the both inspecting and spraying of water in the field. This is most innovative among others.

3.1. ARDUINO

Figure3.1Arduino UNO.

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.It is the very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6

analog pins and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

3.2. SENSORS

Measurement is an important subsystem in any major system, whether it may be a mechanical system or an electronic system. A measurement system consists of sensors, actuators, transducers and signal processing devices. The use of these elements and devices is not limited to measuring systems.These are also used in the systems which perform specific tasks, to communicate with the real world. The communication can be anything like reading the status of a signal from a switch or to trigger a particular output to light up an LED.

The words sensors and transducers are widely used in association with measurement systems. The sensor is an element that produces signals relating to the quantity that being measured. According to Instrument Society of America, "a sensor is a device that provides usable output in response to a specified quantity which is measured. Here, the output signal can be any measurable signal and is generally an electrical quantity.

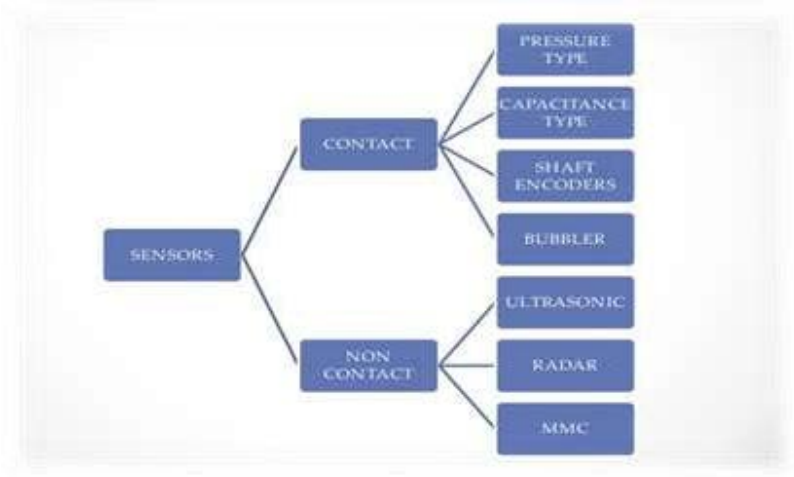

Figure3.2. Types Of Sensors.

According to this phenomena, three different sensors are used in our process proecedure. They are,

1. Temperature sensor

2. Humidity sensor

3. Soil Moisture Sensor

3.2.1. TEMPERATURE SENSOR

Figure 3.3Temperature Sensor.

Temperature sensor is a device, to measure the temperature through an electrical signal it requires a thermocouple or RTD (Resistance Temperature Detectors). The thermocouple is prepared by two dissimilar metals which generate the electrical voltage indirectly proportional to change the temperature. The RTD is a VARIABLE RESISTENCE, it will change the electrical resistance indirectly proportional to changes in the temperature in a precise, and nearly linear manner.

The measurement of the temperature sensor is about the hotness or coolness of an object. The working base of the sensors is the voltage that read across the diode. If the voltage increases, then the temperature rises and there is a voltage drop between the transistor terminals of base & emitter, they are recorded by the sensors. If the difference in voltage is amplified, the analogue signal is generated by the device and it is directly proportional to the temperature.

This provides for temperature measurement through an electrical signal. These sensors are the key to read temperatures correctly and to control the temperature in industrial applications.

3.2.2. HUMIDITY SENSOR

Figure 3.4 Humidity Sensor.

A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Relative humidity becomes an important factor, when looking for comfort.

A capacitive humidity sensor measures relative humidity by placing a thin strip of metal oxide between two electrodes. The metal oxide's electrical capacity changes with the atmosphere's relative humidity. Weather, commercial and industries are the major application areas. The capacitive type sensors are linear and can measure relative humidity from 0% to 100%. The catch here is a complex circuit and regular calibration. However for designers this a lesser hassle over precise measurement and hence these dominate atmospheric and process measurements. These are the only types of full-range relative humidity measuring devices down to 0% relative humidity.

Resistive humidity sensors utilize ions in salts to measure the electrical impedance of atoms. As humidity changes, so do the resistance of the electrodes on either side of the salt medium.

Two thermal sensors conduct electricity based upon the humidity of the surrounding air. One sensor is encased in dry nitrogen while the other measures ambient air. The difference between the two measures the humidity.

3.2.3. SOIL MOSITURE SENSOR

Figure 3.5Soil Moisture Sensor.

The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The Soil Moisture Sensor is used to

measure the loss of moisture over time due to evaporation and plant uptake, evaluate optimum soil moisture contents for various species of plants, monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments.

This sensor uses capacitance to measure dielectric permittivity surrounding medium. In soil, dielectric permittivity is a function of water content. This sensor creates voltage proportional to the dielectric permittivity and therefore the water content of soil. The sensor averages the water over the entire length of the sensor.

3.3. MOTOR DRIVER

Figure 3.6Motor Driver.

Motor drives are circuits used to run a motor. These drive circuits can be easily interfaced with the motor and their selection depends upon the type of motor being used and their ratings (current, voltage).

1. Controller: The controller can be a microprocessor or a microcontroller.

2. Motor Driver IC or Motor Driver Circuits: They are basically current amplifiers which accept the low current signal from the controller and convert it into a high current signal which helps to drive the motor.

3. Motor: Motor is defined as an electric or mechanic device that can create a motion. While interfacing with the controller; some of the motors like DC motor, stepper motor and brushless dc motor may require a driver IC or driver circuit.

4. Power Supply Unit: Provides the required power to the motor drive.

Servo motor is a type of actuator device that consists of a motor and a sensor to control velocity, acceleration etc. The major motor drive components for a servo motor are a controller, power supply unit, servo motor and the necessary connections with the motor.. Usually, Arduino are used for controlling a servo motor driver with a multi servo motor.

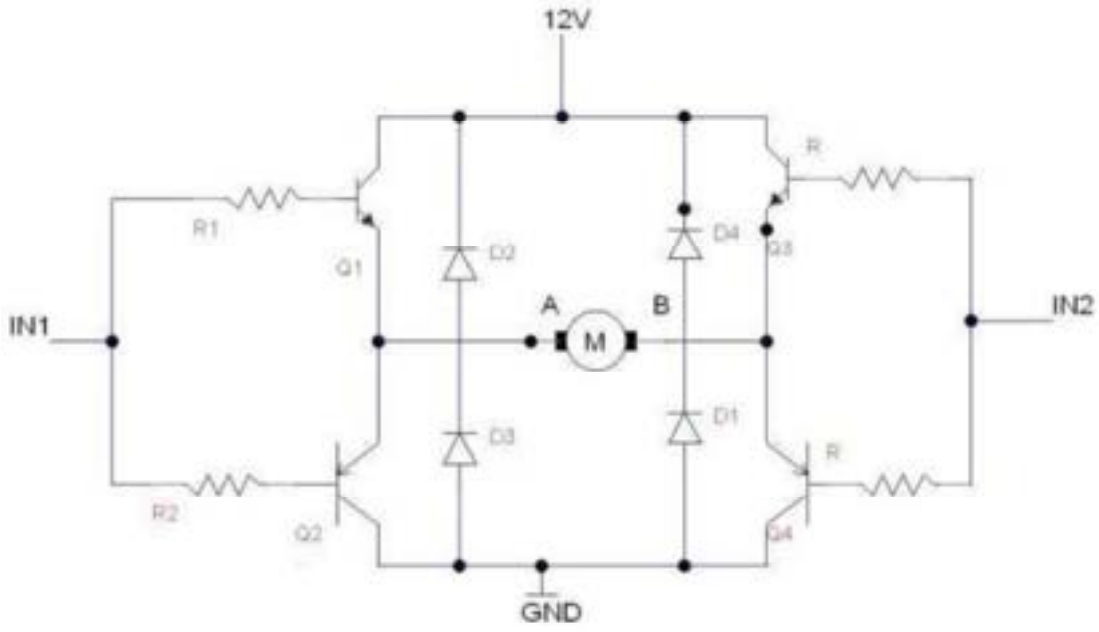

Figure 3.7Circuit Diagram Of Motor Driver.

Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive. Motor drivers are made from discrete components which are integrated inside an IC.. The motor can be a brushless DC motor, brushed DC motor, stepper motor, other DC motors etc.

Input1	Input2	Input3	Input4	Motor State
1	0	0	1	Clockwise rotation
0	1	1	0	Anticlockwise Rotation
0	0	0	0	Idle [High Impedence State]
1	1	1	1	Idle

L293D is a dual H bridge motor driver IC. This 16 pin motor driver IC can drive the motors in anti-clockwise and clockwise direction. Pin Description of L293D

- 1 and 9 are Enable Pins.
- 2, 7, 10, 15 are Input pins.
- 3,6,11,14 are output pins
- 4, 5, 12, 13 are the Ground pins.

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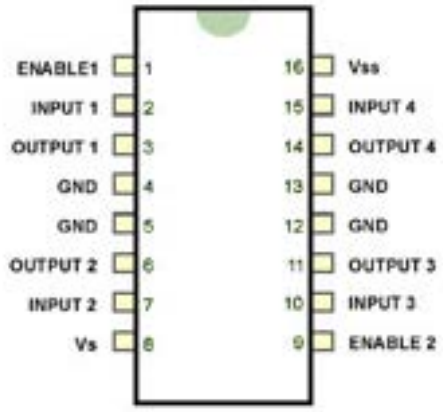

Figure 3.8Pin Diagram Of Motor Driver.

3.4. RFID TAG AND READER

Figure 3.9 RFID Tag And Reader.

1. RFID tag: It consists of a silicon microchip attached to a small antenna and mounted on a substrate and encapsulated in different materials like plastic or glass veil and with an adhesive on the back side to be attached to objects.

2. Reader: It consists of a scanner with antennas to transmit and receive signals and is responsible for communication with the tag and receives the information from the tag.

3. Processor or a Controller: It can be a host computer with a Microprocessor or a microcontroller which receives the reader input and process the data.

2.4.1. Types of RFID Systems:

Active RFID system: These are systems where the tag has its own power source like any external power supply unit or a battery. The only constraint being the life time of the power devices. These systems can be used for larger distances and to track high value goods like vehicles. An active **RFID** system can read tags from 1,500 feet away or more, as the tags broadcast a signal and the systems are designed for longer-**range** applications. Even within one type of **RFID**, however, there can be a wide array of read range.

Active tags possess a battery and usually have larger SMD components. After a preset amount time the tag emits an RF '*chirp*'. A reader in the vicinity can listen and hear for this chirp. Because an active tag is they can be read over much larger distances than passive tags (tens of feet).

Downsides to active tags include greater bulk (because of the battery), limited life span (tag is dead when the battery is exhausted), increased cost per tag, and varying report rates.

Passive RFID system: These are systems where the tag gets power through the transfer of power from a reader antenna to the tag antenna. They are used for short range transmission.

RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention. In a passive RFID system, the tags do not use a battery; instead, they receive their energy to run from the reader. The reader emits an energy field of a few feet, providing the energy for any tag in the vicinity. The tag gathers the electromagnetic energy from the card reader, powers up, and responds with 'hello world' and its identification information.

Passive tags have the benefit of being able to be read at a fast rate (10 or more times a second). They are extremely thin (allowing them to be placed between layers of paper) and are extremely cheap (less than $0.05 in 10,000+pcs volumes).

RFID methods utilize radio waves to accomplish this. At a simple level, RFID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags contain an integrated circuit and an antenna, which is used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then transferred through a communications interface to a host computer system, where the data can be stored in a database and analyzed at a later time.

Some frequencies and systems are designed to only read one tag at a time, while others can read multiple. Cost of readers can also vary wildly based the frequency rating of the modules. In prior years a reader capable of reading multiple tags was in the thousands of dollars, sometimes tens of thousands.

3.5. 24v DC MOTOR

Figure 3.10. DC MOTOR

A Direct Current (DC) motor is a rotating electrical device that converts direct current, of electrical energy, into mechanical energy. An Inductor (coil) inside the DC motor produces a magnetic field that creates rotary motion as DC voltage is applied to its terminal. Inside the motor is an iron shaft, wrapped in a coil of wire. This shaft contains two fixed, North and South, magnets on both sides which causes both a repulsive and attractive force, in turn, producing torque. ISL Products designs and manufactures both brushed DC motors and brushless DC motors. We tailor our DC motors size and performance to meet your desired specs.

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in) and efficiency (%). In order to select the most suitable gear motor for your application you must first compute the load, speed and torque requirements for your application. ISL Products offers a variety of Spur Gear Motors**,** Planetary Gear Motors and Worm Gear Motors to meet all application requirements.

3.6. BLADES

FIG3.11. BLADES

The co joined blades of these type is used to cut the crops in our project. These types of blades are used to cut the crops easily without any damage to the crops. this blade is driven by the 24v dc motor manually by the user.

In this project a mechanism is being developed for harvesting of crop cutter so that harvesting can be done easily in the minimum period of time. The mechanism will be used to cut the crop and that will be a help of farmers. Basically the design is made according to the need of small farmers at very low price. It is fabricated for small piece of land.

CHAPTER 4

EXPERIMENTATION SETUP

4.1 CIRCUIT DIAGRAM

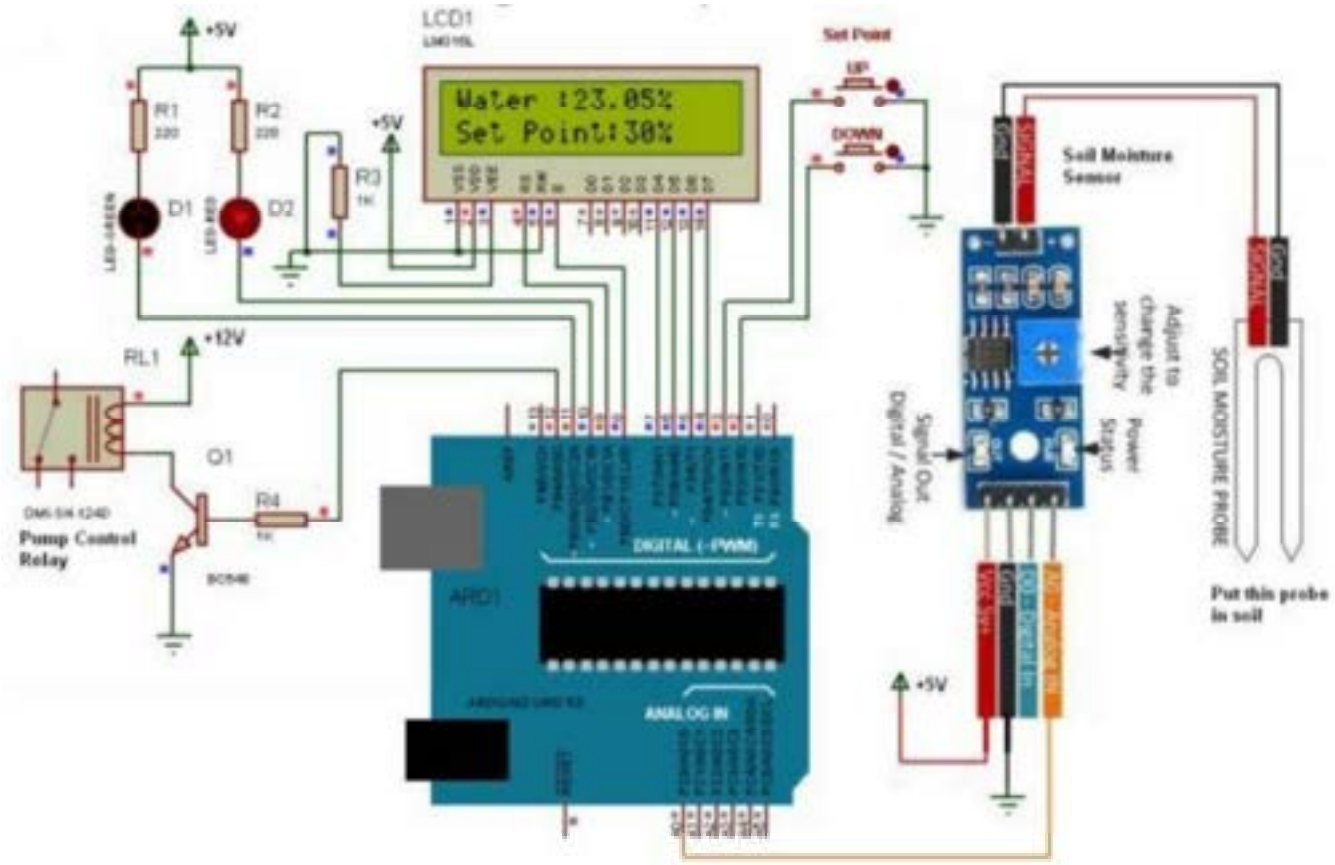

Figure: 4.1Circuit Diagram

This circuit diagram I the connection between the Arduino, senosrs and motors. This also shows the motor driver which is responsible for the movement of the motors in all directions. Supply of 5V is provided to each motor of the vehicle.

The motor driver is used to run the wheels of the agricultural robot. In that way L293D motor driver is used in this phase. The wheels are driven by dc geared motor with specification of 12V and 100RPM. DC motor with this specification has been used so

as to vary the speed of the robot. Front end of the frame is used for harvesting purpose. It is connected to a cutter to serve the harvesting purpose. The cutter is connected to a dc motor which has more rpm (800). The cutter is made of Aluminum sheet and sun board.

Back end of the frame is used for digging process. Metallic teeth like structure are used for digging. This can be elevated using a robotic arm when not in use or when the robot is performing other process than digging. A Funnel has been used to drop the seeds at their location. The funnel is made of plastic material and is connected to vibrating dc motor and the seeds flow through the funnel through the drilled hole on the shaft to the digged soil. A circuit has been designed on the PCB Board to interface all the components and control the agricultural processes. The main component which executes the processes is a microcontroller Atmega 328p which is commonly known as Arduino.

The circuit contains a dc motor driver L293D which can control two dc motor simultaneously, a LCD to display the ongoing operation and to display the parameter of the field defined, Switches which are used for input value and selection of mode of operation, a power supply circuit which consists a voltage regulator (7812) to regulate the power from 16V TO 12V. The circuitry defined above is interfaced and controlled by Arduino UNO. Arduino UNO is a microcontroller which can be used to operate multiple tasks using logical programming. A Solar panel is placed on top of the robot and is connected to the battery for charging and providing power to the robot. 15W solar panel has been used in this robot and 4X4V battery is connected to the power supply circuit.

We are using four switches for setting the parameter and mode selection and for reset. A separate mechatronic sprinkler with water motor is used for irrigation process. It connects with the humidity sensor which sense the moisture of the soil.

The trajectory and sector angles of the jet were controlled by dc motor. A humidity sensor is attached with this sprinkler which will sense the moisture of the soil and give command to the water pump for supplying the water.

4.2. BLOCK DIAGRAM

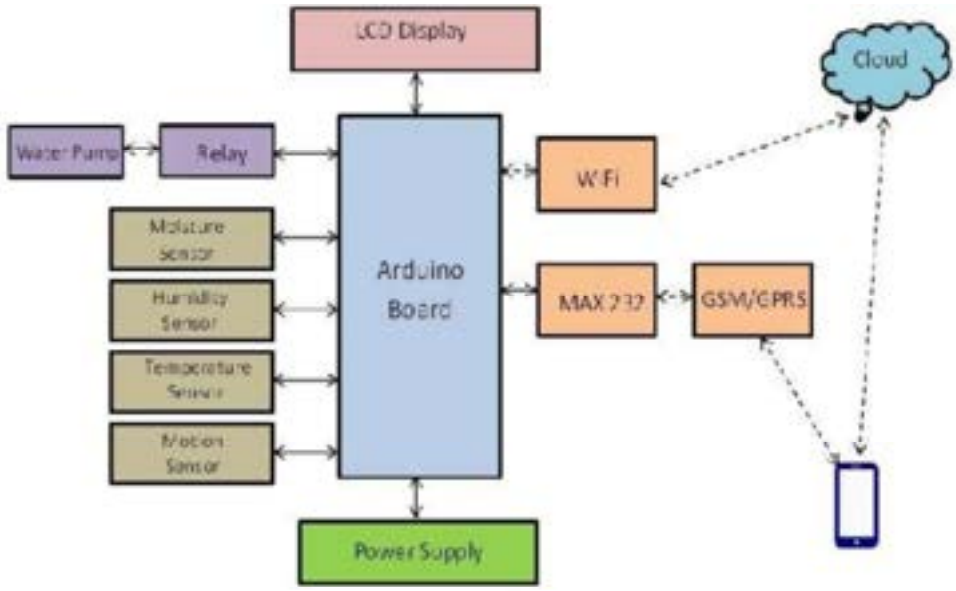

Figure 4.2 Block Diagram

4.2.1. POWER SUPPLY

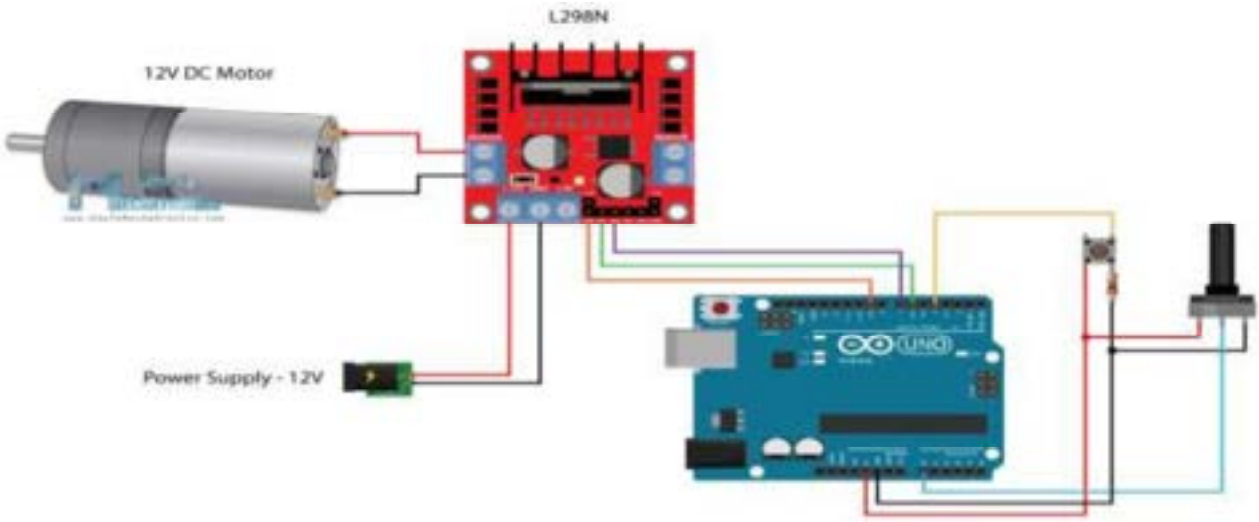

Figure 4.3 Circuit Diagram Power Supply

Since the usage of Arduino UNO, the power supply of 5V is required to activate the Arduino interface. But in other parameters of the project the battery is able to operate the robot within some time duration. That time duration may be varied according to the specification of the operation.

Depending on the specific solution for the docking station it needs either 49 m2 or 44m2 of solar modules to repower the battery of the robot. The robot has a consumption of 520 W when navigating and it can operate for 13 hours, the weeding consumes 625 W and the robot can then operate for 11 hours. It takes 4.8 hours to repower the battery of the robot.

4.2.2. RELAY

Figure. 4.4 Relay

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins.

This relay module has two channels (those blue cubes). There are other models with one, four and eight channels. This module should be powered with 5V, which is appropriate to use with an Arduino.

COM: common pin

NC (Normally Closed): the normally closed configuration is used when you want the relay to be closed by default, meaning the current is flowing unless you send a signal from the Arduino to the relay module to open the circuit and stop the current.

NO (Normally Open): the normally open configuration works the other way around: the relay is always open, so the circuit is broken unless you send a signal from the Arduino to close the circuit.

```
// Relay pin is controlled with D8. The active wire is connected to Normally Closed and common
int relay = 8;
Volatile byte relay State = LOW;

// PIR Motion Sensor is connected to D2.
int PIR Interrupt = 2;

// Timer Variables
long lastDebounceTime = 0;
long debounceDelay = 10000;

void setup() {
  // Pin for relay module set as output
  Pin Mode (relay, OUTPUT);
```

```
  Digital Write (relay, HIGH);
  // PIR motion sensor set as an input
  Pin Mode (PIR interrupt, INPUT);
  // Triggers detectMotion function on rising mode to turn the relay on, if the condition
is met
  AttachInterrupt (digitalPinToInterrupt (PIRInterrupt), detectMotion, RISING);
  // Serial communication for debugging purposes
  Serial.begin (9600);
}
void loop() {
  // If 10 seconds have passed, the relay is turned off
  if ((millis() - lastDebounceTime) > debounceDelay && relayState == HIGH)
    digitalWrite(relay, HIGH);
    relay State = LOW;
    Serial.println("OFF");
  }
  delay(50);
}

Void detectMotion () {
  Serial.println ("Motion");
  if (relayState == LOW {
    DigitalWrite (relay, LOW);
  }
```

```
relayState = HIGH;
Serial.println("ON");
lastDebounceTime = millis();
```

4.2.3. USER INTERFACE

Figure 4.5 User Interface

User Interface Panel was created to modify settings and control Arduino programs using serial commands. Most programs have a few settings that you'd like to change from time to time:

- A set-point temperature,
- The data transmission rate, or
- The power for a radio transmitter, for example.

Information entered into common controls such as buttons, check boxes and sliders can be sent through a serial channel. By sending configuration through a serial port or Ethernet connection, you don't need to modify and upload a new program for every change. Almost any program, even Blink, could benefit from a simple user interface:

This application is developed in the android application studio. This app can be installed in the android smart phone to control the RC unit. This app includes buttons for the movement of the vehicle in different directions. These commands are as follows: Forward, backward, left, right, start and stop.

- Our function could, for example:
- Updating a variable,
- Turn on a light,
- Move a motor.

4.3. SOURCE CODE

```
#include<Arduino.h>
#include<SoftwareSerial.h>//Header for GSM Module
#include<LiquidCrystal.h>//Header for LCD Display
#include"HardwareSerial.h"
#include"RTC.h"
#include"SD.h"

Filefile;
RTC_TIMETYPEt;


SoftwareSerialmySerial(0,1);//Object and pin declaration of GSM Module
LiquidCrystallcd(7, 6, 5, 4, 3, 2);//Object and pin declarations of LCD
/*
 * LCD RS pin to digital pin 7
 * LCD Enable pin to digital pin 6
 * LCD D4 pin to digital pin 5
 * LCD D5 pin to digital pin 4
 * LCD D6 pin to digital pin 3
 * LCD D7 pin to digital pin 2
 * LCD R/W pin to ground
 * 10K resistor:
 * ends to +5V and ground
 * wiper to LCD VO pin (pin 3)
 */
```

```
/**********************/

intsm=A0;//Asign input variable and pin for Soil Moisture Sensor
intldr=A1;//Asign input variable and pin for Light Sensor
inthm=A2;//Asign input variable and pin for Humidity Sensor
inttemp=A3;//Asign input variable and pin for Temperature Sensor
//Variables declaration
intsmValue,ldrValue,hmValue,tempValue,lightValue,soilValue;
floathmVoltage,relativeHm,tempVoltage,degreesC,degreesF;
voidsetup()  // this setup code here is to run once:
{
lcd.begin(20, 4);//Declaration of LCD size and begin the LCD
mySerial.begin(9600);//Start the Serial Communication between GSM and GR-Kaede
Serial.begin(9600);//Start the Serial Monitor

pinMode(sm, INPUT);//Assign Soil Moisture Sensor as Input
pinMode(ldr, INPUT);//Assign Light Sensor as Input
pinMode(hm, INPUT);//Assign Humidity Sensor as Input
pinMode(temp, INPUT);//Assign Temperature Sensor as Input
pinMode(PIN_LED0, OUTPUT); // for SD access
pinMode(PIN_LED1, OUTPUT); // for File access
pinMode(PIN_LED2, OUTPUT); // for File write access
pinMode(PIN_LED3, OUTPUT);
/**********************/
lcd.clear();//Clear the LCD
lcd.setCursor(0, 0);//Set the cursor to origin point
lcd.print(" SMART AGRICULTURE ");//To print SMART AGRICULTURE in LCD
lcd.setCursor(0, 1);//Set the cursor to next row
lcd.print("       SYSTEM ");//TO print SYSTEM in LCD
/**********************/
rtc_init();
t.year=15;
t.mon=10;
t.day=25;
t.weekday=RTC_WEEK_SUNDAY;
t.hour=16;
t.min=31;
t.second=0;
rtc_set_time(&t);
/**********************/
if (!SD.begin()) {
```

```
while (1)

        ; // error

} else {

digitalWrite(PIN_LED0, HIGH); // Success to access SD.

  }
/***********************/
if (SD.exists("myData.csv")) {

SD.remove("myData.csv");

  }
/***********************/
Filefile=SD.open("myData.csv", FILE_WRITE);

if (file) {

//Write

file.println(",,SMART, AGRICULTURE ,SYSTEM,,");
file.println("DATE, TIME, SOIL MOISTURE, LIGHT INTEN., HUMIDITY, TEMP.('C),
TEMP.('F)");

file.close();

digitalWrite(PIN_LED1, HIGH); // Success to open file.

  } else {

while (1)

        ;//Error in opening file

  }
/***********************/
}
voidloop() // put your main code here, to run repeatedly:
```

```
{
staticunsignedlongcurrenttime, oldtime=0;
staticunsignedlongstarttime=millis();

currenttime=millis() -starttime;

if ((currenttime-oldtime) >=2000) //@1sec
{
digitalWrite(PIN_LED2, HIGH); // blink LED

Filefile=SD.open("myData.csv", FILE_WRITE);

/*****************************************************************/

rtc_get_time(&t);
file.println();
file.print(t.day);
file.print('/');
file.print(t.mon);
file.print('/');
file.print(t.year);

file.print(',');

file.print(t.hour);
file.print(':');
file.print(t.min);
file.print(':');
file.print(t.second);


file.print(",");


/*************************************************************************************/

soilValue=analogRead(sm);//Get analog values of Soil Moisture Sensor
smValue=soilValue-24;//Displaying reading within 1000 in LCD
ldrValue=analogRead(ldr);//Get analog values of Light Sensor
lightValue= (ldrValue+200)/10;//Displaying values within 100 in LCD
hmVoltage= (hmValue/1023.0)*5.0; // Convert hmValue to voltage (5V circuit)
```

```
relativeHm= ((hmVoltage+0.958)/0.0307); // Convert voltage to relative humidity
tempValue=analogRead(temp);//Get analog values of Temperature Sensor
degreesC= (tempValue/10)+17;//Convert millivolts to Celsius
degreesF=degreesC*1.8+32;//Convert Celsius to Fahrenheit



/*****************************************************************************/


//Soil Moisture Sensor Details
file.print(smValue);
file.print(',');
//Serial.print("Soil Moisture : ");//Print "Soil Moisture : " in Serial Monitor
lcd.setCursor(0, 2);//Set the cursor in LCD to 2nd row 4th Column
lcd.print(" SM:");//To print "SM:" in LCD display
lcd.setCursor(5, 2);//Set the cursor in LCD to 2nd row 8th Column
lcd.print(smValue);//Display the Soil moisture level in LCD
//Serial.print(smValue);//Display the Soil moisture level in Serial Monitor


//Light Sensor Details
file.print(lightValue);
file.print(',');
//Serial.print("| Light : ");//Print "Light : " in Serial Monitor
lcd.setCursor(0, 3);//Set the cursor in LCD to 3rd row 0th Column
lcd.print(" L :");
lcd.setCursor(5, 3);//Set the cursor in LCD to 3rd row 2nd Column
lcd.print(lightValue);
//Serial.print(lightValue);//Display the Light Intensity level in Serial Monitor

//Humidity Sensor Details
file.print(relativeHm);
file.print(',');
//Serial.print("% | Humidity : ");//Print "Humidity : " in Serial Monitor
lcd.setCursor(9, 3);//Set the cursor in LCD to 3rd row 5th Column
lcd.print("HM:");
lcd.setCursor(13, 3);//Set the cursor in LCD to 3rd row 8th Column
lcd.print(relativeHm);
//Serial.print(relativeHm); //Display the Humidity level in Serial Monitor
```

```
//Temperature Sensor Details
file.print(degreesC);
file.print(',');
file.print(degreesF);
file.print(',');
//Serial.print("% | Temperature : ");//Print "Temperature : " in Serial Monitor
lcd.setCursor(9, 2);//Set the cursor in LCD to 2nd row 11th Column
lcd.print(" T:");
lcd.setCursor(13, 2);//Set the cursor in LCD to 2nd row 14th Column
lcd.print(degreesC);
//Serial.print(degreesC);//Display the Temperature - Celsius in Serial Monitor
//Serial.print("C ");

//Serial.print(degreesF);//Display the Temperature - Fahrenheit in Serial Monitor
//Serial.println("F ");

/*****************************************************************************/


delay(500);
mySerial.print(" Soil Moisture : ");
mySerial.print(smValue);
mySerial.print(" % ");
mySerial.println(" Light Level : ");
mySerial.print(ldrValue);
mySerial.print(" % ");
mySerial.println(" Humidity : ");
mySerial.print(hmValue);
mySerial.print(" % ");
mySerial.println(" Temperature : ");
mySerial.print(tempValue);
delay(100);
mySerial.println("1\x1A");// ASCII code of CTRL+Z
delay(500);
}
```

CHAPTER 5

COMPONENTS COST ESTIMATION

Table 5.1 Components Cost Estimation.

Sl.no	Name of the component	Cost in Rs/item
1.	Arduino UNO	500
2.	Soil Moisture Sensor	370
3.	24v DC Motor	330
4.	Humidity Sensor	300
5.	Motor Driver	210
6.	RFID Tag and Reader	300
7.	Relay	700
8.	Others/Body kit/Blades	1800
Total Cost		**4410.00**

CHAPTER 6

RESULT AND DISCUSSION

Internet of Things has enables the automatic inspection in agricultural field easy and efficient to enhance the productivity of the crop and hence profits for the farmer. Wireless sensor network and sensors of different types are used to collect the information of crop conditions and environmental changes and these information is transmitted through network to the farmer/devices that initiates corrective actions. Farmers are connected and aware of the conditions of the agricultural field at anytime and anywhere in the world. Some disadvantages in communication must be overcome by advancing the technology to consume less energy and also by making user interfaceeaseofuse.

This project will be very useful and helpful to the farmers in the future generation. This project is a user friendly that unskilled persons are also can able to operate easily. Hence by using this project the each and every need of agricultural work can be satisfied easily.

CHAPTER 7

CONCLUSION

The high efficiency of integrated agriculture production systems delivers socio-economic and ecological benefits that benefit farmers as well the whole society.

There are many ways in which integrated agriculture production systems can help producers to adapt to climate change and provide important mitigation co-benefits. However, several factors hamper the effective adaptation of integrated production systems, such as lack of data on the impacts of climate change, and high requirements in terms of knowledge and labor and initial investments that may pay off only over long time periods.

The sustainable intensification of integrated agriculture production systems requires: a better understanding of the impacts of changes in climate and climate variability on these systems; the generation and sharing of local and global knowledge, experiences and practices; capacity development through research and development, dialogue and dissemination of information; and support and coordination of policies, particularly policies that can provide incentives and create enabling institutions

REFERENCES

1. Balaji Banu, "Agriculture Field Monitoring and Analysis using Wireless Sensor Networks for improving Crop Production", 2014 Eleventh International Conference on Wireless and Optical Communications Networks (WOCN)

2. Joseph Haule, "Intelligent agent greenhouse environment monitoring system based on IOT technology", 2015 International Conference on Intelligent Transportation, Big Data & SmartCity

3. Patrick M. Grace, Kisangiri Michael, "Deployment of wireless sensor networks (WSN) in automated irrigation management and scheduling systems: a review", Science, Computing and Telecommunications (PACT),2014,PanAfricanConference

4. M.S.Rahman, M.A.Monayem Miah, Moniruzzaman and S. Hossain,"Preliminary Design for Crop Monitoring Involving Water and Fertilizer Conservation Using Wireless Sensor Networks", Communication Software and Networks (ICCSN), 2011IEEE3rdInternationalConference.

5. James F. Thompson and Steven C Blank, "Wireless Sensor Network Based Automated Irrigation and Crop Field Monitoring System", 2014 Sixth International ConferenceonAdvancedComputing(IcoAC).

6.S.S.Katariya, S.S.Gundal, Kanawade M.T and Khan Mazhar, "A Global Crop Growth MonitoringSystem Based on RemoteSensing",2006 IEEE International SymposiumonGeoscienceandRemoteSensing.

7. Drishti Kanjilal, Divyata Singh, Rakhi Reddy and Prof Jimmy Mathew, "Wireless Sensor Networks for Habitat Monitoring", InternationalConference.

MASK 2ND GENERATION

A PROJECT REPORT PHASE- II

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

DEPARTMENT OF MECHATRONICS ENGINEERING

PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

APRIL 2020

ABSTRACT

The Masks are used as a protection device but it is not highly efficiency to protect a person from the dust, pollution, gases, etc. By this project mask-2 nd generation the protection of a person's life from dust, pollution, gases can be increased, by this increment in protection leads a person to healthy life from pollution and other form of dust, gases that affects the human health. This mask gives fresh air to breath were the breathing problems are reduced and the person may have a cure.

This mask is categorizing into two types based on the filters used in it: uni- functional filter and multi-functional filters. The filters play a major role in this mask which is the heart of the mask. The airflow is maintained by the motors which are in the form of 2:2 rations where 2- motors for suction and 2-motors for exhaustion. These motors and connecting tubes used in this mask act as nerves. The air flow is the important thing to be maintained to get a good air for breathing.

The technology used here is the compression/minimization of large industrial technologies like Electro Static Precipitator (ESP), filters. It is a device used to collect carbon particles from the polluted atmospheric air. This is minimized into a pocket device where the high voltage supply is to be given for that ESP-process.

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LIST OF ABBREVATIONS

ABBREVATIONS

PM	-	Particulate Matter
BC	-	Black Carbon
FFP	-	Face Filtering Piece
EPA	-	Environmental Protection Agency
TIL	-	Total Inward Leakage
NIOSH	-	National Institute for Occupational Safety and Health
RNA	-	Ribonucleic Acid
CPE	-	Cyto Pathic Effect
CFU	-	Colony Forming Units
PFU	-	Plaque Forming Units
FLTF	-	Faceseal-Leakage-to-Filter
CFD	-	Computational Fluid Dynamics
ESP	-	Electro-Static Precipitator
CM	-	Centi Meter
KV	-	Kilo Volt

CHAPTER 1

INTRODUCTION

The Masks are used as a protection device but it is not highly efficiency to protect a person from the dust, pollution, gases, etc. By this project mask-2 Nd generation the protection of a person's life from dust, pollution, gases can be increased, by this increment in protection leads a person to healthy life from pollution and other form of dust, gases that affects the human health. This mask gives fresh air to breath were the breathing problems are reduced and the person may have a cure.

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The technology used here is the compression/minimisation of large industrial technologies like Electro Static Precipitator (ESP), filters. It is a device used to collect carbon particles from the polluted atmospheric air. This is minimized into a pocket device where the high voltage supply is to be given for that ESP-process.

CHAPTER 2

LITERATURE REVIEW

John W Cherrie et.al, - Many residents in Beijing use disposable face masks in an attempt to protect their health from high particulate matter (PM) concentrations. Retail masks may be certified to local or international standards, but their real-life performance may not confer the exposure reduction potential that is marketed. This study aimed to evaluate the effectiveness of a range of face masks that are commercially available in China.

S. Steve Zhou1 et.al, - Prevention of infection with airborne pathogens and exposure to airborne particulates and aerosols (environmental pollutants and allergens) can be facilitated through use of disposable face masks. The effectiveness of such masks for excluding pathogens and pollutants is dependent on the intrinsic ability of the masks to resist penetration by airborne contaminants. This study evaluated the relative contributions of a mask, valve, and Micro Ventilator on aerosol filtration efficiency of a new N95 respiratory face mask.

Xingzhou Li et.al - This system is based on making a vehicle which is moved automatically by the signals of the ultrasonic sensor, controlled by the arduino Uno processor and its software commands. If any obstacle is detected then the movement of the vehicle will be stopped. This helps to move the vehicle automatically and safe without striking to any object and avoiding accidents.

CHAPTER 3

CAPSULE

3.1 CAPSULE OPERATION

The capsule consists of filters such as glass fibre filter, carbon filter, macro and sterilized filter. This unit purifies the dust and other particles from the air. The diagram and image of the capsule is shown below in figure 1**.** The capsule is of two types' they are as follows: -

- Primary capsule
- Secondary capsule / filter tube

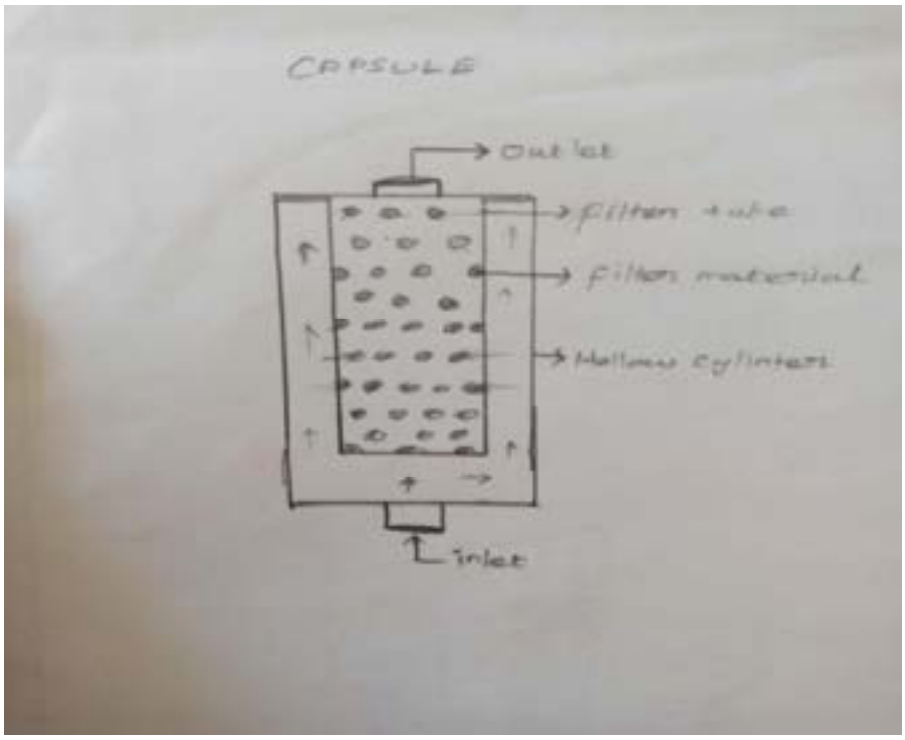

Figure 1 Capsule

3.2 PRIMARY CAPSULE:

It is a external tube which protects the filter material and secondary capsule and also acts as a Support structure. The two ends of the capsule is closed and a valves for air flow is fixed on that end caps, Where the top end cap is fixed to the secondary filter, where the fresh filtered air flows through the top valve Where the bottom end cap is free from secondary capsule in this the dust air flows through it.

3.3 SECONDARY CAPSULE

It is a internal tube which covers by the filter material and secondary capsule and also acts as a Support structure. The two ends of the capsule is closed and a valves for air flow is fixed on that end caps, Where the top end cap is fixed to the secondary filter, where the fresh filtered air flows through the top valve Where the bottom end cap is covered by the filters, where to filter the dust.

The filters are classified in to three types based on the placing of the filter in to the capsules. They are as follows:

- Internal placing
- External placing
- Universal placing

3.3.1 INTERNAL PLACING:

In this internal placing, the filters are placed inside the filter tube/secondary capsule. This holds the un-purified air between the primary and secondary capsule. Where the space for un-purified air is high compared to the purified air, hence this makes the air stabilisation less in the breathing area. The diagram and image of internal placing is shown below in figure 2(a) and 2(b).

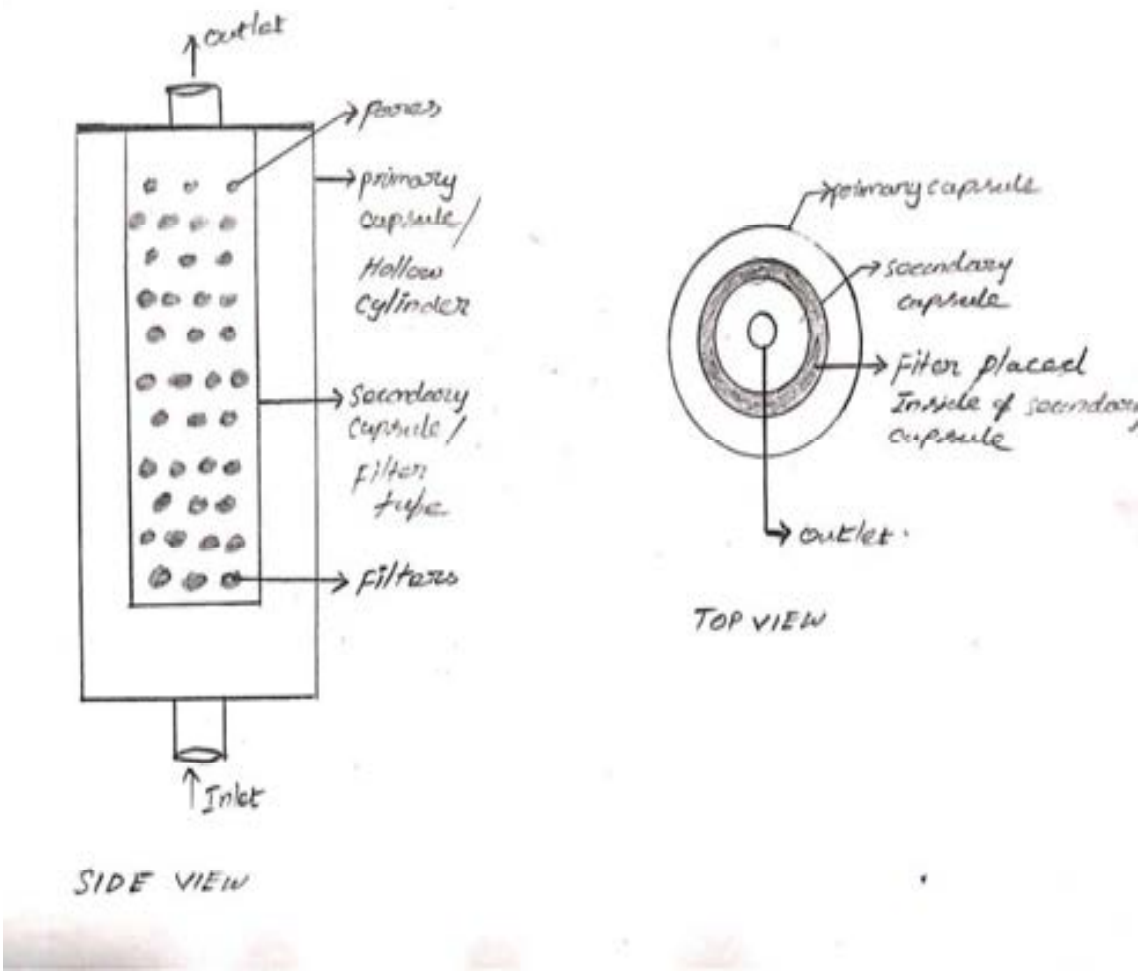

Figure 2(a) Side View and 2(b) Top View (Internal Placing)

3.3.2 EXTERNAL PLACING:

In this external placing, the filters are placed outside of the filter tube/secondary capsule, where in-between the primary and secondary capsule. The efficiency and air holding capacity is high in external placing compared to the internal placing. Here the air holds inside the secondary capsule, which also acts as an additional storage for

breathing. Hence this type is mostly preferred then the internal placing. The diagram and image of the external placing is shown below on 3(a) and 3(b).

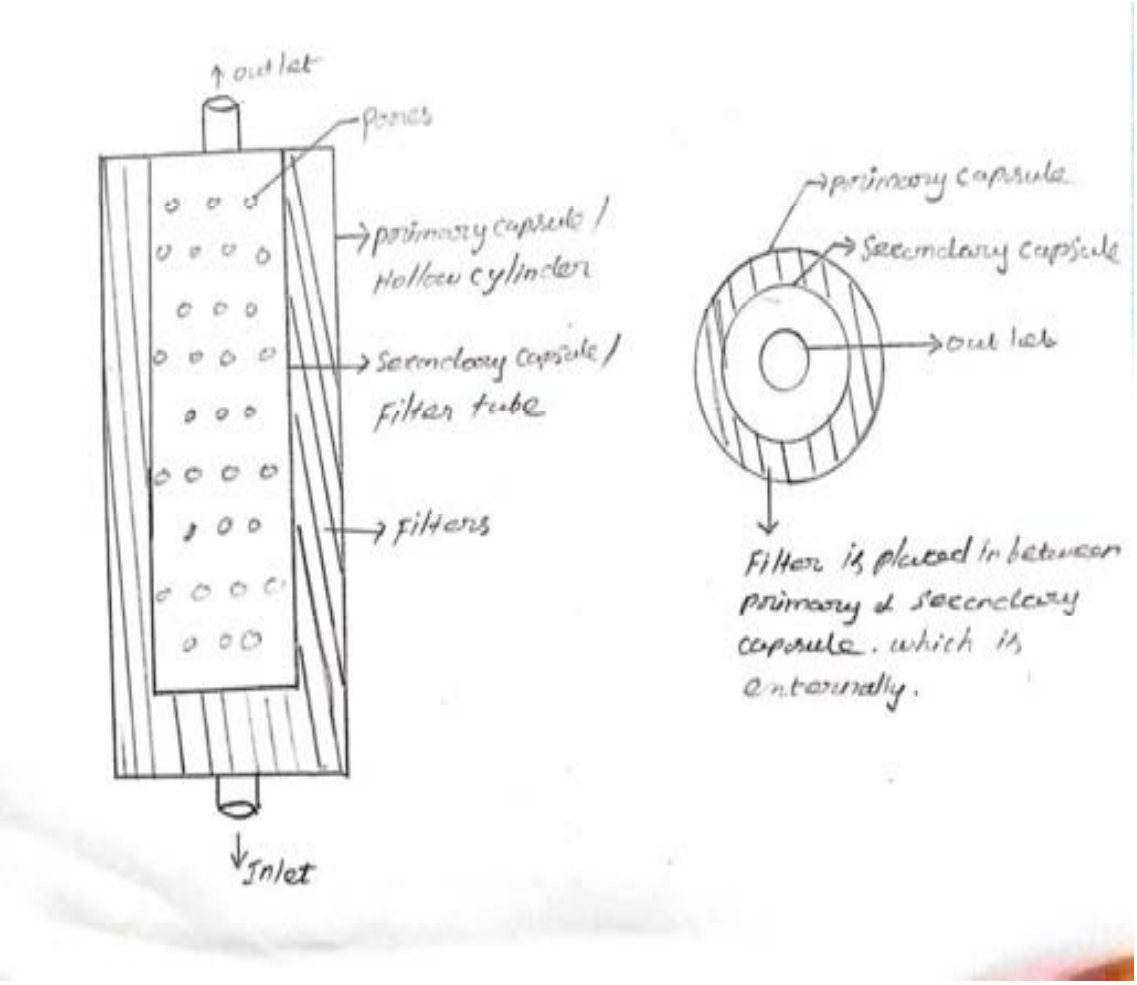

Figure 3(a) Side View and 3(b) Top View (External Placing)

3.3.3 HALLOW TUBE PLACING:

In this Hallow Tube placing, the filters are placed inside the hallow tube. The efficiency and air holding capacity is high in this hallow tube placing type compared to the internal placing and external placing. Here the air holds inside the capsule/ hallow tube, which also acts as an additional storage for breathing. Hence this type is mostly preferred then the internal placing and external placing. The diagram and image of the external placing is shown below on 3.

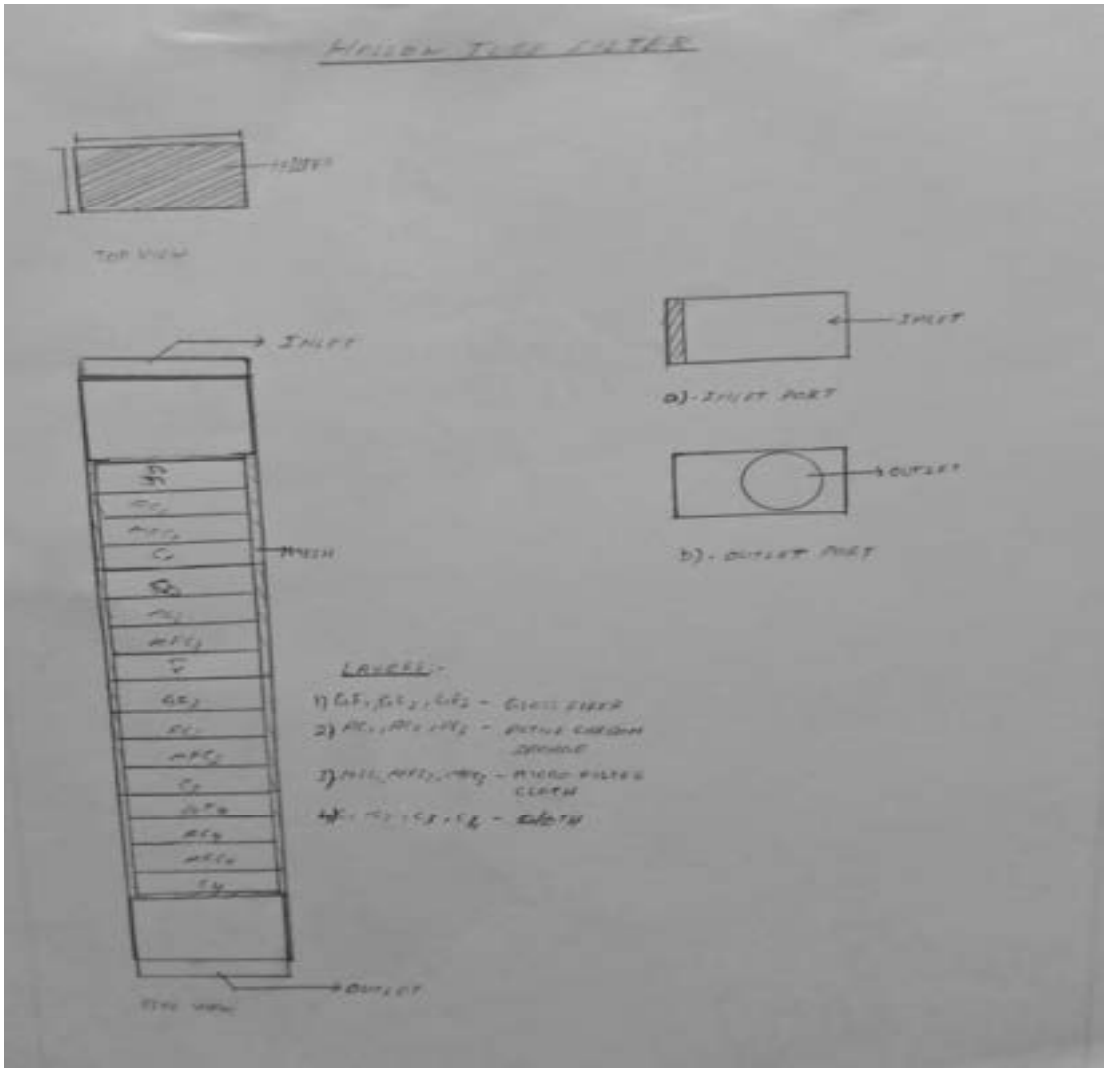

Figure 4 Inside view of the hallow tube placing

3.4 POLYMERIC NANOFIBER GAUZE MASK TO PREVENT INHALING (PM2.5) PARTICLES FROM HAZE POLLUTION

PM2.5 (particulate matter with diameter of 2.5micronor less) in polluted air can directly go through the lung alveolar to cause many diseases including asthma. Recently, many Chinese cities are covered by haze air. The heavy metals adhered on PM2.5 particles may even lead to severe chronic health problems such as cancer after long-term exposure under the particles contained environment. In order to prevent

inhaling PM2.5 in haze, people wear regular gauze masks. Most of those masks are made of non-woven fabric, activated carbon, or cotton which has fiber diameter of several micrometres. They have significant shortcoming of poor PM2.5 rejection and low air permeability. In this paper, a novel polymeric nanofiber masks were synthesized by electro spinning. Such masks based on nanofiber\ are expected to well prevent the PM2.5 particles and maintain a good air permeability. These nanofibers can be potentially developed to high efficiency and low-cost mask product.

3.4.1. EXPERIMENT MATERIALS:

Polysulfone, acetone, polyethylene oxide, and dimethyl acetamide were purchased from Beijing Chemical Factory, China. Medical clinic masks, medical operating room masks, ITO PM2.5 masks, N95 respirator, and R95 masks were purchased from Tianjin Youkang medical and health care products factory. All chemicals were of analytical grade and were used without further purification.

3.4.2. PROCEDURE FOR ELECTRO SPINNING:

Polysulfone solution was prepared at a concentration of 18wt% by dissolving in DMAc/acetone (9 : 1) with vigorous stirring. The prepared solution was kept overnight without stirring under room temperature to remove air bubbles. For the electro spinning, the 18wt% Polysulfone solutions were filled into a syringe with a metal needle connected with a high-voltage power supply (Tianjin Dongwen High Voltage Co., China). The voltage is 13KV and the distance between the needle and the aluminium foil is 13cm. The polymer solution was fed at a constant rate of 0.4mL/h by using a syringe pump. The nanofiber were collected on the surface of a non-woven PP on the grounded aluminium foil. The collective time of nanofiber was 15, 30, and 60min.

3.4.3. MORPHOLOGY OBSERVATION:

The membranes were dried in vacuo and sputtered gold before observation. The morphology of nanofiber membranes was imaged by scanning electron microscopy (SEM, Hitachi T-1000, Japan).

3.4.4. PERMEABILITY SIMULATION TEST:

Permeability simulation test device mainly includes a pump, a pressure differential gauge, a meter, and bronchus. The nanofiber matts and the commercial masks as control group were clamped by a well-sealed testing chamber, which was connected with a syringe at top, install a pressure meter at the side exit. The bottom side of the chamber was open to the ambient air. Counterweights were placed on the syringe to adjust the pressure inside the testing chamber. The resulting pressure above the nanofiber matts was measured by the pressure meter.

3.4.5. INTERCEPT RATE TEST:

Intercept experimental equipment was conducted in a nuclear particle counter (Model of CPC 3772 made in TSI Company). That counter can measure the concentration of particles (diameter between 10 and 2500 nm) in the air. The particle concentration in air represented the PM2.5 intercept rate of the filtration material.

3.4.6. DATA ANALYSIS:

All data were mean SD from three independent experiments. Comparisons between multiple groups were performed with the ANOVA test by SPSS. *P* values less than 0.05 were considered statistically significant. 15 min 30 min 60 min : Nano masks on non-woven fabrics.

Figure 5 Nano masks on Non-woven Fabrics.

3.4.7 FACE MASKS USED TO PARTICULATE AIR POLLUTION

In China, air pollution causes around 1.6 million premature deaths each year and the loss of around 31 million disability-adjusted life years. Annual average particulate matter of aerodynamic diameter 2.5 micrometres (PM2.5) concentrations in Chinese megacities well exceed the WHO's guideline of 10 μg/m3, and corresponding black carbon (BC) concentrations are around 5 μg/m3. Beijing PM2.5 concentrations often reach unhealthy levels during the winter and near busy streets.

Chinese residents now have access to air quality information and can take measures to protect themselves in the short term. Studies in China have found that wearing face masks can have positive impacts on\ short-term health outcomes such as blood pressure and heart rate variability, although it is unclear what level of exposure reduction was associated with these impacts, given that only ambient particulate concentrations were measured.

In occupational health, the term 'respirator' includes a range of personal respiratory protection products, including disposable filtering face piece (FFP) respirators, sometimes referred to as 'dust masks' or 'face masks', particularly in lay parlance. In this manuscript, we use the latter term (or abbreviate to 'mask'), as we are evaluating these devices for use in non-occupational air pollution settings. Respirators remove particles from the inhaled airstream by filtration, through gravitational settling, inertial impaction, interception, diffusion and electrostatic deposition.

Filtration efficiency depends on particle size, charge, concentration and flow rate through the filter material. In practice, the contaminant may bypass the filter, by passing through small gaps between the edge of the respirator and the face, so-called 'edge-seal leakage'. The extent of leakage depends on factors such as the size and shape of the face, facial hair, the respirator design and the way that it is worn.

Disposable particulate respirators sold for use in workplaces are generally tested to ensure compliance with appropriate international or national standards, but face masks sold for public protection against air pollution may not need to comply with any standards, and so may not be suitable. In November 2016, the Chinese National Institute of Standardization issued a new guideline to recommend testing of protection levels for 'daily protective masks'.

This guideline (GB/T 32 610–2016) categorises masks based on their filtration efficiency. Unlike GB2626-2006 (the Chinese standard for occupational masks) and other regulatory standards, it is not compulsory that 'daily protective masks' fulfil these testing guidelines. The tests in this study were carried out before the introduction of this guideline.

There is limited information about the performance of face masks against diesel exhaust particulate, which may play an important role in the health impacts of ambient particulate matter (PM). Studies often test the filtration efficiency of a section of the mask filter material in a sample holder or on mannequin heads, usually sealing the mask to the mannequin's face. One study investigated the filtration efficiency of mask filter material complying with the N95 criteria (filtering ≥95% particulate), finding that between <0.5% and 4.3% of the diesel aerosol, measured as elemental carbon, passed through the filters. Languish *et al*demonstrated that several mask materials allowed <5% of a diesel exhaust challenge through the material.

A study of the filtration efficiency of masks mounted on a mannequin head with mask sealed to the head found penetration of diesel aerosol mass between 11% and 15% for FFP2 masks and 13%–24% for FFP3 masks. These studies, however, did not account for inward leakage around the seal between the mask and face on humans.

Previous work on face masks used by the public has indicated poor performance, with masks often being poorly designed and ill-fitting. The Shanghai Municipal Bureau of Quality and Technical Supervision and China Consumers Association tested the filtration efficiency of several commercially available face masks.

The methods are not described in the reports, but few of the masks passed the requirements. We have found no direct measurements of the effectiveness of masks against diesel exhaust particulate or ambient particulate pollution when worn by people. Masks mounted on mannequins provide only partially realistic tests. Therefore, the aim of this study was to test the filtration efficiency of a range of masks sold to consumers in Beijing and, for the best performing masks, to assess mask effectiveness in reducing exposure to diesel exhaust particulates when worn by volunteers.

3.4.8 MASK MATERIAL PENETRATION:

The surface area of each mask was estimated using image editing software (Paint. Net V.4.013, dotPDN LLC, 2016) from a scanned image. A circular area was cut from each mask and fitted to a sample holder (15.9 cm^2). Masks were tested in a chamber for 30 min under flow rates equivalent to 40 L/min and 80 L/ min through the whole mask but scaled to the area of the mask in the sampler. These rates were chosen to reflect high intensity breathing rates, which would be expected to draw more particles through the filter material and therefore mimic a worst case scenario (eg, cycling or running through traffic). The US Environmental Protection Agency (EPA)'s Exposure Factors Handbook, suggests the mean high activity breathing rate for males and females aged 21–<31 years old is 50 L/min (95^{th} percentile 76 L/min). The testing order of the masks was randomised. The target challenge BC concentration was 50µg/m3. A

MicroAeth AE51 (Aethlabs, San Francisco, USA) measured BC, and a Sidepak AM510 (TSI) measured PM2.5. The Sidepak was not calibrated for diesel exhaust, because we were examining the relative change in filtration, rather than absolute concentrations.

Figure 6 General Mask

3.4.9 VOLUNTEER TESTS:

Four masks for the volunteer tests were selected based on performance in the material penetration tests and mask design, including how the masks would seal against the face and method of attaching the mask to the head. Volunteers were recruited via word of mouth, social media and a local marketplace website. Volunteers were screened to ensure they had no underlying health problems. The original design was to have eight volunteers (four male, four female), each wearing all four masks, with two tests per mask (one standing and one sitting). However, the first two female volunteers dropped out after testing two masks, and two other female volunteers were recruited to test the remaining two masks. The total number of volunteers, therefore, was 10 (4 male, 6 females). Four facial dimensions were measured using anthropometric callipers: lip length, distance from chin to nasal root (menton– sellion length), facial width

(bizygomatic width) and tragion (ear) to the tip of the nose. One individual measured all of the volunteers to reduce any variability in the measurement method. A Latin square design was employed to randomise the order in which the masks were tested by the volunteers. Additional information on the mask and sampling equipment donning are available in online supplementary information. The tests were conducted in an exposure chamber supplied with air from a mixing chamber connected to a small diesel engine with the target average BC concentration of 50$\mu g/m^3$.

3.4.10 SIMULATION TESTS:

Volunteers performed two simulation tests, designed to reflect everyday activities: (1) sitting (sedentary) and (2) standing and walking on the spot (active). All simulations had subtasks breathing normally (5 min), deep breathing (2 min), moving the head up and down (2 min), moving the head side to side (2 min), talking (2 min), bending over (2 min) and breathing normally (2 min). BC was measured simultaneously inside the mask (penetration concentration) and in the exposure chamber (challenge concentration).

3.4.11 DATA ANALYSIS:

The per cent penetration for each mask's filter material was calculated by dividing the penetration concentration by the challenge concentration at each time point, for BC and PM2.5. Agreement between the penetration percentages from the MicroAeth and Sidepak readings were assessed using a Spearman correlation. For the simulation study, the total inward leakage (TIL) percentage of BC was calculated by dividing the concentration measured inside each mask by the concentration in the exposure chamber for each time point. The unadjusted mean, median and interquartile range (IQR) of TILs were generated for each mask. Autocorrelation for time-series data, where values are influenced by previous time points, was assessed with the Durbin-Watson statistic. A Cochrane-Orcutt first-order autoregression model was developed to adjust TILs by the following covariates: mask type, time, gender, face size and activity. Covariates were

included in the model using a likelihood ratio test significant at P<0.05. Goodness of fit of a log-linear model was compared using the Bayesian information criterion. For categorical variables, the level contributing the smallest incremental increase in TIL was used as the reference.

3.5 ACTIVITIES OF TESTS

The activities undertaken during the tests were grouped if volunteers were (1) sitting or standing/walking, (2) moving their head, (3) remaining stationary, (4) talking, (5) breathing deeply or (6) bending. Volunteers were classified as either small/ medium or large face sizes by National Institute for Occupational Safety and Health (NIOSH) guidelines based on face length and width and through the assessment of lip length and face depth. Data analysis was performed using the 'prais' command in Stat V.13.1.μ.

3.6 MASK MATERIAL PENETRATION:

Overall agreement of penetration between the two instruments was very good (rho=0.84, P<0.001). In the 40 L/min flow rate scenario, eight of the nine masks demonstrated median rates of penetration below 9% for both PM2.5 and BC . The median penetration of BC ranged from 0.2% (IQR: 0.2%–0.3%) to 20.7% (IQR: 19.6%–22.1%) with the lowest value being for the 'Yimeijian' mask and the highest being for the 'Gucheng Professional AntiHaze W&G' ('Gucheng') mask. Values were similar, but slightly higher, using 80 L/min, ranging from (IQR: 0.4%–1.0%) to 32.8% (IQR: 21.1%–35.3%) with the same masks performing best/worst. Penetration of PM2.5 was typically greater than for BC: the Yimeijian mask exhibited the lowest median penetration at 0.3% (IQR: 0.2%–0.3%) for the 40 L/min flow, with the highest corresponding penetration seen for the Gucheng, with a median of 29.3% (IQR: 27.7%–30.3%). The median range for 80 L/min tests extended from 0.8% (IQR: 0.7%–1.1%) for Yimeijian to 41.4% (IQR: 33.9%–50.2%) for Gucheng.

3.7 VOLUNTEER STUDY:

The 3M9322, 3M9502, Yi Jie PM2.5 mask and the Yimeijian mask were selected for the volunteer trials. There was relatively little variability in face size among volunteers, with the exception of two, which were classified as large. The eight other volunteers were classified as having 'Small' or 'Medium' faces. provides the TIL ranges for the four masks tested in the volunteer studies, in the same order shown in. TIL values in excess of 100% are possible where there is a very poor facial seal; in this instance, TIL values would largely represent fluctuations of similar concentration levels inside and outside the mask. A number of high outliers are evident in the TIL values for both 3M masks; the TIL values exceeding 30% occurred for a single subject for each 3M mask, although the volunteers differed between masks. There was clear variation in the unadjusted median TILs across the four masks tested, spanning from 1.8% (IQR: 0.6%–4.7%) for 3M9322 to 67.3% (IQR: 56.6%–75.2%) for the Yi Jie PM2.5 mask.

There was apparent variation in the TIL across volunteers, time and activities. The Durbin-Watson statistic was 0.12 from a simple regression model with mask type as the dependent variable, indicating positive autocorrelation. The transformed value produced in a Cochrane-Orcutt regression was close to 2.00 (1.85), suggesting autocorrelation had been sufficiently addressed. Only mask type and activity were significant in the model at $P<0.05$. Face size, sitting/standing and elapsed time had no measureable effect on TIL.

A log-linear model was deemed a better fit than a linear model according to the Bayesian information criterion difference. After adjustment for covariates, the 3M9322 mask was significantly better than the three other masks, which increased leakage by a factor of 2.0 (95% CI 1.2 to 3.3) to 26.7 (95% CI 16.4 to 43.5). Compared with talking, only bending and head moving contributed to higher TIL, ranging from 1.1 (95% CI 1.0 to 1.3) to 1.2 (95% CI 1.1 to 1.3) times greater than the reference category of talking, respectively. After adjustment for autocorrelation, the regression model explained 11% of the variation in the TIL data.

We assessed the real-life effectiveness of masks worn by Beijing residents, to protect against urban air pollution. We demonstrate that a mask with highly efficient particle filtering material may confer little protection when worn. Facial fit and movement have a large impact on the actual protection. In spite of the generally good filtration efficiency of the tested mask materials, two of the masks performed poorly when worn because of inadequate fit to the face. These included a reusable mask with disposable filters (PM2.5) and a single-fold disposable mask . The reusable mask cloth was loose, and the filters did not cover the whole surface area of the mask. These masks used elasticated ear loops to hold them onto the face rather than head straps. Even for the better-performing masks (3M9502 and 3M9322), some volunteers' results indicated that the fit was not sufficient to ensure maximal performance of the mask.

Our first-order auto regression model suggested the presence of large differences in the efficacy of the tested masks, and that activities, namely, bending and head moving, adversely affected the fit. The best performing mask had an estimated mean leakage of 2.3%, which corresponds to a protection factor of 43 (protection factor being the inverse of the leakage, or TIL). The poorest performing mask had a mean leakage of 61% (protection factor 1.6). The face size of the volunteer or the duration did not have a detectable effect on leakage; however, the tests were conducted over a short time, and we cannot be certain of the effect of longer duration wear.

Our results correspond with findings from van der Sande *etal*, who tested an FFP2 mask versus a surgical mask and a home-made tea cloth mask against sodium chloride (NaCl) particles <1 μm diameter on volunteers. They found differences between protection factors for volunteers within a single mask type, with children much less protected compared with adults. Variation of protection by activity was Boxplots of the per cent penetration of each mask assessed for black carbon (MicroAeth) and PM2.5 (Sidepak) monitors. Boxes indicate the 25th–75th percentiles (the IQR), and the lines inside the boxes indicate the median (50th percentile). The whiskers indicate values within 1.5 times the IQR, and the dots are the outliers. Boxplot showing the total inward leakage for each mask tested in the volunteer trial. Boxes indicate the 25th–75th percentiles (the IQR), and the lines inside the boxes indicate the median (50th

percentile). The whiskers indicate values within 1.5 times the IQR, and the dots are the outliers.

3.8 DISCUSSION ABOUT THE MASK:

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although the ffp2 mask conferred greatest protection in terms of its material composition, fit were an important factor.

In this study, a novel nanofiber mask was synthesized by electro spinning for preventing the PM2.5 from haze air. That nanofiber mask showed better performance than the commercial Masks in both air permeability and PM2.5 rejection. To make a clear comparison, the advantages and disadvantages of commercial masks have been summarized in. Most of the masks were made of non-woven fabric microfibers with large diameters of several micro meters.

The thin microfiber mask such as the disposable non-woven mask, though showed excellent air permeability, performed poor rejection on PM2.5 due to the insufficient thickness of fibers and larger inter fiber space. In contrast, the thick microfiber masks of Ito PM2.5 and N95 improved the rejecting ratio of PM2.5 to >80% which is enough for daily use. But they both had high resistance on air permeability which led to uncomfortable breathability in use. The R95 mask, which is commonly used in medical purpose, could well protect the doctors from virus infection. However, it was not suitable for preventing air pollution in daily use because of the extremely poor air permeability.

The Nano fiber mask with 15 min electro spinning had a high PM2.5 rejection of 90% and acceptable air permeability. Therefore, it is a good mask raw material for preventing haze air pollution. The requirement on air permeability and PM2.5 rejection is a contradiction. That means the high air permeability usually reduces the particle rejection of PM2.5 and vice versa. As shown in Figure 3, the nanofiber mask (15min) displayed the largest difference between air permeability and PM2.5 rejection among these masks. We attribute that unique feature to the nano scaled fiber size. At the same porosity, which indicates air permeability, the smaller fiber required higher quantity to achieve the same coverage as that of the bigger fiber. More fibers in the same area result in smaller inter fiber space. when the fiber scale is down to submicron, the inter fiber space between the nano fibers is also reduced to micron scale, which is smaller than the PM2.5 size, consequently rejecting the PM2.5 passing efficiently.

3.9 ASSESSMENT OF INFLUENZA A VIRUS AND RHINOVIRUS TYPE 14 PENETRATION

An aerosol filtration test apparatus assembled at Microbac per modified ASTM F2101-14 was used for the influenza and rhinovirus penetration study. Test masks (the mask with operating Micro Ventilator, the mask with operating Smart Valve but without Micro Ventilator, or the mask with the Smart Valve covered/sealed) were placed between upstream and downstream chambers. The virus filtration efficiency test was performed in triplicate (N=3). For each run, a six-jet Collison nebulizer (Mesa Labs, Butler, USA) was filled with a measured amount of virus suspended in 0.1× Minimum Essential Medium (MEM) and the virus was aerosolized and delivered into the upstream chamber using high-pressure air. A downstream vacuum was turned on to create an air flow (28.3 L/min) through the mask that was intended to mimic human breathing. After the delivery of the aerosol, the upstream air pressure was turned off and the downstream vacuum pump was left on for another minute to pull residual aerosol from the chambers into the one-stage Andersen sampler. Virus aerosol that passed through the mask was captured on a Petri dish containing semi-solid medium (5% gelatin/minimal essential medium). The collected sample was liquefied at 36±2 ℃ for approximately 10 min. The resulting samples were divided into separate portions for ribonucleic acid (RNA) extraction and for infectivity assays.

Viral infectivity was measured on the basis of cytopathic effect (CPE) generated in MDCK cells (for influenza virus) and H1-HeLa cells (for rhinovirus). For the infectivity assay, a ten-fold dilution series of the samples collected as described above was prepared in a dilution medium. The sample dilutions were then inoculated onto the host cells. After 4–9 days of incubation, the CPE was scored under a phase-contrast light microscope. Viral titers were calculated in units of log10 50% tissue culture infectious doses (TCID50) per mL.

3.10 ASSESSMENT OF S. AUREUS AND BACTERIOPHAGE ΦX174 PENETRATION

Bacterial and phage filtration efficiencies for the masks without Micro Ventilator were determined at Nelson Laboratories per EN 14683:2014 and ASTM F2101-07, respectively. The purpose of this testing was to assess the filtration efficiency of the filter material used in the test mask.

The bacterial filtration efficiency test compared the upstream bacterial control counts to downstream counts (i.e., counts attributed to passage of bacteria through the face mask). A suspension of *S. aureus* was aerosolized using a six-jet Collison nebulizer and delivered to the face mask (N=5 replicate measurements) at a constant flow rate (28.3 L/min) and challenge delivery [1.7–2.7×103 colony forming units (CFU)] with a mean particle size (MPS) of 3.0±0.3 µm. The aerosolized droplets were drawn through a six-stage Andersen sampler for collection. The viral filtration efficiency test compared the upstream bacteriophage control counts to downstream counts (i.e., counts attributed to passage of bacteriophage through the face mask). A suspension of bacteriophage ΦX174 was aerosolized using a six-jet Collison nebulizer and delivered to the face mask (N=5 replicate measurements) at a constant flow rate (28.3 L/min) and challenge delivery [1.1–3.3×103 plaque forming units (PFU)] with a MPS of 3.0±0.3 µm. The aerosolized droplets were drawn through a six-stage Andersen sampler for collection.

CHAPTER 4

REPIRATORY PROTECTION

A study of respiratory protection against volcanic ash also found that industry-certified n95 or n99 equivalent masks performed best in volunteer til tests compared with masks made from other materials with similar filtering abilities. similarly, grin shpun *et al* found that 70% of total variability in the faceseal-leakage-to-filter (fltf) ratio was associated with subject characteristics, compared with 30% due to how the subject put on the respirator.

They also found that movement exercises resulted in larger fltf ratios and that the ratio increased as particle size increased (from 0.04 to 1 μm). Conversely, lee *et al* did not find a particle-dependent protection relationship in a similar size range, and shakya *et al* found variable results with regard to filtration efficiency and particle size (all below 1 μm). These size-dependent effects may be due to submicron-sized particles being more likely to deposit by diffusion. Diesel exhaust particulate primarily consists of the ultrafine fraction of the aerosol, which can be breathed deep into the alveolar region of the lung and may then cross into the bloodstream.

The use of a diesel exhaust challenge, rather than sodium chloride, provides a scenario that is closer to real-world exposures, particularly near busy roads, where people are more likely to wear masks. Gao *et al* found that N95 filters did not perform as well compared with R95 or P95 filters when exposed to combustion source aerosol (wood, paper and plastic) compared with NaCl, although all these filters did filter at least 95% of the aerosol. None of the masks tested in our study were certified to the Chinese guidelines for 'daily protective masks' (GB/T 32 610–2016), because the guidelines were introduced after our study was conducted, but six of the nine masks we tested were reportedly certified to GB2626-2006, or an international equivalent. One of these (Yi Jie) performed poorly in the volunteer trial. While respirators for workplace use are required to be tested to a rigorous standard, including TIL, respirators for the consumer market are not.

An analysis of internet purchases of face masks in urban areas across China found that a 100-point increase in the Air Quality Index resulted in a 70% increase in sales of masks marketed as 'anti-PM2.5' and a 54% increase in all mask purchases, indicating that this is a popular method of protection used by people in China. To ensure that the general public are able to effectively protect themselves, all consumer air pollution masks should be required to fulfil the same standards as workplace masks, and sales of non-compliant models should be restricted.

Consumers in China also need better information about the type of masks that should be used, the actual TIL that might be achieved with face masks and how to wear the masks to achieve a good fit. Consumers should know that, although surgical masks may have reasonable filtration efficiency, the design generally confers poor facial fit and high TIL with regards to air pollution. In addition to consumer applications, our study has implications for research studies that investigate health benefits of mask-wearing to protect against air pollution. While studies have shown some reduction in blood pressure and increases in heart rate variability from wearing a respirator over a few hours, there was no assessment of the exposure reduction while the respirators were being worn in any of these studies. That there may be considerable inter individual and intra individual variation in TIL, even with relatively well-constructed respirators, and there are potentially large, systematic differences among respirator brands.

4.1 RESEARCH IN MASK:

Our study was not a comprehensive survey of air pollution face masks, but rather, provides preliminary results. We selected a convenience sample of masks from retail outlets based on accessibility and design type. There are a wide variety of masks on the market, and we were not able to test all of them. We also had a relatively small sample size of volunteers, and not all volunteers wore all four masks that were being tested; therefore, we cannot draw conclusions about the fit across all tested masks for a

given face shape. We had more small/medium face types than large and did not have sufficient volunteers to distinguish small from medium.

We had similar numbers of males and females but, due to small numbers, this was not a representative sample, nor were the subjects exclusively Chinese. Another potential uncertainty in our study relates to the response of the instruments to the aerosol concentration. If the response is not linear across the range of concentrations, we may be underestimating or overestimating the filtration efficiency. We have previously evaluated the MicroAeth AE51 in the field versus a reference aethelometer (AE22) and found a consistently linear relationship across the range of concentrations tested in this study (unpublished data).

Although we do not have a reference comparison for the Sidepak for PM2.5, the relationship between the penetration ratios for each instrument is linear, implying that the Sidepak should have a similar response across the range of concentrations in the study.

In future work, we suggest that a comprehensive survey of the different face mask types available and of their popularity of use be conducted. A larger, more representative population sample should be recruited for testing, and a wider variety of face mask types should be tested for TIL. In day-to-day use, respirators will not be constantly worn, and this will inevitably reduce the overall protection offered although, to our knowledge, there are no extensive study data available on wearing behaviour of consumers in China.

To assess the exposure-reduction potential of real-world face mask use in the public, it is necessary to understand wearing patterns and to assess the effect of constant donning and doffing of masks by the general public. In future studies of the public health benefits of wearing respiratory protection, we recommend the researchers monitor particulate concentrations inside the face piece and take these data into account in analysis of the association between exposure to particulate pollution and health

markers. This would provide a more accurate assessment of particulate exposure change and more robustness to the evaluation of the exposure–response relationship.

4.2 RESEARCH IN PROTECTION ON ENVIRONMENT:

Protection of individuals from environmental pollutants, including pathogens, allergens, and fine particulates (PM2.5), can be achieved, in part, through use of personal protective devices such as respiratory face masks. The use of face masks for this purpose is more common in certain geographical regions, such as China and India, where population densities are higher, and the residents are more likely to be chronically exposed to PM2.5 levels exceeding annual World Health Organization Air Quality Guidelines (<10 μg/m3).

The compliance of use of respiratory face masks should be facilitated by features such as the Smart Valve and operational Micro Ventilator, which are designed to aid in the evacuation of exhaled gases from the interior of the mask. The enhancement of user comfort may be measured quantitatively through assessment of gas content in the dead space of the mask and systemic and facial thermoregulation.

A randomised clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children found, in a clinical study in children aged 7–14 years, that wearing this test mask without Micro Ventilator increased the end-tidal CO_2 ($ETCO_2$) and fractional concentration of inspired CO_2 ($FICO_2$), compared to children without masks at rest and during brisk walking. In contrast, wearing the mask with operational Micro Ventilator brought $FICO_2$ levels for both activities closer to baseline levels obtained in children not wearing the mask.

Computational Fluid Dynamics (CFD) simulation experiments conducted in adult subjects have demonstrated that the introduction of a ventilation fan to the N95 mask is a feasible option for reducing CO_2 accumulation in the dead space of the mask and also for controlling the temperature of the air within the dead space.

A randomised clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children. confirmed the earlier CFD studies indicating reduction of CO_2 in the dead space of the mask with operational ventilator fan. Furthermore, CFD studies performed in adult subjects have demonstrated reduction in heat, CO_2, and moisture build-up within N95 masks configured with operational ventilator fans. Moisture build-up in N95 masks used in high humidity atmospheres has been shown to reduce filtration efficiency of the masks for Ebola-Makona virus .

Mask inhalation and exhalation breathing requirements were met by the test mask with operational Smart Valve and Micro Ventilator fan. Additional evidence that the Smart Valve and Micro Ventilator fan results in a mask that provides acceptable breathing resistance characteristics (inhalation and exhalation) is the fact that the test mask was awarded an N95 rating by NIOSH. Testing for satisfaction of this rating includes evaluation of inhalation and exhalation resistance. The use of respiratory face masks with operational ventilation fans is therefore useful both from a comfort-enhancement perspective as well as for providing optimal filtration efficiency.

Ideally, any features added to a respiratory protective device solely for the purpose of enhancing wearer comfort should not adversely impact the primary function of the device, which is to filter airborne particulates and infectious agents from the contaminated air. In the present study, we have assessed the efficiency of the test mask for filtration of surrogate pathogens (bacteria and respiratory viruses) and pollutants. Various configurations of the mask were challenged, including the mask with operating Micro Ventilator, the mask with operating Smart Valve but without Micro Ventilator, and the mask with the Smart Valve covered/sealed. The latter configuration would be considered "best case" for excluding experimentally aerosolized contaminants [surrogate pathogens/particulates such as PM2.5], while the fully operational Micro Ventilator would be considered "worst case" for this purpose. For instance, a poorly functioning Smart Valve may allow environmental contaminants into the interior of the mask, defeating the purpose of the mask as a filtration device

CHAPTER 5

HARDWARE DESCRIPTION

5.1 COMPONENTS USED

- Active carbon filters
- Glass fibres as filters
- Metal sheets
- Mini motor with propeller
- Cylinder
- Adult oxygen mask
- Tubes
- Electro static precipitator(ESP)
- Connectors

5.2 ACTIVE CARBON FILTERS:

Activated carbon filters are generally employed in the process of removing organic compounds. In air purification systems, activated carbon filters can be used in conjugation with HEPA filters to trap known allergens and impurities like dust, mould spores, carbon dust, etc. the image at figure 6(a) and 6(b) is how the carbon filter tube looks.

Figure 7(a) Carbon Filter

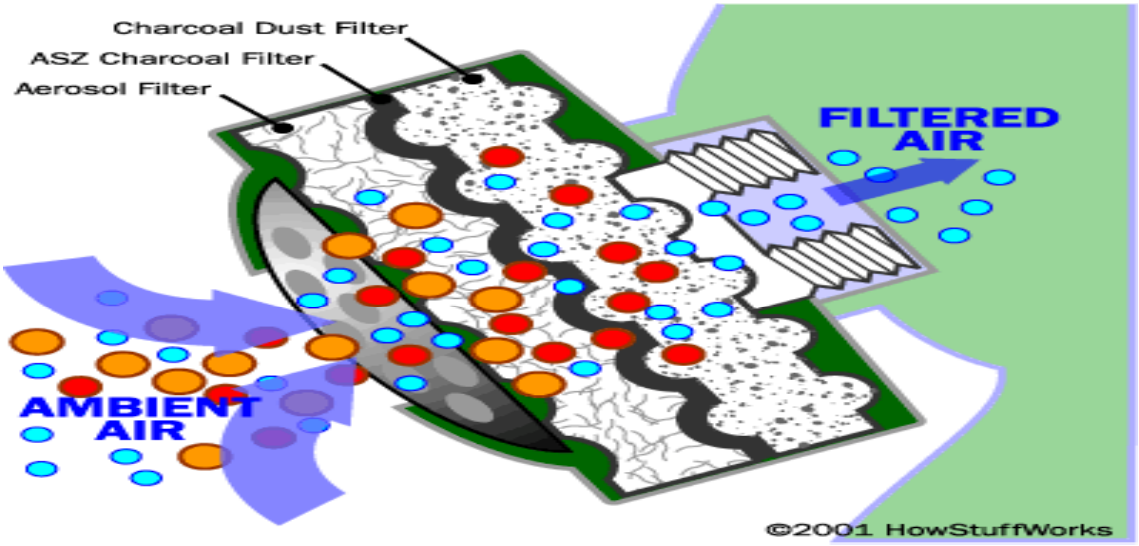

Figure 7(b) Carbon Filter in Gas Mask

5.3 GLASS FIBRES AS FILTERS:

The low cost filters are commonly referred to as depth filters. They are ideal for general gravimetric air sampling and analysis. Suitable when no other analysis than weighting is required binder and additive free. Available un-weighed and pre-weighed. Glass filter is shown in figure 7.

Figure 8 Glass Fibre

5.4 METAL SHEETS:

The metal sheets are used to get strong shape and structure of the mask. This is supportive to internal and external design

5.5 MOTOR WITH PROPPELER:

The motor with propeller is used as a suction unit to suck the air from atmosphere for breathing which pass through the filters.

5.6 ELECTRO STATIC PRECIPITATOR:

A device that removes suspended dust particles from a gas or exhaust by applying a high-voltage electrostatic charge and collecting the particles on charged plates. It is of various types based on the shapes we use here is plates and cylindrical type as shown in the figure 8(a) and 8(b).

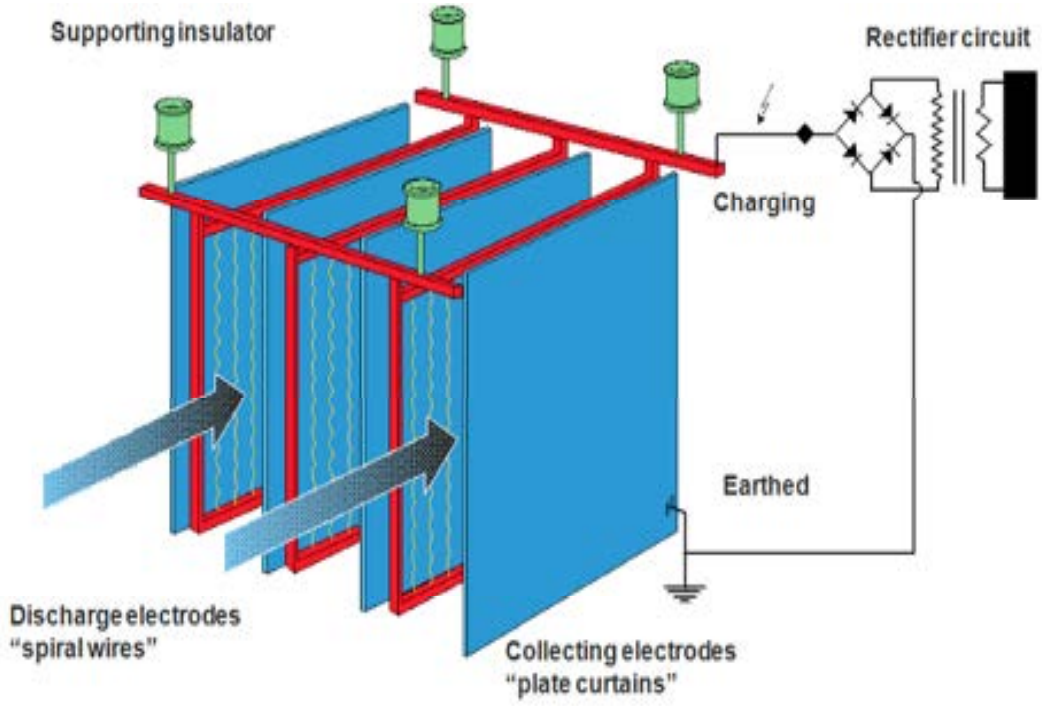

Figure 9(a) Plates Type ESP

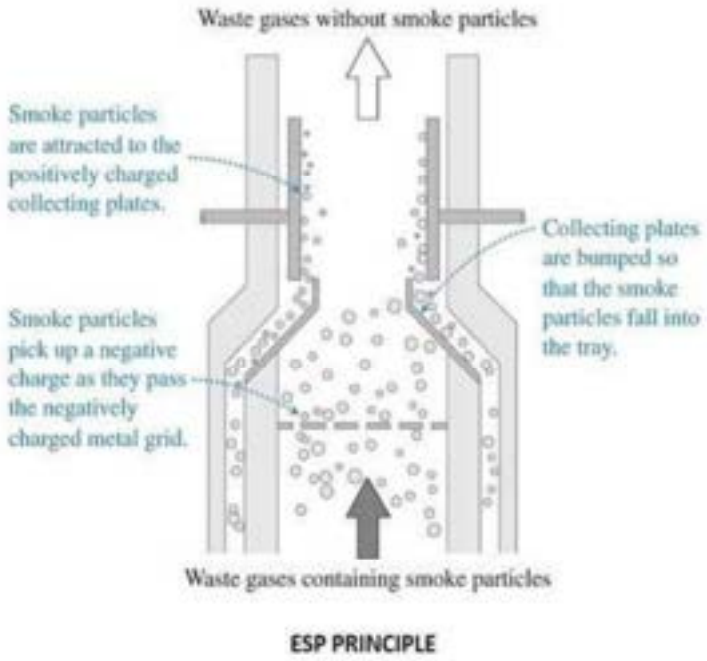

Figure 9(b) Cylindrical Type ESP

5.7 TUBES AND CONNECTORS:

The tubes and connector's are used to connect the devices end to end. Where the fresh air can be send for breathing and the exhaust air flows out with the help of motors.

Figure 10(a) Tube

Figure 10(b) Elbow Connector

CHAPTER 6

ADVANTAGES

- Used as multi-purpose device.
- It can be altered based on customers design.
- The filters can be replaced with new one.
- It gives us pure air to breath.
- The disease due to air pollution is reduced.
- It provides high safety to the people who are all having asthma, vising, and other breathing problems.
- It also gives protection to the face from obstacles which is suspended in air.
- The metal-sheet frame gives protection to face and jaws.

CHAPTER 7

COST ESTIMATION

Table 1 Cost Estimation.

Sl.No	Description	Quantity	Price
1	Active carbon filters	1	3700
2	Glass fibres as filters	1	2750
3	Metal sheets	2	500
4	Mini motor with propeller	1	100
5	Adult oxygen mask	1	250
6	Tubes	25	200
7	Connectors	2	1000
8	Electro static precipitator(ESP)	1	3000
Total			11,500

CHAPTER 8

CONCLUSION

This project is designed to reduce the breathing problems due to dust and carbon dust polluted areas such as roads, desert storms in desert regions. Here the tech used is electrostatic precipitation and filters as in regular masks. It consists of two units' suction unit and exhaustion unit; it is powered by mini motors. To power up the electric components, tritium is used or by regular batteries with solar power can also be used. This provides high safety and pure clean air to breath. As further we are doing research on weight reduction and addition of technology such as SPO2 sensor to detect the content of oxygen in the blood which is easy to increase the flow of air to breath when the oxygen content in the blood is low.

REFERENCES

1. John W Cherrie, Andrew Apsley, Hilary Cowie, Susanne Steinle, William Mueller, Chun Lin, Claire J Horwell, Anne Sleeuwenhoek, Miranda Loh" Effectiveness of face masks used to protect Beijing residents against particulate air pollution".

2. S. Steve Zhou, Salimatu Lukula, Cory Chiossone, Raymond W. Nims, Donna B. Suchmann, M. Khalid Ijaz," Assessment of a respiratory face mask for capturing air pollutants and pathogens including human influenza and rhinoviruses".

3. Xingzhou Li and Yan Gong" Design of Polymeric Nanofiber Gauze Mask to Prevent Inhaling PM2.5 Particles from Haze Pollution".

AUTOMATIC TEMPERATURE BASED FAN CONTROLLER USING THERMISTOR

A PROJECT REPORT-PHASE II

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(AUTONOMOUS)

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ABSTRACT

Over the last decade, advances in electronics have made devices smaller, cheaper and faster. This project is about how the speed of a fan can be controlled, based on temperature sensor. It is also a part of smart home application where the fan will gradually increase its speed if the temperature is increasing. In general, home appliance fans need to be operated manually with the help of regulators with the variation of temperature, thus requires a repeatedly extra effort for regulating the fan speed which acts to our agony. So as to reduce this extra effort and to add comfort, it is intended in this paper designing an "Automatic Temperature based Fan Controller using Thermistor". In this project the main intension is to control the fan by heating the sensor, i.e. the thermistor, where the speed of the fan is dependent and controlled by any device's temperature like PC. As the temperature of the device increases or decreases, the speed of fan increases or decreases respectively. So it can be used mainly as a cooling device. By modifying the circuit slightly, it can also be used to control the room temperature, depending on the property of thermistor. The thermistor used in the circuit here, decreases its resistance with increasing temperature, hence the electrical conductivity also increases, increasing voltage across it, resulting in an increment in the speed of the fan. Thus, it is possible to control the speed of the fan automatically when the device's temperature varies. Experiment can be followed to evaluate whether this circuit can save energy through the use of temperature sensor and thus promote efficiency.

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LIST OF ABBREVIATIONS AND SYMBOLS

SYMBOLS

V	-	Voltage
cm	-	Centimeter
Ω	-	Ohm
mm	-	Millimeter
W	-	Watt
K	-	Kilo
Hz	-	Hertz
℃	-	Celsius
µF	-	Microfarad

ABBREVIATIONS

PTC	-	Positive Temperature Coefficients
NTC	-	Negative Temperature Coefficients
AC	-	Alternating Current
DC	-	Direct Current
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
RMS	-	Root Mean Square
CRT	-	Cathode Ray Tube
OLED	-	Organic Light Emitting Diode
RGB	-	Red Blue and Green
TFT	-	Thin Film Transistor
TN	-	Twisted Nematic
VAP	-	Vertical Alignment Panels
IPS	-	In Panel Switching
AFFS	-	Advanced Fringe Field Switching
PCB	-	Power Control Box
NRE	-	Non-Recurring Engineering Cost
MOQ	-	Minimum Order Quantities

DVD	-	Digital Versatile Disc
AQUOS	-	Advance Quality Unit Operating System
PDA	-	Personal Digital Assistant
ASV	-	Adaptive Servo Ventilation
CUI	-	Character Oriented User Interface
SPL	-	Sound Pressure Level
PID	-	Positive Identification Device
IC	-	Integrated Circuit
PMDC	-	Permanent Magnet Direct Current
CD	-	Current Density
PWM	-	Pulse Width Modulation
SMD	-	Surface Mount Device

CHAPTER 1

INTRODUCTION

The circuit exploits the property of sensor to operate the DC Fan. A sensor is a type of transducer. In a broader sense, a transducer is sometimes defined as any device that converts energy from one form to another. Besides that, the component that made up the temperature sensor is known as thermistor. Thermistor is a kind of temperature dependent resistor and its resistance varies depending on the temperature in its vicinity. There are two types of Thermistors- Negative Temperature Coefficient Thermistor (NTC) and Positive Temperature Coefficient Thermistor (PTC).

NTC Thermistor decreases its resistance when the temperature increases while PTC Thermistor increases its resistance when the temperature increases. Thermistors are bead like resistors available from 100 ohms to 10K or more values. In this circuit, a 1K (25°C) NTC Thermistor is used. A small DC fan increases or decreases its speed as per the temperature change. When the temperature decreases below a certain level, Fan automatically turns off.

Electronic fan is one of the most post electrical devices due to its cost effectiveness and low power consumption advantages. It is a common circuit and widely used in many applications. It is one of the most sensible solutions to offer a comfortable and energy efficient. In fact the fan has been long used and still usable in the market.

Nowadays, the demand for accurate temperature control and air freshening control has conquered many of industrial domains such as process heat, automotive, industrial places or occupants. One of the most important concern involved in heat area consist in the desired temperature achievement and consumption optimization. So, an automatic temperature control system technology is needed for the controlling purpose in the fan speed according to the temperature changes.

Many researches focusing on automatic temperature control system application in different fields will gain the benefits. For examples, an automatic temperature controller for multi element array hyperthermia systems, multi loop automatic temperature control system design for fluid dynamics. Design of automatic temperature based fan controller using thermistor involved controlling of the fan speed according to the room or any surrounding temperature with our need of suitable conditions.

1.1 Objectives of the Temperature Sensor

- Enable the electric fan to consequently change the rate level as indicated by temperature changes.
- Develop an automatic fan framework that can change the speed level because of the environment temperature changes.
- Apply this method to building a rudimentary on/off heater controller that will maintain a sample at a desired temperature.
- Convert the temperature changes to an equivalent voltage value using sensor.
- Measure RMS / Mean voltage of the captured signal using inbuilt functions of the scope.

1.2 Scope of the Project

- Knowledge about the output voltages from the temperature sensor and how to convert them to byte values.
- The particular formula that will be used to convert the byte values to Centigrade scalar (for LCD display).
- The programming of the Micro-controller and development of the Control Program.
- Driver circuit operation and function of each component.

CHAPTER 2

LITERATURE REVIEW

2.1 An Automatic Room Temperature Control with Security System

Ahmad Faris Bin Zulkifli, 2009, In this paper the author have explained about automatic room temperature control system with an added security system for controlling the temperature in server rooms, especially those that are poorly ventilated and have no cooling units. Finally, if the current temperature reaches lower than desired value, the fan also stops functioning and the LED indicator for cold temperature comes on. Any changes in temperature in the room are continuously displayed on the LCD and the LEDs are used to indicate the current state and range of temperature in the server room.

2.1.1 Conclusion from the Journal

In this journal we have read door lock system and temperature of the room can also be easily controlled automatically by this type sensor systems.

2.2 Temperature Controlled DC Fan using Thermistor

Al Mamun Parvez, 2012, In this paper the author have explained about automatic fan control system based on thermistor for controlling temperature on the room is to allow users to adjust the fan speed automatically. So it can save and streamline the work that is usually done manually which could the work automatically and effective for humans. Fan can be controlled manually by pressing on the switch button where in this method, any change in the temperature will not give any change in the fan speed, except the usage change the speed of the fan which is manually.

2.2.1 Conclusion from the Journal

In this journal we have read that fan can be automatically controlled according to the users need with the any change in the temperature will not give any change in the fan speed, except the usage change the speed of the fan which is manually.

2.3 Temperature Controlled DC Fan using Microcontroller

Ghana Shyam Soren et al., 2010, In this paper the author have explained about the configuration, development, advancement, control and assessment of an automatic switching speed electric fan. This paper shows that the microcontroller base programmed

fan framework introduced in this task to control the electric fan naturally switches the speed as indicated by the environment temperature changes.

2.3.1 Conclusion from the Journal

In this journal we have read development, advancement, control and assessment of an automatic switching the speed of the electric fan.

2.4 Temperature based Fan Control System using Pulse Width Modulation Technique

Vaibhav Bhatia et al., 2013, In this paper the author have explained about the design and simulation of a novel fan speed control system based on room temperature using pulse width modulation technique. This shows the duty cycle is made to vary according to the room temperature and the fan speed is controlled accordingly.

2.4.1 Conclusion from the Journal

In this journal we have read the design and simulation of a novel fan speed control system based on room temperature using pulse width modulation technique.

2.5 Development of Automatic Temperature Control System in Blast Furnace

Choi.W et al., 2006, In this paper the author have explained about the temperature controlled development of automatic temperature control system in blast furnace. This shows the paper is to suggest and propose a low cost wireless sensor network with a low power IR remote sensor to control the distributed air conditioning system and integrated with automatic monitoring system. Due to its advantages, many researches focusing on the automatic temperature control system applications in the different fields will gain the benefits.

2.5.1 Conclusion from the Journal

In this journal we have read the development in the temperature controlling system in blast furnace using low cost wireless sensor network with a low power IR remote sensor to control the distributed air conditioning system and integrated with automatic monitoring system.

2.6 Temperature based Automatic Power Controller for Electrical Devices

SharifulAlam et al., 2014, In this paper the author have explained about the temperature based automatic power controller for electrical devices. This shows a way it can able to control the input voltage as well as power to any load or electrical device not only manually such through the computer but also automatically and based on temperature. The

existing control system can be done manually by supplying the proper manpower which becomes time and cost effective, disgusting and unsuitable as well as main specialty of this researches is to maintain enhanced precision and hysteresis without harmonics in output variation.

2.6.1 Conclusion from the Journal

In this journal we have read the temperature based automatic power controller for electrical devices with the voltage control techniques by the control of the power to the load through maintaining enhanced precision and hysteresis without harmonics in output variation.

CHAPTER 3

DESCRIPTION OF EQUIPMENTS

3.1 Basic Components of the Temperature Control System

There are many electronic components that will be used during the development of temperature controlled fan circuit. There are some that we familiar with and some rarely used components. All components play its important role and interrelated between each other in completing the circuit design. Temperature Control Systems down through the years have been made up of the following five major units:

- The Power Supply Unit: This Unit provides the Temperature Control System with the Electrical Energy that drives it. In this case, the Power Supply Unit consists of a Step down transformer which works based on the principle of induction. The transformer steps down the voltage received from the power outlet from the national rating of 230V to 15V, which is all the voltage needed to drive the system. This voltage is further rectified (using a bridge rectifier) and filtered (using a power capacitor) to give a perfect and undistorted voltage to the system. Of this 15V input voltage, about 5V drives the microcontroller. The rest are needed to drive the other units of the circuit.
- The Sensor Unit: This Module consists of devices (thermometers in traditional systems) that detect the current temperature status. These devices sense the current room/surface temperature, and provide its result to be used as input in the Control unit and in the Display Unit.
- The LCD/Display Unit: This displays the current temperature status of the environment as received from the Sensor Unit. In this case it consists of a 7-bit graphic large-digit display device that reveals the results/reading of the temperature sensor to the external user.
- The Control Unit: The Control unit houses the Controller and related devices (thermostats in automatic systems) that process information to produce effects/action by the system. In this case, this unit houses the microcontroller (and control program/algorithm) that stores the set-point temperature. The control program

receives temperature status from the sensor unit and ensures that it doesn't compromise the set-point by initiating the appropriate sequence of action(s).

- The Menu/Function Unit: This unit consists of input buttons that are used to give commands to the control program and also to program the set-point for the system. In this case, a variable resistor which changes the set-point temperature when its resistance is varied.
- The Alarm Unit: This unit consists of an alarm system that alerts the inhabitants of the environment of a temperature breach. This is an optional component of Temperature Control Systems. It comes mostly with those systems that are built to specifications (custom systems). Most commercial Temperature Control Systems prefer to maintain a silent profile in the environment where they function.

3.2 LCD Display Introduction

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

LCDs were a big leap in terms of the technology they replaced, which include light-emitting diode (LED) and gas-plasma displays. LCDs allowed displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. Where an LED emits light, the liquid crystals in an LCD produces an image using a backlight.

As LCDs have replaced older display technologies, LCDs have begun being replaced by new display technologies such as OLEDs.

3.2.1 LCD Working

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example, a 4K display is made up of 3840 x2160 or 4096x2160 pixels. A pixel is made up of three sub pixels; a red, blue and green commonly called RGB. When the sub pixels in a pixel change color combinations, a different color can be produced. With all the pixels on a display working together, the display can make millions of different colors. When the pixels are rapidly switched on and off, a picture is created.

The way a pixel is controlled is different in each type of display; CRT, LED, LCD and newer types of displays all control pixels differently. In short, LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90 degrees. In between both filters are the liquid crystals, which can be electronically switched on and off.

LCDs are made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.

Some passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same time that it took for one scan in the original technology. However, active matrix is still a superior technology out of the two.

3.2.2 Types of LCDs

- Twisted Nematic (TN) which are inexpensive while having high response times. However, TN displays have low contrast ratios, viewing angles and color contrasts.
- In Panel Switching displays (IPS Panels)- which boast much better contrast ratios, viewing angles and color contrast when compared to TN LCDs.
- Vertical Alignment Panels (VA Panels) which are seen as a medium quality between TN and IPS displays.
- Advanced Fringe Field Switching (AFFS) which is a top performer compared IPS displays in color reproduction range.

3.2.3 Monochrome LCD Display: Segment Display

Segment LCD's, also called static or direct drive are an older technology but are still in heavy use today. These displays are reliable and have been in use for many years. They show no signs of going away anytime soon.

The goal of this display is simplicity. Their only job is to display letters, numbers and icons. There is no 3-D effect or range of brilliant colors and most do not contain

a touch screen or any other type of human interface. They normally are not equipped with a controller/driver chip.

In fact, you could reduce the static/direct drive LCD down to the simple formula of one pin equals one segment. If you need a display that contains a 7 segment number, you need 7 pins. The exception to this is if you increase the number of backplanes and convert this to a multiplex display.

3.2.4 Monochrome LCD Display: Multiplex Display

The formula for a multiplex display is a little more complicated. One pin equals 2 or 4 segments. The advantage of multiplexing is that you reduce the number of pins which, in turn, reduces the cost of the display and the amount of time required to mount the display to a PCB.

One disadvantage of multiplex display over direct drive displays is that the refresh rate is slower and this may allow the segments that are ON to 'fade' or not look as sharp. Some times this is referred to as 'ghosting'. This is not a very common occurrence as the technology has improved since the days of pagers and low cost calculators.

When a customer cannot decided what LCD display type to use we have a general rule: If the total number of segments is 20 or less, we advise a static (direct drive) display since a display with 20 pins is low cost to build and to install on the PCB.

Once the number of segments exceed 20, we recommend multiplex. A display with more than 120 segments becomes cost prohibitive.

If your design exceeds 120 segments we would recommend converting your design to a graphics type of LCD display that makes use of the controller driver chip. The controller driver chip allow the number of connections for multiple segments to be reduced to 14 or 16 pins. This LCD technology is covered later in the article.

3.2.5 Low Power LCD Displays

One key advantage of the monochrome LCD display is that they are not power hungry. They operate with very little current draw. This becomes an ideal choice when the only power you have is a battery. These displays are built to operate at 3.0V, 3.3V (in some case they can operate as low as 1.7V) and 5V. The current draw for a display with no backlight can run slow as 6A per cm. If all you need to display is what time it is, the current temperature, or the number of gallons, and your customer does not wish to pay for vibrant, flashy power-hungry color, then this display will work perfectly for you.

3.2.6 Customizable LCD Displays

The majority of the static or multiplex displays we offer have been customized to meet the customer's requirements. This is a great advantage to consider when choosing one of the LCD display types you will use in your product.

The tooling or NRE (non-recurring engineering cost) of this type of display is much lower than newer technologies and the MOQ (minimum order quantities) are also lower than other types of displays.

If your goal is to display basic information, with a low tooling cost and you need to operate on a low power budget than the best type of LCD Display is a static or multiplex LCD.

3.2.7 LCD Advantages

- Sharpness, Image is perfectly sharp at the native resolution of the panel. LCDs using an analog input require careful adjustment of pixel tracking/phase (see Interference, below).
- Geometric Distortion, Zero geometric distortion at the native resolution of the panel. Minor distortion for other resolutions because the images must be rescaled.
- Brightness, High peak intensity produces very bright images. Best for brightly lit environments.
- Screen Shapes, Screens are perfectly flat.
- Physical, Thin with a small footprint. Consume little electricity and produce little heat.

3.2.8 LCD Disadvantages

- Each panel has a fixed pixel resolution format determined at the time of manufacture that cannot be changed. All other image resolutions require rescaling, which generally results in significant image degradation, particularly for fine text and graphics. For most applications should only be used at the native resolution of the panel. If you need fine text and graphics at more than one resolution do not get an LCD display.
- LCDs using an analog input require careful adjustment of pixel tracking/phase in order to reduce or eliminate digital noise in the image. Automatic pixel tracking/phase controls seldom produce the optimum setting. Timing drift and jitter

may require frequent readjustments during the day. For some displays and video boards you may not be able to entirely eliminate the digital noise.

- Limited viewing angle. Brightness, contrast, gamma and color mixtures vary with the viewing angle. Can lead to contrast and color reversal at large angles. Need to be viewed as close to straight ahead as possible.
- LCDs have difficulty producing black and very dark grays. As a result they generally have lower contrast than CRTs and the color saturation for low intensity colors is also reduced. Not suitable for use in dimly lit and dark environments.
- The bright-end of the LCD intensity scale is easily overloaded, which leads to saturation and compression. When this happens the maximum brightness occurs before reaching the peak of the gray-scale or the brightness increases slowly near the maximum. Requires careful adjustment of the Contrast control.
- The internal Gamma and gray-scale of an LCD is very irregular. Special circuitry attempts to fix it, often with only limited success. LCDs typically produce fewer than 256 discrete intensity levels. For some LCDs portions of the gray-scale may be dithered. Images are pleasing but not accurate because of problems with black-level, gray-scale and Gamma, which affects the accuracy of the gray-scale and color mixtures. Generally not suitable for professional image color balancing.
- LCDs can have many weak or stuck pixels, which are permanently on or off. Some pixels may be improperly connected to adjoining pixels, rows or columns. Also, the panel may not be uniformly illuminated by the backlight resulting in uneven intensity and shading over the screen.
- Slow response times and scan rate conversion result in severe motion artifacts and image degradation for moving or rapidly changing images.
- LCDs have a fixed resolution and aspect ratio. For panels with a resolution of 1280x1024 the aspect ratio is 5:4=1.25, which is noticeably smaller than the 4:3=1.33 aspect ratio for almost all other standard display modes. For some applications may require switching to a letterboxed 1280x960, which has a 4:3 aspect ratio.
- Considerably more expensive than comparable CRTs.

3.2.9 LCD Applications

- Technological improvements to liquid crystal display (LCD) screens have seen them become more popular in the high definition television market. With the improvement

of broadcasting pictures moving quickly from analogue to digital television so too is the television market moving from regular Cathode Ray Tube (CRT) to large flat panel LCD or Plasma screens.

- While liquid crystal display television (LCD TV) is new technology, we have been using liquid crystal display for many years in other household items such as digital clocks, oven timers and home computers.
- LCD technology is not restricted to just large flat screen TVs with LCD projectors available for corporations to display video, images or data in much the same way that the old overhead projector once did.
- LCD technology provides a cheaper alternative to large Plasma screens. Historically the LCD screens have been smaller but new technology is increasing the size of these large flat screen TVs to be more competitive than ever before.
- While the size of LCDs has increased the advantage one has in price comparison with a Plasma screen has seen the LCD screens enjoy their fair share of high definition large flat screen sales in the home entertainment market.
- LCD screens also need less power to function giving the consumers considerable savings on their electricity bills.
- LCD technology is not restricted to just large flat screen TVs with LCD projectors available for corporations to display video, images or data in much the same way that the old overhead projector once did.
- An LCD projector works by sending light from a halogen lamp through three LCD panels (one for red, blue and green). The individual pixels then open to allow light to pass or close to block the light producing our image.
- We also use LCD technology in the world of computers with a LCD computer monitor the most popular display device for computers. An LCD monitor is the popular choice amongst consumers because of the flat panel screen taking up very little space.
- Having replaced the bulky computer monitors the LCD monitor is here to stay with all new computer purchases going hand in hand with a LCD computer monitor. The advantages in buying an LCD monitor is not only restricted to the size but also the savings with LCD monitors using very little of your power supply to work.
- Liquid crystal display television (LCD TV) provides the viewer with a far greater experience watching television. With the LCD TV set you don't have to close the

curtains because the screen is too bright to see the picture properly like you do with a normal CRT television.

Figure 3.1 LCD Display

- One major advantage an LCD screen has is that it is not only a capable of displaying high definition TV, video, DVD or normal television but it can also be used as a computer monitor. Just like your everyday PC monitor you can play games on your LCD screen, you just going to have a bigger, better view of your screen playing on your large screen TV mounted on the wall.
- The new LCD modules combine technology characteristics of the Sharp AQUOS Liquid Crystal TV, referred to as the ASV LCD with Sharp's proprietary small format display technology, referred to as the Advanced-TFT. With this breakthrough, Sharp has attained a new mobile display that is ideally suited for mobile devices, such as camera phones, PDAs, and personal media players, which display streaming video content or color images. The displays achieve excellent visibility in any lighting situation, while offering a wide viewing angle, high contrast ratio, and superior color reproduction.
- The displays are slated for sampling in December of 2003, with volume production to begin next spring.
- "The explosive growth in the use of multi-functional mobile devices has rapidly accelerated the demand for high-resolution color displays that allow users to view a wider range of content," said Joel Pollack, vice president of the Display Business

Unit at Sharp Microelectronics of the Americas. "Sharp's new mobile ASV LCD technology offers design engineers high quality display technology similar to that which is used in our AQUOS LCD TVs. The result is a clear, bright display visible from virtually any angle and under any ambient lighting condition."

- The continued growth in the mobile market is expected to stimulate new demand for the capability to view video and graphic content, including photographic images, scenes from television shows, movies, sports events and news.

3.3 Buzzer Alarm Introduction

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.

There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beeeeeeppp.... sound, the other type is called a readymade buzzer which will look bulkier than this and will produce a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customized with help of other circuits to fit easily in our application.

This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or key stroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play."

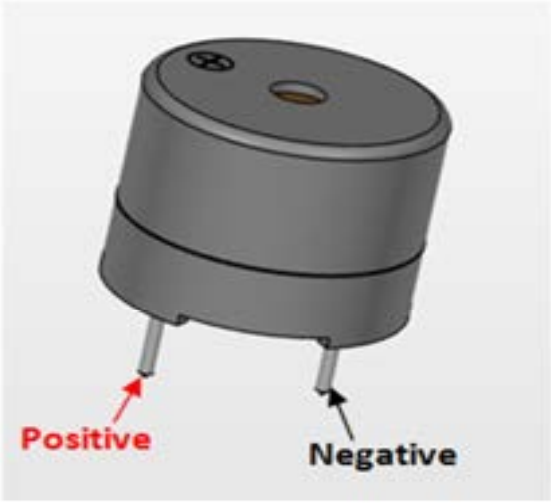

Figure 3.2 Buzzer Alarm

3.3.1 Buzzer Features and Specifications

- Rated Voltage: 6V DC
- Operating Voltage: 4-8V DC
- Rated current: <30mA
- Sound Type: Continuous Beep
- Resonant Frequency: ~2300 Hz
- Small and neat sealed package
- Breadboard and Perf board friendly

3.3.2 Piezo Buzzer

At the heart of all piezo type buzzers is the piezoelectric element. The piezoelectric piezoelectric effect. Exposure to mechanical strain will cause the material to develop an electric field, and vice versa element is composed of a piezoelectric ceramic and a metal plate held together with adhesive. Both sides of the piezoelectric ceramic plate contain an electrode for electrical conduction. Piezo materials exhibit a specific phenomenon known as the piezoelectric effect and the reverse.

3.3.3 Working of Piezo Buzzer

At the heart of all piezo-type buzzers is the piezoelectric element. The piezoelectric element is composed of a piezoelectric ceramic and a metal plate held together with adhesive. Both sides of the piezoelectric ceramic plate contain an electrode for electrical conduction. Piezo materials exhibit a specific phenomenon known as the piezoelectric effect

and the reverse piezoelectric effect. Exposure to mechanical strain will cause the material to develop an electric field, and vice versa.

3.3.4 Types of Piezo Buzzer

There are two types of piezo buzzers - transducers and indicators. Transducers consist of a casing, a piezoceramic element and a terminal. In order to operate a transducer, the user must send a square wave signal to the buzzer. Indicators consist of a casing, a piezoceramic element, a circuit board and a terminal. In order to operate an indicator, the user must send the buzzer a specified dc voltage.

3.3.5 Piezo Buzzer Characteristics

- Wide operating voltage: 3~250 V
- Lower current consumption: less than 30 mA higher rated frequency
- Larger footprint
- Higher sound pressure level

3.3.6 Piezo Buzzer Feedback

Some CUI Devices piezo buzzers include a feedback line. Driving circuits for buzzers with feedback tend to be simpler than those circuits without. Feedback is accomplished by dividing the piezo element into two, electrically isolated pieces. When the main piezo element is actuated it squeezes the feedback portion, creating a voltage on the feedback line.

A simple way to use feedback is to have the feedback line connected to the base of a transistor. As the piezo element oscillates, the feedback signal will oscillate and the transistor will alternately block or allow current to flow.

- The feedback line provides a voltage that is proportional to the strain on the main piezo element.
- This voltage can be used to create a simple, self-oscillating circuit.

3.3.7 Magnetic Buzzer

This illustration highlights the structure of a typical magnetic buzzer. Like piezo technology, magnetic buzzers are available in transducer and indicator configurations. In a magnetic buzzer, the transistor acts as the driving circuit. Indicators include the transistor, creating a tone when a dc voltage is applied. Transducers lack this transistor, requiring a square wave signal to operate properly.

3.3.8 Magnetic Buzzer Working

The vibrating disk in a magnetic buzzer is attracted to the pole by the magnetic field. When an oscillating signal is moved through the coil, it produces a fluctuating magnetic field which vibrates the disk at a frequency equal to that of the drive signal.

3.3.9 Magnetic Buzzer Characteristics

- Narrow operating voltage: 1~16 V
- Higher current consumption: 30~100 mA
- Lower rated frequency
- Smaller footprint
- Lower sound pressure level

3.3.10 Magnetic Buzzer Types

As mentioned earlier in the presentation, piezo and magnetic indicators have the driving circuitry built into the design, creating a "plug and play" solution. Because of this, engineers do not need to worry about building a complex circuit to drive the buzzer. The disadvantage, however, is that indicators operate on a fixed frequency, reducing the flexibility offered to achieve an alternate frequency as application requirements change. Transducers, on the other hand, do not have the driving circuit built-in, so engineers are offered a greater range of flexibility when designing their circuit. The downside comes in the fact that transducers do require an external driving signal to operate properly, potentially adding complexity and time to the design cycle.

3.3.11 Key Buzzer Specifications

- Frequency Response, How efficiently a buzzer produces sound at a given frequency.
- Sound pressure level, SPL, is the deviation from atmospheric pressure caused by the expressed in decibel Pascal's. It is generally proportional to input voltage and decays by 6 dB when doubling the distance from the buzzer.
- All things have a specific frequency at which they tend to vibrate. This frequency is called the resonant frequency. For buzzers, the resonant frequency is the frequency at which they will be the loudest.
- Electrical impedance is the ratio of applied voltage to current. The electrical impedance varies with frequency.

- In a perfect world all devices would recreate every frequency at the exact same amplitude. In real life every device will have frequencies which it may amplify and frequencies which it will tend to reduce or attenuate. Frequency response curves show how a particular device responds to each frequency. SPL is plotted against frequency to indicate how the device will handle certain frequencies. Note: frequency is plotted on an exponential basis, similar to dB's, it allows the full range of human hearing to be fit in a compact space.
- 20 Hz to 20 kHz tends to be the general range for human ears. This range is reduced with age, especially in males. In older males 13 kHz tends to be the upper end of the audible range. The human ear does not have a flat frequency response over the audible range. Certain frequencies tend to be attenuated while others are magnified. A-weighting attempts to compensate for this by discounting frequencies which the human ear is less sensitive to. It places priority on sounds between 1 kHz and 7 kHz.
- Every system has a particular frequency that it tends to vibrate at. For instance, if you pluck a string on a guitar that string will vibrate very near, or at its resonant frequency. By driving a system at its resonant frequency, very large displacements, relative to the input signal strength can be achieved. Driving a buzzer with an input signal which has the same frequency as the buzzer's resonant frequency, will create the greatest SPL with the least input power.
- CUI Devices has developed an SPL calculator to allow users to convert a buzzer's specified SPL on the datasheet to different real-world conditions, or to compare SPLs between two devices with different specified parameters. This tool makes it quick and easy for designers to specify the proper buzzer for their application.

3.3.12 Advantages of a Buzzer Alarm

There are some advantages of piezoelectric transducer which are given below,

- The piezoelectric transducer is available in desired shape.
- It has rugged construction.
- It is small in size.
- It has good frequency response.
- It has negligible phase shift.

3.3.13 Disadvantages of a Buzzer Alarm

There are some disadvantages of piezoelectric transducer which are given below,

- The piezoelectric transducer is used for dynamic measurement only.
- It has high temperature sensitivity.
- Some crystals are water soluble and get dissolve in high humid environment.

3.3.14 Applications of a Buzzer Alarm

There are some important applications of piezoelectric transducer which are given below,

- The piezoelectric transducer is used in spark ignition engines.
- It can be used in electronic watches.
- It is used in accelerometer.
- It is used in record player.

3.4 DC Motor Fan Introduction

A **DC motor** is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

DC motors are rarely utilized in normal applications as a result of all electrical supply firms furnish electrical energy but, for special applications like in steel mills, mines and electric traction, it's advantageous to convert AC into DC so as to use DC motors. The

rational is that the speed/torque characteristics of DC motors are much more superior thereto of AC motors. Therefore, it's not stunning to notice that for industrial drives, DC motors are as common as 3-phase induction motors. Similar to DC generators, DC motors are also classified into 3 kinds; they are series-wound, shunt-wound and compound- wound. The employment of a specific motor depends upon the mechanical load it's to drive.

3.4.1 Principle of DC Motor

A machine which transforms the DC power into mechanical power is called as a DC motor. Its operation relies on the principle that once a current carrying conductor is placed in a very magnetic field, the conductor experiences a mechanical force.

The direction of this force is given by Fleming's left hand rule and magnitude is given by F=BIl newtons.

Fundamentally, there's no constructional distinction between a DC motor and a DC generator. The same DC motor will be run as a generator or motor.

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field.

It will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy.

It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

3.4.2 Types of DC Motor

A DC motor (direct current motor) has a lot of applications in today's field of engineering and technology. From electric shavers to automobiles – DC motors are everywhere. To cater to this wide range of applications – different types of DC motors are used depending on the application.

The types of DC motor includes:

- Permanent Magnet DC Motor (PMDC Motor)
- Separately Excited DC Motor
- Self Excited DC Motor
- Shunt Wound DC Motor
- Series Wound DC Motor

- Compound Wound DC Motor
- Short shunt DC Motor
- Long shunt DC Motor
- Differential Compound DC Motor

3.4.3 Separately Excited DC Motor

As the name suggests, in case of a separately excited DC motor the supply is given separately to the field and armature windings. The main distinguishing fact in these types of DC motor is that, the armature current does not flow through the field windings, as the field winding is energized from a separate external source of DC current as shown in the figure beside.

From the torque equation of DC motor we know $T_g = K_a \varphi I_a$. So the torque in this case can be varied by varying field flux φ, independent of the armature current I_a.

3.4.4 Permanent Magnet DC Motor

The permanent magnet DC motor (also known as a PMDC motor) consists of an armature winding as in case of a usual motor, but does not necessarily contain the field windings. The construction of these types of DC motor are such that, radially magnetized permanent magnets are mounted on the inner periphery of the stator core to produce the field flux.

The rotor on the other hand has a conventional DC armature with commutated segments and brushes. The diagrammatic representation of a permanent magnet DC motor is given below.

The torque equation of DC motor suggests, $T_g = K_a \varphi I_a$

Here φ is always constant, as permanent magnets of required flux density are chosen at the time of construction and there after that can't be changed.

3.4.5 Self Excited DC Motor

In case of self excited DC motor, the field winding is connected either in series or in parallel or partly in series, partly in parallel to the armature winding. Based on this, self-excited DC Motors can be classified as:

- Shunt wound DC motor
- Series wound DC motor
- Compound wound DC motor

3.4.6 Shunt Wound DC Motor

In case of a shunt wound DC motor or more specifically shunt wound self excited DC motor, the field windings are exposed to the entire terminal voltage as they are connected in parallel to the armature winding.

The shunt wound DC motor is a constant speed motor, as the speed does not vary here with the variation of mechanical load on the output.

3.4.7 Series Wound DC Motor

In case of a series wound self excited DC motor or simply series wound DC motor, the entire armature current flows through the field winding as it is connected in series to the armature winding.

In a series wound DC motor, the speed varies with load. And operation wise this is its main difference from a shunt wound DC motor.

3.4.8 Compound Wound DC Motor

The compound excitation characteristic in a DC motor can be obtained by combining the operational characteristic of both the shunt and series excited DC motor. The compound wound self excited DC motor or simply compound wound DC motor essentially contains the field winding connected both in series and in parallel to the armature winding.

The excitation of compound wound DC motor can be of two types depending on the nature of compounding.

3.4.9 Short Shunt DC Motor

If the shunt field winding is only parallel to the armature winding and not the series field winding then it is known as short shunt DC motor or more specifically short shunt type compound wound DC motor.

3.4.10 Long Shunt DC Motor

If the shunt field winding is parallel to both the armature winding and the series field winding then it's known as long shunt type compounded wound DC motor or simply long shunt DC motor.

3.4.11 Working of an DC Motor

Once the terminals of the motor are connected to an external DC supply. Then, the field magnets are excited developing alternate N and S poles. The armature

conductors carry currents. All conductors below N-pole carry currents in one direction whereas all the conductors below S-pole carry currents within the opposite direction.

Assume the conductors below N-pole carry currents into the plane of the paper and those below S-pole carry currents out of the plane of the paper which is shown in Fig. Since each armature conductor is carrying current and is placed within the magnetic field, mechanical force acts on that.

Stating to the Fig and applying Fleming's left hand rule, it's clear that force on every conductor is tending to rotate the armature in anticlockwise direction. All these forces add along to provide a driving torsion that sets the armature rotating. Once the conductor interchanges from one side of a brush to the opposite.

The current in the conductor is reversed and at identical time it comes below the influence of next pole that is of reverse polarity. Accordingly, the direction of force on the conductor rests identical.

A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator.

The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)

The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed.

By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a torque

on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

Different number of stator and armature fields as well as how they are connected provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature.

The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage.

Figure 3.3 12V DC Motor Fan

Since the series-wound DC motor develops its highest torque at low speed, it is often used in traction applications such as electric locomotives, and trams. The DC motor was the mainstay of electric traction drives on both electric and diesel-electric locomotives, street-cars/trams and diesel electric drilling rigs for many years.

The introduction of DC motors and an electrical grid system to run machinery starting in the 1870s started a new second Industrial Revolution. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles and today's hybrid cars and electric cars as well as driving a host of cordless tools.

Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Large DC motors with separately excited fields were generally used with winder drives for mine hoists, for high torque as well as smooth speed control using thyristor drives. These are now replaced with large AC motors with variable frequency drives.

If external mechanical power is applied to a DC motor it acts as a DC generator, a dynamo. This feature is used to slow down and recharge batteries on hybrid and electric cars or to return electricity back to the electric grid used on a street car or electric powered train line when they slow down.

This process is called regenerative braking on hybrid and electric cars. In diesel electric locomotives they also use their DC motors as generators to slow down but dissipate the energy in resistor stacks. Newer designs are adding large battery packs to recapture some of this energy.

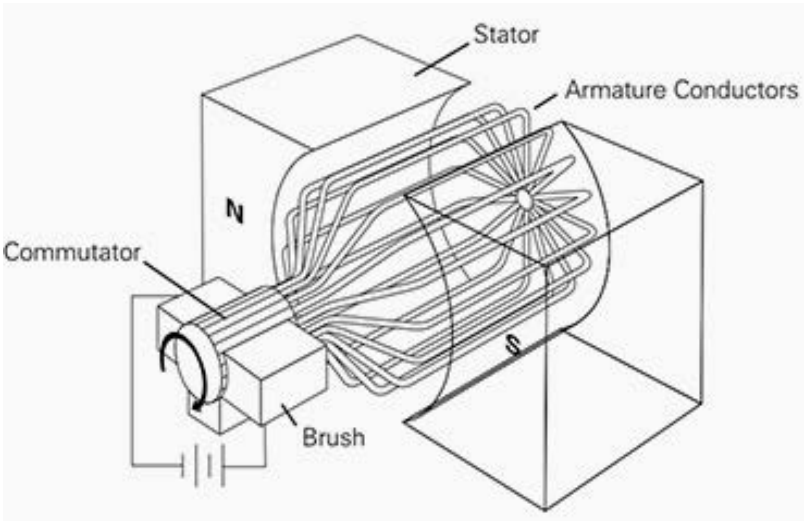

Figure 3.4 DC Motor Structure

3.4.12 DC Motor Advantages

- Starting torque of DC Series motor is comparatively higher than other motors so this kind of motors are widely used for traction applications.
- Series wound motors can use for AC or DC supply so it's also known as universal motors.
- Compare with Shunt Motor DC series motor develop more power for the same construction size.
- Quick start and stop of the motor can do.

- Reversing and acceleration of the motor can do fast.
- Shunt wound motor able to runs at a predetermined speed.
- The power supply of DC motor is any way cheap.

3.4.13 DC Motor Disadvantages

- Speed control and regulation of DC series motor are not good.
- It is necessary to have a load before starting the DC series motors. So Dc Series motors are not good to use where load does not apply to the initial stage.
- Installation of a DC machines is expensive compare with other types of machines.
- Since Shunt motors are constant speed motor, it would be a disadvantage where it's necessary to operate under variable speed.
- DC motors are unreliable at low speeds operations.
- The Size of DC motors is large compared with Alternative Current Motors.
- Operation and maintenance cost of DC motors are expensive.
- DC motors unable to operate in hazard situation where spark occurs at the brush of the motor.
- In generally Every DC motor using brushes so the lifetime of such motors is less compared with AC motors.

3.4.14 DC Motor Applications

- Direct Current series motors are useful traction applications in electrical such as locomotives and trolley cars.
- DC Series Motors are also used for cranes and conveyor belt where higher starting torque is required.
- This motors got great speed controlling characteristics so this type of motors are used in rolling mills.
- Use of lathe machines where constant speed is highly required.
- These motors are also widely used for fans, blowers, reciprocating and centrifugal pumps.
- Compound motors are widely used in applications such as elevators, conveyor belts, air compressors, and punches.
- Can use for variable speed domestic appliances.

3.5 Transformer Introduction

A transformer is one of the most common devices found in electrical system that links the circuits which are operating at different voltages .These are commonly used in applications where there is a need of AC voltage conversion from one voltage level to another.

It is possible either to decrease or increase the voltage and currents by the use of transformer in AC circuits based on the requirements of the electrical equipment or device or load. Various applications use wide variety of transformers including power, instrumentation and pulse transformers.

In a broad, transformers are categorized into two types, namely, electronic transformers and power transformers. Electronic transformers operating voltages are very low and are rated at low power levels. These are used in consumer electronic equipment like televisions, personal computers, CD/DVD players, and other devices.

The term power transformer is referred to the transformers with high power and voltage ratings. These are extensively used in power generation, transmission, distribution and utility systems to increase or decrease the voltage levels. However, the operation involved in these two types of transformers is same. So let us go in detail about the transformers.

3.5.1 Transformer Principle

A transformer is a static device (means that has no moving parts) that consists of one, two or more windings which are magnetically coupled and electrically separated with or without a magnetic core. It transfers the electrical energy from one circuit to the other by electromagnetic induction principle.

The winding connected to the AC main supply is called primary winding and the winding connected to the load or from which energy is drawn out is called as secondary winding. These two windings with proper insulation are wound on a laminated core which provides a magnetic path between windings.

This flux circulates through the core and hence links with the secondary winding. Based on the principle of electromagnetic induction, this magnetic linking induces a voltage in the secondary winding. This is called as mutual induction between two circuits. The secondary voltage depends on the number of turns on the secondary as well as magnetic flux and frequency.

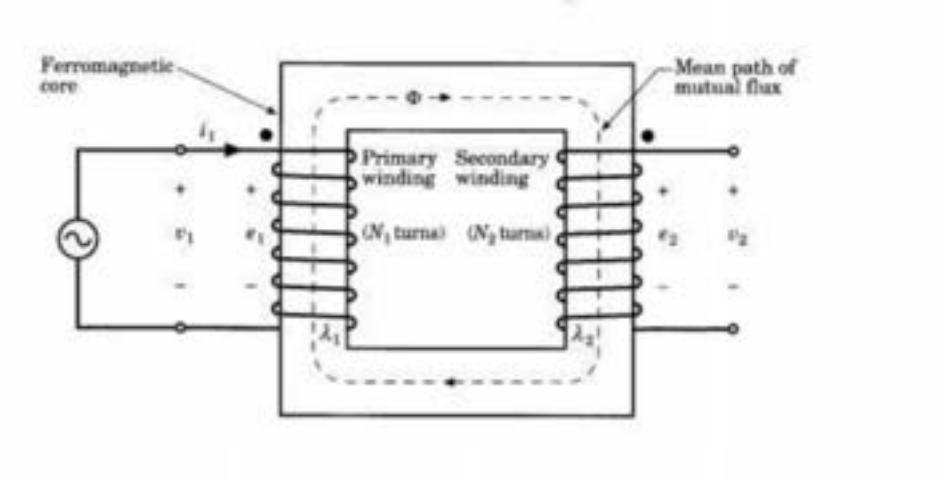

Figure 3.5 Transformer Circuit

3.5.2 Applications of a Transformer

- Step-up or step-down the level of the voltage in power transmission systems like transmission and distribution systems.
- To isolate the low voltage circuits from high voltage circuits in case of substations, control circuitry circuits in industries, etc.
- Instrument transformers like current and potential transformer are used in protection and meter indication systems.
- These are also used for impedance matching.

3.6 Transistor Introduction

- A transistor is a three-terminal electronic device where small current at one terminal is used to control large current at other terminals. Transistors are mainly used for the amplification of the electronic signals.
- Transistor comes with three terminals called emitter, base, and collector which are used for the external connection with electronic circuits.
- Transistors were created with the intention of providing cheap electronics. They are available individually, however, most of the time they are packed together in integrated circuits which are then used for the developments of processors, computer memory chips, and complex ICs.
- A transistor is a combination of two words i.e. transfer and varistor where each layer comes with an ability to transfer current to other layers when a proper biasing voltage is applied across one of the layers.

- Transistor comes with three layers and two PN junctions where an emitter-base junction is forward biased and the collector-base junction is reverse biased.
- Most of the transistors are created using silicon and germanium that are less expensive to vacuum tube and require less power to operate.

Figure 3.6 Transistor

3.6.1 Transistor Types

- Based on the mobility of major charge carriers, transistors are divided into two types NPN and PNP transistors. Both are different in terms of electrical behaviors and physical construction.
- The NPN transistors comes with three layers i.e. two N-doped layers and one P-doped layer. The P-doped layer is sandwiched between two N-doped layers. In NPN transistors, conduction is carried out by both charge carriers i.e. electrons and holes, however, electrons are major charge carriers in NPN transistors.
- Similarly, PNP transistors comes with three layers i.e. two P-doped layers and one N-doped layer. The N-doped layer exists between two P-doped layers. Actually, N-doped layer is responsible for triggering transistor action. When a proper bias voltage is applied at the P-doped layer, it draws current which is then used to control large current at other terminals. Transistors that come in NPN and PNP configurations are nothing but the combinations of two diodes joined back to back.
- In NPN transistor current flows from collector to emitter, while in PNP transistor current flows from emitter to collector.
- The current directions and voltage polarities are always opposite in both transistors. Suppose, if a current is flowing in a clockwise direction in NPN transistor and comes

with positive polarity at the base terminal, it will flow in an anticlockwise direction in a PNP transistor where voltage polarity becomes negative.

- PN junction formed between two semiconductor materials is a building block of the transistor. When PN junction is formed, major charge carriers in N-region (electrons) cross the junction and reach the P-region where they recombine with holes. Similarly, major charge carriers in P-region (holes) cross the junction and reach the N-region where they recombine with electrons.
- The diffusion of electrons and holes depends on the biasing voltage applied across the junction.
- The voltage is said to have forward biased when P-region is connected with positive terminal of the battery and N-region is connected with the negative terminal battery.

3.6.2 Applications of Transistor

- Transistors are mainly used for the amplification of low and high-frequency AC signals.
- No current is produced at the collector terminal unless there is a current at the base terminal. This process allows the transistor to work as a switch. The transistor can be turned ON and OFF by controlling the bias voltage at the base terminal.
- Based on requirements, a transistor can be made to operate in cut-off or saturation region for switching applications.
- Integrated circuits added in the development of the processors are made from transistors.

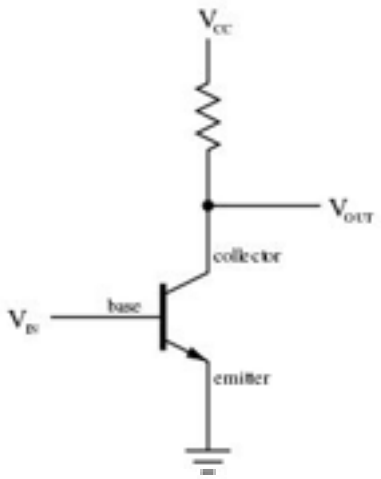

Figure 3.7 Transistor Circuit

- Used in the development of logarithmic converters and logic gates.
- Transistors are widely used in modern electronics especially where signal processing and radio transmission is required.

3.7 LED Introduction

LED is a PN-junction diode that mainly used as a replacement of incandescent lights. It is based on the electroluminescence effect, process where diode converts electric current to light when electrons change their state inside the LED semiconductors.

The PN-junction is nothing but a combination of both N-type and P-type semiconductor materials. The material forming the junction diode is not identical to other mainstream didoes, as it comes with a transparent package, allowing the infrared and visible light to pass through the junction.

The LED contains two terminals known as anode and cathode. The former contains a positive charge on it and comes with the longer lead as compared to other, and later contains negative charge on it.

LED will be working under one condition: the anode terminal should be put at a higher potential than cathode terminal as current flows from anode to cathode (positive to negative). LED won't conduct if the respective terminals are connected in the reverse order.

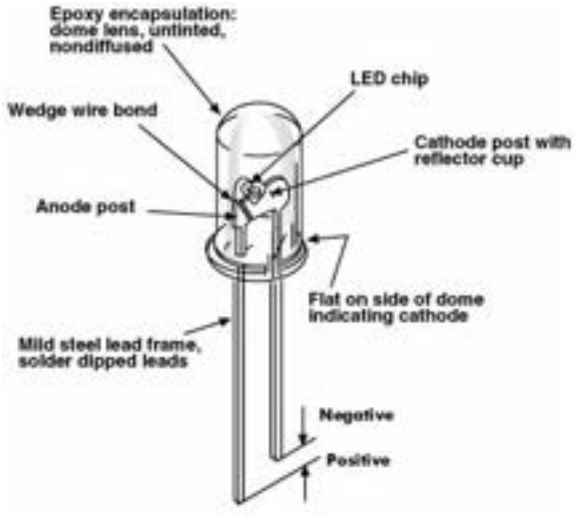

Figure 3.8 LED Structure

3.7.1 LED Working Principle

LED is mainly comprised of four parts known as die, substrate, phosphor, and lens. The die is a semiconductor material containing gallium nitride (GaN) that emits

blue light when the electric current passes through it. In order to provide easy integration of LED, one or two dies are used in combination with the substrate, generating enough power to light up the LED.

The white light is mainly preferred over blue one in general lighting applications where the desired color is produced using phosphor. The blue light, emitting from the die, will generate white light once it hits phosphor particles.

It is important to note that the phosphor can be applied to die material both ways: directly or layered with the lens material that either extracts or directs the light and mainly comes with silicon or glass. The LED, more often than not, generates monochromatic light ranging from red to blue and violet.

Traditional LEDs are formed using inorganic semiconductor materials including aluminum, gallium, silicon, indium, and zinc that produce a different color based on the type of material used: aluminum gallium phosphide produces green color, while aluminum gallium nitride, and aluminum gallium arsenide producing ultraviolet and red light respectively.

The LEDs are also rated with respect to the voltage required to turn them on where red LEDs come with a maximum voltage rating of around 2.2V, while blue LEDs and white LEDs come with a voltage rating of 3.4V and 3.6V respectively.

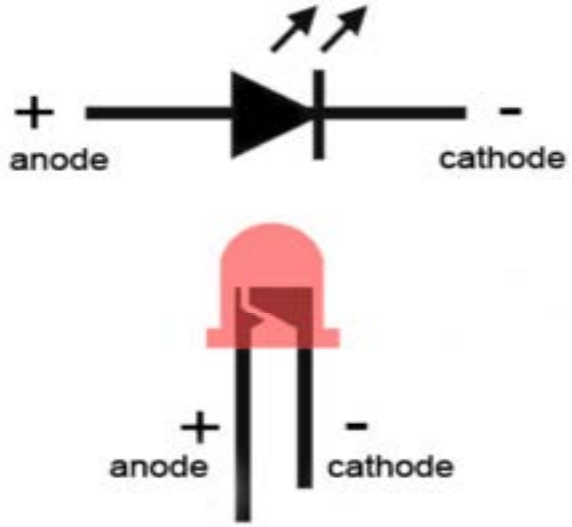

Figure 3.9 LED Circuit Diagram

3.7.2 LED Types

LEDs are available in a variety of types. Some are preferred over others based on the nature of applications. Following are some main types of LEDs.

- **High Power LEDs,** LEDs are known as High Power LEDs if their power rating is greater than or equal to 1 Watt. They are mainly used for generating the maximum brightness. The input power required for these LEDs is very high, making them prone to heat dissipation. Heat sinks are required to keep these LEDs cool and impede from burning. The flashlights, spotlights, and automobile headlamps are some major applications of High Power LEDs.
- **RGB LEDs,** It is widely used in many computer applications and comes with an ability to generate three lights, as the name suggests, red, blue and green. The color of these lights is controlled by using PWM (pulse width modulation). Both the duty cycle of PWM and frequency used for generating the signal per second, prove to be handy for controlling all three colors.
- **SMD LEDs,** SMD LED stands for Surface Mount Device LED. It comes in a special package with the ability to be mounted on the PCB surface. It can be easily categorized based on the physical dimensions. It works both ways: separately or in combination with a compatible device.
- **Thru-hole LEDs,** Thru-hole LED comes with two terminals leads that are embedded into the holes of the printed circuit board. They are available in a variety of different packages and shapes. Most common colors they come with are white, red, blue and green.

3.7.3 LED Applications

- The compact size of the LED makes it stand fit in hard to reach places including ceiling lighting, cove lighting, tray, and cabinet lighting.
- Thanks to the robust nature of LEDs – without them, Landscape lighting would never be so easy and created flawlessly as it has been right now.
- The LEDs play a vital role in generating and optimizing the light beam angle at the desired distance and their ability to disguise any shape as per the nature of the environment they are incorporating in, help them serve a real purpose, adding curated light layered with beauty using a single source.
- Some of the digital clocks are developed using the LED interface. And the 7-segment LED display is widely used student project that incorporates the array of LEDs in an organized manner.

- They are profoundly used in automotive industries, LCD panels, fiber optics data transmission, and remote control devices. While pointing out the sheer advantages of the LEDs, we can't write off their value in advertising.
- They are mainly used to captivate the visitors – when placed in the advertising banner and tree decorated with a number of infrared lights will help in getting the instant attention of the customers.

3.8 Resistor Introduction

A resistor is a two-terminal device that is used to resist the flow of current. It is one of the most commonly used components in electrical circuits.

Resistance of any resister is described in ohms. Ohm is denoted by the Greek letter omega. Each resister has a different value of resistance which tells us how strongly it resists the flow of current. More the value of resistance more is the capability of resisting the current.

Resistance will be considered as one ohm if the potential difference between the two ends of the conductor is 1 V and a current flowing through it is 1 Ampere.

Resistance can be derived from Ohm's law which indicates voltage is directly proportional to the current flowing through the conductor.

Each resistor comes with two wires, also called as leads. Between these two leads there lies a ceramic part which actually resists the flow of current. Resistor consists of three colored strips that indicate the value of resistance.

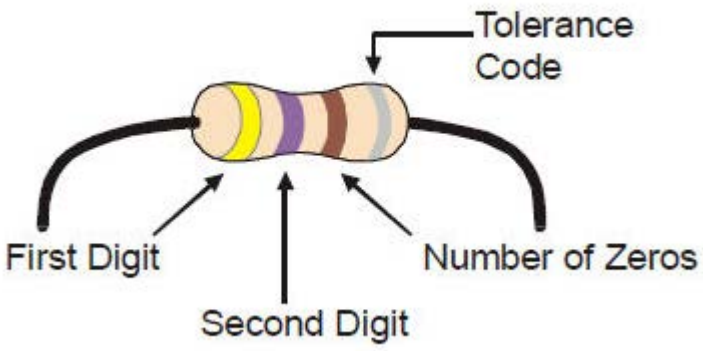

Figure 3.10 Basic Resistor Diagram

Some resistors come with four colored strips. In such case, fourth strip indicates the value of tolerance. Tolerance is the value of the deviation of resistance from its given value on the resistor. Gold color of forth strip indicates tolerance is 5% and silver color indicates tolerance is 10%. Where there is no forth strip, tolerance is considered as 20%. Suppose, if resistance has 50-ohm resistance with no forth strip. Then tolerance of such resistor can be 50 ±20%.

3.8.1 Resistor Applications

Resistors are widely used in many electrical circuits. Following are the main applications of resistors.

- They are used to limit current in order to avoid short circuit.
- They are used to control voltage in order to avoid high spikes at the end of output voltage.
- Used in many electronic industries.
- Temperature can also be controlled using these resistors.
- In home electronic appliances like heater and iron.

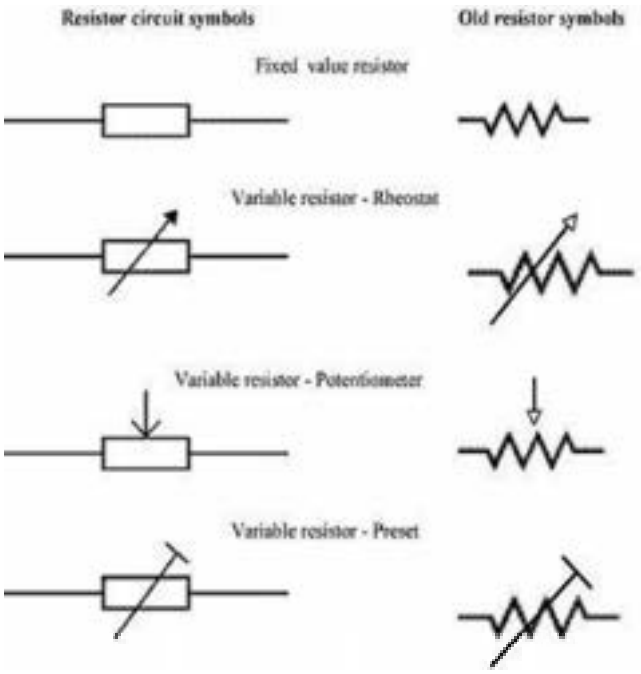

Figure 3.11 Resistor Circuit Symbols

3.9 Diode Introduction

- A diode is an electronic device which allows the current to flow in one direction only and blocks in other direction.

- It is a semiconductor device that comes with two terminals called anode and cathode. An anode is positive while the cathode is negative.
- Most of the diodes are made from silicon because it can afford high temperature, however, germanium is also used for manufacturing where low voltage drop is required.
- A diode is analogous to check valve which is mainly used to carry out ON and OFF operations. This process is used for rectification where AC signal is converted to DC signal. However, diodes are more complicated than simple ON-OFF operation because of a non-linear behavior of current and voltage characteristics of the diode.
- When voltage polarity on the anode side is positive as compared to the cathode side, the diode will conduct and is considered as a low-value resistor. If voltage polarity at the anode side is more negative as compared to the cathode side, the diode is said to have in reverse biased mode and it won't conduct.

Figure 3.12 Diode Diagram

3.9.1 Diode Types

Diodes are divided into two types based on the formation of the junction between the terminals.

- A PN junction diode is made from semiconductors like silicon or germanium where an N-type region is created with the help of negative charge carriers called n-type semiconductor while the P-type region is created with the addition of positive charge carriers called p-type semiconductors.

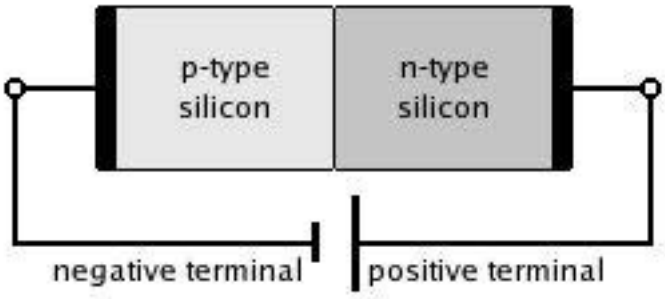

Figure 3.13 PN Junction Diode

- Initially, there is no flow of current between two regions until they are joined together, resulting in a formation of PN junction where movement of electrons starts from N-type semiconductor to P-type semiconductor.
- Schottky diode is another type of junction diode where the junction is formed using metal-semiconductor instead of using p-n junction. It is an ideal choice for the applications where high switching speed is required.

Figure 3.14 Schottky Diode

3.10 Capacitor Introduction

The capacitor is a component which has the ability or "capacity" to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery.

There are many different kinds of capacitors available from very small capacitor beads used in resonance circuits to large power factor correction capacitors, but they all do the same thing, they store charge.

In its basic form, a capacitor consists of two or more parallel conductive (metal) plates which are not connected or touching each other, but are electrically separated either by air or by some form of a good insulating material such as waxed paper, mica, ceramic, plastic or some form of a liquid gel as used in electrolytic capacitors. The insulating layer between a capacitors plates is commonly called the Dielectric.

Figure 3.15 Capacitor

There are two types of electrical charge, positive charge in the form of Protons and negative charge in the form of Electrons. When a DC voltage is placed across a capacitor, the positive (+ve) charge quickly accumulates on one plate while a corresponding and opposite negative (-ve) charge accumulates on the other plate. For every particle of +ve charge that arrives at one plate a charge of the same sign will depart from the -ve plate.

Then the plates remain charge neutral and a potential difference due to this charge is established between the two plates. Once the capacitor reaches its steady state condition an electrical current is unable to flow through the capacitor itself and around the circuit due to the insulating properties of the dielectric used to separate the plates.

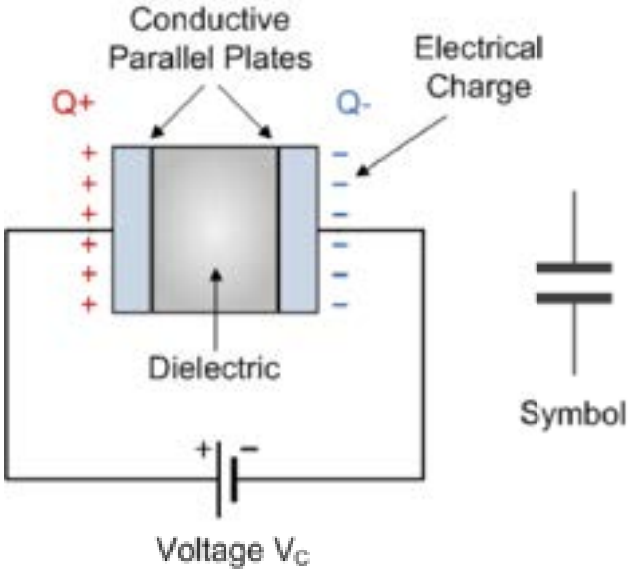

Figure 3.16 Capacitor Symbol

3.11 Thermistor Introduction

A thermistor is a temperature sensing element composed of sintered semiconductor material that exhibits a large change in resistance in proportion to a small change in temperature. A thermistor can operate over a wide temperature range and give temperature value by its resistance change, which is formed by two words: Thermal and resistor. The Positive temperature coefficients (PTC) and the negative temperature

coefficient (NTC) are the two major thermistor types that are used for temperature-sensing applications.

Thermistors are easy to use, inexpensive, and sturdy and respond predictably to a change in temperature. Thermistors are mostly used in digital thermometers and household appliances, such as ovens and refrigerators, and so on. Stability, sensitivity and time constant are the general properties of thermistor that make these thermistors durable, portable, cost-effective, highly sensitive and best for measuring single-point temperature.

Figure 3.17 LM35 Thermistor

3.11.1 Applications of NTC Thermistor

- **Surge Protection:** When a NTC thermistor is turned on, it absorbs the surge current across the equipment and protects it by changing its resistance.
- **Temperature Control and Alarm:** NTC thermistor can be used as a temperature control system or temperature alarm system. When the temperature increases, and the resistance of the thermistor decreases – the current becomes high and gives alarm or switches the heating system on.

CHAPTER 4

WORKING PRINCIPLE

The circuit is an open loop system. In this circuit initially 220V AC is stepped down to 12V AC. Then this AC is converted into DC by a rectifier circuit consisting of 4 diodes D1, D2, D3 and D4. Two electrolytic capacitors C1 and C2 are connected parallel to give more sensitivity to the circuit as they have the ability to smoothen the voltage across them. As the capacitor charges, the rate of change of voltage slows, and charge slows, as the charging current falls thus showing an exponential curve. An LED L1, through a resistance R1 is there across the capacitors to detect the flow of current. Now it is seen that, the thermistor't' and a variable resistor R2 (Potentiometer used here) is divided by R3 resistance of 1K. Initially R2 resistance and that of the Thermistor is almost same and there is no potential difference, so there is no voltage difference thus no current flows though the circuit. Hence the motor does not rotate.

When thermistor senses the temperature, as it is NTC (Negative Temperature Coefficient), its resistance decreases with the increase of temperature. As a result the current and voltage also increase creating a voltage difference across thermistor and the potentiometer R2. Due to this potential difference, a current starts flowing through R3. But this current is not sufficient to start the motor as the rated current of the motor is of high value. In order to amplify the current to a desired value Darlington pair is used. The Darlington transistor (often called a Darlington pair) is a constructed using two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one.

The current output from the Darlington Pair has sufficient high gain to drive the motor. The second LED, L2 is used for the same purpose as L1. Diode D5 is used as a Suppression diode or Fly-back diode, to suppress the sudden voltage spike across the inductive load, i.e. the motor, when the voltage is suddenly increased or decreased.

4.1 Construction and Components

The circuit is designed considering simplicity as the first priority and secondly in an economic way. So the components are also taken as simple as possible, which are very cheap in cost and easily available in the market. The purpose of this circuit is to

vary the speed of a fan related to temperature with a minimum parts counting and avoiding the use of special-purpose ICs, often difficult to obtain.

To do so, first of all, a number of Temperature Sensing Circuits are being developed and their characteristics have been studied. Thermistor as a main component has been chosen for sensing the temperature for designing the circuit. Other components are also there in the circuit design.

Table 4.1 Component Specification

S.NO.	Name of Components	Specifications	No. of Components Used
1.	LCD Display	-	1
2.	Buzzer Alarm	3KHz	1
3.	DC Motor Fan	12V	1
4.	Transformer	220/12V	1
5.	NPN Transistor	BC548C	3
6.	LED Bulb	1.8-2.2V	6
7.	Resistors	2KΩ	4
8.	Diodes	IN4001	3
9.	Capacitor	1000µF	2
10.	Thermistor	1K at 25°C	1
11.	Card Board	Stripped Board	1
12.	Relay	12V	1
13.	Microcontroller	16 Pin	1

4.2 Applications

- **Very low temperature thermometers**: They are used as resistance thermometers in very low-temperature measurements.
- **Digital thermostats**: These thermistors are also commonly used in modern digital thermostats.
- **Battery pack monitors**: NTC thermistors are also used to monitor the temperature of battery packs while charging. As modern batteries such as Li-ion batteries are very sensitive to overcharging, the temperature provides a very good indication of the charging state, and when to terminate the charge cycle.

CHAPTER 5

FUTURE DEVELOPMENT

Artificial Intelligence may be the key to solving the problems/limitations of the PID Controller and making it the perfect method. A little bit of artificial intelligence added to the PID controlled system that would perform an uninformed search with the aim of gaining some prior knowledge of the model of the process would perfect the PID Controller methodology. The major difficulty and defect of the PID Controller is that is acts or performs instinctively and this could sometimes compromise its role because its parameters are constant and precise and hence making it impossible for it to implement knowledge gained of the process because it has no knowledge of the model. Thus, an Artificial Intelligence system would completely remove this defect and perfect the PID Controller methodology.

PID Controller Algorithms are considered the most efficient and effective of all control Algorithms having successfully overcome the limitations of both the On/Off Control and the Proportional Control Algorithms. But even with its efficiency and effectiveness, we can still see some limitations evident in its control structure.

5.1 Scope of the Future Development

- This circuit can be expanded by incorporating a passive infrared sensor along with the temperature sensor. The passive infrared sensor can include a Fresnel lens for sensing a 360° circumference beneath the fan so that the fan can be turned on and off based the motion of persons approaching and leaving a selected area.
- A change over switch can be connected further using which the Fan can be controlled manually as well as automatically.
- This temperature controlled fan with some modifications can further be used in other Heater Circuits to maintain the constant temperature of the device.
- With this circuit, an alarm circuit can be added and used effectively in large equipment where the risk of being overheated and explosions are the serious problems, in various industries.

CHAPTER 6

COST ESTIMATION

Table 6.1 Cost Estimation

S.NO.	TYPE OF COST	Amount(in Rs)
1	Material cost	3500
2	Overhead chargers	600
	Total cost	4100

CHAPTER 7

CONCLUSION

Thus, in our project we have designed a temperature controlled fan using thermistor because of Controlling the temperature is a major problem in our rapidly evolving world and it needs cost-efficient solutions. This Temperature Control System shows a way to get the temperature value and displaying the value on a graphical LCD. In this Project temperature values are measured in analog form, and then it is converted to digital by the Microcontroller. Digital data is used for driving the graphical LCD by the microcontroller unit. The user can configure a set-point temperature value and control an external heating and/or cooling device by using the Temperature Control System. The system can be used as the basis for developing custom solutions for networked and standalone data collection and control equipment. It can be centrally powered due to its low current requirement and its small size makes it more portable, allowing it to be placed almost anywhere.

REFERENCES

1. Ahmad Faris Bin Zulkifli, 2019, "An Automatic Room Temperature Control with Security System", International Journal of Recent Technology and Engineering, volume no. 6, pp. 21-24.
2. Al Mamun Parvez, 2012, "Temperature Controlled DC Fan using Thermistor", IOP Conference Series: Materials Science and Engineering, volume no. 420.
3. Ghana Shyam Soren, Zairi Ismael Rizman, Kim Ho Yeap, 2010, "Temperature Controlled DC Fan Using Microcontroller", International Journal of Online and Biomedical Engineering, volume no. 16, pp. 167-169.
4. Vaibah Bhatia and Gavish Bhatia, 2006, "Temperature based Fan Speed Control System using Pulse Width Modulation Technique", International Journal of Computer Applications,volume no. 5, pp. 81-83.
5. W.Choi and W.Yoo, S.Won, 2016, "Development of Automatic Temperature Control System in Blast Furnace", International Journal of Engineering and Science Research, volume no. 24, pp. 55-56.
6. SharifulAlam and Duane, 2009, "Temperature based Automatic Power Controller for Electrical Devices", International Journal of Artificial Intelligence and Applications (IJAIA), volume no. 26, pp. 420-422.

GUESTURE CONTROL CAR CONTROLLING SYSTEM USING ANGLE SENSOR WITH RASPBERRY PI

A PROJECT REPORT – PHASE II

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PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

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ABSTRACT

The goal of gesture recognition in Computer Science field has always been the minimization of the distance between the physical world and the digital world. The way humans interact among themselves could be implemented in communication with the digital world by interpreting gestures via mathematical algorithm. Numerous ways and algorithms have been proposed and implemented to achieve the goal of gesture recognition and its use in communicating with the digital world. Gestures can be tracked using accelerometers. Since modern Smartphone are equipped with an in-built accelerometer, gesture control using Smartphone can be easy to implement, cheap to provide and the output will be more intuitive. This paper deals with the design and implementation of a wireless gesture controlled Robot using Arduino Lily pad processor and an Android operated application to control the gestures with minimal, and cheap hardware requirements.

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LIST OF ABBREVIATION AND SYMBOL

SYMBOL

V	Volt
^{0}	Degree
MHz	Mega Hertz
Rpm	Rotational per Meter

ABBREVIATION

USB	Universal Serial Bus
IC	Integrated Circuit
OS	Operating System
DC	Direct Current
TCL	Transport Layer Security
PIR	Passive Infrared Sensor
HSV	Herpes Simplex Virus
DWT	Dead Weight
ICSP	In-Circuit Serial Programming
FTDI	Future Technology Devices International
CRF	Cortrcotropin Releasing Factor
YCBCR	Luminance;Chroma;Blue;Chroma;Red

CHAPTER 1

INTRODUCTION

Humans interact in the physical world by the means of the five senses. However, guestures have been an important means of communication in the physical world from ancient times, even before the invention of any language. In this era of machines taking control of every complex works, interactions with machines have become more important than ever. Robots are classified into two types: Autonomous robots like Line sensing or edge sensing robots, and Remote controlled robots like Guestures controlled Robots. Since this paper deals with guestures controlled robot, the primary focus will be on the remotely controlled robots only. Undoubtedly, the output and the functioning of machines will be more intuitive if they are communicated using human guestures. A guesture is a form of communication in a non-verbal manner by using visible body movements or actions conveying messages.

There are several ways to capture human guestures that a machine would be able to understand. The guestures can be captured using a camera, or a data glove. Guestures can also be in infrared waves, Acoustic, Tactile, optical or motion technological means. The embedded systems designed for specific control functions can be optimized to reduce the size and cost of the device, and increase the reliability and performance. The Guestures are equipped with in-built accelerometer which may be used for guestures recognition and such other tasks. Moreover, Android platform is being used in the development of numerous applications for cell phones.

Researchers have shown interest in guestures recognitions and have built several robots and devices that are controlled by human guestures. There is a constant development in the field of guestures controlled devices. Apart from hand guestures recognition, emotional guestures recognition from face is also done in some cases. There are two types of guestures used in guestures recognition: Online guestures and Offline guestures. In Online guesturesahan, direct manipulations like rotation and scaling are done. In Offline guestures, the processing is done only after the user interacts with the object. Guestures technologies are applied in several fields like in Augmented Reality, Socially assistive Robots,

recognition of sign languages, emotion detection from facial expressions, Virtual mouse or keyboard, recognition of sign languages, remote control, etc.

There are various modes of communication between the microcontroller of the robot and the Smartphone. However, the popularly used means of communication is done via RF, Bluetooth or Wi-Fi. Using RF limits the distance from which the robot can be controlled. Using Wi-Fi increases the overall cost for setup. So, the robot has been built with Bluetooth which has intermediate range of distance covered and cost between RF and Wi-Fi. Rashberry PIto detect the direction of movement of the user's hand and move the robot accordingly. The prime aim of the design is that as the user moves his hand in some direction, the robot moves in the same direction as well. In other words, the robot is solely controlled by the hand movements and guestures of the user. The goal of this paper is to develop a method to control and program a robot with guestures and assure high level of abstraction, cheap and minimal hardware and a simplified robot programming.

The automated allow the you to automate task using drag and drop interface that make programming this task easier for beginners automated. Hand guestures recognition system provides us an innovative, natural user friendly way of interaction with computer has a wide a area of application including human machine interaction sign language immersive gain technology.

A guestures controlled robot using an accelerometer is one kind of robot which can be operated by the movement of hand by placing an accelerometer on it. This project is divided into two parts transmitter devices and receiver devices. Where a guestures devices works as a transmitter devices works as a transmitter devices and a robot works as a receiver devices when a transmitting devices is placed on the hand, then it will send signals to the robot for the required operation

The main goal of the of this project is to control the movement of the robot with the hand guestures using a PIR sensor it is used to detect the human body and motion accuracy with the sensing devices

CHAPTER 2

LITERATURE SURVEY

2.1 Study on Hand Guesture Segmentation

BaoHong, et.al., 2010, explains the detects the hand guestures from a monocular video image under complex background using a skin colour detection and background subtraction algorithm. The arm removal and the noise reduction have improved performance of the guestures recognition.

2.2 Bare Hand Guesture Recognition with a Single Colour Camera

Yishen Xu, et.al., 2009, explains the devised a technique for detecting the bare hand without any colour cap. The RGB image is transformed into Hue image. The skin segmentation algorithm is used to localize and segment the hand derived from image and eliminates arm region through using wrist line. Features are extracted to identify the different hand guestures.

2.3 Real-time hand guestures detection and recognition, using boosted classifiers and active learning

H. Francke et.al., 2007, explains proposed a robust, real time method for segmenting and hand guestures identification under dynamic environment hand guestures. To detect and recognize hand guestures extraction of the hand with skin colour detection and adaptive skin colour model, tracing of the hand location based on colour and finally to classify the guestures the boosted classifiers and multi guestures classification tree are used. The classifiers are trained using active learning and bootstrap training techniques, enhancing system performance regarding rate of detection, processing times, and false positives volume.

2.4 A Robust Method for Hand Guestures Segmentation and Recognition Using Forward Spotting Scheme in Conditional Random Fields

Mahmoud Elimezain et.at., 2010 explains the article has put forwarded a forward 6 spotting method for segmentation and recognition simultaneously with less time

delay. A stochastic non-guestures framework utilizing CRF is utilized to identify guestures without requiring data training. The model yields appropriate confidence measures utilized as part of an adaptive threshold to elaborate the initiation and conclusion of effective measures.

2.5 Hand Guestures Recognition based on Shape Parameters

Menak shi Panwar et.at., 2012 explains the approach is based on shape parameters. The shape information is extracted using computer vision techniques. Using the shape based approach hand guestures is matched.

2.6 Hand Segmentation using Skin colour and Background information

Wai wang et.at., 2012 explains the propose a new procedure for segmentation of human hands through adaptive skin colour model and background data with effect to split the image into upturned side to improve performance.

2.7 Stability analysis for tactile pattern based recognition system for hand guestures

Yuichiro Honda et.al., 2007 explains that Has developed a new pattern recognition system for the artificial limb control using the tactile pattern generated in the prosthetic socket due to muscle contraction.

2.8 Ethiopian Sign Language Recognition Using Artificial Neural Network

Yonas Fantahum et.al., 2010 explains and discusses about hand guestures detection and recognition for an Ethiopian sign language by using Garbor filters and PCA for feature extraction and artificial Neural Network for classification of the patterns drawn by the hand.

2.9 Accurate Recognition of Large Number of Hand Guestures

A. Shamaie et.al., 2003 explain and established a hierarchical guestures algorithm to recognize the hand guestures. A very low resolution images are processed. Each input frame of sequence is mapped onto a sequence of resulting in a trajectory. Using PCA, HMM and Graph matching, the reduction in the size of the image and noise removal, for temporal analysis and recognition of guestures are made respectively.

2.10 Guestures Recognition for Human-Computer Interaction Using Neural Networks

Y. Zhang et.al., 2001, explains the process incorporates detection and segmentation, Feature extraction and finally recognition of guestures assigned as control commands. Each stage includes a neural network for skin colour detection, principal component analysis and the clustering encoding for hand guestures.

2.11 Recognizing action at a distance

A. Efros et.al., 2003, explains and focuses on identifying people's action at a far of distance by using new motion identification based over optical flow assessments under spatiotemporal volume for all stable human image, and identical measure to the closest-neighbour structure. Here the optical flow is regarded as a pattern of noise in spatial domain which forms the motion descriptor in spatio- temporal domain. Nearest –neighbour technique is used to classify the actions performed by the person.

2.12 Actions as space-time shapes

M.Blank et.al., 2005, explains and have considered human interactions in 3D figures developed through outlines towards the time and space volume. The solution characteristic of Poisson equation is utilized for the extraction of attributes i.e. shape structure and orientation, action dynamics, local time space saliency. This method is fast; video alignment is not required and is applicable to images with known background.

Segmentation is a procedure of splitting an image into numerous parts. Automatic segmentation of object of interest from its background in video sequences has drawn lot of interest in computer vision. Skin colour is used for detection, recognition and tracking of hand. A review of various skin colour modelling and recognition techniques along with their numerical evaluation results are discussed in "A Survey on Pixel based Skin colour Detection Techniques". [V Sazonova, 2003]

2.13 A real time Face Tracker

Jie Yang et.al., 1996 explains and discusses about tracking the face of person while moving freely. The system is described as three models. Stochastic model is used to characterize skin colour distribution of human faces. The features extracted from this model

are used for tracking the face at different angles and possess and can adapt for any races of human being and for any lighting conditions. The motion based framework is utilized for assessing image motion and to predict the window of search. 8 The camera framework it utilized to forecast and balance out the motion of the camera. This procedure is implementable towards recognition of hand guestures.

2.14 Hand Guestures Segmentation Based on Improved Kalman Filter and TSL Skin Colour Model

Shu Mo et.al., 2011 explains the ponders on the new concept of segmentation which avoids the misclassification of objects with the same skin colour in the environment. A new segmentation concept combined with kalman filtering and TSL colour space provides high accuracy and efficiency. Kalman filter assist in anticipating the hand location so as avoid the interference of non-hand objects of the skin colour. TSL colour model is used to realize the hand region. Morphological executions are utilized for the removal of outlying objects and holes.

2.15 A New Method for Hand Segmentation Using Free-form Skin Colour Model

I Abdullah et.al., 2010 Deals with the extraction of hand pixel and characterized in YCbCr colour space. CbCr space is then transformed into CbCr plane to form the clusters region of skin colour. Edge detection is applied to form free form skin colour model. The concept works well in complex background.

2.16 Statistical colour models with application to skin detection

M. J. Jones et.al., 2002 explains the focuses of the simple histogram learning techniques to build a model for low image characteristics, i.e. colour of the skin. Skin pixel detector is utilized for isolating skin pixels from the contrary using histogram models and its performance is compared with mixture models in skin detection. The histogram model proved more efficient in skin detection.

2.17 Hand Segmentation for Augmented Reality System

Wu Yueming et.al., 2007, explains and focuses towards appearance and colour based procedures for detection of the skin for segmenting the hand and the background. The method does not emphasize on the still camera and a background. It does not depend upon the intensity variation of the illumination. The performance is high as the appearance model avoids the misclassification of the pixels of the skin.

The hand region is recovered using the 3D reconstruction technologies in the paper "Estimation of the fundamental matrix from un-calibrated stereo hand images for 3D hand guestures recognition",. A method is presented for predicting epipolar geometry amidst two non-calibrated cameras through stereo-based hand images. The hand undergoes segmentation utilizing RCE neural network based over colour algorithm segmentation and finger tips are extracted as features of interest and are matched with topological features of hand. The procedure has been proven over images based from both calibrated and non-calibrated cameras. [Yin X, 2002]

A learning based chromatic matching method is used to find out the skin chroma without the effect of illumination. Coarseness of skin is used to segment the skin accurately. To further increase the accuracy of the segmentation low level geometrical constraints is used. [J-S Lee, 2007]

2.18 Face Detection using Quantised skin colour regions merging and wavelet packet analysis

Arica C et.al., 1999, explains for deals with the detection of human faces in the colour images in a complex background with varying illumination conditions. YCbCr and HSV colour models are applied to form the cluster region of the skin. The face skin quality is assessed using wavelet packet decomposition in the detection of faces. The wavelet coefficients of the band filtered images characterize the face skin texture and the statistical differences extracted results in the feature vectors. The probabilistic metric based on the distance parameter is used for classification of the feature vectors as skin or non-skin areas of the face using the trained data set.

2.19 Enhanced Skin Detection Technique Using Block Matching

Kaabneh et.al., 2007, explains the highlights on a technique to detect the skin region in a static image. This procedure utilizes a model encompassing five faces detection with critical alterations to enhance facial detection rates. The hybrid model detects the face region using the block matching technique.

2.20 Computer monitoring and control with hand movements

R.O. Dogan et.al., 2014, explains the implemented computer controlling and monitoring utilizing hand motions through image and computer vision techniques In proposed study, the face of the user is detected with Harr Classifier and the hand region is detected using YCbCr model. The hand is traced by means Blob 10 Tracking Technique and the features are extracted using Convexity Defect-Hull. Finally, position of mouse is controlled according to features of hand region, and Computer controlling and monitoring using hand movements are implemented by tracking hand guestures.

2.21 Hand guestures recognition with depth images

J. Suarez et.al., 2012, explains and provides an extensive review of the literature based on the usage of depth assessment and identification of guestures. It concentrates towards depth-oriented guestures identification with reference to the methods developed for hand detection and classification of guestures, the implementation of guestures identification and implementation of OpenNI and Kinect software archives over guestures identification. Studies focuses towards OpenNI and Kinect archives for identification of hand guestures exhibit tendency to focus more towards application, as compared to classification or localization procedures, illustrating that OpenNI tracking procedure is the most efficient to the tested scenarios till now. Regardless, limitation factors for Kinect and associated sensors for guestures identification have not yet been assessed over difficult settings and applications.

The executed sign, utilizing glove-worn hands, are illustrated as letters over the screen. The framework is built to allow communication between the receiver and transmitter so that the elaboration of the message is conduced accurately and is fully comprehensible. [El Hayek, 2014]

A molecular modelling for understanding and visualizing chemical structures in 3D spatial domain and in their dynamic behaviour, using an Augmented Reality frameworks for viable interaction with ocular indicator using molecules. When individuals bring forward multiple molecules within single vicinity, prospective bonds are illustrated and molecules uniquely alter their 3D makeup in accordance with the prospective chemical reactions. Guestures-based procedures, proximity and shake based procedures are recommended to overcome the issues potentially arising when individuals are required to choose one specific bond from amongst a diverse array of prospective bonds whilst utilizing both hands for the alteration of molecules. [Maier, Patrick, 2010]

Author taking into consideration the identical traits found in human hands, i.e. featuring one thumb with four additional fingers, has written "Hand guestures recognition based on shape parameters," with the fundamental goal to provide a realtime framework for identification of hand-based guestures over viable shapes, i.e. finger and thumb status, orientation, mass centre etcetera. The framework presented in this research is based entirely on shape-related factors with the hand committing the guestures. The input sequence of images obtained from a simple web camera with 20 fps and seven mega pixel intensity is pre-processed to remove background noise. Kmean clustering is utilized for segmenting hand from the background. [M. Panwar, 2012]

A Kinect based dynamic guestures trajectory identification method which overcomes the limitation of guestures recognition rate in traditional dynamic guestures track recognition system uses OpenNI, under which palm has been elaborated as Kinect node. The palm position can be quickly and accurately obtained. The HMM technology is used for training the guestures models, therefore leading to enhanced rate of detection. The results demonstrate that these frameworks are faster and efficient with identification rates as compared to the conventional frameworks. [Youwen Wang, 2012]

2.22 Real-Time Hand Guestures Detection and Recognition Using Bag-of-Features and Support Vector Machine Techniques

Dardas, N.H et.al., 2011, explain the presents a hand guestures recognition model that detects and tracks the naked hand under a busy background using detection of skin and position of the hand's outline similarity procedure after deletion of the face. The guestures are recognized using BoF and multi-class Support vector machine. The generated

guestures commands are employed to control an application. The features from every trained image are extracted by applying SIFT. A vector quantization procedure mapping features belonging to all trained images into a solitary dimensional histogram vector (BoW) after K-means clustering. The SVM is fed with the histogram to construct a trained classifier. In each input image frame the hand is detected using the algorithm, followed by the feature extraction for all smaller images featuring solely the observed guestures. The features extracted are entered into group systems to categorize them in a BoW format, which is eventually applied to the multiclass SVM to recognize the action of the hand.

A hand guestures detection algorithm based on DWT and multi- class probability is proposed. Directional features based on Quaternion algebra are extorted utilizing a colour-depth camera. Directional characteristics, i.e. orientation or position which are invariant are utilized. DWT is applied to make speed and size of guestures as invariant, alongside improving the detection capacity. Hierarchical thresholding for deforming distance and guestures probability are utilized for guestures detection. Multi-class estimates are employed for classification of guestures. [Pisharady, P.K, 2013]

A real time model to identify the action of the hands based on wave controller technology is used to simplify the interaction between the human and machines. The presently interfacing devices between the human and computers like mouse, joystick etc suffers from major drawback that have restricted the capability of users, as they are required to respond to computer through the physical contact. Voice recognition cannot be applied where multiple users are present. These mentioned disadvantages are overcome by using hand guestures identification framework. It is also to be extended to the sign language recognition. [Zhengmao Zou, 2010]

A 6° of liberty over virtual mouse hand guestures utilizing a webcam powered through USB is focused in this article. The procedures of hand guestures and tracking constitute the skin colour, finger movement and hand motion. People with disabilities are able to access the computer easily. [Xingfeng Wang, 2010]

An efficacious skin colour detection system utilizing face detection technology to enhance skin model for a précised individual, whilst tracking is gained through a basic data algorithm is proposed. An efficient guestures identification procedure utilizing various extracted data, i.e. hand motion, local features, finger tips, and hand orientation is

brought forward. The suggested framework for identification of hand guestures is implemented towards administration of computer mouse and executing computer applications and games. [Nam Vo, 2010]

2.23 A Real Time Vision-Based Hand Guestures Interaction

Yee Yong pang et.al., 2010, explains has focused on vision based guestures recognition. This application necessitates pinpoint identification and detection. Moreover, the clutter and real environment make a significant influence 13 towards the recognition procedure. In this study, a real-time, vision-oriented, hand motion identification system was suggested for administering the desktop cursor, allowing for the navigation through utilizing only guestures of the hand.

A system was proposed for physically challenged people who are powerless to use conventional input systems for communication with computers. In this paper, Computer commands are implemented through hand motion. Dynamic and static movement of hand are obtained by using inertial navigation sensor to administer the mouse cursor, allowing for the opening and usage of computer through motion. Therefore accelerometer profiles are transformed into interactions without wired connection. The tool includes nontactile usage of equipments to alter and administer them as per the provided hand motions.[Dand 2010]

2.24 Advanced mouse pointer control using trajectory-based guestures recognition

Manchanda K et.al., 2010, explains and presents a technique for the administration of the mouse pointer motion utilizing basic guestures from the human hand, utilizing a camera. A real-time algorithm for tracking is implemented over adaptive skin identification and motion assessment. The motion and steering of movement is assessed and then utilized for the identification of a guestures. A section of interest algorithm is suggested, for scaling motion when users are stationed at a far distance from camera. The steering of the pointer is scaled subsequently.

A realistic game system employing a multi-modal user interface is proposed in "A realistic game system using multi-modal user interfaces," The framework utilizes gaze tracking, a hand guestures identification and analysis of bio-signal. In this system, addictive and realism-orientated graphical software is implemented over the Head Mounted Display with an eye ball tracer, hand guestures recognizer and a bio-signal analysis. The grasping

and pitching towards a object are executed through the individual's guestures by means of a Hand glove. Based on the measurement and analysis of bio-signals of the user are used to control the difficulty adaptively. [Hwan Heo, 2010]

2.25 A Real-Time Hand Guestures Recognition System for Daily Information Retrieval from Internet

Sheng-Yu et.al., 2011, explains and proposed a system to acquire regular data through the internet, i.e. news, finance news, weather information without requiring interaction with a mouse or keyboard. The daily information's are regained from Internet, using his/her hands' movements. On selection of the function by means of hand guestures the system gives out the information to the users through synthesized speech. The system also provides individual services by identifying the user with the face detection technique. Under this study, a PCA technique is utilized for the identification of facial and hand guestures, and afterwards, guestures are registered into the database for their meaning for further practical applications.

In this paper, the hand guestures captured from the camera provides virtual reality mechanism which can be operated on the entire system in real time. Hand guestures recognition system is composed of three steps namely skin detection, feature extraction and recognition A virtual mouse is designed for moving the cursor up and down. [Aksac A 2011]

The paper elaborates regarding the virtual touchpad, one that is built utilizing a camera and some other identification procedures, generally hand-based. It utilizes a section of a rectangular object as a pad, functioning similar to a conventional touchpad but features an additional array of controls. The pad supports different clicks, and allowing for guestures-based commands based on the hand and finger motions. This pad is capable of identifying and commanding most simple interactions, i.e. V shape, horizontal, vertical etcetera. [Edwin G, 2011: 1-5]

2.26 Guestures Recognition Based Mouse Events

Rachit Puri et.al., 2004, explains and describes an efficient strategy for mouse points and executes several basic operations, i.e. double and single clicking, dragging etc. utilizing identification procedures. Identifying motions can become a difficult tasks, as there are several aspects involved, e.g. modelling of motions, analysis, recognition of patterns, and learning according to machines. Taking into consideration all the critical factors, a framework has been established with the capacity to identify the motion of hands and fingers, fully understanding the meaning behind it. Coloured caps are utilizes in place of fingers to identify different factors, i.e. skin and background colour. Therefore, identifying the guestures, different events be performed 15 using the cursor. This software was created through MATLAB, and Windows is the supported OS.

The subjects like the fast response time and high-level precision of the systems are conferred with a stress on computer vision techniques, as guestures interaction presents technical problems. This paper presents an updating study of real time applications of the system using hand guestures along with body movements, vision, facial expression and voice recognition in health clinics and supportive technologies, entertainment, disaster management and in robotics. [J. P. Wachs, 2011]

2.27 Model-based 3d hand posture estimation from a single 2d image

C. Chua et.al., 2002, explains has focused on three dimensional hand guestures detection based on a two dimensional image. The hand prototype with 27º of freedom is introduced and its limitations are examined to reduce the 27º to 12º of freedom without any major deterioration of performance. The two dimensional feature points are used to estimate three dimensional hand poses through the algorithm.

The study elaborates on developing efficient guestures of the hand identification framework through the Kinect sensor. To acquire shape of hand acquired from the sensor, FEMD procedure is implemented. FEMD takes into consideration only the fingers, and disregards fingers. Therefore, allowing for the ascertaining of hand shape featuring trivial discrepancies. The long and expansive study illustrates the efficacy, precision, and effectiveness of the guestures identification system. [Z. Ren, 2011]

2.28 Hand guestures estimation and model refinement using monocular camera-ambiguity limitation by inequality

N. Shimada et.al., 1998, explains have proposed a method to find concurrently the shape and guestures of hand from the monocular imaging system without the depth information. The crude guestures is detected by matching the shape of the hand. Using motion detection and shape features the Region of Interest is efficiently reduced and possible crude guestures are developed. The crude guestures with high probability are selected and corresponding features are extracted. The modified Extended Kalman Filter with condensed distribution is used for fine-tuning of a three dimensional shape prototype and the crude guestures by disparity limitations. The depth uncertainty is 16 restricted with the knowledgeable observations of the images. The ambiguity of the balanced guestures is determined by producing and conserving the several solutions.

A frame work is designed for Bayesian tracking to approximate the posterior distribution at multiple resolutions. To remove least probability cluster and to estimate the distribution to a subjective accuracy, a tree based delineation of distribution is projected in this paper. In tree based depiction, the leaves describe the separation of the Region of Interest with the steady density. This method is used to track three dimensional distinct and flexible motions in a complex environment. The joint angles and the orientation of the hand are estimated in this method. [B. Stenger,1999]

The paper compares the performance of tracking system in kinect sensor camera and the optitrack in optical system in this paper. The data accumulated from the six upper limb Data is used in game based rehabilitation application. The Kinect and optitrack showed equal performance in tracking the movement of the hand. Kinect provides an prevalent accessibility for patients to recover from paralysis stroke and muscle rejuvenation in clinic and home. [C Y Chang, 2012]

CHAPTER 3

WORKING METHODOLOGY

Guestures recognition is the main aim of this work. The user holds an Android operated Smartphone, and moves, or rotates his hand in any direction. The accelerometer within the phone is regulated to generate a maximum and minimum value for the movement of the hand in three dimensional co-ordinates depending upon the external environmental conditions. The android application does the work of sensing the accelerometer calibration and generating the maximum and minimum values from it. Depending upon the values obtained, it sends a determinant value to the microcontroller and moves the robot accordingly. The whole process is under an infinite loop, so it runs as long as the power is supplied. The output depends on the accelerometer inputs directly that can be used to control the robot. The accelerometer input depends on the guestures of the user's hand.The steps stated above are broadly described in this section. The system consists of the following steps to work as mentioned.

3.1 Block Diagram of the system

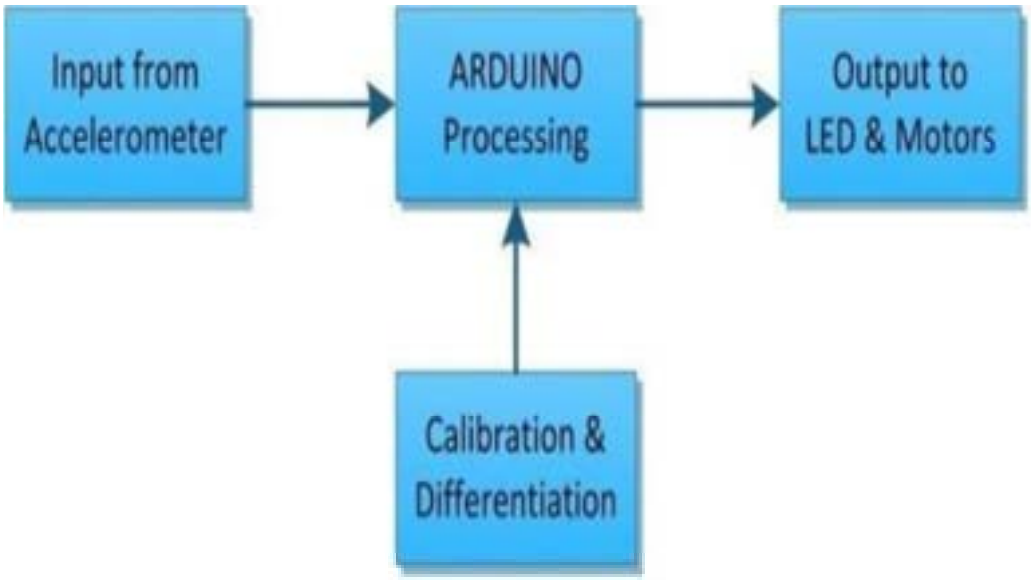

Figure 3.1 Block Diagram of Guesture Controlled Robot.

The data is received from the PIR sensor via HC-05 Bluetooth module on the digital pins of the Rashberry PImicrocontroller. It is then processed in Arduino. This processed data is received by the Adafruit motor shield. Based on the data.

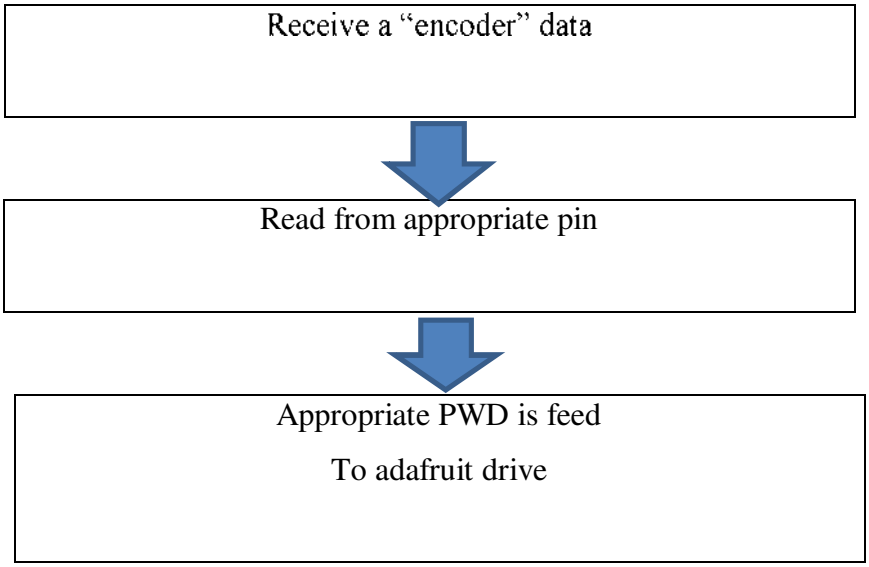

Figure 3.2 Flow chart of data transfer

3.2 Guestures Recognition

The application designed in this retrieves in the value of the accelerometer and sends a determinant value to the microcontroller via Bluetooth. As the user moves his hand, the accelerometer reading changes. It is then retrieved by the application. There are two values: One is maximum value and the other is minimum value. The range is specified using these two values for each function of the robot. If the value retrieved by the application lies between these specified values, then the corresponding determinant is generated. This determinant is sent to the microcontroller, which then receives the determinant value, process it to recognize.

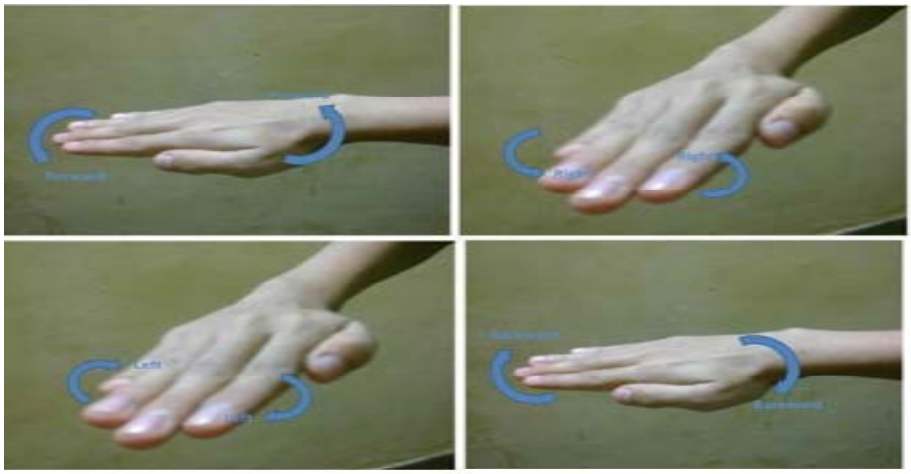

Figure 3.3 Hand recognition

When the user tilts hand forward. The guestures are recognized as the forward movement, and the robot moves in the forward direction. The angle of the tilt or the difference between the angle of tilt of user's hand and the threshold value of forward movement guestures determines the speed of the robot. When the user tilts his hand on the right direction, the guestures is recognized as the right turn, and the robot moves in the right direction. When the user tilts his hand in the left direction, the guestures is recognized as the left turn, and the robot moves in the right direction. The angle of the tilt of user's hand determines whether the left or right turn is a normal turn or a sharp turn. A sharp turn is one in which a car changes direction without slowing down before turning. When the user tilts his hand backwards, the guestures is recognized as the move backward guestures, and the robot moves in the backward direction. If the user's hand is somewhere between the two guestures, i.e., the accelerometer value is somewhere between the threshold of two directions(forward and left turn, left turn and backwards, backwards and right turn, forward and right turn), then the robot moves in that diagonal direction.

3.3 Movement of Motors and Wheels

There are four DC motors used in the design of this robot: one motor for each wheel. The motors are controlled by There are four DC motors used in the design of this robot: one motor for each wheel. The motors are controlled by the Adafruit Motor Shield library gives the flexibility of using the motors just by calling some pre-defined functions as motor1.setSpeed(value) that sets the speed of the motor to 250 rpm, or motor1.run(FORWARD) that makes the motor1 to rotate forward. These functions are called

from the program burnt in the Raspberry PI microcontroller. The signal is sent to the motor shield that runs the motors.

The wheels are connected to the motors. 4 DC motors are used Two for left wheels, and two for right wheels. When the signal received in the motor shield is to move forward, all the four wheels of motors rotate forward, this turns all the four wheels in the forward direction. The robot moves in the forward direction. When the signal received in the motor shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right shield is to turn the robot in the forward left direction, the left diagonal motors are rotated backwards while the right backward while the left diagonal motors are rotated forwards. This makes the robot turn in the forward right direction.

When the signal in the motor shield is to move backward, both the pairs of the motors are rotated backwards resulting the robot to move backwards. When the signal in the motor shield is to stop the robot, all the motors are made stationary resulting the robot to stop. Similarly, to rotate the robot in backward directions, similar methodology is used. To turn the robot in the backward left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This left direction, the left diagonal motors are rotated forwards while the right diagonal motors are rotated backwards. This motors are rotated forwards while the left diagonal motors are rotated backwards. This makes the robot turn in the backward right.

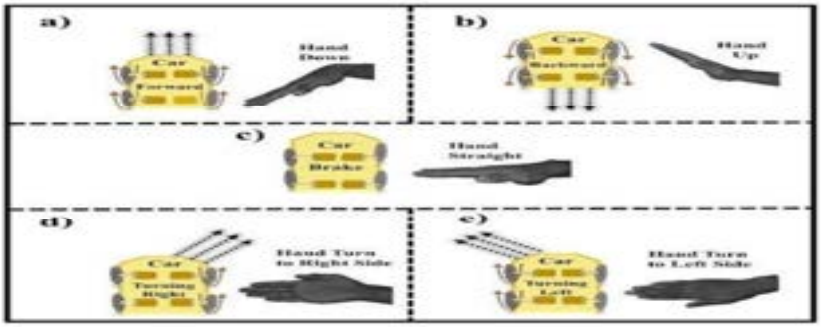

Figure 3.4 Movements of Motors and Wheels

CHAPTER 4

TECHNICAL REQUREMENTS

In this work, there are six fundamental components are required as shown in the figure 4.1. Technical Components used in the work

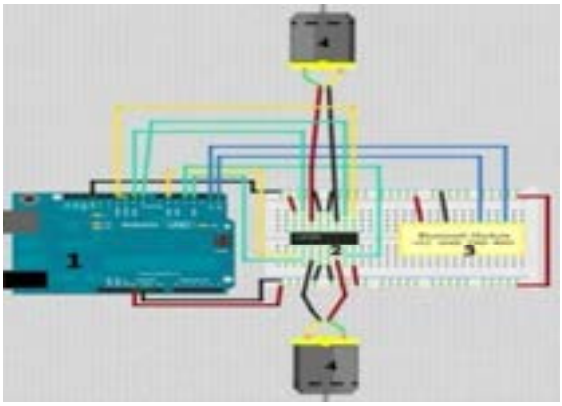

Figure: 4.1 Working Model of Guesture

4.1Microcontroller

The first requirement for the design of the robot is the microcontroller. In this work, Rashberry PIATMEGA 328 has been used. It is an open-source electronics prototyping platform with 14 digital I/O pins, 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.it is marked with 1.

Figure 4.2 Microcontroller chip

4.2 Mechanical Components

Motor driver is an additional requirement in this work. But to make the output more intuitive, this component is necessary. DC motors are used in this work to rotate the four wheels due to its effectiveness while designing robot with a high gear ratio. The motors are shown in the figure as. The motor shield used here is Adafruit Motor Shield V2. The

chip marked as 2 in the figure is motor shield, though a commercial manufactured motor driver is used to complete the work.

4.3 Raspberry PI

Figure 4.3 Raspberry PI

It is a designed for wearable application. It works on rechargeable batteries and allows easy connections with sensors and actuator's developed for an easy integration in clothes and fabrics. The Lily pad Rashberry PIUSB2 serial interface is the one we recommend, but any standard FTDI compatible interface suitable. The Rashberry PIUSB 2 serial interface behaves as an Rashberry PIUNO and shares the same driver.

4.4 Physical Characteristics

The raspberry is a circle, approximately 50mm (2") in diameter. The board itself is 0.8mm (1/32") thick (approximately 3mm (1/8") where electronics are attached0) .The operating voltage are 2.7-5.5V and the input voltage is 2.7-5.5V. The digital input pins 14 analog input pins 6 DC current per input pin 40mA flash memory 16KB SRAM 1KB.

4.4.1 Angle Sensor

An angle sensor or rotary sensor measures the relationship of an objects positioning with respects to another position that is enables that is establish. Angle sensor

Can be caterogies according to supply voltage, output type, sensing range, operating temperature range ,supply current, and packing type.

Figure 4.4 Angle sensor

4.4.2 Accelerometer

Accelerometer is an electro- mechanical devices used to measure acceleration forces such forces may be static like continuous forces of gravity as it case with many mobile devices, dynamic to senses movement or vibration . Acceleration is the measurement of the change the velocity, or speed divided by time.

Figure 4.5 Accelerometer

4.4.3 RF433module

These RF module are very popular among the rashberry PItinkerers are used on a wide variety of applications requires wireless controls its frequency of range is 433.92Mhz and it have a input voltage of 5V it is works as a transmitter and receiver in arduino.

Figure 4.6 RF433MODULE

4.4.4 HT12D

HT12D is a 2^{12} series decoder integrated circuit for remote control application for manufactured by HOTTEK. It is commonly used for radio frequency. Wireless application by

using the paired HT12E encoder and HT12D decoder can transmitter's bits of parallel data serially.

Figure 4.7 HT12D

4.4.5 1293DNE

Its current enhancing integrated circuit has the output from sensor is not able to drive motors itself so 1293DNE is use for this purpose and is 16pin IC having to enables pins which should always be remain high to enables pins which should always be remain high to enables both the H-bridges.

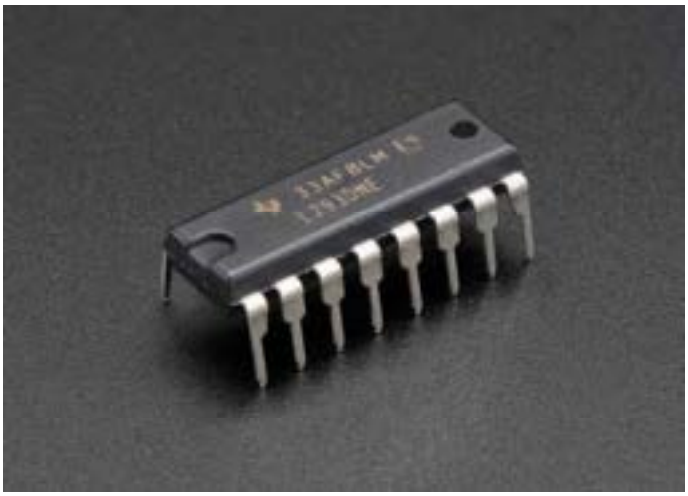

Figure 4.8 1293DNE

CHAPTER 5

DESING OF EQUPMENT AND WORKING

5.1 Components

The major components are used in guestures mode the are used to function in a guestures control car controlling system using PIR sensor.

1. Motor
2. Battery
3. Raspberry PI
4. RF433 Module
5. HT12D
6. 1293DNE

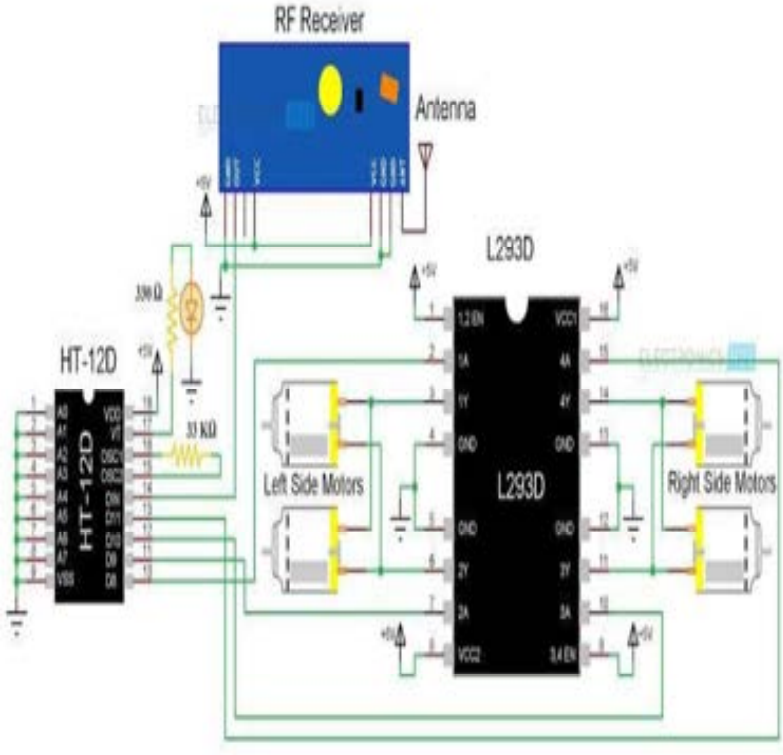

Figure 5.1 Connection of Guesture

5.2 Working Principle

The emergence of robots can be traced back to the 90's with Helpmate Robots and Robot-Caddy. Since then, there is an exponential development in the field of robotics,

and controlling robots through human guestures have been the topic of research for as long time. With the implementation of guestures to control robots, there have been several methodologies to perform the action. Some of the related works are being described in this section:

Our guestures controlled robots works on the principle of accelerometer which records our hand movements and sends that data to be comparator which assigns proper voltage levels to the recorders movements. That information is then transfer to the encoder which makes it ready for RF transmission. On the receiving end. The information is received wirelessly via RF, decoder and then passed on to the microcontroller which takes various decisions are passed to the motor driver in which triggers the motors in different configuration to make the robot moving a specific direction. With help of block diagram to understand the working of the robot.

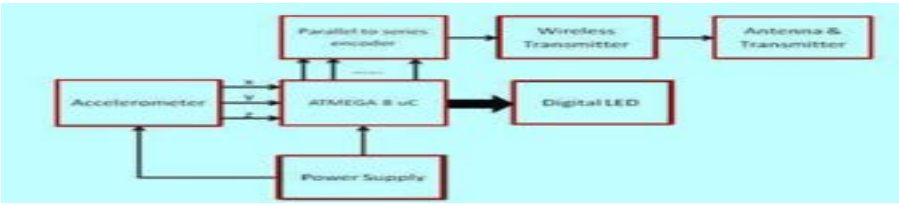

Figure 5.2 Block diagram for Processor

In our project we are have a two type of section which are work as a transmitter and receiver section.

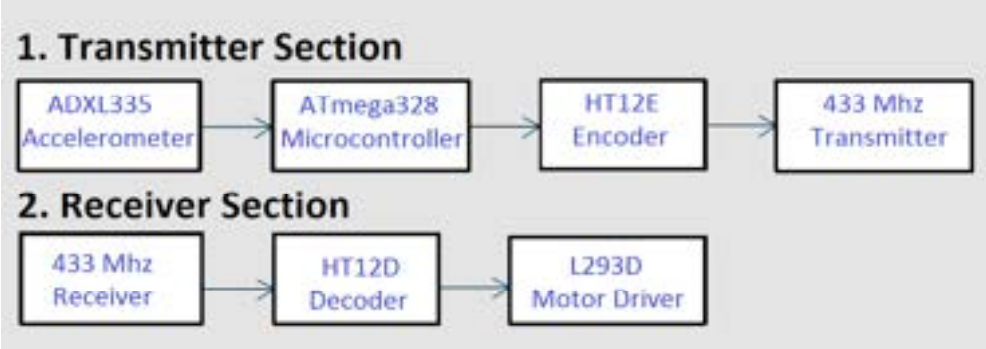

Figure 5.3 Block Diagram of encoder and decoder

5.2.1 Light-based Guesture Recognition

Light or illumination tracking and controlling robots with light sensors are being done in a lot of cases. Such robots are autonomous in nature. Generally, there are some light

sensors associated with the robot. The sensors send some rays of light and track them as they gets absorbed in the surface or reflected back to it. According to this, the robot can be line-sensing robots where it is made to follow a black or a white path autonomously.

5.2.2 Vision-based Guestures Recognition

Several robots are designed to be controlled by vision-based guestures. In such robots, there are, generally, some cameras as the sensor, which also acts as an interface to control the robot with some manipulators. The input guestures can be some patterns, movements of hands, colour tracking, face recognition, finger tracking, or some templates. They are also used in ball tracking and Robo-football games where the robots play the traditional game of football by tracking the movement of the ball. Though it has paved a way for advanced robot operations, but it is affected by factors such as illumination, foggy weather, background lights, etc.

5.2.3 Motion-based Guestures Recognition

The motions can be used to control a robot. This is generally done by incorporating an accelerometer to control the robot wirelessly. This can also be done using sensors. This method is beneficial over other methods in the sense that it can interact with machines naturally without being intruded by the factors that affects the mechanical devices. One important development in this field is done by Sauvik Das et al in 2010, where he designed a spying device yielding location and activities of the user without his/her knowledge.

5.2.4 Sixth Sense Technology

The Sixth sense technology begins in 1990 by Steve Mann who implemented a wearable computing device via neck-projector or head-mounted projector coupled with a camera. Later, following his idea, Pranav Mistry, a young research scientist at MIT at that time came up with new applications of this technology. Pranav Mistry came up with the name „Sixth Sense Technology" and has since been named Wear Ur World (WUW). This technology applies all of the techniques mentioned above and designing applications that give an intuitive output with the connection of internet.

CHAPTER 6

FUTURE DEVELOPMENT

A few decades ago, touchscreens were impressive, yet clunky pieces of technology reserved for applications that did little more than show off that touchscreens were possible. Today's touchscreens are commonplace and readily accepted as an easy way to interact with an operating system; they're accurate, support multi-touch, are comfortable to use, and can even operate in multiple dimensions (pressing hard). We may not have perfected touchscreens yet, but we're getting close. Accordingly, engineers and researchers are already speculating about the next phase of UI development, especially for robotics control. So far, the leading candidate is guesture-based control—the use of physical guestures to relay commands. The major limitation for touchscreens is the fact that they operate only in two dimensions; the third dimension introduced with force touch is extremely limited. Comparatively, hand guestures and physical movements can operate in three dimensions, and depending on how they're designed, could feel more natural than swiping and tapping a smartphone screen. Demand for three-dimensional gestural control is increasing with the onset of virtual reality (VR) and augmented reality (AR) technology; because the digital world we experience will be moving from two dimensions to three dimensions, the controls we use to manage those experiences will also need to change. With enough sophistication, these systems could provide better feedback to the users in control; rather than merely responding with visual feedback like movement or lights, users could feasibly be immersed with physical feedback like vibration or resistance. Generally, different types are used, and it's not always necessary to use one over the other, it does make things simpler to understand though.

The Two Types of Guestures:

1. Online guesture
2. Offline guesture

Online Guestures:

Put simply, these are guestures that control a machine or computer system in real time. Also called direct manipulation guestures, these are the sort that let you interact with objects and impose changes viewable as you do them.

Offline Guestures:

Guestures that are processed after they're done are called offline guestures. In other words, these are the guestures that don't show a real time change. For example, some new smartphones have the option to open a certain application after a specific guesture is made, this is basically an offline guesture. Besides being really functional, it cannot be argued against that guesture control looks really cool. Like in the 2002 hit movie Minority Report, there will probably come a time where everything is controlled by guestures. While it might seem like a technology that will only increase our lethargy, truth is that other than making life easier, it also has a vast array of applications in almost all fields.

Medical Applications:

Advanced robotics systems with guesture recognition can be placed in hospitals or homes to recognize and treat life threatening conditions like heart attacks or strokes.

Alternative Computer Interfaces:

Guesture recognition, along with voice recognition, facial recognition, lip movement recognition and eye tracking combined can be used to create something called a perceptual user interface (PUI), a completely different way to interact with computer systems which will improve usability and creativity by leaps and bounds.

Entertainment Applications:

Most videogames today are played either on game consoles, arcade units, and all require a combination of input devices. Guesture recognition can be used to truly immerse a players in the game world like never before.

Automation Systems:

In homes, offices, transport vehicles and more, guesture recognition can be incorporated to greatly increase usability and reduce the resources necessary to create primary or secondary input systems like remote controls, car entertainment systems with buttons or similar.

An Easier Life for the Disabled:

One of the biggest challenges faced today is providing separate and equally non cumbersome services to the differently abled and handicapped. While there are special

provisions around the world, there's still huge room for improvement to bring all lives on equal footing. Guesture recognition technology can eliminate a lot of manual labor and make life much easier for those who aren't as fortunate as most of us are.

6.1 Arm Control Based on Human Arm Motion

This paper discusses the development of a robotic arm whereby its motion is controlled based on the movements of the human arm. There are three major components in this project. They are a wearable control device, microcontroller and robotic arm. The wearable control device acts as a sensor to translate the physical movement of the human arm into electrical signals. The translated signals in the form of positional. The microcontroller unit processes the signals and outputs it to the robotic arm as physical replicated movements. The wearable control device is capable of sensing six degrees of freedom by the human arm joints movements. This includes rotation of the shoulder, arm, bending of the shoulder, elbow, wrist, and gripping motion. The fabricated robotic arm is able to perform six different motions replicating and mimicking the motions of the human arm.

CHAPTER 7

ADVANTAGES AND APPLICATION

7.1 Advantages

- It Requires Acceptable Speed.
- It Is Sufficient Reliable For Recognition System.
- It Is Performance A Good For Complex Background.
- It Is Successfully Recognized Static and Dynamic Guestures.
- It Is Applied On Mobile Robot Control.
- Simple, Fast and Easy To Implement.
- This Also Can Be Applied For Real System And Play Games.
- It does Not Need Training Is Required.
- Easy To Maintains
- It Is More Complex.
- It Reduces A Man Power.
- Good Performances.
- It Can Be Related To The All Four Wheelers.

7.2 Application

- Image Controlling And Scaling.
- To Control Mouse.
- Sign Language Recognition.
- It Is Support For The Gaming Interface.
- Robot Control.
- Controlling Machines.
- It Can Be Used In Post Offices And Banks.
- It Is Used For Especially Socially Assistive Robotics.

CHAPTER 8

COST ESTIMATION

Table 8.1 Cost Estimation

S.No.	TYPE OF COST	AMOUNT (in Rs)
1	Materials Cost	3500.00
2	Labour Cost	1500.00
3	Overhead Charges	500.00
4	Total cost	5500.00

CHAPTER 9

CONCLUSION

Based on the phase I study the following conclusion are made:

The Guesture controlled robot designed in this work has many future scopes. The robot can be used for surveillance purpose. The robot can be applied in a wheelchair where the wheelchair can be driven by the movements of rider's hand.

Edge sensors can be incorporated to it to prevent the robot from falling from any surface. Some camera can be installed which can record and send data to the nearby computer. It can be implemented on a watch, or in any home appliances like Room heater. Modern RASHBERRY PIchips support Intranet as well as Internet connections which can be utilized to a greater extent.

This robotic car can be enhanced to work in the military surveillance where it can be sent to some enemy camps and track it's activities via Internet. With a mind full of creation, the possibilities are endless. In this paper, the design and implementation of Guestures Controlled Robot is presented and developed using Rashberry PI microcontroller. An algorithm has been provided and its working is detailed thoroughly. Since the updating possibilities are endless, updating the system has been kept as a future scope. The built device is cheap, and is easy to carry from one place to another.

The addition of the some additional sensors or camera will make it more productive. The limitation of the hardware being associated with a system has been reduced to a great extent. As an end thought, the system will allow the user to control it in a way that reduces the gap between the physical world and the digital world with an output more intuitive.

APPENDICES

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REFERENCES

1. Pankaj Kumar Gautam, Sudhasnhu Pandey and Vishwajeet Kumar Nanda, 2018, "Robot Control by Accelerometer Based Hand Guesture using Rashberry PI Microcontroller", International Journal of Recent Technology and Engineering, volume no. 7, pp. 24-27.
2. Prem Kumar.Ch and Salumari Madhu, 2018, "Guesture Control Robot with Arduino", IOP Conference Series: Materials Science and Engineering, volume no. 455.
3. Pooja Pawar, Dinesh Kumar Bhusare, Shilpa Karale and R. K. Sarawale, 2015, "Hand Guesture by Using Robotic Car Control", International Journal of Advanced Research in Computer Engineering & Technology, volume no. 4, pp. 830-833.
4. Rafiqul Zaman and Noor Adnan Ibraheem, 2012, "Hand Guesture Recognition: A Literature Review", International Journal of Artificial Intelligence & Applications (IJAIA), volume no. 3, pp.161-174.
5. Suree Pumrin, Thittaporn and Ganokratanaa, 2017, "Hand Guesture Recognition Algorithm for Smart Cities based on Wireless Sensor", International Journal of Online and Biomedical Engineering, volume no. 13.
6. Siddharth Rautaray.S and Anupam Agrawal, 2012, "Real Time Guesture Recognition System for Interaction in Dynamic Environment", Procedia Technology, volume no. 4, pp. 595-599.
7. Vijaya Laxmi, 2016, "Image Processing Based Hand Guesture Controlled Robot on Raspberry PI", International Journal of Engineering & Science Research, volume no. 6, pp. 49-54.

PLANT DOCTOR

A MINI PROJECT REPORT

Submitted by

KALAISELVAN.K	**(16202019)**
RANJITHKUMAR.S	**(16202036)**
VINOTH.K	**(16202052)**

in partial fulfillment of the award of the degree of

BACHELOR OF TECHNOLOGY

in

INFORMATION TECHNOLOGY

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(AUTONOMOUS)

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ABSTRACT

Agriculture has become much more than simply a means to feed ever growing populations. It is very important where in more than 70% population depends on agriculture in India. That means it feeds great number of people. The plant diseases effect the humans directly or indirectly by health or also economically. To detect these plant diseases we need a fast economic way. Diseases are analyzed by different digital image processing techniques. In this way, we have done on different digital image processing techniques to detect the plant diseases. Image processing system are developed for agricultural applications, such as detection of leaf diseases, fruit diseases and so on. Farmers experience great difficulties in changing from one disease control policy to another. Relying on pure naked eye observation to detect and classify diseases can be expensive various plant diseases pose a great threat to the agricultural sector by reducing the life of the plants. The present work is aimed to develop a simple disease detection system for plant diseases.

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LIST OF ABBREVATIONS

S NO.	ABBREVATIONS	EXPANSIONS
1.	**API**	Application program interface
2.	**AIS**	Application program specification
3.	**SA form**	Service availability form
4.	**l**	Length
5.	**d**	Distance
6.	NNE	Neutral network efficiency

CHAPTER 1

INTRODUCTION

Agriculture is the mother of all cultures. It has played a key role in the development of human civilization.Agricultural practices such as irrigation,crop rotation,fertilizers,and pesticideswere developed long ago, but have made great strides in the past century. By the early 19th century, agricultural techniques had so improved that yield per land unit was many times that seen in the middle ages. Agricultural production system is an outcome of a complex interaction of soil, seed and agro chemicals (including fertilizers). Therefore, judicious management of all the inputs is essential for the sustainability of a complex system. The focus on enhancing the productivity, without considering the ecological impacts has resulted into environmental degradation. Without any adverse consequences, enhancement of the productivity can be done in a sustainable manner.

Plants exist everywhere we live, as well as places without us. Many of them carry significant information for the development of human society. As diseases of the plants are inevitable, detecting disease plays a major role in the field of Agriculture. Plant disease is one of the crucial causes that reduces quantity and degrades quality of the agricultural products.

Diseases and insect pests are the major problems that threaten pomegranate cultivation. These require careful diagnosis and timely handling to protect the crops from heavy loses [2]. In pomegranate plant, diseases can be found in various parts such as fruit, stem and leaves. Major diseases that affect pomegranate fruit are bacterial blight (Xanthomonas axonopodis pv punicae), antracnose (Colletotrichum gloeosporoides) and wilt complex (ceratocystis fimbriata).

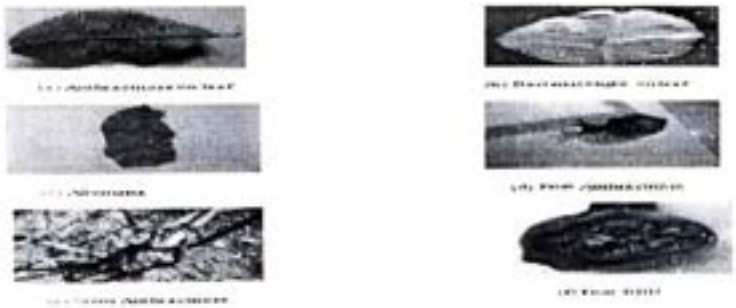


Figure 1.1Image Samples Diseases

Bacterial blight is the most severe disease of the pomegranate. The disease symptoms can be initially found on stem part which gradually pervades to leaves and then to

fruits. On leaves, the disease starts with small, irregular, water soaked spots that are 2 to 5 mm in size with necrotic centre of pin head size. Spots are translucent against light. Later, these spots turn light to dark brown and are surrounded by prominent water soaked margins.Numerous spots may coalesce to form bigger patches. Severely infected leaves may drop off. High temperature and high relative humidity favors the disease. The disease spreads to healthy plants through wind splashed rains and in new area through infected cuttings.

In this work we will be focusing on three different diseases which are attacked on pomegranate crop.

1) Alterneria.
2) Bacterial blight.
3) Anthractnose.
4) Fruit Anthractnose.
5) Stem Anthractnose
6) Fruit Bacterial blight.

1.1 RELATED WORKS

Google Lens is an technology developed by image recognition Google, designed to bring up relevant information related to objects it identifies using visual analysis based on a neural network.[2] First announced during Google I/O2017,[3] it was first provided as a standalone app, later being integrated into Android's standard camera app.

When directing the phone's camera at an object, Google Lens will attempt to identify the object or read barcodes, QR codes, labels and text, and show relevant search results and information. For example, when pointing the device's camera at a Wi Filabel containing the network name and password, it will automatically connect to the Wi-Fisource that has been scanned. Lens is also integrated with the Google PhotosandGoogle Assistantapps.The service is similar to Google Goggles,a previous app that functioned similarly but with less capability. Lens uses more advanced deep learning routines in order to empower detection capabilities, similar to other apps like BixbyVision(for Samsungdevices released after 2016) and Image Analysis Toolset (available on Google Play); During Google I/O2019, Google announced four new features. The software will be able to recognize and recommend items on a menu. It will have the ability to also calculate tips and split bills, show how to prepare dishes from a recipe and can use text-to-speech.

1.2 OVERVIEW OF THE PROJECT

The methodological analysis of the present work has been presented. The work commence with capturing images using cameras or scanners. These images are made to undergo pre-processing steps like filtering and segmentation. Then different texture and colour features are extracted from the processed image. Finally, the feature values are fed as input to the ANN classifier to classify the given image.

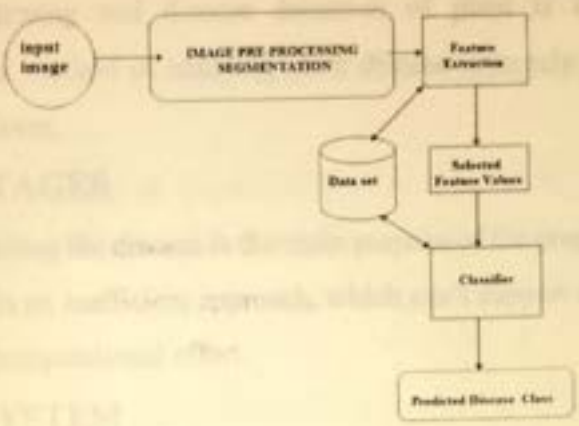


Figure1.2Block Diagram

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

In this paper we experimentally evaluate a software solution for fast, accurate and automatic detection of plant diseases through Image Processing. Identification of the plant diseases is the key to preventing losses in the quality and quantity of the agricultural product. Health monitoring and disease detection of plant is critical for sustainable agriculture. The typical method of studying plant disease is to rely on visually observable patterns on the plant leaves.

2.1.1 DISADVANTAGES

Recognizing the disease is the main purpose of the proposed approach. But the results indicate that it is an inefficient approach, which can't support an accurate detection of leaf disease in a little computational effort.

2.2 PROPOSED SYSTEM

Digital Image Processing is the use of computer algorithms to perform image processing on digital images. An image may be defined as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of at any pair of coordinates (x, y) is called the intensity or grey level of the image at that point. When x, y and the intensity values of f are all finite, discrete quantities, we call image a digital image. Digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, image elements, pels, and pixels. Pixel is the term most widely used to denote the elements of a digital image. Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception.

It take the image which is RGB model as input image and then feature values will be calculated and get required output. Then image analysis will be performed and after that classifier will be applied.

2.2.1 FEATURES

1) Disease detection and used image growing, image segmentation techniques on this.
2) Compresence Farmer's Work.
3) User friendly.
4) Efficient approach

2.2.2 ADVANTAGES

1) The results indicate that it is an efficient the main characteristics of disease detection are speed and accuracy.
2) Hence there is working on development of fast, automatic, efficient and accurate system, which is use for detection disease on unhealthy leaf
3) Approach, which can support an accurate detection of leaf disease in a little computational effort.
4) It will be encouraging and promise the development of a good machine vision system in the area of recognition and classification of plant diseases.

CHAPTER 3

SYSTEM REQUIREMENTS AND SPECIFICATIONS

3.1 APPLICATION REQUIREMENTS

To develop the android based mobile application the station and the environment of the surrounding have to been interviewed then the dangerous and the suspicious activates should be notified to the device by the user. If the device detects the problem then only other process creates the attention for reporting to the authority.

Tri-Axial Accelerometer

Tri-axial accelerometer is a device which is used for the detection of trigger using the higher threshold value, which is generally works on the basis of three parameters such as height, weight, and level of activity. The algorithm adapts to unique movements that a phone experiences as opposed to similar systems which require users to mount accelerometer to their chest or trunk.

Network provider support

Network provider has got the important role, by sending the commands through the short message type to the different applications.

3.2 OPERATING SYSTEM

By considering the today's environment most of the people using the android based mobile phones and android is the open source which can be used and adapted easily so android operating system can be used. **Android** is an operating system based on the Linux kernel, and designed primarily for touch screen mobile devices such as smart phones and tablet computers.

Initially developed by Android, Inc., which Google backed financially .Android was unveiled in 2007 along with the founding of the Open Handset Alliance: a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first publicly available Smartphone running Android, the HTC Dream, was released on October 22, 2008 The user interface of Android is based on direct manipulation, using touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching and reverse pinching to manipulate on-screen objects. Internal hardware

such as accelerometers, gyroscopes and proximity sensors are used by some applications to respond to additional user actions, for example adjusting the screen from portrait to landscape depending on how the device is oriented. Android allows users to customize their home screens with shortcuts to applications and widgets, which allow users to display live content, such as emails and weather information, directly on the home screen. Applications can further send notifications to the user to inform them of relevant information, such as new emails and text messages. Android is open source and Google releases the source code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. In practice, Android devices ship with a combination of open source and proprietary software. Android has a large community of developers writing applications ("apps") that extend the functionality of devices, written primarily in the Java programming language. In October 2012, there were approximately 700,000 apps available for Android, and the estimated number of applications downloaded from Google Play, Android's primary app store, was 25 billion. A developer survey conducted in April–May 2013 found that Android is the most popular platform for developers, used by 71% of the mobile developer population.

Android is the world's most widely used Smartphone platform, overtaking Symbian in the fourth quarter of 2010. Android is popular with technology companies who require a readymade, low-cost, customizable and lightweight operating system for high tech devices. Despite being primarily designed for phones and tablets, it also has been used in televisions, games consoles, digital cameras and other electronics. Android's open nature has encouraged a large community of developers and enthusiasts to use the open-source code as a foundation for community-driven projects, which add new features for advanced user or bring Android to devices which were officially released running other operating systems. As of November 2013, Android's share of the global Smartphone market, led by Samsung products, has reached 81%.The operating system's success has made it a target for patent litigation as part of the so called "Smartphone" between technology companies. As of May 2013, 48 billion apps have been installed from the Google Play store, and as of September 2013, 1 billion Android devices have been activated.

APPLICATIONS

1) These are applications written in Java. Some of basic applications include a calendar, email client, SMS program, maps, making phone calls, accessing the Web browser, accessing your contacts list and others. If you are an average user, this is the layer you will us most, rest all layers are used by Google programmers, developers and hardware manufacturers.
2) This is the skeleton or framework which all android developers has to follow.
3) The developers can access all framework APIs an manage phone's n to keyword ki: basic functions like resource allocation, switching between processes or programs, telephone applications, and keeping track of the phone's physical location. The **architecture** is well designed to simplify the reuse of components. Think of the application framework as a set of basic tools with which a developer can build much more complex tools.
4) This layer consists of **Android** libraries written in C, C++, and used by various systems. This library tells the device how to handle different kinds of data and are exposed to Android developers via Android Application framework. Some of these libraries includes media, graphics, 3d, SQLite, web browser library etc. The Android runtime layer which includes set of core java libraries and DVM (Dalvik Virtual Machine) is also located in same layer.
5) This layer includes set of base libraries that are required for java libraries. Every Android application gets its own instance of Dalvik virtual machine. Dalvik has been written so that a device can run multiple VMs efficiently and it executes files in executable (.Dex) optimized for minimum memory.
6) This layer includes Android's memory management programs, security settings, power management software and several drivers for hardware, file system access, networking and inter-process communication. The kernel also acts as an abstraction layer between hardware and the rest of the software stac.

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 APPLICATION PROGRAM INTERFACE (API) TRAINER

An **Application Programming Interface (API)** is aninterfaceorcommunication protocolbetween aclient and a serverintended to simplify the building of client-side software. It has been described as a "contract" between the client and the server, such that if the client makes a request in a specific format, it will always get a response in a specific format or initiate a defined action.[1]

An API may be for a web-based system,operating system,database system, computer hardware, orsoftware library.

An API specification can take many forms, but often includes specifications forroutines,data structures,object classes,variables, orremote calls.POSIX,Windows APIandASPIare examples of different forms of APIs. Documentation for the API usually is provided to facilitate usage and implementation.

4.1.1 APPLICATION SOURCE CODE

Application programming interface (API) specifies how some software components should interact with each other. In practice in most of the cases an API is a library that usually includes specification for routines, data structures, object classes, and variables. An API specification can take many forms, including an International Standard such as POSIX, vendor documentation such as the Microsoft Windows API, the libraries of a programming language, e.g., Standard Template Library in C++ or Java API.

The estimated number of spots or area is smaller than the real ones. The errors concerning the number of spots and the estimated area are inversely proportional. This means that when changing the parameters.

4.1.2 API TRAINED DATA

Imagine you are a botanist seeking an automated way to categorize each Iris flower you find. Machine learning provides many algorithms to classify flowers statistically. For instance, a sophisticated machine learning program could classify flowers based on photographs. Our ambitions are more modest we're going to classify Iris flowers based on the length and width measurements of theirsepalsandpetals.

The Iris genus entails about 300 species, but our program will only classify the following three:

- Iris setosa
- Iris virginica
- Iris versicolor

Figure 4.1. Dieases occurred in flowers

Fortunately, someone has already created adataset of 120 Irisflowerswith the sepal and petal measurements. This is a classic dataset that is popular for beginner machine learning classification problems.

4.1.3 MACHINE LEARNING ALGORITHM

Machine learning (ML) is thescientific studyofalgorithmsandstatistical modelsthatcomputer systemsuse to perform a specific task without using explicit instructions, relying on patterns andinferenceinstead. It is seen as a subset ofartificial intelligence. Machine learning algorithms build amathematical modelbased on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task.Machine learning algorithms are used in a wide variety of

applications, such asemail filteringandcomputer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task.

Machine learning is closely related tocomputational statistics, which focuses on making predictions using computers. The study ofmathematical optimizationdelivers methods, theory and application domains to the field of machine learning.Data miningis a field of study within machine learning, and focuses onexploratory data.

Analysisthroughunsupervised learning.In its application across business problems, machine learning is also referred to aspredictive analytics

4.1.4 IMAGE PROCESSING

Incomputer science, digital image processing is the use of computeralgorithmsto perform image processing ondigital images.[1]As a subcategory or field ofdigital signal processing, digital image processing has many advantages overanalog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form ofmultidimensional systems.

Digital image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analog means.

4.2 ANDROID STUDIO

Android Studio is a windowed environment. To make the best use of limited screen realestate, and to keep you from being overwhelmed, Android Studio displays only a small fraction of the available windows at any given time. Some of these windows are contextsensitive and appear only when the context is appropriate, while others remain hidden until you decide to show them, or conversely remain visible until you decide to hide them. To take full advantage of Android Studio, you need to understand the functions of these windows, as well as how and when to display them. In this chapter, we're going to show you how to manage the windows within Android Studio.

One of the essential functions of any integrated development environment (IDE) is navigation. Android projects are typically composed of many packages, directories, and files, and an

Android project of even modest complexity can contain hundreds of such assets. Your productivity with Android Studio will depend in large measure on how comfortable you are navigating within these assets and across them. In this chapter, we're also going to show you how to navigate in Android Studio.

Finally, we'll show you how to use the help system within Android Studio. To take full advantage of this chapter, open the HelloWorld project we created in Chapter 1. If this project is already open in Android Studio, you're ready to go.

Figure 4.2 Android studio

4.2.1 The Editor

The primary purpose of any IDE is to edit files. As one would expect, the window that allows users to edit files in Android Studio is located in the center pane of the IDE. The Editorwindow is unique among windows in that it is always visible and always located in the center pane.

In fact, the Editor window is such a pervasive feature of Android Studio that from here on out, we refer to it simply as the Editor. All the other windows in Android Studio are called tool windows and cluster in side panes (left, bottom, and right) around the Editor.

The Editor is a tabbed window, and in this respect it resembles a contemporary web browser. When you open a file from one of the tool windows, from a keyboard shortcut, or from a context menu, the file displays as a tab of the Editor. As you already discovered when you built your first project, HelloWorld, the MainActivity.java and the activity_main.xml files were automatically loaded in the Editor as tabs. Android Studio tries to anticipate which files you're likely to start editing, and then opens them automatically as tabs in the Editor upon completion of the New Project Wizard. Virtually any file may be opened in the Editor, though raw image and sound files cannot (yet) be edited from within Android Studio. You may also drag and drop a file from a tool window onto the Editor; doing this opens the file as a tab in the Editor.

Along the top of the Editor are the Editor tabs. Along the left margin of the Editor is the gutter, and along the right margin of the Editor is the marker bar. Let's examine each in turn.

4.2.2 Editor Tabs

To navigate among Editor tabs in Android Studio, use the Alt+Right-Arrow | Ctrl+RightArrow or Alt+Left-Arrow | Ctrl+Left-Arrow keys. Of course, you may always select an Editor tab with your mouse. The Editor tabs' options are located in the main menu bar at Window ➤ Editor Tabs. Any action you select from this menu applies to the currently selected tab. Roll your mouse over the MainActivity.java tab and right-click (Ctrl-click on Mac) it. In the resulting context menu.

It will notice many of the same options that you discovered in Window Editor Tabs. From this context menu, select the Tabs Placement submenu. The menu options Top, Bottom, Left, and Right allow you to move the tabs bar. Moving the tabs bar to the right or left accommodates more visible tabs, though at the expense of screen real-estate.

Figure 4.3 Editor Tab context menu

The Close and Close All actions of the Editor Tab context menu are straightforward. The Close Others action is used when you want to close all the tabs except the active tab.

The Split Vertically and Split Horizontally actions are used to subdivide your Editor into panes. Split Vertically is particularly useful if you want to compare two files side by side. You may split panes ad infinitum, though the utility of such nested splits quickly diminishes.

You may also drag and drop files from other windows to any pane of the Editor, or from one pane to another. Closing the last tab of a pane causes the entire pane to disappear.

4.2.3 The Gutter

The gutter is used to convey information about your code. Perhaps the most obvious feature of the gutter is that small color swatches and image icons are displayed there alongside corresponding lines of code that refer to those visual resources. The gutter is also used to set breakpoints, facilitate code-folding, and display scope indicators. All of these features are covered in more detail in subsequent sections and chapters.

4.2.4 The Marker Bar

Along the right side of the Editor is the marker bar. The marker bar is used to indicate the location of important lines in your source files. For example, the marker bar highlights warnings and compile-time errors in your Java or XML files. The marker bar also shows you uncommitted changes, search results, and the locations of bookmarks.

The marker bar does not scroll like the gutter does; rather, the colored ticks on the marker bar are positioned relative to the length of the file. Clicking a colored tick in the marker bar immediately jumps you to that location in the file. Practice using the marker bar by clicking some of its colored ticks now.

4.2.5 Tool Buttons

You have already seen the Project tool window, displayed in the left pane by default. To see a list of all the tool windows, choose View Tool Windows from the main menu bar. Now look carefully along the left, right, and bottom margins of the IDE. There you will find tool buttons that correspond too many of the tool windows. Notice that some of these tool buttons are also labeled with a number, which is used in combination with the Alt (Cmd on Mac) key to toggle that tool button's corresponding tool window open/closed.

Side panes (left, bottom, and right) may be shared by up to two tool windows at a time. To see how side panes may be shared, open both the Favorites and the Project tool windows. Notice that the Favorites and Project tool buttons are located in opposing corners of the same margin. Attempting to share a side pane between two tool windows whose corresponding tool buttons are located in the same corner will not work. For example, the Project and Structure tool windows cannot be displayed simultaneously—at least not in Android Studio's default configuration.

Default Layout

Don't confuse default layout in Android Studio with layouts in the Android SDK. A default layout is a specific set of tool windows clustered around the Editor. Android Studio is configured out-of-the-box with a default layout that shows the Project tool window in the left pane.

Let's examine the Window menu in the main menu bar. The first two menu items are Store Current Layout as Default, and Restore Default Layout. The Restore Default Layout action is typically used when the IDE becomes overcrowded, or you just want to clear the slate and return to a familiar layout. You may also customize your default layout by opening and closing whichever tool windows you like, resizing and/or repositioning them, and then setting that new layout as the default by selecting Store Current Layout as Default.

REPOSITIONING TOOL BUTTONS

As mentioned, the Project and Structure tool-windows can't be displayed simultaneously because their corresponding toolbuttons are located in the same corner. However, you can move any tool-button to any corner you want. Drag-and-drop the Structure tool button to the bottom corner of the left margin. Now, toggle the Project and Structure tool-windows open by using either the keyboard shortcuts Alt+1 | Cmd+1 and Alt+7 | Cmd+7 or by clicking their tool buttons.

Navigation Tool Windows

This section discusses tool windows that are used specifically for navigation: Project, Structure, Favorites, TODO, and Commander. The function of each of these navigation tool windows. Subsequent chapters cover many of the other tool windows.

The Project Tool Window

We find the Project tool window to be the most useful of navigation tool windows because it combines wide scope with relatively easy access. To appreciate the power and scope of the Project tool window, you may want to set the window's mode to Project. There are three modes; Project, Packages, and Android. By default, Android Studio will set the mode to Android. Android and Project are the most useful modes, though the Android mode may hide certain directories from you. The mode setting combo-box is located at 90 degrees and adjacent to the Project tool button in the upper left corner of the IDE.

The Project tool window provides a simple tree interface with files and nested directories that you can toggle. The Project tool window gives you an overview of all the packages, directories, and files in your project. If you right-click (Ctrl-click on Mac) a file in the Project tool window, a context menu appears. There are three important menu items in this context menu: Copy Path, File Path, and Show in Explorer. Clicking Copy Path copies the operating system's absolute path to this file to the clipboard. Clicking File Path displays the path as a stack of directories, terminating with the file on top, and clicking any of these directories opens them in the operating system. Clicking Show in Explorer shows the file in a new window of your operating system.

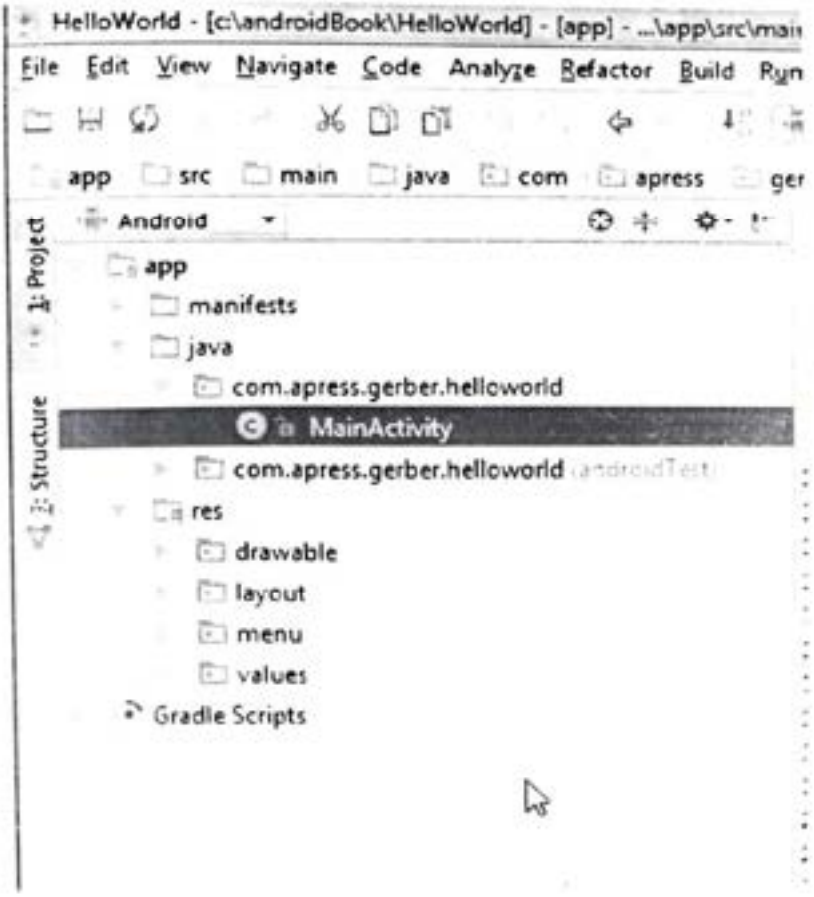


Figure 4.4The Project tool window

The Structure Tool Window

The Structure tool window displays a hierarchy of elements in your file. When the Editor is displaying a Java source file such as MainActivity.java, the Structure tool window displays a tree of elements such as fields, methods, and inner classes. When the Editor is displaying an XML file such as activity_main.xml, the Structure tool window displays a tree of XML elements. Clicking any element in the Structure tool window immediately moves your cursor to that element in the Editor. The Structure tool window is particularly useful for navigating among elements in large source files. Practice this skill by opening the Structure tool window and navigating among the elements of both MainActivity.java and activity_main.xml.

Figure 4.5 The Structure tool window

The Favorites Tool Window

When developing a feature (or debugging a bug) in Android, you will likely create or modify several related files. Moderately complex Android projects may contain hundreds of individual files, so the ability to group related files is useful indeed. The Favorites tool window contains favorites that allow you to logically group references to related files that might otherwise be physically located in completely different pa.ts of your project.

Make sure that both the MainActivity.java and activity_main.xmi files are loaded as tabs in the Editor. Now right-click (Ctrl-click on Mac) either tab in the Editor and select Add All to Favorites from the context menu. In the Input New Favorites list Name field, type **main** and press OK. If the Favorites tool window is not open, activate it now by toggling Alt+2

Cmd+2. Expand the favorite's item called main, and double-click one of the files listed therein to open/activate it.

Just as the Favorites window allows you to navigate immediately to any particular file or groups of files, bookmarks allow you to navigate immediately to any particular line in a file. Position your cursor on any line in MainActivity.java. Now press F11 (F3 on Mac). This action creates or removes a bookmark in any source file, including XML files. Notice both the checkmark in the gutter and the black tick in the marker bar indicating the new bookmark. To view the bookmark you just created, toggle open the bookmarks in the Favorites tool window.

Breakpointsare used for debugging. Unlike bookmarks, which may be set in any file, you need to be in a Java source file in order to set a breakpoint. Open MainActivity.java and click in the gutter next to the following line of code: setContentView(R.layout.activity_main); You will notice that a red circle now occupies the gutter and that the line is also highlighted red. Breakpoints can be set only on executable lines of code; trying to set a breakpoint on a comment line, for example, will not work. To view your newly created breakpoint, toggle open the Breakpoints tree in the Favorites tool window. There are several more interesting things you can do with breakpoints, and we discuss breakpoints at length which is devoted to debugging.

The TODO Tool Window

TODO means, of course, to do. TODOs are essentially comments that indicate to the programmers and their collaborators that there remains work yet to be done. TODOs are written like comments, beginning with two forward slashes, the word TODO in all-caps, and a space.

The Commander Tool Window

The Commander tool window is a navigation aid with left and right panes. These panes function much like the Project and Structure tool windows do. The Commander tool window differs from these other navigation windows in that it displays only one directory level at a time, rather than displaying nested directory trees. If you prefer Windows-style navigation or you find that the Project tool window is too overwhelming, then the Commander tool window may be a good navigation alternative.

The Main Menu Bar

The main menu bar is the uppermost bar in Android Studio, and you can execute virtually any action by navigating through its menus and submenus. Unlike the other bars in Android Studio, the main menu bar cannot be hidden. Don't be overwhelmed by the many actions contained in the main menu bar and its submenus. Even the most seasoned Android developer will use only a fraction of these actions on a daily basis, and most of the actions have corresponding keyboard shortcuts and/or context menu items. We discuss many of the actions contained in the main menu bar in subsequent sections and chapters.

The Toolbar

The toolbar contains buttons for frequently used text operations such as Cut, Copy, Paste, Undo and Redo. As you've already seen in Chapter 1, the toolbar also contains buttons to various managers within Android Studio, including the SDK Manager and the Android Virtual Device Manager. The toolbar also has buttons for Settings and Help, as well as buttons to Run and Debug your app. All of the buttons in the toolbar have corresponding menu items and keyboard shortcuts.Advanced users may want to hide the toolbar to conserve screen real-estate by unchecking the View Toolbar menu item.

The Navigation Bar

The navigation bar displays a horizontal chain of arrow boxes representing the path from your project's root directory (on the left) to the currently selected tab in the Editor (on the right). The navigation bar may be used to navigate your project's assets without having to resort to the Project or Commander tool windows.

The Status Bar

It displays relevant and contextsensitive feedback, such as information about any running processes or the state of your project's Git repository. Let's explore the status bar in some detail now.

In the leftmost corner of the status bar is the Toggle Margins button. Clicking this button toggles hiding and showing the margins. In addition, when you hover your mouse over this button, a context menu appears that allows you to activate any of the toolwindows.

The message area is used to provide feedback and display any information about concurrently running processes. This area also displays hints as you roll your mouse over UI elements such as menu items or buttons in the toolbar. Clicking on this area opens the Event log.

The Editor cursor position displays the location of your cursor in the Editor in line:column format. Clicking on this area activates a dialog box allowing you to navigate directly to a particular line in your code.

The line separator area displays the format of the carriage returns used in your text files. On Windows, the default is CRLF, which stands for carriage return line feed. LF is the standard format used on Unix and Mac machines, as well as in Git. If you're developing on a Windows computer, Git will typically convert from CRLF to LF when committing your code to the repository.

The text format area describes the text encoding used for your source files. The default is UTF-8, which is a superset of ASCII and includes most of the Western alphabets, including any characters that you might find in a standard Java or XML file.

The file access indicator area allows you to toggle between read/write and read-only. An unlocked icon means that the current file in the Editor has read/write access. A lock icon means that the current file in the Editor is read-only. You can toggle these settings by clicking the indicator's icon.

The Highlighting Level button activates a dialog box with a slider that allows you to set the level of highlighting you want to see in your code.

The default setting is Inspections, which corresponds to an icon of a frowning Inspections Manager. This setting indicates that you should be prepared for some tough love, as the Inspections Manager will be strict in identifying both syntax errors and possible problems with your code, called warnings. You can see some of the warnings generated by the Inspections Manager in the marker bar as yellow ticks.

The next setting on the slider is Syntax, which corresponds to an icon of the Inspections Manager in profile. For this setting, the Inspections Manager is turning a blind eye to warnings. Syntax mode is less strict than Inspections mode, but still highlights problems with syntax that will prevent your code from compiling.

The last highlight mode on the slider is None, which corresponds to an icon of a smiling Inspections Manager. This icon makes me think that the Inspections

Manager is happydrunk and just doesn't care about your code. Even the most egregious syntax errors are ignored in this mode, though the compiler will still choke on them when you attempt to build. I recommend leaving the highlight level to Inspections and learning to appreciate the Inspections Manager's tough love.

CHAPTER 5

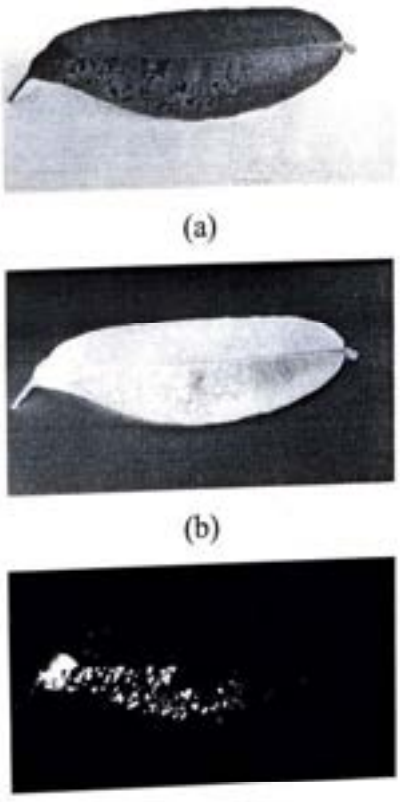
COMMON OPERATIONS

This section reviews various common operations used in Android Studio. If you've used a text editor like Microsoft Word, you will likely be familiar with the features covered in this section.

5.1 APPLICATION INTERACTION

The **Application Interface Specification (AIS)** is a collection of open specifications that define theapplication programminginterfaces(APIs) for high-availability application computer software. It is developed and published by theService Availability Forum(SA Forum) and made freely available. Besides reducing the complexity of high-availability applications and shortening development time, the specifications intended to ease the portability of applications between different middleware implementations and to admit third party developers to a field that was highly proprietary in the past.

5.1.1 API TRAINING



(a)

(b)

(c)

Figure 5.1 Difference between Diseases occurred in Plants

The visualization of BW1 with T_h=115. If the difference between the grey level of the pixel and the average is higher than the threshold T_h the specific pixel is assumed to belong to a spot (lesion) and a 01 matrix BW1 (with the same dimensions as the original image) is constructed with 1's at the positions of pixels belonging to spots as shown in Fig. 3. The BW1 is scanned again to group neighboring pixels belonging to the same spot. The resulting matrix BW2 has an integer spot identity at the position of each pixel or 0 if the pixel does not belong to a spot. TheBW2 matrix is constructed using the following algorithm: a) the rows are scanned from left to right and neighboring pixels are assigned with the same identity, b) if the previous pixel on the left of the current one does not belong to a spot, the already visited neighboring pixels at the row above are checked and if one or more of these has been assigned to a spot identity, this identity is also used for the current pixel, c) the BW2 matrix is scanned iteratively merging spot identities if neighboring spots are found with different identities until no change is detected. A filtering can also be applied discarding spots consisting of very few pixels (less than MinArea) because either they are noise or they are too small to be considered.

5.1.2 MACHINE LEARNING

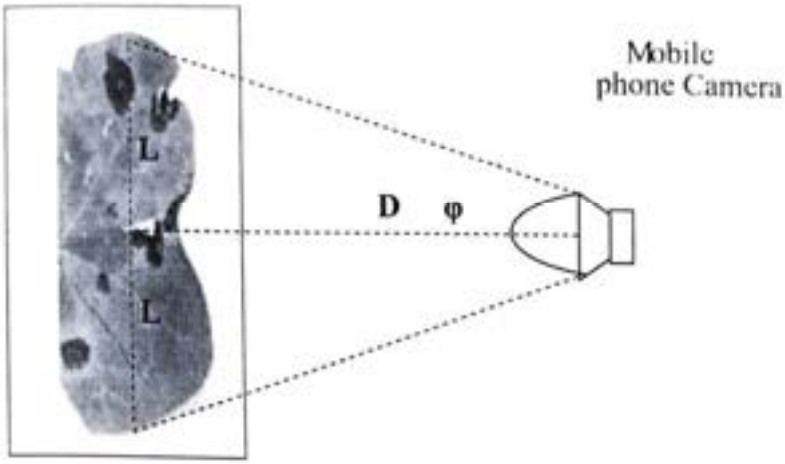


Fig. 2. Estimation of the leaf dimensions.

Fig 5.2 Estimation of Leaf Dimensions

The Spot Recognition System (SRS) assumes that the picture of the plant part has been captured from as known distance D as shown in Fig 5.1.2. The awareness of the distance D can be guaranteed if the user is ordered to take the picture from a roughly known distance e.g., related to his hand or to adjust the distance so that the plant part that will be captured fits the photograph. If the camera angle φ is also known then, the half leaf length is estimated by:

$$L=D^{*}\tan(\varphi). \quad \ldots\ldots\ldots (1)$$

If the length L is known and it corresponds to P pixels then, the constant S can be used to estimate a distance from any other number of pixels:

For example, if two points in the horizontal axis, correspond to a real distance L' and the number of intermediate pixels is P' their distance L' is

If the two points do not reside on the same axis, the same method can be used to estimate their distance and P' is the number of pixels between the two points in the diagonal line connecting them. In 2D, if the dimensions of the covered area are L_x, L_y in the x and y axis, corresponding to P_x and P_y pixels, then each pixel occupies an area A_p estimated as: A spot of any shape consisting with P_i pixels will correspond to an area: P_i•

The next issue is how the spots and their features (dimensions, position, color or grey level features) will be recognized using a simple algorithm. First of all, the plant part should be separated by its background. This can be performed by a segmentation procedure that nevertheless is based on complicated operations or a dedicated image processing

libraries. A simple method used in this work is to assume that the background is much brighter than the plant color. This can be easily reassured if for example a leaf is captured with a white sheet of paper as its background. The user's hand can also be used as a background in most cases if the plant part has a darker color.

Although, the three color components of an image (Red, Green, Blue) can be easily handled to extract detailed image features we focus on a grey scale characterization of the image components and the spot number, coordinates, area and darkness are the outputs of the SRS. Thus, the captured image is initially converted into an inverted grey image and the original pixels with high brightness (below a threshold T_w in the inverted grey image) are ignored since they are assumed to belong to the background. An average grey level A_g is estimated by the rest of the pixels that are assumed to belong to the plant part. Then, the image matrix is scanned to locate the pixels i with a grey level G_i.

5.1.3 IMAGE PROCESSING

Table: 5.1Number of hidden Neurons v/s NN efficiency.

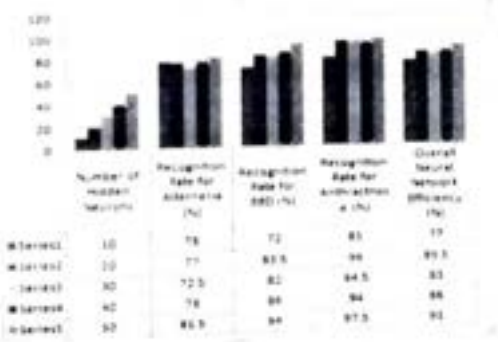


Figure 5.3Graphical Analysis for Hidden Neurons v/s NN efficiency.

The table 1 shows the dependency of the efficiency on the number of hidden layers. Number of hidden layer represents number of states of the neurons in the network. The

efficiency of the network is optimum when there are at least n x n numbers of hidden layers. The n here represents number of features per training set. The figure 3 shows the graphical representation of analysis with respect to Number of Hidden Neurons v/s Neural Network Efficiency which shows the network is optimum when 50 hidden neurons are considered. Experimental Analysis WRT Termination error rate v/s Neural Network efficiency

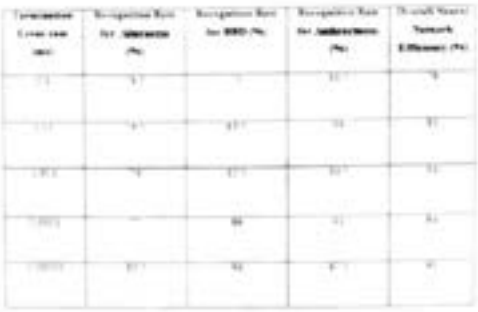


Table: 5.2 number of termination error v/s neural network efficiency

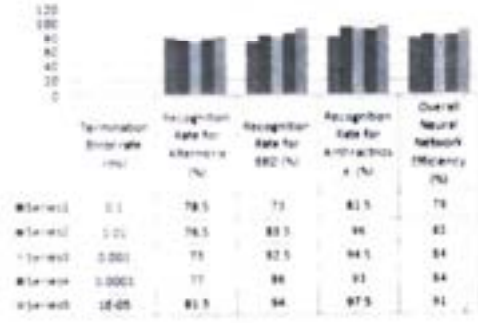


Figure: 5.4 Termination error rate v/s Neural Network efficiency

Graphical Analysis for Termination error rate v/s ANN efficiency .The table 5.1.3 shows the dependency of the efficiency on the termination error rate. Termination error rate represents the maximum tolerable error in classifying the values in a neural network. The efficiency of the network is optimum for more termination rate, better is the performance of the neural network. The figure 4 shows the graphical representation of analysis with respect to Termination Error Rate v/s Neural Network Efficiency which shows the network is optimum when termination error is set to 0.00001.

In this approach, the network is trained on 140 samples from which 8 samples are alternaria, 26 samples are BBD and 89 samples are Anthractnose are used for training and testing. The Below table 3 shows the recognition rate for diseases by setting the parameters as specified in table 4.

Diseases	Recognized Samples	Misclassified samples	Recognition Rate (%)
Alternaria	8	2	77
BBD	23	3	80.76
Anthracnose	86	3	96

Table: 5.3 Recognition rate of the diseases with uniform background

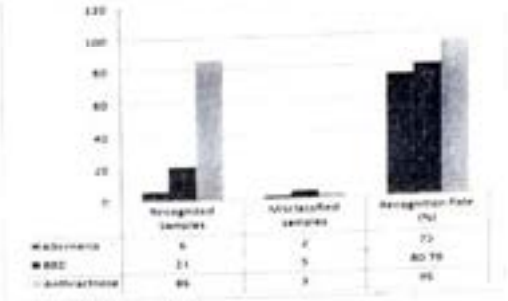


Figure 5.5 Recognition rate of the diseases with uniform background

5.1.4 DETECTION PROCESS

Digital image processing is the use of computeralgorithmsto performimage processingon digital images. An image may be defined as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of at any pair of coordinates (x, y) is called the intensity or grey level of the image at that point. When x, y and the intensity values of f are all finite, discrete quantities, we call image a digital image. Digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, image elements, pels, and pixels. Pixel is the term most widely used to denote the elements of a digital image. Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception.

5.1.4.1 IMAGE ACQUISITION

Images of the infected leaves are captured using a webcam via a graphical user interface in matlab. GUIs (also known as graphical user interfaces or UIs) provide point-and-click control of software applications, which automate a task or calculation. The user will capture the picture of the plant leaf by just clicking the button on the GUI.

5.1.4.2 IMAGE PRE-PROCESSING

Pre-processing of plant leaf images is done to remove the noise from the image.

The image is enhanced in the preprocessing step.

5.1.4.3 IMAGE SEGMENTATION

Segmentation is one of the critical tasks. The disease affected region of the leaf is segmented into a number of parts to locate objects and boundaries.

5.1.4.4 FEATURE EXTRACTION

The relevant feature is then extracted. The feature value of the input image is compared with the features of already learned images in order to detect the disease.

5.2USER INTERACTION

5.2.1 Scanning process

Input Image is the first step in the proposed approach is to capture the sample from the digital camera and extract the features. The sample is captured from the digital camera and the features are then stored in the database.

Image Database is the next point in the project is creation of the image database with all the images that would be used for training and testing. The construction of an image database is clearly dependent on the application. The image database in the proposed approach consists of 140 image samples. The image database itself is responsible for the better efficiency of the classifier as it is that which decides the robustness of the algorithm.

Image segmentation is process i.e. used to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. As the premise of feature extraction and pattern recognition, image segmentation is one of the fundamental approaches of digital image processing. Image Segmentation is the process that is used to distinguish object of interest from background. The proposed approach uses CIE L*a*b*, or CIELAB, color scale for use. It was intended to provide a standard, approximately uniform The CIELAB color scale is an approximately uniform color scale. In a uniform color scale, the differences between points plotted in the color space correspond to visual differences between the colors plotted. The CIELAB color space is organized in a cube form. The L* axis runs from top to bottom. The maximum for L* is 100, which represents a perfect reflecting diffuser. The minimum for L* is zero, which represents black. The a* and b* axes have no specific numerical limits. Positive a* is red. Negative a* is green. Positive b* is yellow. Negative b* is blue. Below is a figure representing the CIELAB color space.

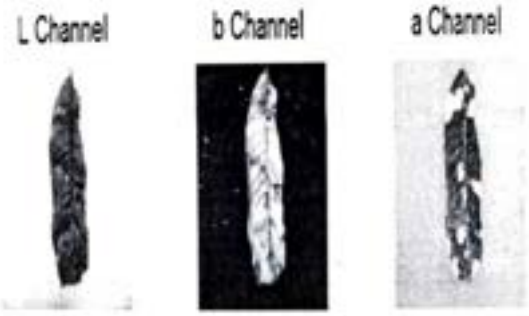


Figure5.6 Segmentation using CIELAB space color

5.2.2 Searching process

In this project work the area of plant diseases recognition is introduced. The system developed here is for plant diseases recognition, the development of good classification methods and precise features is very important in order to run the system in real time. Therefore proposed approach which is based on Gabor filter for feature extraction and ANN classifier for classification got a better results and recognition rate up to 91%.An ANN based classifier is adopted which uses the combination of color and texture features to recognize and classify different plant diseases. The results are encouraging and promise the development of a good machine vision system in the area of recognition and classification of plant diseases. The proposed approach can significantly support in recognizing normal and affected produce.

CHAPTER 6

APPENDIX

6.1SAMPLE SOURCE CODE

```
load('Training_Data','Train_Feat','Train_Label'); catch ex  Train_Feat = [];  Train_Label  =
      [];                save('Training_Data','Train_Feat','Train_Label');
load('Training_Data','Train_Feat','Train_Label'); end


handles.output =
hObject;  ss =
ones(300,400);
axes(handles.axes1);
imshow(ss);
axes(handles.axes2);
imshow(ss);
axes(handles.axes3);
imshow(ss);
axes(handles.axes4);
imshow(ss);
[filename, pathname] = uigetfile({'*.*';'*.bmp';'*.jpg';'*.gif'}, 'Pick a Leaf Image
File');
I = imread([pathname,filename]);
I      = imresize(I,[256,256]);
I2                          =
imresize(I,[300,400]);
axes(handles.axes1);
imshow(I2);title('Input
Image');
I3=I;
I4                          =
imadjust(I3,stretchlim(I));
I5                          =
```

```
imresize(I4,[300,400]);
axes(handles.axes2);
imshow(I5);title(' Contrast
Enhanced ');
I =I4;

cform =
makecform('srgb2l')
; % Apply the
colorform lab_he
=
applycform(I,cfor);

% Classify the colors in a*b* colorspace using K means clustering.
% Since the image has 3 colors create 3 clusters.
% Measure the distance using Euclidean
Distance Metric.
ab =
double(lab_he(:,:,2:
3)); nrows =
size(ab,1); ncols
= size(ab,2); ab =
reshape(ab,nrows*ncols,2
);
nColors = 3;
[cluster_idx cluster_center] = kmeans(ab,nColors,'distance','sqEuclidean', ... 'Replicates',3);
%[cluster_idx cluster_center] =
kmeans(ab,nColors,'distance','sqEuclidean','Replicates',3);
% Label every pixel in tha image using results from K means
pixel_labels = reshape(cluster_idx,nrows,ncols);
%figure,imshow(pixel_labels,[]), title('Image Labeled by Cluster Index');

% Create a blank cell array to store the results of clustering
segmented_images = cell(1,3);
```

```
% Create RGB label using
pixel_labels  rgb_label =
repmat(pixel_labels,[1,1,3]);

for k = 1:nColors  colors
= l;  colors(rgb_label ~=
                =              0;
k)
segmented_images{k}
= colors;  end

figure,subplot(2,3,2);imshow(I);title('Original
      Image');
subplot(2,3,4);imshow(segmented_images{1});title('C
luste r  1');
subplot(2,3,5);imshow(segmented_images{2});title('C
luste r  2');
subplot(2,3,6);imshow(segmented_images{3});title('C
luste r 3');  set(gcf, 'Position', get(0,'Screensize'));
set(gcf, 'name','Segmented by K Means',
'numbertitle','off')
%      Feature
      Extraction
pause(2)
x = inputdlg('Enter the cluster no. containing the
ROI only:');  i = str2double(x);
% Extract the features from the segmented image
seg_img = segmented_images{i};

% Convert to
grayscale if image is
RGB  if
ndims(seg_img) == 3
img =
```

```
rgb2gray(seg_img);
end
figure, imshow(img); title('Gray Scale Image');

% Evaluate the disease affected area  black
= im2bw(seg_img,graythresh(seg_img));
figure,
      imshow(black);title('Black
      & White Image'); m =
size(seg_img,1);  n =
size(seg_img,2);

zero_image = zeros(m,n);
%G = imoverlay(zero_image,seg_img,[1 0 0]);

cc = bwconncomp(seg_img,6);  diseasedata =
regionprops(cc,'basic');  A1 = diseasedata.Area;
sprintf('Area of the disease affected region is :
%g%',A1);

I_black        = im2bw(I,graythresh(I));  kk
=          bwconncomp(I,6);
leafdata                        =
regionprops(kk,'basic');  A2
= leafdata.Area;  sprintf('
Total leaf area is :
%g%',A2);

%Affected_Area = 1-
(A1/A2);
Affected_Area
      = (A1/A2);
      if
Affected_Area < 0.1
```

```
Affected_Area =
Affected_Area+0.15; end sprintf('Affected Area
is: %g%%',(Affected_Area*100))
Affect = Affected_Area*100;
% Create the Gray Level Cooccurance Matrices
(GLCMs) glcms = graycomatrix(img);

% Derive Statistics from GLCM stats =
graycoprops(glcms,'Contrast Correlation Energy Homogeneity');
Contrast = stats.Contrast;
Correlation = stats.Correlation;
Energy = stats.Energy;
Homogeneity = stats.Homogeneity;
Mean = mean2(seg_img);
Standard_Deviation = std2(seg_img);
Entropy = entropy(seg_img);
RMS = mean2(rms(seg_img));
%Skewness = skewness(img)
Variance = mean2(var(double(seg_img))); a
= sum(double(seg_img(:)));
Smoothness = 1-(1/(1+a));
Kurtosis = kurtosis(double(seg_img(:)));
Skewness =
skewness(double(seg_img(:))); %
Inverse Difference Movement m =
size(seg_img,1); n
=
size(seg_img,2);
temp = seg_img(i,j)./(1+(i-
j).^2); in_diff = in_diff+temp;
end
end
IDM = double(in_diff);
```

```
feat_disease = [Contrast,Correlation,Energy,Homogeneity, Mean,
Standard_Deviation, Entropy,
RMS, Variance, Smoothness, Kurtosis, Skewness, IDM];
I7 = imresize(seg_img,[300,400]);
axes(handles.axes3);
imshow(17);title('Segmented ROI');
Label = menu('Select a disesses','1','2','3','4','5','6','7');
db_count =
length(Train_Feat) + 1;
db_count =
length(Train_Label) + 1;
%
Train_Feat(:,db_count1)
= feat_disease;
Train_Label(:,db_count) = Label;
save('Training_Data','Train_Feat','Train_Label'); ch = menu(sprintf('Database
saved',db_count),'Add More','Clear DB','Exit'); if(ch == 1)
pushbutton19_Callback(hObject, eventdata, handles)
elseif(ch == 2) ch =
menu('Are you
sure','Yes','No');
if(ch == 1)
Train_Feat = []; Train_Label = [];
save('Training_Data','Train_Feat','Train_Label');
end end
```

6.2 SCREENSHOTS

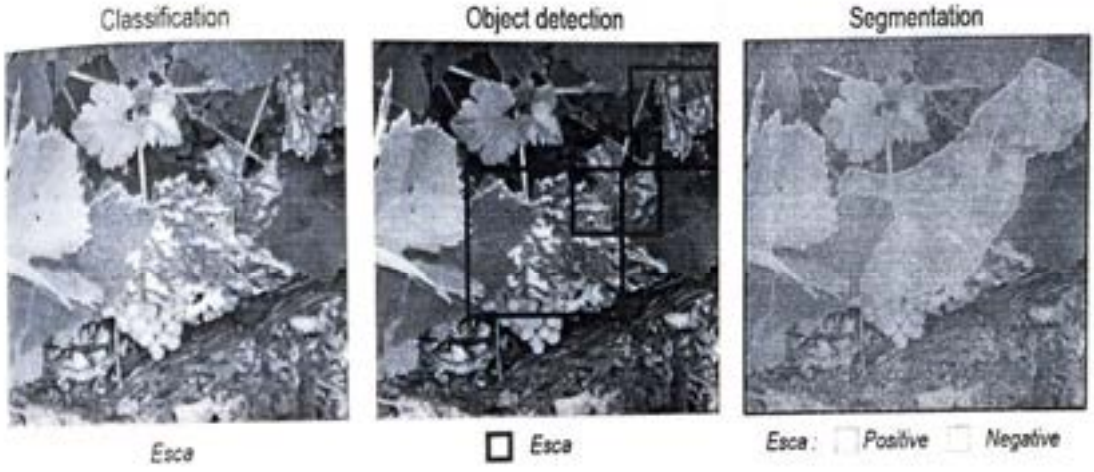


Figure: 6.1 Difference Diseases Identified in Plants

CHAPTER 7

7.1 CONCLUSION

This paper provides the survey of different techniques for leaf disease detection. The main characteristics of disease detection are speed and accuracy. Hence there is working on development of fast, automatic, efficient and accurate system, which is use for detection disease on unhealthy leaf. Also Comparison of different techniques of digital image processing is done which gives the different results on different databases. Work can be extended for development of system which identifies various pests and leaf diseases also.

CHAPTER 8

BIBILIOGRAPHY AND REFERENCES

[1] Christos Stergiou and Dimitrios Siganos,"Neural Networks". http: www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/r eport.html.

[2] Dheeb Al Bashish, Malik Braik and Sulieman Bani-Ahmad, "Detection and Classification of Leaf Diseases using K-means-based Segmentation and NeuralNetworks – basedClassification", Information *Technology Journal* 10(2): 267-275, 2011.

[3]Gonzaliz RC., Woods RE., "Digital image processing", Pearson EducationInc., 2002Image Processing Toolbox™ 7 User"s Guide. ©Copyright 1993–2010 by *the MathWorks, Inc.*Integrating Diagnostic Expert System with Image Processing via Loosely Coupled Technique.

[4] Krystian Mikolajczyk and Cordelia Schmid "A performance evaluation of local descriptors", Pattern Analysis and Machine Intelligence", IEEETransactions on Pattern Analysis and Machine Intelligence, Volume 27, Issue 10, 2005, pp 1615 – 1630.

[5] Muhammad Faisal Zafar, Dzulkifli Mohamad, Muhammad Masood Anwar "Recognition of Online Isolated Handwritten Characters by Backpropagation Neural Nets Using Sub-Character Primitive Features", Informatics Complex, FSKSM, Universiti Teknologi Malaysia, ©2006 IEEE

[6] Rafael C.Gonzalez, Richard E.Woods, Steven L.Eddins, *Digital Image Processing*, Pearson Education, 2nd Edition

[7] Rong Zhou, Shun'ichi Kaneko, Fumio Tanaka, Miyuki Kayamori, Motoshige Shimizu "Early Detection and Continuous Quantization of Plant DiseaseUsing Template Matching and Support Vector Machine Algorithms"2013.

[8] Y.Tian, L. Wang and Q. Zhou , "Grading method of Crop disease based on Image Processing", Computer and computing technologies in agriculture 427433, 2011

HOME AUTOMATION USING ESPRESSIF SYSTEM 8266

A PROJECT REPORT

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ABSTRACT

This paper presents a proposal for home automation using voice via Google Assistant. Home automation introduced over these years from Zigbee automation to Amazon Echo, Google Home and Home from Apple. Home Automation is building automation for home, called a Smart House/Smart Home. This paper describes the implementation of Home Appliances control system. The system is implemented using ordinary household appliances Natural language voice commands are given to the Google Assistant and with the help of IFTTT (If This Then That) application and the Adafruit the commands are decoded and then sent to the microcontroller, the microcontroller in turn controls the relays connected to it as required, turning the device connected to the respective relay On or OFF as per the users request to the Google Assistant. The microcontroller used is NodeMCU (ESP8266) and the communication between the microcontroller and the application is established via Wi-Fi (Internet).The Microcontroller are connected into Bread board. These system are accessed by over the Internet(online).

KEY WORDS:

Node MCU 8266, Bread Board, Google Assistant, IFTTT, SSR Relay, Home Appliances, Adafurit

LIST OF ABBREVIATION

S.NO	ABBREVIATION	EXPANSION
1.	GACHAS	Google Assistant Controller Home Automation system
2.	GSM	Global System for Mobile
3.	IC	Integrated Circuit
4.	IDE	Integrated Development Environment
5.	IFTTT	If This Then That
6.	IOT	Internet of Things
7.	MQTT	Message Queuing Telemetry Transportation
8.	Node MCU	Node Micro Controller Unit
9.	SDK	Software Development Kit

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Home, it is the place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable.

Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel cosier and rather, feel homelier. Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit. Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. This paper proposes such inexpensive system. It uses the Google Assistant, the IFTTT [1] Web interface, the Adafruit [2] Web Interface and the NodeMCU [3] microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant [4]. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT [5].

1.2 OBJECTIVES

Our aim is to provide a cheap home automation system to assist common man's life to make his schedule more efficient and help conserve energy; it will also be of great use to handicapped and elderly members of our society.

This paper presents the project as two modules in totality; the first module consists of control of lights, blinds and fans which will be switched on and off using voice commands on Google assistant. The second module consists of control of common household appliances such as television, projector, air conditioners etc. Intend to attach four loads in this work. The control of the appliances will be done using two methods in particular; they are App and voice control. Voice control can easily be achieved on an Android mobile using Google Assistant.

CHAPTER 2

LITRATURE SURVEY

2.1 Review of Related Literature

When people think about home automation, most of them may imagine living in a smart home: One remote controller for every household appliance, cooking the rice automatically, starting air conditioner automatically, heating water for bath automatically and shading the window automatically during night. To some extent home automation equals to smart home. They both bring out smart living condition and make our life more convenient and fast. Early home automation began with labor-saving machines. Self-contained electric or gas powered home appliance became viable in the 1900s with the introduction of electric power distribution led to the introduction of washing machine, water heater, refrigerator, sewing machines, dishwashers and clothes dryers. As per our survey currently there exists system neither at cheaper rates nor easy to handle. Various systems are hard to install, difficult to use and maintain. Current systems are generally proprietary, closed and not very user friendly Based on Arduino or GSM or low cost home security system and home automation system.

2.2 Development of Internet Based System

In their paper, Tan, Lee and Soh (2002) proposed the development of an Internet-based system to allow monitoring of important process variables from a distributed control system (DCS). This paper proposes hardware and software design considerations which enable the user to access the process variables on the DCS, remotely and effectively rent designations.

Potamitis, Georgila, Fakotakis, and Kokkinoss, G. (2003) suggested the use of speech to interact remotely with the home appliances to perform a particular action on behalf of the user. The approach is inclined for people with disability to perform real-life operations at home by directing appliances through speech. Voice separation strategy is selected to take appropriate decision by speech recognition.

2.3 Home Automation and Security using Android ADK

This paper describes the design of home automation and security system using android ADK. The design is based on Standalone embedded system board android ADK (Accessory

Development Kit) at home. Home appliances are connected to the ADK and communication is established between the ADK and android mobile device or tablet. The home appliances are connected to the input/output ports of embedded system board and their status is passed to ADK. They have developed an authentication to the system for authorized person to access home appliances. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

2.4 Bluetooth Based Home Automation System

The paper refers "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, architecture and computing (Huidobro and Millan, 2004). HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and old aged due to their complexity and cost, do not always accept these systems. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, ZIGBEE, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, Bluetooth is being chosen with its suitable capability. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class.

2.5 Home Automation Using Internet of Things

This paper proposes a Home Automation system that employs the integration of multi-touch mobile devices, cloud networking, wireless communication, and power-line communication to provide the user with remote control of various lights and appliances within their home. This system uses a consolidation of a mobile phone application, handheld wireless remote, and PC based program to provide a means of user interface to the consumer.

Basil Hamed The main objective of this Paper is to design and implement a control and monitor system for smart house. Smart house system consists of many systems that controlled by LabVIEW software as the main controlling system in this paper. Also, the smart house system was supported by remote control system as a sub controlling system. The system also is

connected to the internet to monitor and control the house equipment's from anywhere in the world using Lab VIEW.

DeepaliJavale, Mohd. Mohsin, ShreerangNandanwar The prime objective of this paper is to assist handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using Android phone/tab. The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors.

Basma M. Mohammad El-Basioni, Sherine M. Abd Elkader and Mahmoud AbdelmonimFakhreldin This paper proposes a new design for the smart home using the wireless sensor network and the biometric technologies. The proposed system employs the biometric in the authentication for home entrance which enhances home security as well as easiness of home entering process. The structure of the system is described and the incorporated communications are analyzed, also estimation for the whole system cost is given which is something lacking in a lot of other smart home designs offers. WB-SH is designed to be capable of incorporating in a building automation system and it can be applied to offices, clinics, and other places. The paper ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form. The paper ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In the existing system, IOT i.e. IEEE 802.11 b/g/n is used in order to control the home appliances, it can be remotely used to control a web page buttons, and go to the particular link, they press buttons in order to control the home appliance.

3.1.1 DISADVANTAGE OF EXISTING SYSTEM

- The operating is difficult.
- A separate web page is required.
- For every switching on and off we want to login into web page.

3.2 PROPOSED SYSTEM

The idea of the project is to integrate the concept of Google Assistant into Arduino and control the appliances in the home that the device is installed. Google recently released an API for Google Assistant, for platforms other than Android, such as Linux and Windows, using Python language.

When the user sends command through Google assistant it first goes to the IFTTT there we given set statements that states he IF THIS THEN THAT you can understand this when you see the architecture of our system. From there it goes to the adafruit is cloud service it is like MQTT broker which interacts with the Node MCU The Control Unit comprises of the microcontroller- Node MCU and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet. Figure 1below shows the basic system design architecture.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM

- It can be easily accessible from mobile itself.
- Can Access from anywhere the system is connected to server.
- No need of any interface for communication only Google assistance is enough.

3.2.2 SYSTEM ARCHITECTURE

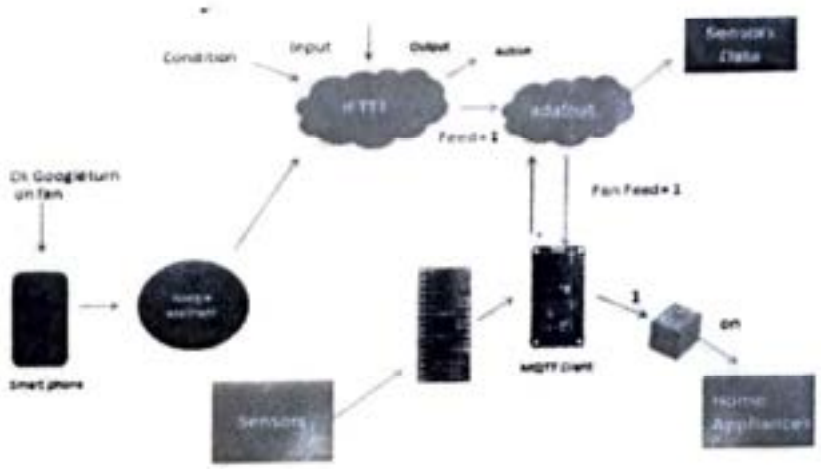

Fig 3.1 System Architecture for Home Control System

3.2.3 FLOWCHART

Fig 3.2 Flowchart for Home Control System

CHAPTER 4

SYSTEM SPECIFICATION

4.1 HARDWARE REQUIREMENTS

1. 5V relays
2. n4007 Diode
3. BC547 transistors.
4. 330ohm Resistors
5. Multiplexer module
6. Different sensors
7. Ics
8. 9v power adapter

4.2 SOFTWARE REQUIREMENTS

1. Operating System: Windows 7/8/10
2. Arduino IDE
3. Android
4. Adafruit
5. IFTTT

4.3 SOFTWARE ENVIRONMENT

4.3.1 ARDUINO IDE

A minimal Arduino java sketch, as seen by the Arduino IDE programmer, consists of only two functions. Setup (): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch. Loop (): After setup () has been called, function loop () is executed repeatedly in the main program. It controls the board until the board is powered off or is reset. Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions. A typical program for a beginning Arduino programmer blinks a LED repeatedly. This program uses the functions pin Mode (), digital Write (), and delay (), which are provided by the internal libraries included

in the IDE environment. The program is usually loaded in the Arduino by the manufacturer. Arduino IDE and java language allow the programming of the low level registers in the atmega328P. Instructions like DDRB=0b00000001 for changing PORTB input/output pins are allowed. Fig 4.1 shows the basic program of Arduino IDE.

Fig 4.1 Arduino IDE

4.3.2 Adafruit

Adafruit Industries is an open-source hardware company based in New York City. It was founded by Limor Fried in 2005. The company designs, manufactures and sells a number of electronics products, electronics components, tools and accessories. It also produces a number of learning resources, including live and recorded videos related to electronics, technology, and programming. MQTT, or message queue telemetry transport, is a protocol for device communication that Adafruit IO supports. Using a MQTT library or client you can publish and subscribe to a feed to send and receive feed data.

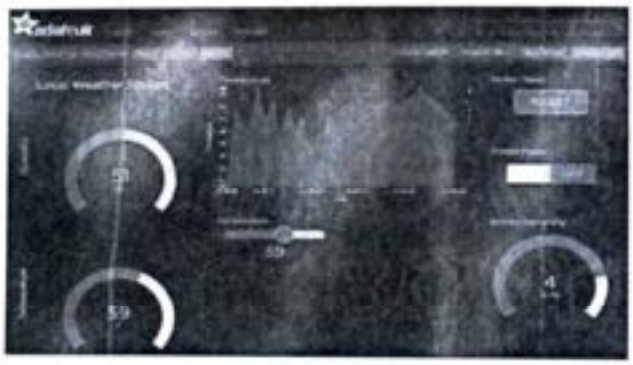

Fig 4.2 Adafruit Feeds

4.3.3 IFTTT

IFTTT derives its name from the programming conditional statement if this, then that. IFTTT is both a website and a mobile app that launched in 2010 and has the slogan "Put the Internet to work for you". The idea is that you use IFTTT to automate everything from your favourite apps and websites to app - enabled accessories and smart devices. What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services. Here, IFTTT application is used to bridge the gap between the Google Assistant commands and the Smart phone.

Setting up the IFTTT application first requires logging in after which we need to create an applet and then this i.e. the trigger, 16 here select Google Assistant and then we will type in the commands to which the Google Assistant should respond and to this command it should control the appliance/relay associated with it. The response command from the Goggle Assistant can also be typed in as desired. After configuring the trigger, i.e. This of the application need to configure the That. What should be done once the Google Assistant hears the command which we just configured? This is decided by setting That of the app. communication is done via the internet and since the microcontroller, NodeMCU comes with inbuilt Wi - Fi module , it is programmed to connect to the desired network once plugged in. Java language is used to program the microcontroller and is programmed in the Arduino IDE

Fig 4.3 IFTTT

CHAPTER 5

PROJECT DESCRIPTION

5.1 PROBLEM STATEMENT

The IOT i.e. IEEE 802.11 b/g/n is used in order to control the home appliances ,it can be remotely used to control a web page buttons and go to the particular link, they can press buttons in order to control the home appliance.

5.1.1 OVERVIEW OF THE PROJECT

The place where one fancies or desires to be after a long tiring day. People come home exhausted after a long hard working day. Some are way too tired that they find it hard to move once they land on their couch, sofa or bed. So any small device/technology that would help them switch theirs lights on or off, or play their favourite music etc. on a go with their voice with the aid of their smart phones would make their home more comfortable. Moreover, it would be better if everything such as warming bath water and adjusting the room temperature were already done before they reach their home just by giving a voice command. So, when people would arrive home, they would find the room temperature, the bath water adjusted to their suitable preferences, and they could relax right away and feel costlier and rather, feel homelier.

Human assistants like housekeepers were a way for millionaires to keep up their homes in the past. Even now when technology is handy enough only the well to do people of the society are blessed with these new smart home devices, as these devices costs are a bit high. However, not everyone is wealthy enough to be able to afford a human assistant, or some smart home kit

Hence, the need for finding an inexpensive and smart assistant for normal families keeps growing. This paper proposes such inexpensive system. It uses the Google Assistant, the IFTTT [1] application, the Adafruit and the Node MCU [3] microcontroller as the major components along with a relay board comprising of 4/8 relays along with ULN 2803 IC. Natural language voice is used to give commands to the Google Assistant [4]. All of the components are connected over the internet using Wi-Fi which puts this system under the IoT [5].

An important usability goal when the user sends command through google assistant it first goes to the IFTTT there given set statements tha[illegible]tes he IF THIS THEN THAT can understand this when see the architecture of our system. From there it goes to the adafruit is cloud service it is like MQTT broker which interacts with the Node MCU The Control Unit

comprises of the microcontroller- Node MCU and the 4 Channel Relay board. Android device communicates with the microcontroller and sends the desired signal via the internet. Figure 1below shows the basic system design architecture.

5.2 MODULE DESCRIPTION

5.2.1 NodeMCU (ESP8266)

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266 is designed and manufactured by Express, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for this system design. The NodeMCU aims to simplify ESP8266 development. It has two key components.

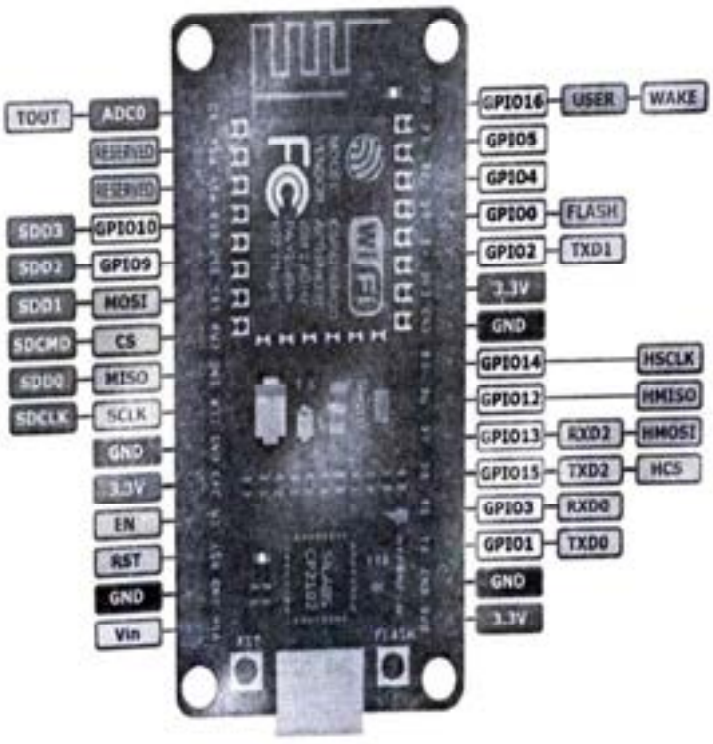

Fig 5.1 Node MCU

An open source ESP8266 firmware that is built on top of the chip manufacturer's of the proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn. And to add on NodeMCU can be programmed with the Android IDE too.

A development kit board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

5.2.2 RELAY BOARD

A relay is an electromagnetic switch. It is activated when a small current of some microampere is applied to it. Normally a relay is used in a circuit as a type of switch, an automatic switch. There are different types of relays and they operate at different voltages. When a circuit is built the voltage that will trigger it has to be considered. In this system the relay circuit is used to turn the appliances ON/OFF. The high/low signal is supplied from the NodeMCU microcontroller. When a low voltage is given to the relay of an appliance it is turned off and when a high voltage is given it is turned on. The relay circuit to drive four appliances in the Home automation. The number of appliances can be modified according to the user's requirements

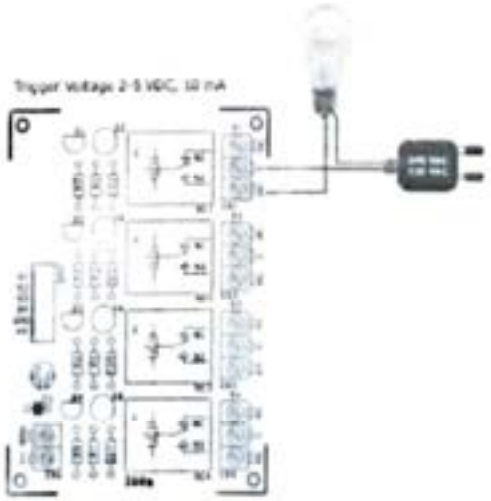

Fig 5.2 Relay module

CHAPTER 6

APPENDIX

6.1 SOURCE CODE

```
// Adafruit IO Digital Output Example
// Tutorial Link: https://learn.adafruit.com/adafruit-io-basics-digital-output
// Adafruit invests time and resources providing this open source code.
// Please support Adafruit and open source hardware by purchasing
// products from Adafruit!
// Written by Todd Treece for Adafruit Industries
// Copyright (c) 2016 Adafruit Industries
// Licensed under the MIT license.
// All text above must be included in any redistribution.
/************************** Configuration ***********************************/
// edit the config.h tab and enter your Adafruit IO credentials
// and any additional configuration needed for WiFi, cellular,
// or ethernet clients.
#include "config.h"
/************************** Example Starts Here *****************************/
// digital pin 5
#define LED1 D0
#define LED2 D2
// set up the 'digital' feed
AdafruitIO_Feed *led1 = io.feed("led1");
AdafruitIO_Feed *led2 = io.feed("led2");
void setup() {
pinMode(LED1, OUTPUT);
pinMode(LE
D2, OUTPUT);
 // start the serial connection
Serial.begin(115200);
 // wait for serial monitor to open
while(! Serial);
```

```
// connect to io.adafruit.com
Serial.print("Connecting to Adafruit IO");
io.connect();
// set up a message handler for the 'digital' feed.
// the handleMessage function (defined below)
// will be called whenever a message is
// received from adafruitio.
led1->onMessage(handleMessage);
led2->onMessage(handleMessage1);
// wait for a connection
while(io.status() < AIO_CONNECTED) {
Serial.print(".");
delay(500);
}
// we are connected
Serial.println();
Serial.println(io.statusText());
led1->get();
led2->get();
}
void loop() {
// io.run(); is required for all sketches.
// it should always be present at the top of your loop
// io.adafruit.com, and processes any incoming data.
io.run();
}
// this function is called whenever an 'digital' feed message
// is received from Adafruit IO. it was attached to
// the 'digital' feed in the setup() function above.
void handleMessage(AdafruitIO_Data *data) {
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
```

```
Serial.println("LOW");
digitalWrite(LED1, data->toPinLevel());
}
void handleMessage1(AdafruitIO_Data *data)
{
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED2, data->toPinLevel());
}
void handleMessage2(AdafruitIO_Data *data)
{
Serial.print("received <- ");
if(data->toPinLevel() == HIGH)
Serial.println("HIGH");
else
Serial.println("LOW");
digitalWrite(LED2, data->toPinLevel());
}
void handleMessage3(AdafruitIO_Data *data)
{
// convert the data to integer
int reading = data->toInt();
Serial.print("received <- ");
Serial.println(reading);
// write the current 'reading' to the led
#if defined(ARDUINO_ARCH_ESP32)
ledcWrite(1, reading); // ESP32 analogWrite()
#else
digitalWrite(LED2, reading);
#endif
}
```

CONFIG.H

```
/************************** Adafruit IO Config *********************************/

// visit io.adafruit.com if you need to create an account,
// or if you need your Adafruit IO key.
#define IO_USERNAME  "diwakarit"
#define IO_KEY       "c489a31ccab84a37b229062b35cecfe4"

/******************************* WIFI **************************************/

// the AdafruitIO_WiFi client will work with the following boards:
//   - HUZZAH ESP8266 Breakout -> https://www.adafruit.com/products/2471
//   - Feather HUZZAH ESP8266 -> https://www.adafruit.com/products/2821
//   - Feather HUZZAH ESP32 -> https://www.adafruit.com/product/3405
//   - Feather M0 WiFi -> https://www.adafruit.com/products/3010
//   - Feather WICED -> https://www.adafruit.com/products/3056
//   - AdafruitPyPortal -> https://www.adafruit.com/product/4116
//   - Adafruit Metro M4 Express AirLiftLite -> https://www.adafruit.com/product/4000
//   - AdafruitAirLift Breakout -> https://www.adafruit.com/product/4201
#define WIFI_SSID   "WIFI"
#define WIFI_PASS   "1122334455"
// uncomment the following line if you are using airlift
// #define USE_AIRLIFT
// uncomment the following line if you are using winc1500
// #define USE_WINC1500
// comment out the following lines if you are using fona or ethernet
#include "AdafruitIO_WiFi.h"
#ifdef USE_AIRLIFT
 // Configure the pins used for the ESP32 connection
 #if !defined(SPIWIFI_SS) // if the wifi definition isnt in the board variant
 // Don't change the names of these #define's! they match the variant ones
 #define SPIWIFI SPI
 #define SPIWIFI_SS 10  // Chip select pin
 #define SPIWIFI_ACK 9  // a.k.a BUSY or READY pin
 #define ESP32_RESETN 6 // Reset pin
 #define ESP32_GPIO0 -1 // Not connected
 #endif
```

```
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS, SPIWIFI_SS,
SPIWIFI_ACK, ESP32_RESETN, ESP32_GPIO0, &SPIWIFI);
#else
AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);
#endif
/************************** FONA ***************************************/
// the AdafruitIO_FONA client will work with the following boards:
//   - Feather 32u4 FONA -> https://www.adafruit.com/product/3027
// uncomment the following two lines for 32u4 FONA,
// and comment out the AdafruitIO_WiFi client in the WIFI section
// #include "AdafruitIO_FONA.h"
// AdafruitIO_FONA io(IO_USERNAME, IO_KEY);
/************************** ETHERNET ***********************************/
// the AdafruitIO_Ethernet client will work with the following boards:
//   - Ethernet FeatherWing -> https://www.adafruit.com/products/3201
// uncomment the following two lines for ethernet,
// and comment out the AdafruitIO_WiFi client in the WIFI section
// #include "AdafruitIO_Ethernet.h"
// AdafruitIO_Ethernet io(IO_USERNAME, IO_KEY);
```

6.2 SCREEN SHOTS

Adafruit Data

Fig 6.1 Adafruit light Interface for bulbs

Adafruit Feed Monitor

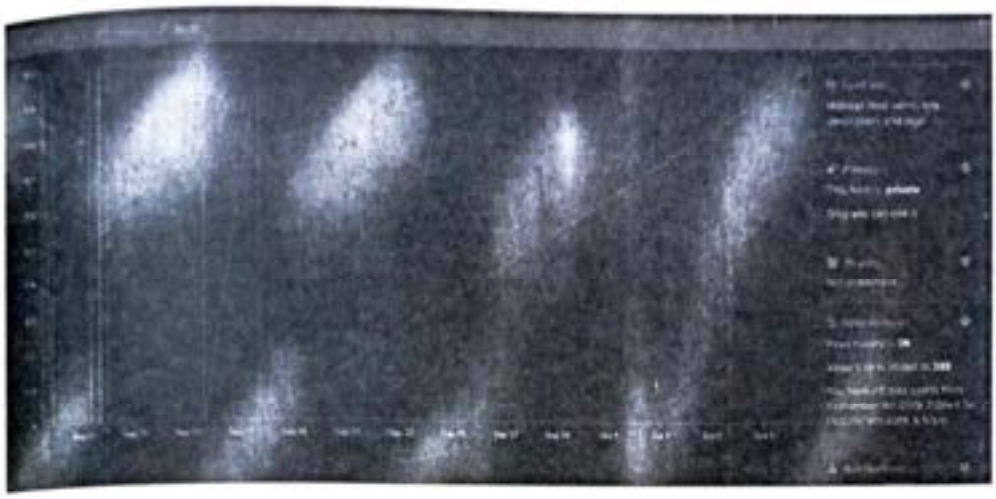

Fig 6.2 Adafruit feed for bulb 1 data

IFTTT interface

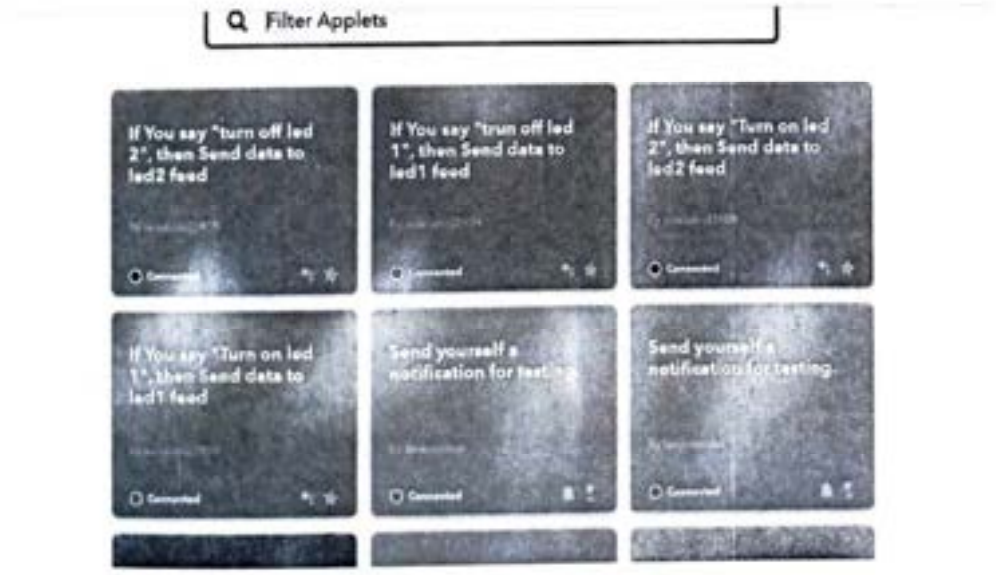

Fig 6.3 IFTTT Interface connection between Google Assistant and Adafruit

Overall design

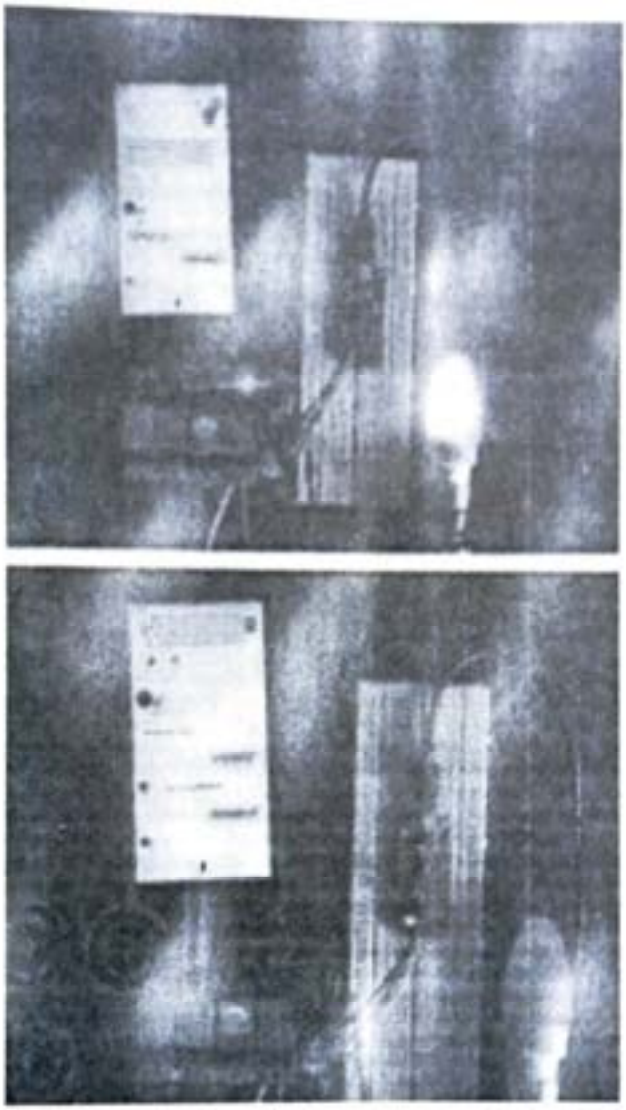

Fig 6.4 Overall Project Design model

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

7.1 CONCLUSION

The aim of this paper was to propose a cost effective voice controlled (Google Assistant) home automation controlling general appliances found in one's home. The approach discussed in the paper was successful as GACHA's (Google Assistant Controlled Home Automation) design was successfully implemented. This system is highly reliable and efficient for the aged people and differently abled person on a wheel chair who cannot reach the switch for the switching ON/OFF the device and are dependent on others. The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through Google Assistance. The designed for switching on the light and other appliances used in Home. It also stores the sensor parameters in the cloud in a timely manner.

7.2 FUTURE ENHANCEMENT

The future scope for GACHA can be huge. There are many factors to improve on to make GACHA more powerful, intelligent, scalable, and to become better overall for home automation. For example, controlling the speed of the fan, more number of devices can be integrated, like a coffee machine, air conditioner etc. Well, no system is ever perfect. It always has a scope for improvement. One just needs to put on a thinking cap and try and make the system better.

VIRTUAL PRIVATE CLOUD FOR MULTIPLE OPERATING SYSTEM

A MINI PROJECT REPORT

Submitted by

NANDHAKUMAR.R	16202024
RAGUL.H	16202032
SELVAKUMAR.C	16202040

in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

in

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DECLARATION

We, **Nandhakumar.R, Ragul.H, Selvakumar.C** hereby declare that the project titled **"Virtual Private Cloud For Multiple Operating System"** done by us under the guidance of **Mr.B.Venkatesan, M.E.,(Ph.D) Associate Professor** at Paavai Engineering College is submitted in partial fulfilment of the requirement for the award of Bachelor of Technology degree in Information Technology. Certified further that, to the best of our knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

1. R. Nandhakumar.
2. Ragul.H
3. C. Selvakumar.

DATE 21.10.2019

PLACE PACHAL

SIGNATURE OF THE CANDIDATES

ABSTRACT

Virtual Private Cloud is most commonly used in the context of cloud infrastructure as a service. **Infrastructure as a service (IaaS)** are online services that provide high-level APIs used to dereference various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc. A hypervisor, such as Oracle VirtualBox, VMware runs the virtual machines as guests. Oracle VirtualBox is a free and open-source hosted hypervisor. Multiple operating systems like Windows, Debian, Ubuntu are pre-configured as a image format (.ISO) on virtual box. Remote Desktop Service is an inbuilt configuration in every operating system to allow a user to take control of a remote computer or virtual machine over a network connection. For remote access of a virtual machine a port forwarding technique would be used. By establishing all these connections, a private cloud for multiple operating system can be implemented.

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LIST OF ABBREVIATIONS

S.NO	ABBREVIATIONS	EXPANSIONS
1	WLAN	Wired Local Area Network
2	LAN	Local Area Network
3	WAN	Wide Area Network
4	OS	Operating System
5	VM	Virtual Machine
6	OTP	One Time Password
7	VPC	Virtual Private Cloud
8	RAM	Random Access Memory
9	ROM	Read Only Memory
10	SSD	Solid State Drive

CHAPTER 1

INTRODUCTION

Virtual Private Cloud

A Virtual Private Cloud for Multiple Operating System is the service which provides the virtualization of Operating System for different users simultaneously. The private cloud for virtual operating system is developed with VirtualBox, MongoDB, Django and Python programming.

Python

Python is an interpreted, high-level, general-purpose programming language. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

VirtualBox

Oracle VM VirtualBox (formerly Sun VirtualBox, Sun xVM VirtualBox and Innotek VirtualBox) is a free and open-source hosted hypervisor for x86 virtualization, developed by Oracle Corporation. VirtualBox may be installed on Windows, macOS, Linux and Solaris. It supports the creation and management of guest virtual machines running Windows, Linux, BSD, OS/2, Solaris, Haiku, and OSx86, as well as limited virtualization of macOS guests on Apple hardware.

MongoDB

MongoDB is an open source database MongoDB, a NoSQL database that stores data in JSON-like documents with flexible schemas. MongoDB Compass allows us to quickly visualize the structure of data in your database, and perform ad hoc queries – all with zero knowledge of MongoDB's query language.

PaaS

Platform as a Service (PaaS) or Application Platform as a Service (PaaS) or platform-based service is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app. As a public cloud service from a provider, where the consumer controls software deployment with minimal configuration options, and the provider provides the networks, servers, storage, operating system (OS), middleware (e.g. Java runtime, .NET runtime, integration, etc.), database and other services to host the consumer's application. As a private service (software or appliance) behind a firewall. As software deployed on a public infrastructure as a service.

Django

Django is a Python-based free and open-source web framework, which follows the model-template-view (MTV) architectural pattern. It is maintained by the Django Software Foundation (DSF). The framework emphasizes reusability and "pluggability" of components, less code, low coupling, rapid development. Python is used throughout, even for settings files and data models.

OBJECTIVE

A virtual private cloud (VPC) is an on-demand configurable pool of shared computing resources allocated within a public cloud environment, providing a certain level of isolation between the different organizations (denoted as users hereafter) using the resources. The isolation between one VPC user and all other users of the same cloud (other VPC users as well as other public cloud users) is achieved normally through allocation of a private IP subnet and a virtual communication construct (such as a VLAN or a set of encrypted communication channels) per user.

The main object of our project is to provide a virtual private cloud in the form of **PaaS** (Platform as a Service) by converting a normal personal computer as a cloud service. An operating system like windows are virtualized to the user by installing it on the VirtualBox - emulator. By configuring the port forwarding network connection, a remote connection will be established and the user can use it anywhere in the world. In our project VirtualBox is used to run multiple operating system simultaneously and the virtual storage disk space are allocated for each of the operating system while booting operation take place. By implementing our concept any of the computer can be converted as a virtual private cloud.

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

In existing system, the virtualization is only possible through the WLAN (Wired Local Area Network) cable which should be connected to client's computer and multiple usage of different operating system at the same time is not possible.

2.2 PROPOSED SYSTEM

In our proposed system virtualization is possible from the outer network connection like WAN (Wide Area Network) and also multiple clients can access our secured cloud service at the same time.

2.2.1 ADVANTAGES:

- Easy to convert a personal computer as a private cloud system.
- Does not require any addition cost to build this cloud system and it will depend upon the computers configuration.
- Clustering of multiple computers are easy as well as efficiency of a computer are also increased.
- Automated user credentials generation for secured connections.

2.3 FEASIBILITY STUDY

A feasibility study is an assessment of the practicality of a proposed project or system.

2.3.1 TECHNICAL FEASIBILITY

The proposed system is technically feasible as it can be developed easily with the help of available technology. The proposed system requires VirtualBox to load the operating the system and for back end we used python for programming and MongoDB as a database. The database is a non-relational database which stores the data's in the JSON format.

2.3.2 OPERATIONAL FEASIBILITY

The proposed system is fully automated. When the client request for a cloud service Django framework will starts the VirtualBox in headless mode and user credentials will be generated by the API (Application Program Interface) developed by us and sent to the client. The client can login to the cloud operating system with that credentials. The login credentials are similar to (OTP) One Time Password. It will be valid for only one login session.

2.3.3 ECONOMIC FEASIBILITY

Economic feasibility is a most important characteristic that has to be evaluated. This is necessary to give the economic justification of the project. Since the needed hardware and software can be available in all the places.

Among the most important information contained in feasibility study is the cost benefit analysis. It is an assessment of the economic justification for a computer-based system project. Cost is only required at the time of upgrading of hardware specifications.

CHAPTER 3

SYSTEM REQUIREMENT SPECIFICATION

3.1 HARDWARE REQUIREMENTS

Hardware is set of physical components, which performs the functions of applying appropriate, predefined instructions. In other words, one can say that electronic and mechanical parts of computer constitute hardware.

Processor	:	INTEL i3
RAM	:	4GB
Hard Disk	:	500GB
SSD	:	150GB

3.2 SOFTWARE REQUIREMENTS

1. **Operating System –** Windows 10
2. **Application Software –** VirtualBox to run operating system virtually.

- Operating System : Windows 10
- Front End : VirtualBox, Python & RDP (Client)
- Back End : MongoDB

CHAPTER 4

SYSTEM DESCRIPTION

Software development life cycle is a logical process by which system analysis, software engineers, programmers and end users build information systems and computer application to entire business problems and needs. The major phases involved in the MIS development process referred to as system development life cycle.

4.1 SDLC PHASES

Each phase of the development process must have well defined objectives and at the end of each phase, progress towards meeting the objectives must be evaluated. The development should not continue until the objectives of all prior phases have been met. Virtual Private Cloud For Multiple Operating System development life cycle is a phased approach to ensure that system are developed correctly.

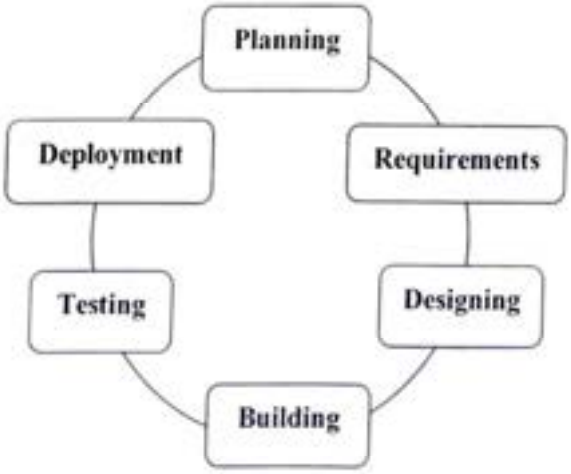

Fig 4.1.1 SDLC Life Cycle

The structured sequence of operation required developing and making operational a new information system it's a cycle because the system will need replacement and development cycle begin.

4.2 SDLC OPERATIONS

System development life cycle is a process of developing software on the basis of the requirement of the end user to develop efficient and good quality software. It is necessary to follow a particular procedure. The sequence of phases that must be followed to develop good quality software is known as SDLC system development life cycle.

The software is said to have a life cycle composed of several phases. Each of these phases results in the development of either a part of the system or something associated with the system such as test plan or user manual.

In the life cycle model, called the "spiral model", each phase has well-defined starting and ending point, with clearly identifiable deliverables to the next phase. In practice, it is rarely so simple. Essentially, good project planning will reduce the complexity and overall time required to complete the project.

Most professional software developers plan software project using a series of steps generally referred to as the software development life cycle. A number of models exist that differ is the number of stages defined, and in the specific activities that take place within each stage. For developing the cloud service model, the same SDLC concepts are used to deploy the good and efficient cloud services.

4.3 FRONT END

PyCharm

PyCharm is an integrated development environment (IDE) used in computer programming, specifically for the Python language. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems and supports web development with Django as well as Data Science with Anaconda.

Remote Desktop Protocol

Remote Desktop Protocol (RDP) is a proprietary protocol developed by Microsoft, which provides a user with a graphical interface to connect to another computer over a network connection. The user employs RDP client software for this purpose, while the other computer must run RDP server software. Microsoft currently refers to their official RDP client software as Remote Desktop Connection, formerly "Terminal Services Client".

4.3.1 FEATURES

- Both RDP & PyCharm are free to use.
- PyCharm support other language other than Python.
- Framework integration like Django, Flask & Ruby Rails can be done easily.
- RDP are inbuilt in windows operating system and for android we can install it freely from play store.
- RDP support virtualization of other operating systems like Debian, Ubuntu and OpenSUSE.

4.4 BACK END

MongoDB is a cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schema. MongoDB is developed by MongoDB Inc. and licensed under the Server-Side Public License.

MongoDB has official drivers for major programming languages and development environments. There are also a large number of unofficial or community-supported drivers for other programming languages and frameworks.

The primary interface to the database has been the mongo shell. Since MongoDB 3.2, MongoDB Compass is introduced as the native GUI. The Clients credentials like OTP (One Time Password) for logging into the operating system and their data are stored in the database.

4.4.1 PROGRAMMING & SCRIPTING SUPPORT

- PYTHON
- JAVASCRIPT
- HTML & CSS
- BOOTSTRAP
- Django Framework

CHAPTER 5

PROJECT DESCRIPTION

5.1 OVERVIEW OF THE PROJECT

A Virtual Private Cloud For Multiple Operating System is most commonly used in the context of cloud **Platform as a Service.** An operating system like windows are virtualized to the user by installing it on the VirtualBox hypervisor. By configuring the port forwarding network connection, a remote connection will be established and the user can access & use it anywhere in the world. Our project is similar to Microsoft Azure but the proposed system is to convert a personal computer into a cloud host machine.

5.2 MOUDLE DESCRIPTION

- VirtualBox Configuration
- API Development
- Framework Configuration
- Database Configuration
- Web Hosting
- Registration & Login
- Logout

5.2.1 VIRTUALBOX CONFIGURATION

The first module of our project is to configure the VirtualBox by downloading it from the oracle website and installing it on the Windows 10 Operating System. Here the base operating system must be Windows 10 because we can extend the RAM (Random Access Memory) by switching the RAM to ROM (Read Only Memory). After installation of VirtualBox the extension packages for the current version of VirtualBox also should be installed. After completing all these process the VirtualBox will ready to boot OS which to be installed over the Virtual Machine. By downloading the OS in ISO file format the booting will takes place when the boot command executed on the VirtualBox. Likewise multiple operating systems should be installed for the virtualization process.

- VirtualBox
- VirtualBox Extension Pack
- Operating System (ISO file format)

5.2.2 API DEVELOPMENT

An API – Application Program Interface is developed by using Python programming language to establish a connectivity between the Client and Host machine. For the API development a tunnelling software called **Ngrok** is used to for Port Forwarding the virtual server. The API are connected with the VirtualBox headless mode command file to automate the OS starting and stopping process as per the client's request. When the client request for OS virtualization from webpage API will automatically initiates the OS to run and provides a login credentials to the client.

5.2.3 FRAMEWORK CONFIGURATION

For the automation process and handling the user request Django Framework is used. It was fully developed on Python programming hence it is very easy to integrate with the VirtualBox headless mode command file and API's. All these configurations are done on the base machine (Windows 10).

In this module a tunnelling process will takes place with the help of **Ngrok** which is similar to Port Forwarding. API is integrated with Ngrok setup file, when OS starts by the Django Framework headless mode command API will automatically initiates tunnelling process and the connection address will be generated and sent to the client.

Here the connectivity address is similar to OTP (One Time Password). OTP will be generated only when the user in at the login session when the client shutdown the OS the address will be automatically became invalid.

5.2.4 DATABASE CONFIGURATION

MongoDB is used as a database to store the client's credentials and data. It stores the data in the form of document schema. Compared to relation database system it very easier to store and validate the data which are given by the user. Here the MongoDB drivers are configured with Python and Django Framework for the database connectivity.

- MongoDB
- Django Framework

5.2.5 WEB HOSTING

Web hosting is the process of enabling the webpage from the local server to the public servers. In our project web hosting module contains the following web pages

- User Account Creation
- User Login
- User Session

The above following pages will be hosted on the Django Framework and configured with the VirtualBox. Whenever client gives a request command for accessing virtual OS the framework will automatically run the VirtualBox.

5.2.6 REGISTRATION AND LOGIN

In this module the user will register with our cloud service portal and creates the user account for them and using those credentials they can claim their login credentials form the web.

5.2.7 LOGOUT

Logout is a process of exiting from their account. When the client logout forms their account the connectivity link will be automatically became invalid and the OS will be saved in the current state and it will be shutdown automatically.

5.3 DATA FLOW DIAGRAM

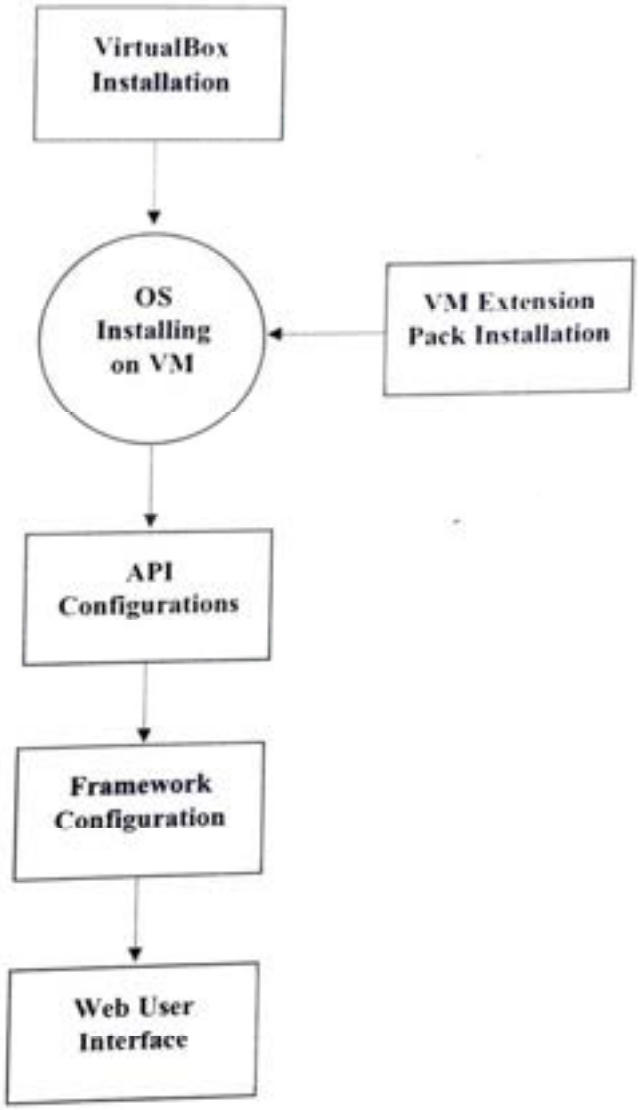

Fig 5.3.1 DFD Diagram

5.4 DATABASE DESIGN

- MongoDB is used for storing data
- It is NoSQL based data storing system (Non-relational Database)
- It stores data in a JSON format
- Here the table is called as collection
- Attributes are called as documents
- In MongoDB the primary key will automatically generated as object ID.

Fig 5.4.1 List of Databases

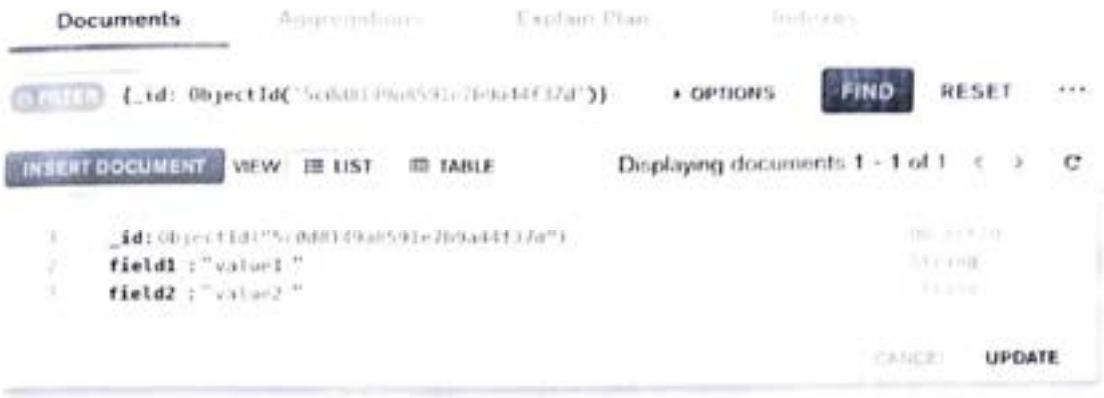

Fig 5.4.2 Document of a database

Fig 5.4.3 JSON format

CHAPTER 6

SYSTEM TESTING

System Testing is usually carried out by a team that is independent of the development team in order to measure the quality of the system unbiased. It includes both functional and Non-Functional testing.

WHITE BOX TESTING

White-box testing is a method of software testing that tests internal structures or workings of an application, as opposed to its functionality. In white-box testing an internal perspective of the system, as well as programming skills, are used to design test cases. The tester chooses inputs to exercise paths through the code and determine the expected outputs

BLACK BOX TESTING

Black-box testing is a method of software testing that examines the functionality of an application without peering into its internal structures or workings. This method of test can be applied virtually to every level of software testing: unit, integration, system and acceptance.

- White Box Testing : API's and programming.
- Black Box Testing : User Interface input commands.

CHAPTER 7

SYSTEM IMPLEMENTATION

A Virtual Private Cloud For Multiple Operating System can be implemented on any of the personal computer. Depending upon the computers hardware configuration cloud service can be deployed. A system with latest hardware configuration can run up to 10 virtual OS simultaneously. The virtual cloud host machine must be configured with Windows 10. A latest Windows 10 edition provides inbuilt Linux terminal service hence we can deploy a secure server in the same machine.

A windows OS having facility to convert ROM as a additional RAM hence we can extend the efficiency of the host machine by configuring SSD (Solid State Drive) for storage and fast boot operations. A VirtualBox virtual machine which is installed on the SSD will run faster.

Networking is the important module in this project. Port forwarding technique should be takes place for remote access of the virtual machine but it is little complex to open the blocked ports. So to reduce the complexity **Tunnelling** technique is used. Tunnelling is the process of transferring the data from one machine to another machine. The software called **ngrok** is used for secure tunnelling. The TCP (Transmission Control Protocol) port **3389** will be configured with tunnelling mechanism to establish the secure remote connection to access the virtual OS.

Client or user can view and operate the GUI of virtual OS using the RDP application.

CHAPTER 8

APPENDIX

8.1 SAMPLE SOURCE CODE

 # To check internet connectivity

```
from urllib import request
try :
res = request.urlopen("https://www.google.com")
print(res.code)
print("Sûccess")
except :
print("Not connected")
```

 # To initialize ngrok

```
import subprocess
subprocess.call("C:\Network\ngrok.exe", shell = True)
```

 # BAT script to run virtual machine

```
C:\Program Files\Oracle\virtualbox\VBoxHeadless.exe --startvm "WindowsXP"
```

 # Command for Database operations

```
import pymongo
myclient = pymongo.MongoClient("mongodb://localhost:27017/")
mydb = myclient["Clientsbase"]
mycol = mydb["Client"]
mydict = { "Name": "John", "Email": "admin@vmos.com"}
x = mycol.insert_one(mydict)
```

#Django Framework Views.py

```
from django.shortcuts import render
from django.contrib import auth
import pyrebase
import subprocess
import time

config = {
  "apiKey": "API Key",
  "authDomain": "Authentication URL",
  "databaseURL": " Database URL ",
  "projectId": "enterprise-r",
  "storageBucket": "Storage_ID",
  "messagingSenderId": "Messaging_ID",
  "appId": "Application_ID"
}

firebase = pyrebase.initialize_app(config)
authn = firebase.auth()
db = firebase.database()

def singIn(request):
  return render(request, "signin.html")

def postsign(request):
  email = request.POST.get('email')
  password = request.POST.get('pass')
```

```
    try:
        user = authn.sign_in_with_email_and_password(email,password)

    except:
        message = "Email or Password is not correct !"
        return render(request, "signin.html",{"msg":message})
    return render(request, "oslist.html")

def logout(request):
    auth.logout(request)
    return render(request, "signin.html")

def signup(request):
    return render(request, "signup.html")

def postsignup(request):
    name = request.POST.get('name')
    email = request.POST.get('email')
    password = request.POST.get('pass')
    user = authn.create_user_with_email_and_password(email,password)
    return render(request, "signin.html")

def mark1on(request):
    subprocess.call("C:\portal\ospush\XP_Mark_1.bat", shell=True)
    time.sleep(70)
    db = firebase.database()
    link1 = db.child("Users/Mark1").get()
    return render(request, "oslist.html",{"link":link1.val()})
```

```
def mark2on(request):
    subprocess.call("C:\portal\ospush\XP_Mark_1.bat", shell=True)
    time.sleep(70)
    db = firebase.database()
    link2 = db.child("Users/Mark2").get()
    return render(request, "oslist.html",{"link":link2.val()})
```

#Django Framework Urls.py

```
from django.contrib import admin
from django.urls import path
from . import views

urlpatterns = [
    path('admin/', admin.site.urls),
    path('',views.singIn),
    path('postsign/',views.postsign),
    path('logout/',views.logout,name='log'),
    path('signup/',views.signup,name='signup'),
    path('postsignup/',views.postsignup),
    path('mark1on/',views.mark1on,name="mark1on"),
    path('mark2on/',views.mark2on,name="mark2on"),
]
```

8.2 SCREEN SHOT

Fig 8.2.1 VirtualBox Installation Wizard

Fig 8.2.2 VirtualBox Manager

Fig 8.2.3 VirtualBox OS View Window

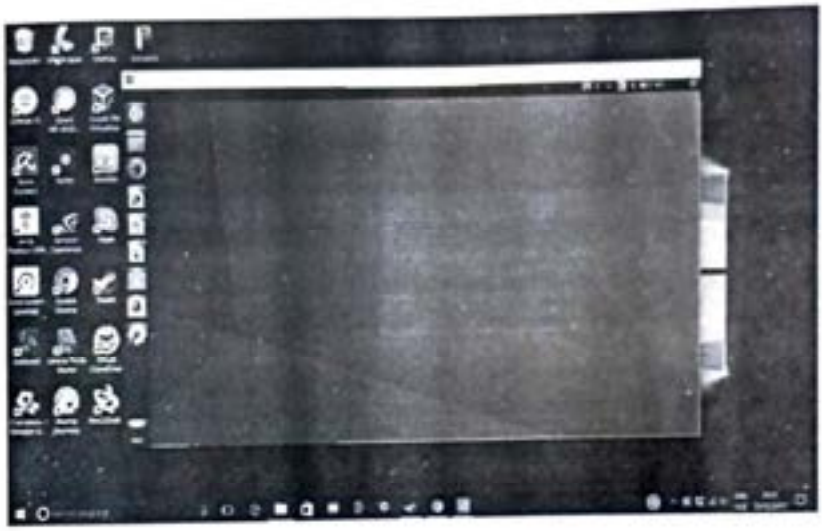

Fig 8.2.4 Remote Desktop Client

CHAPTER 9

9.1 CONCLUSION

An any personal computer with minimum configurations of Intel Core i3 Processor and 4GB RAM can be converted as a cloud host machine. With the help of VirtualBox virtual cloud hosting technique can be implemented in smart way. Our project will be the incorporate solution to develop a Virtual Private Cloud For Multiple Operating System.

- Easy cloud deployment technique.
- Economically Viable to setup.
- Cloud services are built up with Open Source products.
- No complexity in establishing the remote connections.

9.2 FUTURE ENHANCEMENT

- This project can be easily extended in large scale by increasing the server bandwidth.
- By clustering more computer systems especially in combining of multiple SSD's cloud environment can be increased.
- Incorporating of multiple SSD's can provide high speed cloud service for fast booting and running process.
- Android virtualization is also possible by using this cloud deployment technique.
- Virtual OS connections can be established on Android Smart TV's

REFERENCE

[1]. Borislav S. Dordević (2014). "Cloud Computing in Amazon and Microsoft Azure platforms: Performance and service comparison". - IEEE Xplore.

[2]. Eric Victory (2018). "Project Report On Server Virtualization Using PHPVirtualBox".

[3]. Hall, Dennis E. (2013). "A Virtual Operating System". - eScholarship.

[4]. T.Swathi (May 2014). "Virtualization In Cloud Computing". - IJCSMC.

[5]. Wei-Tek Tsai. "Service-Oriented Cloud Computing Architecture". IEEE Xplore.

DUAL POWER IRRIGATION SYSTEM

A MINI PROJECT REPORT

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in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

in

INFORMATION TECHNOLOGY

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

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ANNA UNIVERSITY::CHENNAI 600 025

OCT 2019

DECLARATION

We, **S.SUGASHINI, B.ELAVARASI, P.SHREELEKHA** hereby declare that the project report titled" **DUAL POWER IRRIGATION SYSTEM**" done by me under the guidance of **Mrs. P. ANITHA,M.E., Assistant professor** at Paavai Engineering College is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Information Technology .Certified further that, to the best of our knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

1. S. Sugashini
2. P. Shreelekha
3. B. Elavarasi

DATE : 21/10/19

PLACE: PACHAL

SIGNATURE OF THE CANDIDATES

ABSTRACT

Automatic system is a growing system of everyday object from industrial machine to consumer goods that can complete tasks while you are busy with other activities. India's population is reached beyond 1.2 billion and the population rate is increasing day by day then after 25-30 years there will be serious problem of food, so the development of agriculture is necessary. Today, the farmers are suffering from the lack of rains and scarcity of water. The main objective of this paper is to provide an automatic irrigation system with dual power supply using solar power and grid power supply thereby saving time, money & power of the farmer. The traditional farmland irrigation techniques require manual intervention. With the automated technology of irrigation the human intervention can be minimized. Whenever there is a change in temperature and humidity of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the micro-controller.

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LIST OF ABBREVIATIONS

TABLE NO	TITLE	EXPANSION
1	IDE	Integrated Development Environment
2	GND	Ground pin
3	PWM	Pulse-Width Modulation
4	TX	Transmitter
5	RX	Receiver

CHAPTER 1

INTRODUCTION

The main aim of this project was to provide water to the plants or gardening automatically using microcontroller (Arduino Uno). The device can automatically watering the plants when farmers are going on vacation or don't have to bother my neighbors, Sometimes the neighbors do too much of watering and the plants end up dying anyway. There are timer based devices available in India which waters the soil on set interval. It does not sense the soil moisture and the ambient temperature to know if the soil actually needs watering or not. Assimilation is that the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. When a zone comes on, the water flows through the lateral lines and ultimately finally ends up at the irrigation electrode (drip) or mechanical device heads. Several sprinklers have pipe thread inlets on the lowest of them that permits a fitting and also the pipe to be connected to them. The sprinklers are usually used in the top of the head flush with the ground surface. As the method of dripping will reduce huge water losses it became a popular method by reducing the labor cost and increasing the yields. When the components are activated, all the components will read and gives the output signal to the controller, and the information will be displayed to the user (farmer). The sensor readings are analog in nature so the ADC pin in the controller will convert the analog signals into digital format. Then the controller will access information and when the motors are turned On/Off it will be displayed on the LCD Panel, and serial monitor windows.

1.1 OBJECTIVE

An irrigation system is used to design for irrigation of plants in the agriculture field. In the current irrigation system, there is a major problem is power supply for irrigation. Sometimes, if the electricity for irrigation may disturbed or stopped due to some issues, the irrigation may interrupted and also again the irrigation is started from the first. So, power consumption may high and also the irrigation flow is not continuous. It may cause some problems to the crops and also for the farmers.

To overcome this problem, the project is developed. This project provide two power sources. One is: main electricity and another one is: Solar power. The irrigation is made by the main electricity source initially. Then, if the electricity is stopped or interrupted, the another source of electricity is used, that is Solar power. For switching of electricity, we are using the Arduino Uno and Relay in this project.

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

In the existing irrigation system, only one power source is used for electricity for running the water motor. There is no double power systems is used for the irrigation system.

2.2 PROPOSED SYSTEM:

In the proposed irrigation system, two power sources are used for the irrigation of the crops. The power supply interruptions are overcame by this proposed irrigation system.

2.2.1 ADVANTAGES

- The proposed system is open source and also economically viable.
- It will help the farmers to make the irrigation with no power interruption.
- It is manually controllable. So, no faults are occurred.

2.3 FEASIBILITY STUDY

Feasibility study of a project is based on three characteristics. They are, technical, economical and operational. The project must be a feasible one for the users.

2.3.1 Technical Feasibility

The proposed system is technically feasible one as it can be developed by available technologies. The proposed system requires Arduino Uno IDE (Integrated Development Environment) software for the programming of Arduino Uno kit. It also requires Relay for switching of power supply from the main electricity source to solar power system.

Fig 2.1 THE ARDUINO UNO BOARD

2.3.2 Operational Feasibility

Dual power supply is very feasible one for the users. The proposed system is user friendly. Because, the switching of power is manually controlled. So, if the user wants the solar power source, they can use the power supply. If they don't want the solar power supply, they need not switch ON the solar power system.

And also, the proposed system has the soil moisture sensor. So, the sensor sense the moisture level and also it will automatically stops this irrigation.

2.3.3 Economical Feasibility

Economic feasibility is a most important characteristics of a project to be evaluated. Because, it is to be used by all levels of people. If it is not economically feasible one, it can't be used by middle level and low level people.

According to the feasibility study, the proposed project is economically viable and it can be used by any people.

CHAPTER 3

SYSTEM REQUIREMENT SPECIFICATION

3.1 SOFTWARE SPECIFICATION

The Arduino Uno software IDE (Integrated Software Environment) is required for programming in the Arduino Uno board.

C program is used in this proposed system for programming in the Arduino Uno kit and also for switching of power supply.

Processor : INTEL I3

RAM : 2GB

Keyboard : Standard Keyboard

Monitor : 15'' color Monitor

OS : Windows OS

Software : Arduino Uno software

3.2 HARDWARE SPECIFICATIONS

- Arduino Uno board
- Solar Panel
- Battery
- Power Controller
- Relay and Switch

CHAPTER 4

SYSTEM DESCRIPTION

System description is a description of a whole project system specifications that is, hardware and software specifications. It also described as the life cycle of a system requirements used in the proposed system. In the system life cycle, there is so many processes are involved with each system specifications.

4.1 ARDUINO UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based onWiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

It offers some advantage for teachers, students, and interested amateurs over other systems:

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want t
- Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

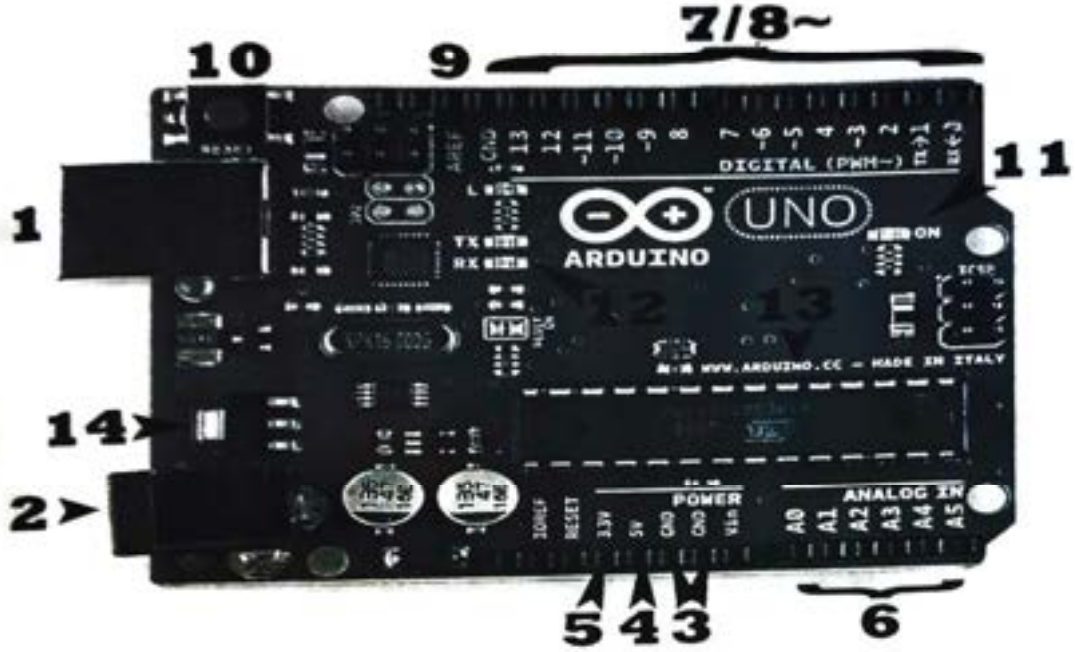

Fig 4.1 ARDUINO UNO PIN SETUP

POWER (USB / Barrel Jack)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply (like this) that is terminated in a barrel jack. In the picture above the USB connection is labeled **(1)** and the barrel jack is labeled **(2)**.The USB connection is also how you will load code onto your Arduino board. More on how to program with Arduino can be found in our Installing and Programming Arduino tutorial.

PINS (5V, 3.3V, GND, Analog, Digital, PWM, AREF)

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

- **GND (3)**: Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.
- **5V (4) & 3.3V (5)**: As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.
- **Analog (6)**: The area of pins under the 'Analog In' label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.
- **Digital (7)**: Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).
- **PWM (8)**: You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

- **AREF (9)**: Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

RESET BUTTON

Just like the original Nintendo, the Arduino has a reset button **(10)**. Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

POWER LED INDICATOR

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' **(11)**. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

TX RX LEDs

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear – once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs **(12)**. These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program onto the board).

MAIN IC

The black thing with all the metal legs is an IC, or Integrated Circuit **(13)**. Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC's from the ATMEL Company. This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If you want to know more about the difference between various IC's, reading the datasheets is often a good idea.

VOLTAGE REGULATOR

The voltage regulator **(14)** is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

PROGRAMMING

The Arduino/Genuino Uno can be programmed with the (Arduino Software (IDE)). Select "Arduino/Genuino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

4.2 SOLAR PANEL

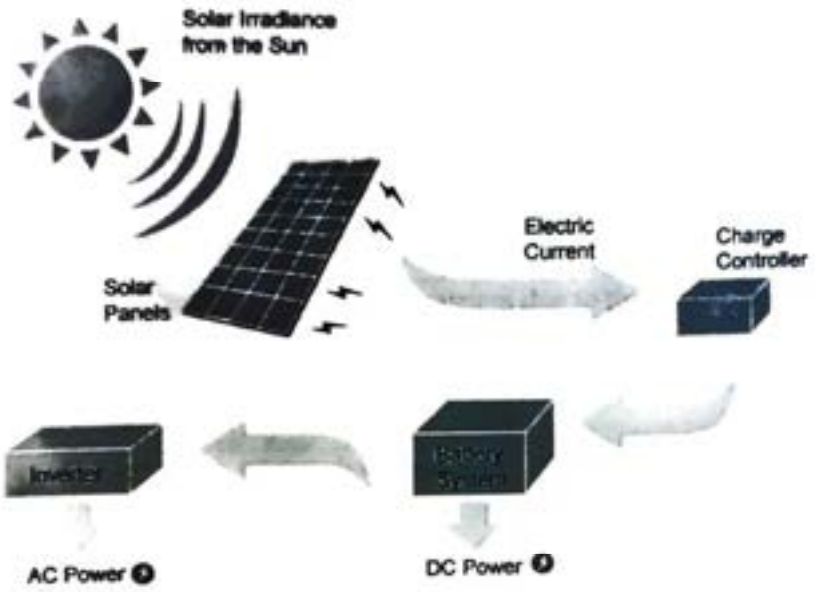

Fig 4.2 SOLAR POWER WORKING MODEL

A **solar panel** is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

WORKING PRINCIPLE

The working principle of all today solar cells is essentially the same. It is based on the photovoltaic effect. In genéral, the photovoltaic effect means the generation of a potential difference at the junction of two different materials in response to visible or other radiation.

The basic processes behind the photovoltaic effect are:

- Generation of the charge carriers due to the absorption of photons in the materials that form a junction
- Subsequent separation of the photo-generated charge carriers in the junction
- Collection of the photo-generated charge carriers at the terminals of the junction

SPECIFICATIONS

- Typical Power: 15 W
- Optimum operating voltage (Vmp): 17.6
- Optimum operating current (Imp): 0.82
- Short circuit current: 3.65
- Dimensions: 12 x 15x 1 in.
- Weight: 1.5Kg
- Dimensions: 12x15x1 in.
- Frame Material: Aluminum with plastic edge caps

4.3 RELAY

Relays are simple switches which are operated both electrically and mechanically. Relays consist of a n electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.

Fig 4.3 RELAY INNER PART

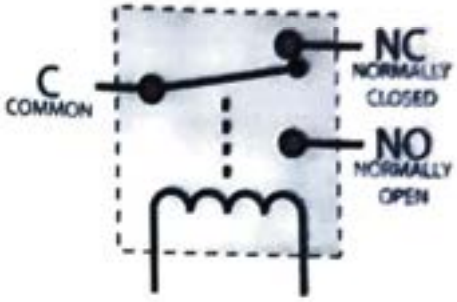

Fig 4.4 RELAY PIN SETUP

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on.

There are only four main parts in a relay. They are

- Electromagnet
- Movable Armature
- Switch point contacts
- Spring

RELAY WORKING PRINCIPLE

CONDITION I: RELAY IN ON STATE

- Coil is energized.
- Contact becomes NO to NC position then load is activated.

CONDITION II: RELAY IN OFF STATE

- Coil is de-energized.
- Contact in NC position then load is de activated.

RELAY SPECIFICATIONS

- Nominal Voltage (VDC): 12V
- Coil Resistance (Ω) (± 10%): 400Ω
- Power Consumption (W): 0.36 W
- Nominal Current (mA) (± 10%): 30 mA
- Pull in Voltage (VDC): 75% Max.
- Drop Out Voltage (VDC): 10% Min.
- Max. Allowable Voltage (VDC): 130%

RELAY APPLICATIONS

- Relays are used to realize logic functions. They play a very important role in providing safety critical logic.
- Relays are used to provide time delay functions. They are used to time the delay open and delay close of contacts.
- Relays are used to control high voltage circuits with the help of low voltage signals. Similarly they are used to control high current circuits with the help of low current signals.

- Relays are also used as protective relays. By this function all the faults during transmission and reception can be detected and isolated.

4.4 CHARGE CONTROLLER

Most stand-alone solar power systems will need a *charge controller*. The purpose of this is to ensure that the battery is never overcharged, by diverting power away from it once it is fully charged. Only if a very small solar panel such as a battery saver is used to charge a large battery is it possible to do without a controller. Most charge controllers also incorporate a low-voltage disconnect function, which prevents the battery from being damaged by being completely discharged. It does this by switching off any DC appliances when the battery voltage falls dangerously low.

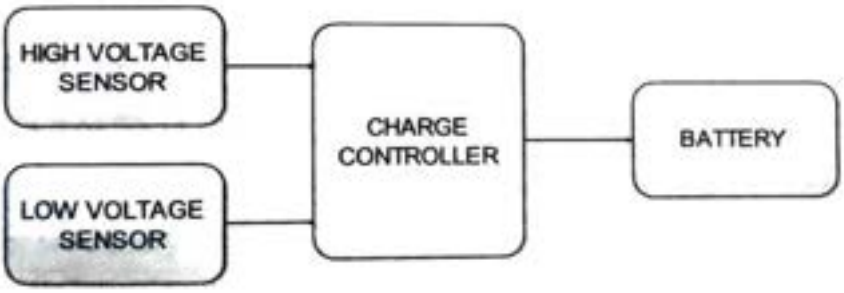

Fig 4.5 CHARGE CONTROLLER WORKING PRINCIPLE

WORKING PRINCIPLE

The principle behind a solar charge controller is simple. There is a circuit to measure the battery voltage, which operates a switch to divert power away from the battery when it is fully charged. Because solar cells are not damaged by being short or open-circuits, either of these methods can be used to stop power reaching the battery.

4.5 BATTERY

An electric **battery** is a collection of one or more electrochemical cells in which stored chemical energy is converted into electrical energy. The principles of operation haven't changed much since the time of Volta. Each cell consists of two half cells connected in series through an electrolytic solution. One half cell houses the **Anode** to which the positive ions migrate from the **Electrolyte** and the other houses the **Cathode** to which the negative ones drift. The two cells are may be connected via a semi permeable membranous structure allowing ions to flow but not the mixing of electrolytes as in the case of most primary cells or in the same solution as in secondary cells.

WORKING PRINCIPLE

The energy released during accepting an electron by a neutral atom is known as electron affinity. As the atomic structure for different materials are different, the electron affinity of different materials will differ. If two different kinds of metals or metallic compounds are immersed in the same electrolyte solution, one of them will gain electrons and the other will release electrons. Which metal (or metallic compound) will gain electrons and which will lose them depends upon the electron affinities of these metals or metallic compounds. The metal with low electron affinity will gain electrons from the negative ions of the electrolyte solution.

CHAPTER 5

PROJECT DESCRIPTION

5.1 OVERVIEW OF THE PROJECT

In the proposed system, first the electrical power is used for the irrigation purpose. The electrical power is continuously given to the irrigation system. If any interruption occur in the power supply, then the irrigation is stopped or interrupted.

On that case, the secondary power system is used. That is Solar power system is used. The solar power system saves the power during the day time and it saves the power in a battery for later use. Then when it is needed, user can switch into this power supply by using a switch. This proposed project is fully based on manual control.

A third phase is used in this project that is soil moisture sensor. This moisture sensor sense the soil moisture and allows the end of the irrigation system. If it sense complete soil moisture, it will stop the irrigation system.

CHAPTER 6

SYSTEM TESTING

System testing ensures that the entire integrated software and hardware requirements. It test a configuration to ensure known and predictable results. An example, of system testing is the configuration oriented system integration test.

6.1 WHITE BOX TESTING

White box testing is the testing of software and hardware specifications in which the tester has the prior knowledge about the working principles of hardware and software specifications. The tester had also has prior knowledge about the series of working principle of the proposed system and also have the knowledge about the whole working principle.

6.2 BLACK BOX TESTING

Black box testing is the testing the software and hardware specifications in which the tester doesn't have prior knowledge about the specific hardware and the software. Black box testing is not like other testing methods, it is not a detailed testing.

White Box Testing : Testing of Power Switching phase

Black Box Testing : Testing of Soil moisture sensing Phase

CHAPTER 7

SYSTEM IMPLEMENTATION

The implementation of the system includes, software implementation as well as hardware implementation. The hardware implementation includes, the connection of Arduino Uno kit and Relay and solar power system. The software implementation includes the programming of switching of power system and also the programming of soil moisture sensor.

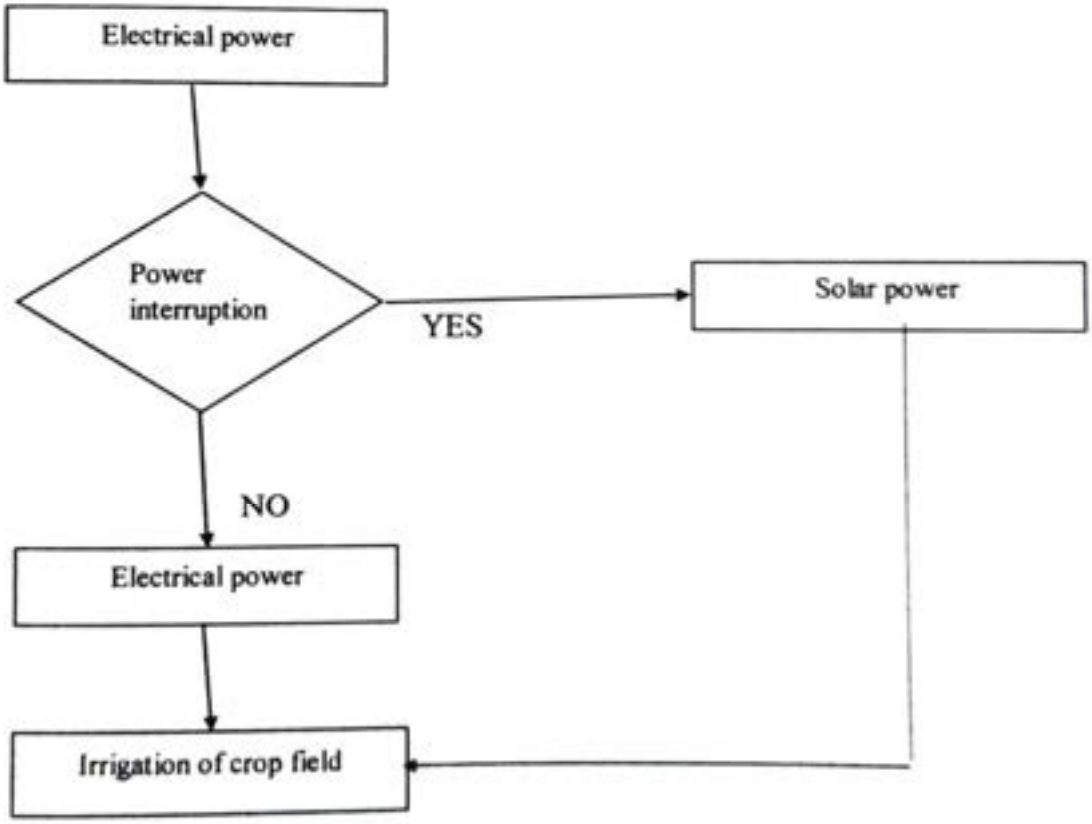

Fig 7.1 SYSTEM IMPLEMENTATION

CHAPTER 8

APPENDIX

8.1 SAMPLE SOURCE CODE

```
int led_pin1 =13;
int sensor_pin = A1;
int sensor_pin1 =8;
int ledPin = 12;
int ldrPin = A0;
void setup() {
 Serial.begin(9600);  /* Define baud rate for serial communication */
  pinMode(led_pin1, OUTPUT);
  pinMode(sensor_pin1, INPUT);
  pinMode(ledPin, OUTPUT);
  pinMode(ldrPin, INPUT);
 }
 void loop() {
 float moisture_percentage;
   int sensor_analog;
   sensor_analog = analogRead(sensor_pin);
   moisture_percentage = ( 100 - ( (sensor_analog/1023.00) * 100 ) );
   Serial.print("Moisture Percentage = ");
   Serial.print(moisture_percentage);
   Serial.print("%\n\n");
   delay(1000);
```

```
if(digitalRead(sensor_pin1) == HIGH){
  digitalWrite(led_pin1, HIGH);
 } else {
  digitalWrite(led_pin1, LOW);
  delay(1000);
 }
int ldrStatus = analogRead(ldrPin);
if (ldrStatus <= 200) {
digitalWrite(ledPin, HIGH);
} else {
digitalWrite(ledPin, LOW);
}
}
```

8.2 SCREEN SHOT

Screen shot of Arduino IDE

Fig 8.1 SCREENSHOT OF ARDUINO IDE

Fig 8.2 RESULT OF THE PROJECT

CHAPTER 9

CONCLUSION AND FUTURE ENHANCEMENT

9.1 CONCLUSION

The proposed controller eliminates the on-place switching mechanism used by the farmers to ON/OFF the irrigation system. Integrating features of all the hardware components used have been developed in it. Occurrence of each module has been logical out and located prudently, thus donating to the best working of the unit. Next, using highly advanced IC's with the help of rising technology, the project has been really employed. The microcomputer irrigation system applied was found to be feasible and cost actual for changing water resource for agricultural manufacture. This irrigation system permits cultivation in places with aquatic insufficiency thereby cultivating sustainability. The micro irrigation system progressive proves that the use of water can be weakened for a given amount of fresh biomass manufacture.

9.2 FUTURE ENHANCEMENT

The main future scope of the project is the implementation of booming technologies in the agriculture.

By using this project, we can make irrigation without any power interruptions. Solar power is a renewable energy. So, this is used continuously. Power is saved much in the future, by using this project.

CHAPTER 10

REFERENCES

[1] Choukr-Allah,(2000).: Protected culture in Morocco. Mediterranean's Books Options, 31, pp. 9-247.

[2] Cottef F. (2001): LabVIEW: programmationet applications. Dunod, pp. 415.

[3] Eddahhak, A.; Lachhab, A.; Ezzine, L.; Bouchikhi, B. (2007): Performance evaluation of a developing greenhouse climate control with a computer system. AMSE Journal Modelling C, 68 (1), pp. 53-64.

[4] Elattir H. (2005): La conduiteet le pilotage de l'irrigationgoutte-à- goutte en maraîchage. Bulletin mensueld'informationet de liaison duprogramme national de transfert de technologie en agriculture (PNTTA), pp. 124

[5] Gonzalez, R .A.; Struve, D.K.; Brown L.C. (1992): A computercontrolled raingun irrigation system for container plant production. Hort Technology, 2(3), pp. 402-407.

[6] Howell, T.A. (2001): Enhancing water use efficiency in irrigated agriculture. Agron. J, 93, pp. 281-289.

[7]Jia Uddin, S.M. Taslim Reza, Qader Newaz, Jamal Uddin, Touhidul Islam, and Jong-Myon Kim,"Automated Irrigation System Using Solar Power" ©2012 IEEE

[8] m. guerbaoui, y. el afou, a. ed-dahhak, a. lachhabpc-based automated drip irrigation system(Vol. 5 No.01 January 2013)

[9] Mansour,H.A, YousifEl-Melhem ,impactthe automatic control of closed circuits raingun irrigation system on yellow corn growth and yield(International Journal of Advanced Research (2013), Volume 1, Issue 10, 33-42)

[10] N.B. Bhawarkar, D.P. Pande, R.S. Sonone, Mohd. Aaquib , P.A. Pandit, and P. D. Patil, "Literature Review for Automated Water Supply with Monitoring the Performance System", International Journal of CurrentEngineering and Technology, Vol. 4, No. 5, Oct 2014.

[11] Purnima, S.R.N Reddy, "Design of Remote Monitoring and Control System with Automatic Irrigation System using GSMBluetooth", on IJCA,2012

[12] Rane, et al .,"Review Paper Based On Automatic Irrigation System Basedon RF Module" , 2014

[13] Suraj S.Avatade, Prof.S.P. Dhanure, "Irrigation System Using a Wireless SensorNetwork and GPRS", International Journal ofAdvanced Research in Computer and Communication Engineering, Vol. 4, Issue 5, May 2015.

[14] VeenaDivyak ,AyushAkhouri,A Real time implementation of a GSM based Automated Irrigation Control System using drip IrrigationMethology(Volume 4, Issue 5,May 2013)

LAB ATTENDANCE MANAGEMENT SYSTEM

A MINI PROJECT REPORT

Submitted by

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In partial fulfillment of the award of the degree

of

BACHELOR OF TECHNOLOGY

in

INFORMATION TECHNOLOGY

PAAVAI ENGINEERING COLLEGE(AUTONOMOUS)

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OCTOBER 2019

DECLARATION

We, **HARITHARANI.V, NAGALAKSHME.N, SWATHI.S** hereby declare that the project titled **"LAB ATTENDANCE MANAGEMENT SYSTEM"** done by us under the guidance of **Mrs.B.DEEPA,M.E., Assistant professor** at Paavai Engineering College is submitted in partial fulfillment of the requirement for the award of Bachelor of technology degree in **INFORMATION TECHNOLOGY**. Certified further that, to the best of our knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

1. V. Harithi
2. N. Nagalakshme.
3. S. Swathi

DATE: 21.10.19

PLACE: Pachal

SIGNATURE OF THE CANDIDATE

ABSTRACT

Attendance management is important to every single organization. Managing student attendance during lab periods has become a difficult challenge. The ability to compute the attendance percentage becomes a major task as manual computation produces errors, and wastes a lot of time. For the stated reason, an efficient Web-based application for attendance management system is designed to track student's activity in the lab. The application takes attendance electronically and the records of the attendance are storing in a database. DoT.NET is adding to the application to improve the use of the system. MySQL used for the Application Database. The system designed in a way that can differentiate the hours of theoretical and practical lessons since the rate of them is different for calculating the percentages of the students' absence. Insertions, deletions, and changes of data in the system can do straightforward via the designed GUI without interacting with the tables. Recording absence at a department having a large number of students in a lab is a difficult task and time-consuming. Moreover, the process takes much time, and many efforts are spent by the staff of the department to complete the attendance rates for each student. The purposes include record keeping, assessment of students, and promotion of optimal and consistent attendance in lab. The process of recording attendances for students was in the form of hardcopy papers and the system was manually done. Besides wasting time and taking efforts for preparing sheets and documents, other disadvantages may be visible to the traditional one due to loss or damage to the sheets-sheet could be stolen.

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CHAPTER 1

INRODUCTION

The main aim of this project **"LAB ATTENDANCE MANAGEMENT SYSTEM"** is to find applications for college. Managing computer labs in an educational environment can be a daunting task – at the best of times – not only from a technical standpoint but from an auditing and planning perspective as well. With more computers in public and private labs, it was unable to efficiently maintain cyclic four year computer renewal plan without adequate and reliable information on lab usage.

This paper will examine a web-based application called Lab Authentication. In Each and every LAB must have maintained student's attendance. If facilitates to access the attendance information of a particular student in a particular LAB. When the student enters into the lab the system asks User Name and password. If the user enters into our correct login the IN Time of the LAB will be automatically stored into the Server Database. The timetable of each class details also maintained separately. The LAB authentication monitors the time schedule for each batch. The system will automatically shut down with help of the corresponding time schedule database.

Automatically it will count day by day. If student take, one day leave means this project indicates one day leave. This information in office room itself monitors and find out in the computer. Every day easily find whose is take leave and present and the same time it will indicate LAB information for each class.

In this project the Admin had the entire control of the Lab. All the systems in the lab has begin controlled by the admin, he had the full details of the systems which being Attendance details. Student details and the Time Table.

Language Used

Front End	:	**VB.NET**
Back End	:	**SQL**

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

The system, which is followed at present, is a manual system. The system consists of attendance records that have to be maintained in all aspects. Calculating student's attendance percentage is difficult one. In the existing system each and every time a reference should be made manually. There are high possibilities to commit errors and mistakes, which leads to produce the wrong statements to the management. Report generation is also not an easy task.

Another important drawback of existing system is time factor. It will not help the management could not act on any report in time controls cannot be used. The above said reasons are overcome by using the Visual Basic .NET. Since the security system in this package is more secure than other software packages.

2.1.1 DRAW BACKS OF THE EXISTING SYSTEM

- Manual Work.
- Security of information is low.
- Time Consumption.
- High Manpower.

2.2 PROPOSED SYSTEM

The drawbacks, which are faced during existing system, can be eradicated by using the proposed system. The main objective of the existing system is to provide a user-friendly interface. The system, which is proposed, now

computerizes all the details that are maintained computerized. Once the details are fed into the computer there is no need for various persons to deal with separate sections. Only a single person is enough to maintain all the reports. The security can also be given as per the requirement of the users.

2.2.1 BENEFITS OF THE PROPOSED SYSTEM

- Large volumes of data can be stored with case.
- Maintenance of file is flexible
- Records stored are updated now and then.
- Stored data and procedures can be easily edited.
- Reports can be generated with case.
- Less manpower required.

2.3 FEASIBILITY ANALYSIS

It is to determine the possibility of either improving the existing system or develop a totally new system. The phrase says, something that is feasible is something that can be accomplished. The given content is competitive with the potential solution.

- Technical Feasibility
- Economic Feasibility
- Operational Feasibility

2.3.1 TECHNICAL FEASIBILITY

Technical feasibility is concerned with such equations as weather easy technology exists to do what is planned. Those the proposed equipment have the data required as far as a project is concerned it is technically

2.3.2 ECONOMIC FEASIBILITY

In this user examine the cost of developing and operating the system with regard to what the organization can effort the project can be done on PC with the hard disk. A well done Feasibility study is firm to avoid common mistakes often made in the system.

- Failure to clearly specify problem and objectives.
- Estimate error.
- The hardware approaches etc.

The cost to conduct a full system investigation

1. The cost of hardware and software for the class of application being considered.
2. The development cost.
3. The cost maintenance etc.

2.3.3 OPERATIONAL FEASIBILITY

The feasibility study is carried out by a small group of people who are familiar with information systems techniques, understand the parts of the business or organization that will involve or affected by the project, and are skilled in the system analysis and design process

CHAPTER 3

HARDWARE & SOFTWARE SPECIFICATIONS

3.1 HARDWARE SPECIFICATION

PROCESSOR	-	Intel Pentium IV 1.8GHZ
CACHE MEMORY	-	512KB
RAM	-	128MB DDR
HARD DISK DRIVES	-	40GB
FLOPPY DISK DRIVES	-	1.44MB
MONITOR	-	15" Color Monitor
KEYBOARD	-	Multimedia Keyboard
MOUSE	-	Scroll Mouse

3.2 SOFTWARE SPECIFICATION

OPERATION SYSTEM	-	WINDOWS XP
FRONT END	-	VISUAL BASIC .NET
BACK END	-	MS SQL 2000

CHAPTER 4

SOFTWARE FEATURES

4.1 VISUAL BASIC.NET

Visual Baic.Net has revolutionized windows programming and with an object based, event driven approach to software designs. Visual basic.Net applications act as a front end to the database. Visual basic.Net application provides the interface between the user and the database. Sophisticated features that make the language truly object oriented and interfaces it with the latest in the database technology.

.NET provides a new, object-oriented API as a set of classes that will be accessible from any programming language. This book describes this framework of classes and provides a reference to what is available and how you can use this framework to write Windows applications in the brave new world of .NET.

Microsoft .NET Framework is a computing platform for developing distributed applications for the Internet. Following are the design goals of Microsoft .NET Framework:

1. To provide a very high degree of language interoperability
2. To provide a runtime environment that completely manages code execution
3. To provide a very simple software deployment and versioning model
4. To provide high-level code security through code access security and strong type checking
5. To provide a consistent object-oriented programming model
6. To facilitate application communication by using industry standards such as SOAP and XML.

Visual basic.net lets the user to add menus, text boxes, command buttons, option buttons, check boxes, list boxes, scroll bars, and file directory boxes to blank windows. Visual basic.net has many different tools.

The Common Language Runtime

The CLR is the mechanism through which .NET code is executed. It is built upon a single, common language—IL—into which source languages are compiled and includes mechanisms for executing the compiled code. This includes code verification and just-in-time (JIT) compilation, garbage collection and enforcement of security policies, and the provision of profiling and debugging services.

The CLR provides a lot of added value to the programs it supports. Because it controls how a .NET program executes and sits between the program and the operating system, it can implement security, versioning support, automatic memory management through garbage collection, and provide transparent access to system services

4.2 IMPORTANT FEATURES

- The application is a graphical user interface.
- Client-Server architecture benefits picture and image box can be easily handled using bit mapped files and icons.
- Bit mapped files and icons are used as simple debugging tools.
- With the advent of .NET, Microsoft has introduced many new technologies that make writing component-based distributed systems easier, more flexible, and more powerful than ever before.

CHAPTER 5

SYSTEM DESIGN

In this chapter, concepts associated with term structured system and how they are implemented in the project has been dealt with the tools used for structure system analysis are,

- Data Flow Diagram
- Entity Relationship Diagram

5.1 ENVIRONMENTAL MODEL

The Environmental model defines the interfaces between the system and the environment. Building an environmental model is the first and the most important part of building complete model of user requirements. The critical aspect of environmental model is to identify the events occurring in the environment to which the system must respond. It also defines the boundary between the system and the environment.

5.2 BEHAVIOURAL MODEL

A system flow diagram is a pictorial representation of the working of the system. It is a tool that depicts the flow of data through a system and the work processing performed by that system. This takes an important role in the system analysis part to know the present level of existing system and what modification is to be done to overcome the problem occurring in the system. It is the starting point of the design phase that functionally decomposed the requirement. A system flow diagram consists of a series of rectangles joined by lines. The rectangles represents data transformation and lines represent data flow in those systems.

5.3 DATA MODEL

Entity Relationship Diagram is a model that describes the stored data layout of a system at high level of abstraction. Entity Relationship Diagram enables us to examine and highlight data structures and relationship independent of the processes or control flow.

Entities are the principal data object about which information is to be collected. Entities are usually recognizable concepts, either concrete or abstract, such as person, places, things, or events which have relevance to the concept.

Relationship represents an association between two or more entities. Relationships are classified in terms of degree, connectivity, cardinality, and existence.

Attributes describe the entity of which they are associated. A particular instance of an attribute is a *value*. Attributes can be classified as identifiers or descriptors. Identifiers, more commonly called *keys*, uniquely identify an instance of an entity. A descriptor describes a non-unique characteristic of an entity instance. The Entity Relationship Diagram shows the relationship and types of relationship between the entities. The entity for the system "**LAB ATTENDANCE MANAGEMENT SYSTEM**" is shown in **Fig 3.3.1**.The major components are

- Rectangle - represent the entity sets
- Ellipses - which represents attributes
- Diamond - which represent relationship set
- Line - which links the attributes to entity sets and entity sets to relationship set.

CHAPTER 6

SYSTEM ANALYSIS AND DESIGN

System design is the process of planning a new system to complement or altogether replace the old system. The purpose of the design phase is the first step in moving from the problem domain to the solution domain. The design of the system is the critical aspect that affects the quality of the software. System design is also called top-level design. The design phase translates the logical aspects of the system into physical aspects of the system

6.1. FACT FINDING

Goals must be developed within the practical bounds of the organization. One way to ensure this is to break down the project goal into more detailed sub goals that consider organization constraints. These sub goals are used in later stages to guide detailed analysis and design. Goals are to identify deficiencies in the existing system. The project goal will remove such deficiencies. During initial analysis the searches for deficiencies are Missing Data Unsatisfactory Performance of Excessive costly operations.

Missing Data can be found in the initial analysis. There may be delay in searching data and by checking the data manually will make errors. Another function is making a wrong entry in the system and this makes difficulties in the current operation.

Unsatisfactory Performance delays in calculating rate and material requirements. This is caused by not maintaining the system properly. The other things of poor performance are modifications of data on the system make delay on processing. The specified goals will remove these deficiencies. It will reduce

the time between requisition and response. The goal is to eliminate errors and delays in proposed system.

6.2 INPUT DESIGN

Input design is the process of converting the user-oriented. Input to a computer based format. The goal of the input design is to make the data entry easier, logical and free error. Errors in the input data are controlled by the input design. The quality of the input determines the quality of the system output.

All the data entry screen are interactive in nature, so that the user can directly enter into data according to the prompted messages. The user is also can directly enter into data according to the prompted messages. The users are also provided with option of selecting an appropriate input from a list of values. This will reduce the number of error, which are otherwise likely to arise if they were to be entered by the user itself.

Input design is one of the most important phase of the system design. Input design is the process where the input received in the system are planned and designed, so as to get necessary information from the user, eliminating the information that is not required. The aim of the input design is to ensure the maximum possible levels of accuracy and also ensures that the input is accessible that understood by the user.

The input design is the part of overall system design, which requires very careful attention. if the data going into the system is incorrect then the processing and output will magnify the errors.

The objectives considered during input design are:

- Nature of input processing.
- Flexibility and thoroughness of validation rules.

- Handling of properties within the input documents.
- Screen design to ensure accuracy and efficiency of the input relationship with files.
- Careful design of the input also involves attention to error handling, controls, batching and validation procedures.

Input design features can ensure the reliability of the system and produce result from accurate data or they can result in the production of erroneous information.

Input design features can ensure the reliability of the system and produce result from accurate data or they can result in the production of erroneous information. The input design of the system includes the following

6.3 OUTPUT DESIGN

Output design is very important concept in the computerized system, without reliable output the user may feel the entire system is unnecessary and avoids using it. The proper output design is important in any system and facilitates effective decision-making. The output design of this system includes various reports.

Computer output is the most important and direct source of information the user. Efficient, intelligible output design should improve the system's relationships with the user and help in decision making. A major form of output is the hardcopy from the printer. Output requirements are designed during system analysis. A good starting point for the output design is the data flow diagram. Human factors reduce issues for design involved addressing internal controls to ensure readability.

An application is successful only when it can provide efficient and effective reports. Reports are actually presentable form of the data. The report generation should be useful to the management for future reference. The report are the main source of information for user's operators and management. Report generated are a permanent record of the transaction occurred. After any valid transactions; have commenced the report of the same are generation and: filed for future reference. Great care has been taken when designation the report as it plays an important role in decision-marking.

6.4 CODE DESIGN

Code is an order collection of symbols designed to provide unique identification of an entry or attribute. Sometimes used in the place of name of the item they can be specified all object's physical or performances characteristics or operational instructions.

Most computer systems are stable from the compiler down to the execution of binary instructions. Therefore, it's natural to think of "product" as the artifact just above that base. That's language source code. The system that produces that artifact is still quite unpredictable, so it's not likely we'll shift our orientation. Artifacts more abstract, be they whatever, will constitute a nebulous range of "designs" or "specifications". I think it's the lack of a direct and strictly repeatable translation of these artifacts that characterizes them.

CHAPTER 7

TESTING AND IMPLEMENTATION

7.1 TESTING

Testing is a series of different tests that whose primary purpose is to fully exercise the computer based system. Although each test has a different purpose, all work should verify that all system element have been properly integrated and performed allocated function. Testing is the process of checking whether the developed system works according to the actual requirement and objectives of the system.

The philosophy behind testing is to find the errors. A good test is one that has a high probability of finding an undiscovered error. A successful test is one that uncovers the undiscovered error. Test cases are devised with this purpose in mind. A test case is a set of data that the system will process as an input. However the data are created with the intent of determining whether the system will process them correctly without any errors to produce the required output.

7.2 Types of Testing

- Unit testing
- Integration testing
- Validation testing
- Output testing
- User acceptance testing

7.2.1 Unit Testing

All modules were tested and individually as soon as they were completed and were checked for their correct functionality.

7.2.2 Integration Testing

The entire project was split into small program; each of this single programs gives a frame as an output. These programs were tested individually; at last all these programs where combined together by creating another program where all these constructors were used.

The user interface testing is important since the user has to declare that the arrangements made in frames are convenient and it is satisfied. when the frames where given for the test, the end user gave suggestion. Based on their suggestions the frames where modified and put into practice.

7.2.3 Validation Testing

At the culmination of the black box testing software is completely assembled as a package. Interfacing errors have been uncovered and corrected and a final series of test i.e., Validation succeeds when the software function in a manner that can be reasonably accepted by the customer.

7.2.4 Output Testing

After performing the validation testing the next step is output testing of the proposed system. Since the system cannot be useful if it does not produce the

required output. Asking the user about the format in which the system is required tests the output displayed or generated by the system under consideration. Here the output format is considered in two ways. The output format on the screen is found to be corrected as the format was designed in the system phase according to the user needs.

7.2.5 User Acceptance System

An acceptance test as the objective of selling the user on validity and reliability of the system. It verifies that the procedures operate to system specification and mat the integrity of vital is maintained.

7.2.6 Performance Testing

This project is a application based project, and the modules are interdependent with the other modules, so the testing cannot be done module by module. So the unit testing is not possible in the case of this driver. So this system is checked only with their performance to check their quality.

7.3 IMPLEMENTATION

System implementation is stage in the project where the theoretical design is turned into the working system. The most crucial stage is giving the users confidence that the new system will work effectively and efficiently.Proper implementation is essential to provide a reliable system to meet organization requirements. During the implementation stage a live demon was undertaken and made in front of end-users.

CHAPTER 8

APPENDIX

8.1 Source code

Main.vb:

```
Imports System.Data

Imports System.Data.SqlClient

Public Class Form1

Dim con As New SqlConnection("Data Source=CRISP2\SQLEXPRESS;Initial
Catalog=STU_LAB;User  ID=sa;pwd=crisp")

 Dim hr As String

 Dim sid As String

 Dim tim2 As String

 Dim month1 As String

 Dim date1 As String

 Dim subj As String

Private Sub bsave_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles bsave.Click

If UCase(uname.Text) = "ADMIN" And UCase(pswd.Text) = "ADMIN" Then

 Me.Hide()

 Dim f As New link
```

```
f.Show()
Else
date1 = Date.Today
Dim datevsl As Date = "#" + date1 + "#"
Dim day1 As String = datevsl.ToString("ddddd")
month1 = datevsl.ToString("MMMMM")
Dim tim As String
Dim tim1 As String = DateAndTime.TimeOfDay()
tim = Mid(tim1, 1, 5)
tim = dot(tim)
If tim > 9.0 And tim <= 10 Then
tim2 = "10.00"
hr = "I"
ElseIf tim > 10 And tim <= 11 Then
tim2 = "11.00"
hr = "II"
ElseIf tim > 11 And tim <= 12 Then
tim2 = "12.00"
hr = "III"
ElseIf tim > 12 And tim <= 13 Then
```

```
tim2 = "01.00"

hr = "IV"

ElseIf tim > 2 And tim <= 3 Then


tim2 = "03.00"

hr = "V"

ElseIf tim > 3 And tim <= 4 Then


tim2 = "04.00"

hr = "VI"

End If

If Not hr = "" Then

Dim cmd As New SqlCommand("select *from regdet where sregno='" +
uname.Text + "' and pwd='" + pswd.Text + "'", con)

Dim da As New SqlDataAdapter(cmd)

Dim ds As New DataSet

da.Fill(ds, "regdet")

Dim count As Integer = ds.Tables(0).Rows.Count

If count > 0 Then

' Dim tim As String = DateAndTime.TimeOfDay()
```

```
Dim command As New SqlCommand("select " + hr + " from T_tble where
day_v='" + day1 + "' and deg='" + ds.Tables(0).Rows(0)(10) + "' and cname='"
+ ds.Tables(0).Rows(0)(11) + "' and yr='" + ds.Tables(0).Rows(0)(12) + "'",
con)

Dim dataadapter As New SqlDataAdapter(common)

Dim dataset As New DataSet

dataadapter.Fill(dataset, "T_tble")

subj = dataset.Tables(0).Rows(0)(0)

Dim com As New SqlCommand("insert into attendance values('" +
date1.ToString() + "','" + month1 + "','" + ds.Tables(0).Rows(0)(2) + "','" +
ds.Tables(0).Rows(0)(3) + "','" + ds.Tables(0).Rows(0)(11) + "','" +
ds.Tables(0).Rows(0)(12) + "','" + hr + "','" + dataset.Tables(0).Rows(0)(0) +
"','" + tim1 + "','Present')", con)

 con.Open()

 com.ExecuteNonQuery()

 con.Close()

 MsgBox("Successful Login")

 Me.Hide()

 Else

 MsgBox("Invlaid Login")

 cmd.ExecuteNonQuery()

 con.Close()
```

```
Dim comm As New SqlCommand("SELECT stregno FROM regdet WHERE
SELECT stu_id FROM attendance;", con)

Dim da As New SqlDataAdapter(common)

Dim ds As New DataSet

da Fill(dset)

Dim count As Integer = ds.Tables(0).

Imports System.Data.SqlClient
Public Class Lab_Ent
 Dim con As New SqlConnection("Data Source=CRISP2\SQLEXPRESS;Initial
Catalog=STU_LAB;User ID=sa;pwd=crisp")
Dim com, com1 As SqlCommand
Dim qry, qry1 As String
Dim adp, adp1 As SqlDataAdapter
Dim ds, ds1 As DataSet
Dim i As Integer
Dim v, v1 As String
Private Sub Lab_Ent_Load(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
Label5.Text = Date.Today
Label7.Text = TimeOfDay
incr()
End Sub
Private Sub incr()
End Sub
Private Sub bexit_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles bexit.Click
 Me.Close()
```

```
End Sub
Private Sub bsave_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles bsave.Click
Dim s As String
s = InputBox("Please Enter PC No")
qry = "select * from lab_pc where pc_no='" + s + "'"
com = New SqlCommand(qry, con)
adp = New SqlDataAdapter(com)
ds = New Data.DataSet
adp.Fill(ds, "lab_pc")
End Sub
End Class
```

8.2 Screenshot

Fig 8.1: LOGIN PAGE

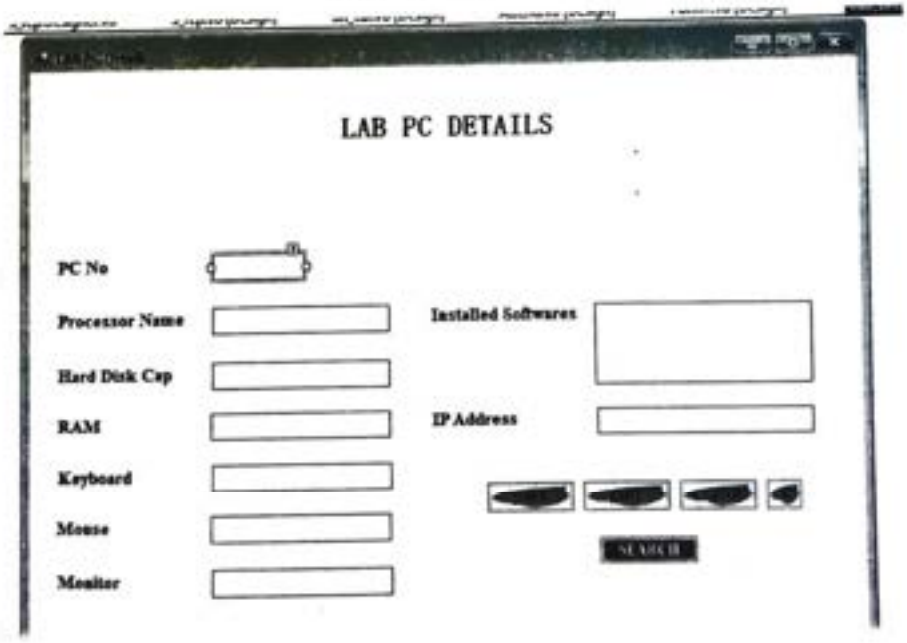

Fig 8.2: LAB PC DETAILS

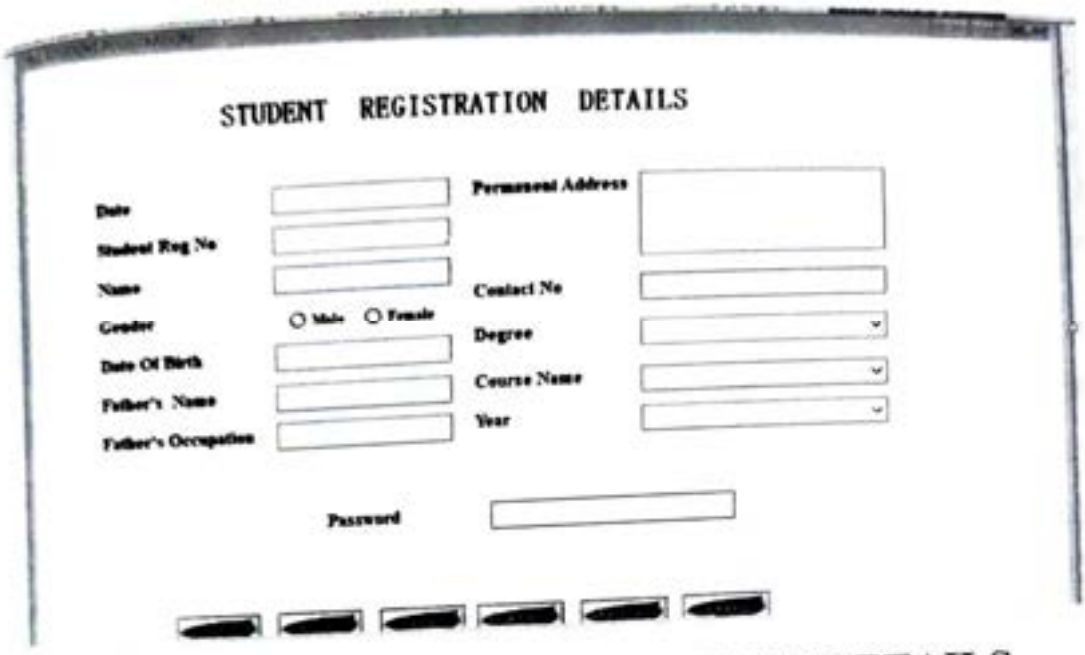

Fig 8.3: STUDENT REGISTRATION DETAILS

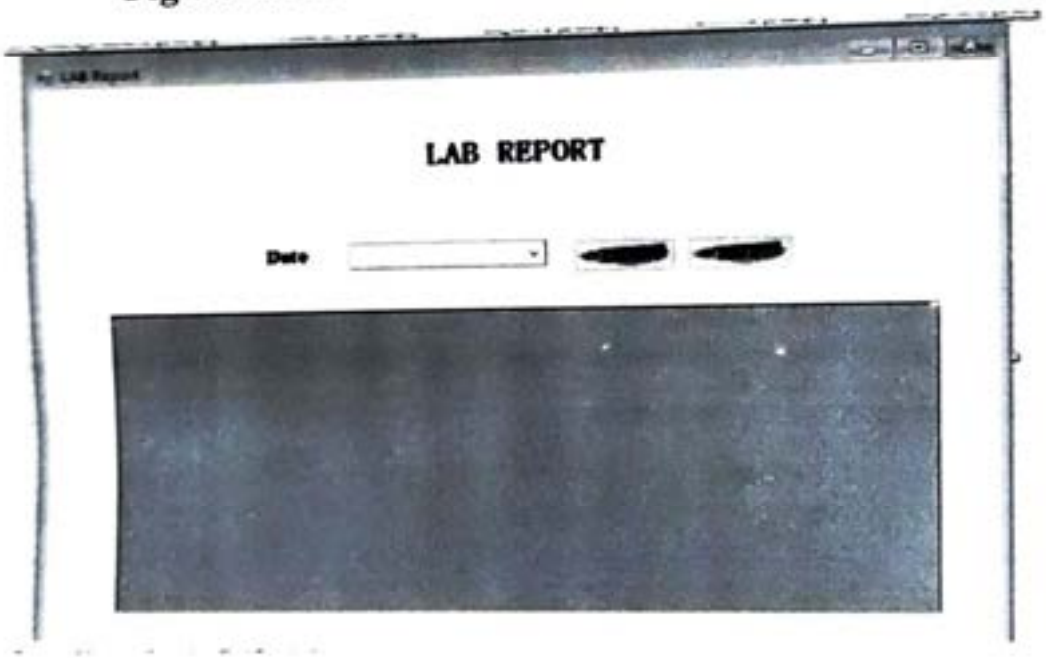

Fig 8.4: LAB REPORT

CHAPTER 9

CONCLUSION

The **"LAB ATTENDANCE MANAGEMENT SYSTEM"** has been developed to satisfy all proposed requirements. The system is highly scalable and user friendly. Almost all the system objectives have been met. The system has been tested under all criteria. The system minimizes the problem arising in the existing manual system and it eliminates the human errors to zero level.

The software executes successfully by fulfilling the objectives of the project. Further extensions to this system can be made required with minor modifications. The invention can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Apparatus of the invention can be implemented in a computer program product tangibly embodied in a machine-readable storage device for execution by a programmable processor; and method steps of the invention can be performed by a programmable processor executing a program of instructions to perform functions of the invention by operating on input data and generating output.

CHAPTER 10

REFERENCE

[1].Elias Awath, "**SYSTEM ANALYSIS AND DESIGN**",Tata Mc Graw Hill Publication, Sixth Edition,2003

[2].Richard Fairley,"**SOFTWARE ENGINEERING CONCEPTS**",Tata Mc Graw Hill Publication, Second Edition,1997

[3]. S.Ramachandran,"**COMPUTER AIDED DESIGN**", Air Walk Publication, Third Edition,2003

- **Distributed .NET Programming in VB .NET** by Tom Barnaby
- **Learning Visual Basic.NET Through Applications** by Clayton Crooks II
- **Professional VB.NET, 2nd Edition** by Fred Barwell, et al
- **Programming VB.NET: A Guide for Experienced Programmers** by Gary Cornell, Jonathan Morrison
- **The .NET Languages: A Quick Translation Guide** by Brian Bischof
- **Visual Basic .NET How to Program (2nd Edition)** by Harvey M. Deitel, Paul J. Deitel, Tem R. Nieto

RECYCLING OF SEWAGE WATER OF PAAVAI INSTITUTIONS FOR GARDENING AND AGRICULTURE

A PROJECT REPORT

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in partial fulfilment for the award of the degree of

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IN

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PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

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DECLARATION

We, **SRIANGALAPARAMESHWARI.S (16201044), MONISHA.D (16201026), ASHIK RAJ (16201011), PRASATH.R (16201032),** hereby declare that the project report titled **"RECYCLING OF SEWAGE WATER OF PAAVAI INSTITUTIONS FOR GARDENING AND AGRICULTURE"** done by us under the guidance of **Dr.K.GOPI,M.Sc.,Ph.D.,** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in **CHEMICAL ENGINEERING**. Certified further that, to the best of our knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

1.

2.

3.

DATE: 4.

PLACE: PACHAL **SIGNATURE OF THE CANDIDATES**

ABSTRACT

The waste water generated from the house hold activities contributes to the major part of the sewage. The domestic waste water is the main source of water pollution in India, especially in and around urban areas. The discharged water is in general either in black or grey colour. Generally domestic sewage does not contain any inorganic matter or organic compounds in highly toxic concentration. Grey water collected from PAAVAI treatment plant is designed to recycle and to use resulting water for agriculture. Primary treatment consist of screens (for removal of floating matter), grid chamber (for removal of inorganic suspended solids) and primary sedimentation tank (for removal residual settleable solids which are mostly organic) alone by the principle of simple gravity settling. However, presence of certain compounds such as metal stearate, oleate, and sulphates in higher concentration disturb the secondary treatments (aeration, ozonation and UV) of sewage. In biological treatment system (BOD), the organic material is metabolized by bacteria. Depending on the mode of disposal, the tertiary treatment is planned for killing pathogens and microorganisms. Generally secondary treatment followed by disinfection will meet the effluent standards for disposal into water bodies. When the treated sewage water is utilized for irrigation, the level of disinfection needs depend on the type of secondary treatment and type of crops with restricted or unrestricted public access.

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CHAPTER 1

1. Introduction

Pollutants in wastewater effluent from industrial manufacturers and normal households, and in landfill leachates. They can be found in ground water wells and surface waters. In all cases they have to be removed to protect our water resources or to achieve drinking water quality. Therefore, many processes have been proposed over the years and are currently being employed to destroy these toxins. various methods and treatments used for water and waste water treatment in order to remove the various constituents of the pollution cycle: solids, organic carbon, nutrients, inorganic salts and metals, pathogens.

Waste-water generally contains high levels of organic material, numerous pathogenic microorganisms, as well as nutrients and toxic compounds. The ultimate goal of waste-water management is the protection of the environment in a manner commensurate with public health and socio-economic concerns. In the earth's crust only 0.01% of total water exists as surface fresh water. Thus fresh water contaminated by inorganic and organic substances such as dissolved solids, metals, detergents, pesticides, Fertilizers, industrial toxic effluents, domestic & agricultural waste etc. At several places on earth there is scarcity of ground water. The quality of water in an aquatic environment depends on the physical, chemical & biological interactions of environment surrounding it.

a) Physical Characteristics:

- Temperature
- Turbidity
- Colour

b) Chemical Characteristics:

- PH
- Hardness
- Dissolved Solids
- Organic Characteristic

c) Biological Characteristics:

- Algae
- Bacteria
- Protozoan
- Viruses

d) Radiological Characteristics.

Pesticides present in nearby farms and chemical effluents given out by industries largely affect growth of micro-organisms. Degradation of organic matter in the presence of bacteria leads to depletion in level of oxygen. Large amount of calcium & magnesium present in water makes the water hard & there by destroying its portability & use for domestic purpose. Chemical oxygen demand (COD) is a measure of organic compounds & other oxidisable elements present in water.

This is directly related to aesthetic quality of water. The minerals and impurities are normally present in very small concentrations are measured either as parts per million (ppm) (how many parts of impurities in a million parts of water) or milligrams per liter (mg/l). The terms are equivalent at low concentrations and are used interchangeably in the water and wastewater. Some parameters are measured in parts per billion (ppb) or micrograms per liter (μg/l). These terms are also essentially equivalent at low concentrations.

1.1 Parameters Of natural water and wastewater:

Natural water can be divided into two categories: surface water, such as rivers and streams (Moorland surface drainage) torrents, natural lakes, reservoirs, ponds (lowland surface drainage) and subterranean water such as springs and ground water. The composition of natural water is determined by a sequence of physical chemical and bio-chemical processes which occur during different stages in hydrologic cycle. Atmospheric agents play an active role in these processes. The quality of natural water is greatly influenced by atmospheric conditions and seasonal variations in temperature.

1.2 Methods for Waste Water Treatment:

1.2.1 Physical method:

physical treatment process include gravity separation , phase change system such as Air steam stripping of volatile from liquid waste , adsorption, reverse osmosis, ion exchange , electro dialysis.

1.2.2 Chemical method:

Chemical methods usually aimed at transforming the hazardous waste into less hazardous substances using techniques such as PH neutralization, oxidation or reduction and precipitation.

1.2.3 Biological methods:

Biological treatment method used micro organisms to degrade organic pollutant in the waste stream.

1.3 Availability of Water and Uses:

Water is one of the most vital natural resources for all life on Earth. The availability and quality of water always have played an important part in determining not only where people can live, but also their quality of life. Major source for irrigation is groundwater. Water use can mean the amount of water used by a household or a country.

1.4 Uses of Water

Commercial water use includes fresh water for motels, hotels, restaurants, office buildings, other commercial facilities, and civilian and military institutions. Domestic water use is probably the most important daily use of water for most people.

Domestic use includes water that is used in the home every day, including water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens.

Industrial water use is a valuable resource to the nation's industries for such purposes as processing, cleaning, transportation, dilution, and cooling in manufacturing facilities.

Major water-using industries include steel, chemical, paper, and petroleum refining. Industries often reuse the same water over and over for more than one purpose.

Irrigation water use is water artificially applied to farm, orchard, pasture, and horticultural crops, as well as water used to irrigate pastures, for frost and freeze protection, chemical application, crop cooling, harvesting, and for the leaching of salts from the crop root zone.

1.5 Wastewater can come from:

- Human excreta (feces and urine) often mixed with used toilet paper or wipes; this is known as black water if it is collected with flush toilets.
- Washing water (personal, clothes, floors, dishes, cars, etc.), also known as grey water or sullage.

1.6 Wastewater Treatment Plants:

Today majority of wastewater treatment plants uses aerobic metabolism for the removal of organic matter. The popularly used aerobic processes are the activated sludge process, oxidation ditch, trickling filter, and aerated lagoons. Stabilization ponds use both the aerobic and anaerobic mechanisms. In the recent years, due to increase in power cost and subsequent increase in operation cost of aerobic processes, more attention is being paid for the use of anaerobic treatment systems for the treatment of wastewater including sewage. Recently the high anaerobic process such as Upflow Anaerobic Sludge Blanket (UASB) reactor is used for sewage treatment at many places.

Depending on the mode of disposal the tertiary treatment may be given for killing pathogens, nutrient removal, suspended solids removal, etc. Generally secondary treatment followed by disinfection will meet the effluent standards for disposal into water bodies. When the treated sewage is disposed off on land for irrigation, the level of disinfection needs will depend on the type of secondary treatment and type of crops with restricted or unrestricted public access.

The treatment and safe disposal of wastewater is necessary. This will facilitate protection of environment and environmental conservation, because the wastewater collected

from cities and towns must ultimately be returned to receiving water body or to the land or reused to fulfil certain needs. The sewage treatment plants constructed near the end of nineteenth century were designed to remove suspended matter alone by the principal of simple gravity settling. It soon became apparent that primary treatment alone was insufficient to protect the water quality of the receiving water body. This was mainly due to the presence of organic material, in colloidal and dissolved form, in the sewage after settling. Thus, in the beginning of twentieth century several treatment systems, called secondary treatment, were developed with the objective of organic matter removal. For this secondary treatment, biological methods are generally used. The aerobic biological treatment processes were popularly used as a secondary treatment, and these processes are still at the first choice.

In the second half of twentieth century, it became clear that the discharge of effluents from even the most efficient secondary treatment plant could lead to the deterioration of the quality of receiving water body. This could be attributed partly to the discharge of ammonia in the effluent. In the receiving water body this discharge exerts an oxygen demand for the biological oxidation of ammonia to nitrate, a process called nitrification. However, even when nitrification is carried out at the treatment plant itself, the discharge of effluent can still be detrimental to the water quality due to introduction of nitrogen in the form of nitrate and phosphorus as phosphate. The tolerance limits of nitrates for the water when used as raw water for public water supplies and bathing ghats is 50 mg/L as NO3. The availability of nitrogen and phosphorous tends to cause an excessive growth of aquatic life notably, autotrophic organisms such as algae, that can use carbon dioxide rather than organic material as a sources for cell synthesis. Thus, explosive development of biomass may occur when nitrogen and phosphorus are abundantly available. Although, this biomass may produce photosynthetic oxygen in the water during daytime, after sunset it will consume oxygen, so that the dissolved oxygen concentration will decrease and may reach to the levels that are too low to sustain the life of other (macro) organisms. This phenomenon of eutrophication has led to the development of tertiary treatment systems. In these, nitrogen and/or phosphorus are removed, along with solids and organic materials.

Once the minimum effluent quality has been specified, for maximum allowable concentrations of solids (both suspended and dissolved), organic matter, nutrients, and

pathogens, the objective of the treatment is to attain reliably the set standards. The role of design engineer is to develop a treatment scheme that will guarantee the technical feasibility of the scheme, taking into consideration other factors such as construction and maintenance costs, the availability of construction materials and equipment, as well as specialized skilled personals for operation and maintenance of the treatment plant.

Primary treatment consists of screens (for removal of floating matter), grit chamber (for removal of inorganic suspended solids) and primary sedimentation tank (for removal residual settleable solids which are mostly organic). Skimming tanks may be used for removal of oils; however, in conventional treatment plant no separate skimming tank is used and oil removal is achieved by collecting the scum in primary sedimentation tank. This primary treatment alone will not produce an effluent with an acceptable residual organic material concentration. Almost invariably biological methods are used in the treatment systems to effect secondary treatment for removal of organic material. In biological treatment systems, the organic material is metabolized by bacteria. Depending upon the requirement for the final effluent quality, tertiary treatment methods and/or pathogen removal may be included.

1.7 Sewage:

It indicates the liquid waste originating from the domestic uses of water. It includes sludge, discharge from toilets, urinals, wastewater generated from commercial establishments, institutions, industrial establishments and also the groundwater and storm water that may enter into the sewers. Its decomposition produces large quantities of malodorous gases, and it contains numerous pathogenic or disease producing bacteria, along with high concentration of organic matter and suspended solids.

1.8 Sewage Treatment Plant:

It is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems or land. It is combination of unit operations and unit processes developed to treat the sewage to desirable standards to suit effluent norms defined by regulating authority.

1.9 Sewer:

It is an underground conduit or drain through which sewage is carried to a point of discharge or disposal. There are three types of sewer systems that are commonly used for sewage collection. Separate sewers are those which carry the house hold and industrial wastes only. Storm water drains are those which carry rain water from the roofs and street surfaces. Combine sewers are those which carry both sewage and storm water together in the same conduit. House sewer (or drain) is used to discharge the sewage from a building to a street sewer. Lateral sewer is a sewer which collects sewage directly from the household buildings. Branch sewer or submain sewer is a sewer which receives sewage from a relatively small area. Main sewer or trunk sewer is a sewer that receives sewage from many tributary branches and sewers, serving as an outlet for a large territory. Depressed sewer is a section of sewer constructed lower than adjacent sections to pass beneath an obstacle or obstruction. It runs full under the force of gravity and at greater than atmospheric pressure. The sewage enters and leaves the depressed sewer at atmospheric pressure. Intercepting sewer is a sewer laid transversely to main sewer system to intercept the dry weather flow of sewage and additional surface and storm water as may be desirable. An intercepting sewer is usually a large sewer, flowing parallel to a natural drainage channel, into which a number of main or outfall sewers discharge. Outfall sewer receives entire sewage from the collection system and finally it is discharged to a common point. Relief sewer or overflow sewer is used to carry the flow in excess of the capacity of an existing sewer

1.10 Sewerage:

The term sewerage refers the infrastructure which includes device, equipment and appurtenances for the collection, transportation and pumping of sewage, but excluding works

for the treatment of sewage. Basically it is a water carriage system designed and constructed for collecting and carrying of sewage through sewers.

1.11 Sources of Sewage:

The wastewater generated from the household activities contributes to the major part of the sewage. The wastewater generated from recreational activities, public utilities, commercial complexes, and institutions is also discharged in to sewers. The wastewater discharged from small and medium scale industries situated within the municipal limits and discharging partially treated or untreated wastewater in to the sewers also contributes for municipal wastewater**.**

1.12 Sewage Discharge:

The quality of sewage and its characteristics show a marked range of hourly variation and hence peak, average and minimum discharge are important considerations. The process loadings in the sewage treatment are based on the daily average characteristics as determined from a 24 hours weighted composite samples. In the absence of any data an average quantity of 150 LPCD may be adopted for design. The hydraulic design load varies from component to component of the treatment plant with all appurtenances, conduits, channels etc., being designed for the maximum discharge, which may vary from 2.0 to 3.5 times the average discharge. Sedimentation tanks are designed on the basis of average discharge, while consideration of both maximum and minimum discharge is important in the design of screens and grit chambers. Secondary treatment is generally designed for average discharge, with sufficient safety margin to accommodate the peak discharge

1.13 Grey water:

Segregation of domestic sewage into black water and grey water components should be regarded as a significant outcome of new conceptual developments concerning waste as a resource. This basically involves a major change in the conventional end of pipe approach routinely adopted for residential communities, where all wastewater streams are mixed, transported in a sewer system, and treated jointly in a wastewater treatment plant. Generally, grey water is defined as urban wastewater without any input from toilets and so includes sources from baths, showers, hand basins, washing machines, dishwashers, and kitchen sinks.

Themost commonly described application for grey water reuse is toilet/urinal flushing, which can reduce water demand within dwelling by up to 30%. However, grey water has been considered for many other applications, including irrigation (as it often contains valuable nutrients) of lawns at cemeteries, golf courses, and college campuses; vehicle washing; fire protection; boiler feedwater; concrete production; and preservation of wetlands.

1.14 Characteristics and Flow:

1.14.1 Flow:

The amount of grey water produced is very different for buildings of different occupancy. At the household level, the amount produced is about 30% of the total water use. With reference to developed countries, literature indicates a volume of grey water in the range of 90–120 L/d per person. While, in low-income countries, the daily volume is lower with values in the range of 20–30 L/d per person. Generally, the amount of grey water produced at the household level is approximately equal to the volume of water required for toilet flushing. Instead, for other type of buildings such as offices, the amount of grey water produced is considerably less than the requirement for toilet and urinal flushing and is equal, respectively, to 27% and 60% of the total water use.

1.14.2 Composition:

The chemical content of grey water depends on the source of the water. Generally, grey water is divided into five categories as bathroom, laundry, kitchen, dishwasher, and mixed. The composition of grey water depends on several factors including sources and installations from where the water is drawn. For example, the quality and type of the water supply (groundwater well or piped water), the activities in the household (lifestyle, custom, and use of chemical products), installation from which grey water is drawn (kitchen sink, bathroom, hand basin, or laundry wash), geographical location, as well as demographics and level of occupancy. Based on the literature

It is possible to observe that kitchen grey water is due to detergents and cleaning agents (chemical characteristics); food particles, oils, fats, grease, and turbidity (physical characteristics); high biological oxygen demand (BOD) (biological characteristics); and

variable thermo tolerant coliform loads (microbiological characteristics). Laundry grey water contains sodium, phosphate, surfactants, ammonia, and nitrogen from soap powders and soiled clothes (chemical characteristics), high suspended solids, lint and turbidity, high BOD, and variable thermo tolerant coliform loads (microbiological characteristics). While bathroom grey water contains soap, shampoo, hair dyes, toothpaste and cleaning chemicals, high suspended solids, hair and turbidity, lower BOD values, and lower rate of thermotolerant coliforms. Further analysis indicates higher concentration of both organics and physical pollutants in the kitchen and the laundry grey waters with respect to bathroom and mixed grey waters.

All types of grey waters show good biodegradability in terms of COD (chemical oxygen demand):BOD5 ratio. Compared to the suggested COD:N:P ratio (N¼nitrogen; P¼phosphorous) of 100:20:1 for sewage wastewater, bathroom grey water is deficient in both nitrogen and phosphorus due to the exclusion of urine and faces. Similar to bathroom grey water, laundry grey water and mixed grey water are also deficient in nitrogen. In some cases, laundry grey water and mixed grey water are low in phosphorus due to the use of phosphorus-free detergents.

The most significant pollutants of grey water are powdered laundry detergents. These are often very alkaline and contain high salt concentrations and in many cases still contain phosphorous. Long-term garden reuse of laundry water containing high salts and phosphorous concentrations can lead to salts accumulations in the soil and stunting of plants with low-phosphorous tolerance. The massive use in households of chemical products such as detergents, soaps, shampoos, perfumes, preservatives, dyes, and cleaners generate xenobiotic organic compounds. While kitchen grey water contains lipids (fat and oils), tea, coffee, soluble starch, dairy products, and glucose, the wastewater produced from laundry will contain different types of detergents, bleaches, and perfumes and long-chained fatty acids originating from soap. showed how at least 900 different substances or groups of substances could be present in grey water and approximately 10% were categorized as priority pollutants.

The major risk associated with the presence of microorganisms in grey water is the risk of infection due to direct contact with the water during infiltration, and the application on/in the soil is the most critical moment. According to, four types of pathogens may be present in grey water: (i) viruses, (ii) bacteria, (iii) protozoa, and (iv) intestinal parasites. However, the microbial populations of fecal origin cause the largest health risk

1.15 Treatment Systems:

Technologies applied for grey water treatment include physical, chemical, and biological systems. The goal of pretreatments such as septic tanks, filter bags, screens, and filters is to reduce the amount of particles and oil and grease incoming to subsequent treatment. As to disinfection, it is used to meet the microbiological requirements in the water product.

Recent advances have highlighted the increasing role of micro pollutants potentially available in grey water. These compounds create environmental problems even at low concentrations, and they can accumulate in the environment. In terms of grey water characteristics, all types of water have good biodegradability. While the bathroom and the laundry grey water are deficient in nitrogen and phosphors, kitchen grey water has a balanced COD:N:P ratio.

CHAPTER 2

LITERATURE REVIWE

2.1 Enhanced treatment of grey water using electrocoagulation/ozonation.

Gelavizh Barzegar.et al. (2018), In this study, Electro coagulation (EC)/ozone process was applied for the treatment of grey water. The effects of several parameters were chemical oxygen demand (COD) and total organic compound (TOC) removals from grey water. Results showed that 85% of COD and 70% of TOC were removed during 60 min electrolysis time, pH=7.0, 47.4 mg/l ozone and 15mA/cm^2 current density. In the presence of UV irradiations, 95% of COD and 87% of TOC were eliminated. And from the experimental study approaches, ozone had a superior compared to other chemical oxidant (peroxidisulfate, peroxymonosulphate and hydrogen peroxide) in combination with EC process for grey water treatment. Current system is an efficient and executable process for the treatment and disinfection of grey water.

2.2 Elimination efficiency of organic UV filters during ozonation and UV/H_2O_2 treatment of drinking water and waste water effluent.

Changdong Seoet al. (2019), In this paper studied on UV filters with ozone and OH were determined by quantum chemical calculations and competition kinetic methods. UV filters were efficiently eliminated by ozone treatment requiring specific ozone doses of <0.5 mg/0_3 for 100% elimination. Elimination efficiency of the UV filters after exposure of the drinking water (DW) and waste water effluent (WW) to ozone for 15 min at pH 7.Results showed that elimination levels of UV filters of over 90% could be achieved under a UV influence of 750 mj/cm_2 in the DW matrix. For the WW matrix, a UV influence of 1500 mj/cm_2 was required to achieve the same elimination level. This experimental study approaches micro pollutant elimination during ozonation and UV/H_2O_2 treatment for indirect potable use of municipal waste water effluents.

2.3 Impact of organic matter from leachate discharged to waste water treatment plants on effluent quality and UV disinfection.

Stephanie C. Bolyard, et al, (2019), examine on his paper two spectroscopic techniques were used to detect leachate in waste water UV-VIS and fluorescence. UV measurement for all waste water samples were taken at 456nm, fluorescence analysis was carried out using a Nano log fluorescence spectrometer. Leachate waste water samples showed a higher dissolved organic nitrogen (DON) and dissolved organic carbon (DOC) concentration in the waste water treatment plants without leachate. The DOC/DON ratio was used as an indicator for the removal selectivity of treatment process. Results showed that these effects were observed by a decrease in UV_{254} transmittance and an increase in waste water apparent color, DOC and DON which can interfere with UV disinfection. The experiment work highlights the basics of these individual processes and a complete over view of the various applications to waste water treatment in the recent years.

2.4 Removal and reduction of selected organic micro pollutants in effluent sewage by the ozone based oxidation processes.

Haidong zhou et al. (2015), investigate on this paper As we know four typical organic micro pollutants in effluent sewage were subjected to the various treatment using three ozone - based oxidation processes.ie, Individual ozonation (O_3), Ultrasonic ozonation (US/O_3) and photo catalytic ozonation (PC/O_3). The increase on the supplied ozone doses would improve the performance of ozonation of the target compounds. I.e., clofibric acid (CFA), nonylphenol (NP), 17α-ethinyllestradiol (EEZ) and carbamazepine (CBZ).Results showed that Compared with individual ozone, the two combined processes enhanced considerably the removal rates, by 13.9% or above for CFA, 12.6% or above for NP, over 13.3% for EEZ, and no less than 14.8% for CBZ. This study was carried out the optimal removal of the target compounds was obtained at the ultrasonic power 240 W for the ultrasonic ozonation treatment. For the PC/O_3 combined process, the enhanced removal of the targets was mainly due to the larger amount of oxidizing species as the adsorption of the targets to the photo catalyst was far less. The US/O_3 combined process could achieve the best removal of the target micro pollutants.

2.5 Electro-ozonizers: A new approach for an old problem.

J.A. Lara-Ramos et al. (2020), Focused on this journal This work focus on the electrochemical production of ozone and its use in the degradation of pollutants contained in waste water. This treatment is also evaluated with ozone supplied by a conventional ozone generator. Results demonstrate that polymer exchange membrane (PEM) electrolyzers can produce efficient ozone, which is consumed in the degradation of pollutants, although other oxidative pathways develop simultaneously, being co-responsible of the high efficiencies obtained. The maximum production of ozone is $10gh^{-1}$, the required oxygen and the electric power consumed were 0.14 m^3h^{-1} and 1500 W. From this work, the average ozone production available to react with organic matter and the electrical efficiency in mineralization, show better performance with PEM electrolyzers than with the ozonator in similar operating conditions.

2.6 Micro pollutants in the waste water treatment plants (WWTPs): Occurrence and removal.

Liping Wang et al. (2019), Studied on this paper, In the study, the influent and effluent from eleven WWTPs in changzhou were collected and analyzed. At the same time, the abundance, size, color, and shape MPs in influent and effluent were investigated. Among these MPs, fibers were the main shape in waste water, followed by fragments, spheres and films. The color of MPs in waste water were various and 14 types of plastics were detected from waste water using attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR). This results showed that the six MPs with a large proportion of waste water were rayon, PET,PP, PE, PS and PE-PP, which were 41.79%, 27.60%, 15.52%, 6.10%,3.35% and 2.08% in the influent and 43.45%, 29.92%, 14.46%, 6.28%, 2.12% and 1.51% in the effluent. The purpose of this study was to study the contamination and removal efficiency of MPs for future monitoring and understanding of which as a way for MPs to enter the aquatic environment. The research results provided basic data for the research and supervision of MPs pollution in WWTPs.

2.7 Municipal waste stabilization in a reactor with an integrated active and passive aeration system.

Slawomir Kasinki et al, (2016), In this study, Active aeration is typical in mechanical-biological treatment (MBT) systems based on aerobic stabilization and bio drying. The reduction of organic matter calculated using this results of Lost of ignition (LOI) and total organic carbon (TOC) showed 40.51-46.62% organic matter loss at the top and 45.33-53.39% in the center of the reactor. At the end of process, moisture content, LOI and TOC at the top were 3.29%, 6.10% and 4.13% higher respectively than in the center. The aim of the present of this study was to analyze the effectiveness of aerobic stabilization of municipal waste in a large scale passively aerated reactor supplemented by two short active aeration modes. Experimental results showed that moisture content in the composing reactor might be controlled in some way by the regulation of the intensity of aeration

2.8 Design of a modified low cist treatment system for the recycling and reuse of laundry waste water.

Hisham EL-Dessouky et al. (2008), investigate on In this study, a low cost system was designed for the recycling and reuse of waste water from a laundry unit. A survey was made to the quality and quantity of waste water generated. Both, the waste water and treated water were compared with tap water. This results showed that the filtration process reduced the pH, turbidity, total hardness (TH) and total suspended solids (TSS) to acceptable limit and total dissolved solids (TDS) to some extent. On the other hand it had negligible effects on chemical oxygen demand (COD) and biological oxygen demand (BOD). The treated water was ranked as low grade water and was found to be suitable for use in the laundry unit for the first rinse only. From this study, reduce, reuse and recycle is a part of cleaner production that concentrates on pollution prevention at source rather than the end of pipe treatment. In other words, it is vitally important to treat water in order to save water as a precious source and protect the environment from pollution.

2.9 Waste water technology; Ozone Disinfection.

Dr. D. R. P. Rajarathnam et al. (2019), investigate on In this study, Disinfection is considered to be the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment. It is important that waste water be adequately treated prior to disinfection in order for any disinfectant to be effective. Ozone is produced when oxygen (0_2) molecules are dissociated by an energy source into oxygen atoms and subsequently collide with an oxygen molecule to form an unstable gas, Ozone (O_3), which is used to disinfect water. Most waste water treatment plants generate ozone by imposing a high voltage alternating current (6 to 20 kilovolts) across a dielectric discharge gap that contains an oxygen-bearing gas. Ozone is generated onsite because it is unstable and decomposes to elemental oxygen in a short amount of time after generation. The effectiveness of disinfection depends on the susceptibility of the target organisms.

CHAPTER 3

MATERIALS AND METHADOLOGY

3.1 Materials and chemicals:

3.1.1 Sewage Waste Water:

Effluent Was Collected From The Paavai Educational Institution Hostel Treatment Plant, It Was Taken About 1.5 L And Having Suspended Organic Compound, Settleble Organic Compounds, Plastic And Also It Contains Soap, Detergents.

3.1.2 Chemical composition:

Chemically the sewage consist of approximately 99% water and 1% of inorganic, organic matter in suspended and soluble forms .lignocellulose, cellulose, proteins, fats and various inorganic particulate matter exit in suspended state, whereas sugar ,fatty acids

3.1.3 Microbial composition:

The microbial pollution per milliliter of sewage may vary from a few laces to several millions. Various type of microorganisms, micro-fungi bacteria and protozoa, collectively called sewage fungus. In addition ,viruses and many.

The approximate composition oforganic carbon found in typical sewage waste water are carbohydrate protein (11-18%),free amino acid(8-10%),fatty acid(0.5-1.5%), dissolvedoganic acids (7-11%)

3.2 Chemicals used:

3.2.1 BOD test:

BOD measures the biodegradable organic carbon and it determine the organic content of wastewater, BOD measure the dissolved oxygen used microorganism.

The microorganisms they break down the organic matter at 20c over a 5 days period. Clean water has a bod value of less than 1mg/lit and wastewater has between 150-1000 mg/lit.

- Firstly, a high concentration of active bacteria is required.
- Secondly only the biodegradable organism is measured.
- Thirdly a particularly long period of time is necessary to obtain the results.
- Fourthly bod doesn't have stoichiometric validity after the soluble organic present in the solution have used.

Figure 1: BOD Incubator

Chemicals;

- Calcium chloride
- Potassium buffer solution
- Magnesium sulphate
- Ferric chloride
- Manganese sulphate
- Alkali iodide acide (NaOH+KI)
- Sulfuric acid
- Starch solution
- Sodium thiosulphate (burette solution)

3.2.2 COD test:

COD is the measure of oxygen needed to chemically oxidize in the organism in the water. Strong oxidizing agent used is potassium-di-chromate solution. instead of microorganism in cod and bod measures.

COD taking three hours to produce the results the temperature need to some inorganic compound will interface with the test different type of water has different translation between BOD and COD.

Figure 2: COD Digestion

Chemicals;

- Sulfuric acid
- Potassium dichromate
- Ferrous ammonium sulphate

3.2.3 BOD and COD removal:

- BOD- Biological oxygen demand.
- COD-Chemical oxygen demand.
- Lower values are better.
- COD is everything oxidized in wastewater including BOD, COD will be higher than BOD.
- TOC content will be unaffected by ozone treatment.

3.2.4 pH meter:

pH meter consists of a measuring glass electrode and represented colonel electrode and they are placed in a solution, circuit is completed. Glass electrode is with buffer solution at the dip and surrounded by sample solution. Potential developed between two solution of differing hydrogen ion concentration.

The pH of water is a measure of acidity or alkalinity. The pH is a logarithmic scale based on a measure of the free hydrogen ions in the water. The scale runs from 0 to 14, where 7 is considered neutral, 0 to 7 is acidic and 7 to 14 is alkaline. Because pH can be affected by dissolved minerals and chemicals, it is an important indicator of the change in water chemistry.

According to the U.S. Environmental Protection Agency, drinking water with a pH between 6.0 and 9.5 generally is considered satisfactory. Several public water supplies that use the Missouri, James or Red River as their source of water have to maintain the pH above 9 keep them in compliance with the Lead and Copper rule of the Safe Drinking Water Act, which details how to prevent leaching of these elements from piping systems.

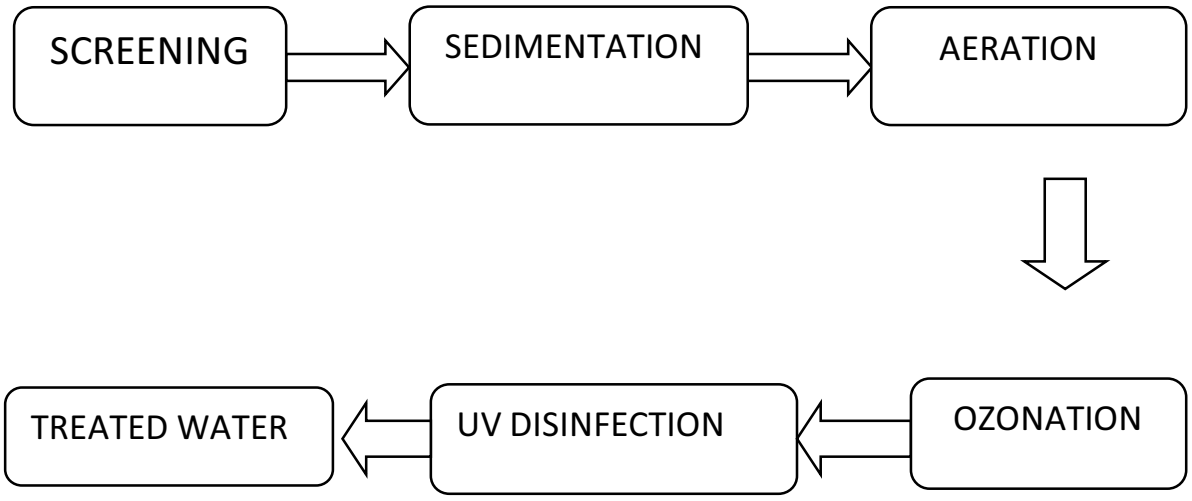
Figure 3: pH Meter

3.2.5 Turbidity:

Turbidity is based on the law of tyndall effect a beam of light passing through a turbid solution being tested scatters light, which in turns is collected at right angles by a photocell and indicated on a digital display. The amount of scattered light as proportional to the turbidity of the solution under test. Turbidity is a measure of suspended minerals, bacteria, plankton, and dissolved organic and inorganic substances. Turbidity often is associated with surface water sources. Treatment includes mixing with a substance such as alum that causes coagulation of the suspended materials, which then can be removed by sand filter filtration.

Figure 4: Turbidity

3.3 Flow diagram:



3.4 Collection of wastewater:

Sewage is a complex of chemicals with many distinctive chemical characteristics these include high concentration of ammonium, nitrate, nitrogen, phosphorus, high conductivity (due to high dissolved solids),high alkalinity .Sewage may be classified mainly into two types, namely, domestic and industrial.

A system of sewer pipe (sewer) collects sewage and it takes it for treatment or disposal the system of sewer is called sewerage system. Sewage may be collected from homes by pipes to waste water disposal tank.

3.5 Screening:

Screening is the first unit operation used at .screening removes objects such as rags, paper, plastic and metals to prevent damage and clogging of downstream equipment, piping.

The efficiency of the screening operation depends of the spacing between screen bars.

- Fine screening, for a spacing under 10mm
- Medium screening, spacing of 10 to 40mm

- Coarse screening, for spacing of over 40 mm
- Coarse screens remove rags, sticks, large solids and other debris ranging from 0.25to 6 inches.

3.6 Sedimentation:

Sedimentation tank is a modern system of WWTP. A sedimentation tank allows suspended particles to settle out of water as it slowly flow through the tank, thereby providing some degree of purification .a layer of accumulated slides called sludge, forms at the bottom of the tank and is periodically removed in water treatment.

In WWT sedimentation might used to reduce the concentration of particle in suspension when sedimentation is applied after coagulation, it's the purpose is usually to reduce the concentration of solids in suspension. the particle that settle out from the suspension become sediment under the effect of gravity.

Sedimentation is accomplished by decreasing the velocity of the water to a point which the particle will no longer remain in suspension. The size of particle to be removed have a significant effect on the operation of the sedimentation tank.

3.7 Aeration:

Aeration brings water and air in close contact in order to remove dissolved gases and oxidizes dissolved metal such as iron, hydrogen sulfide, and volatile organic chemicals. The efficiency of aeration depends upon the amount of surface contact between air and water. Oxygen is added to water through aeration and can increase the palpability of water by removing the flat tastes. The amount of oxygen the water can hold depends primarily on the temperature of the water.

3.8 Chemicals removed or oxidized by aeration:.

- Volatile chemicals, such as benzene, trichloroethylene, dichloroethylene
- Ammonia
- Chlorine
- Carbon dioxide
- Hydrogen sulfide

- Methane
- Iron and manganese

Aeration provides oxygen to bacteria for treating and stabilizing the waste water. The supplied oxygen is utilized by bacteria in the waste water to break down the organic matter containing carbon to form carbon dioxide and water. Without the presence of sufficient oxygen, bacteria are not able to biodegrade the incoming organic matter in a reasonable time under septic condition some of the biological processes convert hydrogen and sulphur to form hydrogen sulphide and transform carbon to methane, absence of oxygen is a very slow biological process.

3.9 Aerator:

An air diffuser or membrane diffuser is an aerator device typically in the shape of a disc, tube or plate, which is used to transfer air and with that oxygen into sewage. Oxygen is required by microorganism/bacteria residents in the water to break down the pollutants.

3.10 Ozonation:

Ozonation is a WWT based on the infusion of ozone into water. ozone is a gas composed of three oxygen atoms (O_3),which is one of the most powerful oxidents. Ozonation is a type of advanced oxidation process, involving the production of very reactive oxygen species able to attack a wide of organic compounds and all microorganism. the treatment of water with ozone has wide range of application, as it is efficient for disinfection as well as for the degradation of organic and inorganic pollutants. Ozone is produced with the use of energy by subjecting oxygen (O_2) to high electric voltage.

Advantage of ozonations, it react rapidly with bacteria, viruses and protozoa over a wide range pH range. there is no chemical are added to water also efficient for organic degradation and inorganic removal. Ozonation remove color, taste and odour.

3.11 Ozone generator:

An ozone generator is a device that sucks in air from one side, passes through an area where electrical discharge turn the Co_2 into O_3. The device can be turned on, after a certain time the device turned of, it depends upon the level of odor and size.

3.12 Ultraviolet Disinfection:

UV disinfection is a physical process that instantaneously neutralizes microorganism as they pass by ultraviolet lamps submerged in the effluent. The process adds nothing to the water but UV light, and therefore, has no impact on the chemical composition .UV is an effective disinfectant for chlorine-resistant protozoa like crytosporidiumand giardia. An UV disinfection system transfers electromagnetic energy from a mercury or clamp to microorganism genetic material . Advantage of UV disinfection is effective at inactivating most viruses, spores, crysts. There is no residual effect that can be harm full to human or aquatic life and also having shorter contact time APX 20-30 sec

3.13 UV disinfection system:

The main components of UV disinfection system are mercury arc lamps ,a reactor, and ballasts. The source of uv radiation is either the low-pressure or medium pressure mercury arc lamp with low high intensities. the optimum wavelength to effectively inactive microorganisms in the range of 250-270nm. The intensity of the radiation emitted by the lamp dissipates as the distance from the lamp increases .

3.14 Interpreting a Mineral Analysis:

3.14.1 Alkalinity:

Alkalinity is a measure of the capacity of water to neutralize acids. The predominant chemicals present in natural waters are carbonates, bicarbonates and hydroxides. The bicarbonate ion is usually prevalent. However, the ratio of these ions is a function of pH, mineral composition, temperature and ionic strength. Water may have a low alkalinity rating but a relatively high pH or vice versa, so alkalinity alone is not of major importance as a measure of water quality.

Alkalinity is not considered detrimental to humans but generally is associated with high pH values, hardness and excessive dissolved solids. High-alkalinity waters also may

have a distinctly flat, unpleasant taste. Treatment is an ion exchange via the addition of a tank media or reverse osmosis.

3.14.2 Chloride:

High concentrations of chloride ions can cause water to have an objectionable salty taste and corrode hot-water plumbing systems. High chloride waters have a laxative effect for some people. An upper limit of 250 mg/l has been set for chloride ions, although noticing the taste at this level is difficult, and even higher concentrations do not appear to cause adverse health effects. An increase in the normal chloride content of water may indicate possible pollution from human sewage, animal manure or industrial wastes.

3.14.3 Color:

Color may indicate dissolved organic material, inadequate treatment and high disinfectant demand, and may indicate the potential for the production of excessive amounts of disinfectant byproducts. Inorganic contaminants, such as metals, are also common causes of color. In general, the point of consumer complaint is variable, ranging from 5 to 30 color units, although most people find color objectionable in excess of 10 color units. Other contaminants that may be related to change in water color include aluminum, copper, foaming agents, iron, manganese and total dissolved solids. Treatment is reverse osmosis.

3.14.4 Total Dissolved Solids (TDS):

High concentrations of TDS may affect taste adversely and deteriorate plumbing and appliances. The EPA recommends that water containing more than 500 mg/l of dissolved solids not be used if other less mineralized supplies are available. However, water containing more than 500 mg/l of TDS is not dangerous to drink.

Exclusive of most treated public water supplies, the Missouri River, a few freshwater lakes and scattered wells, very few water supplies in North Dakota contain less than the recommended 500mg/L concentration of total dissolved solids. Many households in the state use drinking water supplies with concentrations up to 2,000 mg/l and greater. Treatment for household use is reverse osmosis.

3.14.5 Total Hardness:

Hardness is the property that makes water form an insoluble curd with soap and primarily is due to the presence of calcium and magnesium. Very hard waters have no known adverse health effects and may be more palatable than soft waters. Hard water is primarily of concern because it requires more soap for effective cleaning; forms scum and curd; causes yellowing of fabrics; toughens vegetables cooked in the water; and forms scale in boilers, water heaters, pipes and cooking utensils.

The hardness of high-quality water should not exceed 270 mg/l (15.5 grains per gallon) measured as calcium carbonate. Water softer than 30 to 50 mg/l may be corrosive to piping, depending on pH, alkalinity and dissolved oxygen. Water softeners will correct hard water of more than 270 mg/l.

CHAPTER 4

EXPERIMENTAL SETUP

4.1 Collection of raw waste water:

Raw waste water was collected from college waste water treatment plant. It having grey colour and it contains solid particles of biological and plastic elements and also dissolved particles.

Collection point : Paavai institution, Paavai Nagar ,NH-44 Pachal Nmakkal 637018 Waste water treatment plant.

Figure 5: Raw Water

4.2 Screening of collected raw water:

Collected waste water was passed through 6mm (0.25inches)of coarse screens remove large solids, rags, and debris from waste water.

4.3 Sedimentation:

Screened waste water was sediment under sedimentation. Apparatus by the influences of Gravity separation. Screened waste water was taken in a sedimentation apparatus after 48 hours particles will be settled down at the bottom portion, it will be removed and remaining waste water trasfered to another tank containing aeration motor.

Type1: Sedimentation is characterized by particles that settle discretely at a constant settling velocity, or by the deposition of Iron-Rich minerals to streamlines down to the point source. They settle as individual particles and do not flocculate or stick to each other during settling. Example: sand and grit material.

Type 2: It is characterized by particles that flocculate during sedimentation and because of this their size is constantly changing and therefore their settling velocity is changing. Example: alum or iron coagulation.

Type 3: Sedimentation is also known as zone sedimentation. In this process the particles are at a high concentration (greater than 1000 mg/L) such that the particles tend to settle as a mass and a distinct clear zone and sludge zone are present. Zone settling occurs in lime-softening, sedimentation, active sludge sedimentation and sludge thickeners

Figure 6: Sedimentation

4.4 Aeration:

Aeration motor consist of heavy-duty gearbox, driven by a top mounted electrical motor, it was plugged in to a 230V AC supply .The mounting plate was dipped in to the sediment water. Aeration brings the water and air in contact . Air supplied continuously to the waste water at a time of 120 minutes. Air bubbles was be formed showing in the figure 7.

Wastewater aeration is the process of adding air to assist the aerobic microorganisms in the consumption of pollutants. Wastewater aeration is a vital part of most every biological treatment system. A well designed and operated wastewater aeration system will accomplish two main job,

- Adds air to the wastewater thus increasing the dissolved oxygen (DO) levels
- Mixes the wastewater.

Wastewater aeration is typically used during the secondary treatment process. This process is most often an activated sludge process. Aeration in an activated sludge process is accomplished by pumping air into the tank or lagoon. Proper aeration promotes the growth of microorganisms or microbes in the wastewater. The microbes feed on the organic pollutants and form flocs which can easily settle out. The flocs are allowed to settle out in a separate settling tank or lagoon. The flocs of bacteria that settle and accumulate on the bottom of the tank or lagoon form activated sludge. The activated sludge can then be recirculate back to the aeration basin or lagoon to increase the rate of consumption of pollutants.

Wastewater aeration is also used in tanks and lagoons used for storage. Examples of these storage tanks and lagoons would be ones used as sludge holding and flow equalization. In these portions of a wastewater treatment system (tank or lagoon) it is important to maintain the living microorganisms. If the microorganisms begin to die, the wastewater will become septic and odor will start to be an issue.

Wastewater aeration is the process of adding air into wastewater to allow aerobic bio-degradation of the pollutant components. It is an integral part of most biological wastewater treatment systems. Unlike chemical treatment which uses chemicals to react and stabilize

contaminants in the wastewater stream, biological treatment uses microorganisms that occur naturally in wastewater to degrade wastewater contaminants.

Figure 7: Aeration

Aeration provides oxygen to bacteria for treating and stabilizing the wastewater. Oxygen is needed by the bacteria to allow biodegradation to occur. The supplied oxygen is utilised by bacteria in the wastewater to break down the organic matter containing carbon to form carbon dioxide and water. Without the presence of sufficient oxygen, bacteria are not able to biodegrade the incoming organic matter in a reasonable time. In the absence of dissolved oxygen, degradation must occur under septic conditions which are slow, odorous, and yield incomplete conversions of pollutants. Under septic conditions, some of the biological process convert hydrogen and sulphur to form hydrogen sulphide and transform carbon into methane. Other carbon will be converted to organic acids that create low pH conditions in the basin and make the water more difficult to treat and promote odour formation. Bio-degradation of organic matter in the absence of oxygen is a very slow biological process.

4.5 Ozonation:

Aerated water was taken in a vessel and ozonation motor fixed on it. Electrically driver gearbox will be connected to a230V Ac supply and the ozone carrying pipes dipped on the waste water ,ozone is generated in the electrical part and it transferred in to waste water. Air bubbles will be formed shown in figure 8. Ozonation motor having a timer system in this process 125 minutes of continuous supplying of ozonation is done.

Figure 8: Ozonation

- A Welsbach T-816 Ozone Generator was used to ozonate the samples.
- Dry oxygen was used as the supply gas for the generator.
- A constant flow rate of 1.0 liter of gas per minute at a concentration of 0.040 grams of ozone per liter was administered through a fritted glass diffuser to 0.35 liter samples in gas washing bottles for 30 minutes.
- The amount of ozone consumed was measured to determine the efficiency of ozone in treating each of the streams. The amount of ozone throughput was the product of ozone generator output, gas flow rate and treatment time.
- ozone is a powerful oxidant agent for water and wastewater
- Once dissolved in water , ozone reacts with a greater number of organic compounds in two different ways;

- By direct oxidation as molecular ozone,
- By indirect oxidation through formation of secondary oxidants like hydroxyl radicals.

- The conventional fine bubble contactor is the most widely ozone generator used because of the high ozone transfer efficiency (90%) and high performance.

4.5 1 Why ozone:

- Powerful disinfectant
- No residues (compare to chlorine)
- Stronger oxidant (compared chlorine/UV)
- Three ozone plants in southern Nevada
    - AMS 600 MGD drinking water
    - River Mountains 300 MGD drinking water
    - Big bend (Laughlin) 20 MGD drinking water
    - Ozone proven technology for disinfection & contaminant removal

4.5.2 O3/UV:

- According to rein (2001) conventional ozonation of organic compounds does not completely oxidize organics to CO_2 and H_2O in many cases.
- Remaining intermediate products in some solution after oxidation may be toxic as or even more toxic than initial compound and UV radiation could complete the oxidation reaction by supplement the reaction with in.
- O_3/UV is the most effective method of treating sewage water comparing with oxidation by UV or ozonation alone.
- O_3/UV treatment is recorded to be more effective compared to ozone alone , in terms of COD removal.

4.5.3 Algae removal:

- Ozonation of a water contaminated with algae oxides and floats the algae to the top of the reservoir.
- The ozone will oxidize the metabolic by-products of the algae and remove the undesirable odour and taste.

4.6 Ultraviolet disinfection Method:

The waste water was passed through the UV chamber constructed with stainless steel and plastic coating .UV lamps placed in the chamber ,electrically controller is plugged in to a 230V Ac supply. Waste water slowly passed through the chamber and outlet water will be collected us treated water.

Figure 9; UV Disinfection

Mold growth inside the house can affect the indoor air quality. If you can install UV air purification unit in your air conditioner duct then the quality of air can be improved. The UV-C light, which is in the 280 to 100 nm range, is used for air purification. This UV light can kill mold, mildew, germs, viruses, and bacteria that float in the air. You can use an air purifier that has the UV-C light technology. In this type of air filter, air passes through a HEPA filter. Then it passes through a small chamber and gets exposed to the UV-C light. Sometimes, the air goes through another filter before getting inside the room. You should use 36-watt bulbs for this purpose. UV lamps are used for killing bugs in the house as well. It is used in the modern bug zappers and has proved to be very effective in killing bugs. The UV-A light, in the range 380 to 315 nm, attracts many bugs and insects like houseflies, wasps, mosquitoes, etc. Unlike the humans, these insects can actually see the ultraviolet light. When the bug zapper is on, the insects get attracted to UV light and go towards the mesh.

4.7 Wastewater Treatment Process:

- It is estimated that every year 1.8 million people die due to suffering from waterborne diseases. A large part of these deaths can be indirectly attributed to improper sanitation.
- Wastewater treatment is an important initiative which has to be taken more seriously for the betterment of the society and our future. Wastewater treatment is a process, wherein the contaminants are removed from wastewater as well as household sewage, to produce waste stream or solid waste suitable for discharge or reuse.

4.8 Need of STP:

- To clean effluent and recycle it for further use.
- To reduce the usage of fresh/potable water in Industries.
- To cut expenditure on water procurement.
- To meet the Standards for emission or discharge of environmental pollutants from various Industries set by the Government and avoid hefty penalties.
- To safeguard environment against pollution and contribute in sustainable development.

4.9 Treatment Levels & Mechanisms of STP:

- Preliminary
- Primary
- Secondary
- Tertiary (or advanced)

4.9.1 Preliminary Treatment level Purpose:

- Physical separation of big sized impurities like cloth, plastics, wood logs, paper, etc.
- Common physical unit operations at Preliminary level are:

Screening:

A screen with openings of uniform size is used to remove¬ large solids such as plastics, cloth etc. Generally maximum 10mm is used.

Sedimentation:

Physical water treatment process is using gravity to remove suspended solids from water.

4.9.2 Primary Treatment Level Purpose:

- Removal of floating and settable materials such as suspended solids and organic matter
- Both physical and chemical methods are used in this treatment level.
- Chemical unit processes are always used with physical operations and may also be used with biological treatment processes.

4.9.3 Secondary Treatment Level Methods:

Biological and chemical processes are involved in this level.

Biological unit process:

To remove or reduce the concentration of organic and inorganic compounds. Biological treatment process can take many forms but all are based around microorganisms, mainly bacteria. Aerobic Processes Aerobic treatment processes take place in the presence of air (oxygen).

Utilizes those microorganisms (aerobes), which use molecular/free oxygen to assimilate organic impurities i.e. convert them in to carbon dioxide, water and biomass. Anaerobic Processes the anaerobic treatment processes take place in the absence of air (oxygen).

Utilizes microorganisms (anaerobes) which do not require air (molecular/free oxygen) to assimilate organic impurities.

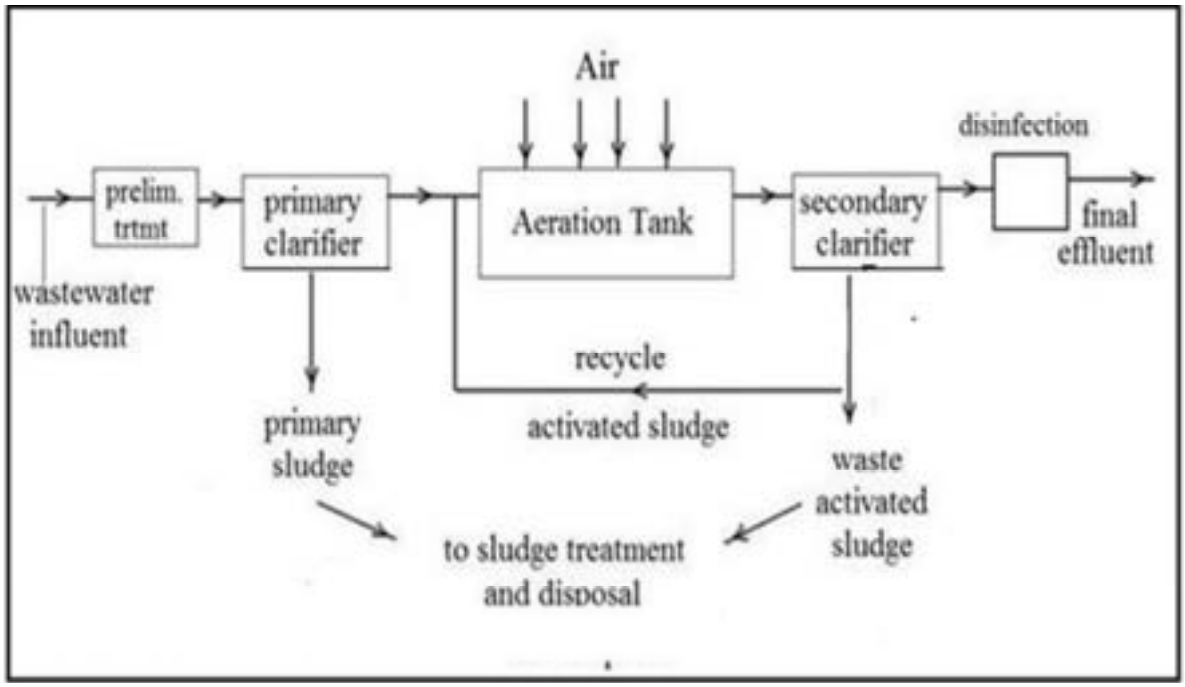
4.9.4 Tertiary / Advanced Treatment Purpose:

Final cleaning process that improves wastewater quality before it is reused, recycled or discharged to the environment.

Removes remaining inorganic compounds, and substances, such as the nitrogen and phosphorus. Bacteria, viruses and parasites, which are harmful to public health, are also removed at this stage.

Alum: Used to help remove additional phosphorus particles and group the remaining solids together for easy removal in the filters. Chlorine contact tank disinfects the tertiary treated wastewater by removing microorganisms in treated wastewater including bacteria, viruses and parasites. Remaining chlorine is removed by adding sodium bisulphate just before it's discharged.

Flow chart for STP:



CHAPTER 5

DESIGN CALCULATION

5.1 Design calculation for ozone generator:

Ozone capacity = flow rate [m3/hr] × ozone dose [gm/m3]

$$\text{Flow rate} = \frac{\text{peak STP capacity per day (m3)}}{\text{average operating hours (hr)}}$$

$$\text{Flow rate} = \frac{200\ (\text{m3/day})}{10\ (\text{hours of operation})}$$

= 20m3/hr.

Ozone dose:

Ozone dose is decided on the basis of two major factors.

A. Characteristics of treated waste water
    - Microbiological load
    - COD
    - BOD
    - Total organic carbons
    - Odor
    - Color
    - pH
    - Temperature
B. Ozone implementation technique
    - Required dissolved ozone
    - Ozone concentration
    - Ozone injection pressure
    - Ozone diffusion technique
    - Ozone dissolution efficiency [in %]
    - Oxygen purity [in %]
    - Retention time

Note: As per design standard applied ozone dose is 3.0 to 6.0 ppm (gm/m3)

Ozonator capacity = flow rate × ozone dose (gm/m3) ppm

= 20 m3/hr× 4.0 gm/m3

= 80 gm/hr

1. Applied ozone dose : 4.0 ppm
2. Ozonator capacity : 40gm/hr
3. Ozonator model no : OG/HC-50
4. System model no : IOS/WW-50S

5.2 Material balance:

Material balance for 1 hr production at 5000 litters feed of water.

Step 1 - Inlet wastewater into aeration tank.

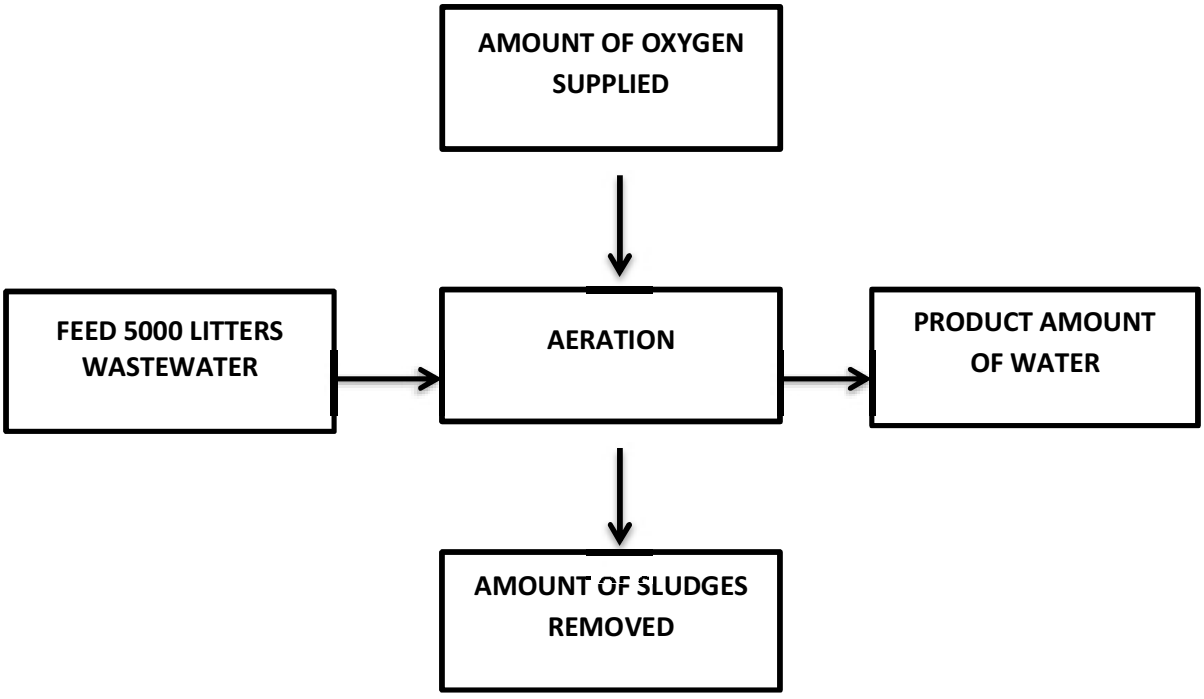


Figure 9; mass balance over the aeration

Water in feed = 5000×0.2

= 1000 lit

Air in feed = 5000×0.8

= 4000 lit

While in filtering the amount of sludge removed is more than that of the air,

Therefore

From the design of aeration tank, it is said that about 2% of sludges will be removed from a solution containing 20% sludges.

Therefore if the product contains 2% sludges apart from that 98% will be water.

Weight of water in product,

$0.98X = 4000$

$X = 4000 \div 0.98$

$X = 4081.63$ lit

Difference in the weight of water in product and feed will give the water content in product.

Weight of sludge in product = (weight solid in product – weight of solid in feed)

= 4081.63 – 4000

= 81.63 lit

Weight of water removed (y) = (weight of water in feed – weight of water)

= 1000 – 81.63

= 918.37 lit

Percent of oxygen removed = $(918.37 \div 1000) \times 100$

= 91.8%

Input (5000 lit) = waters (4081.63 lit) + oxygen removal (918.37 lit)

Step 2 – Ozonation

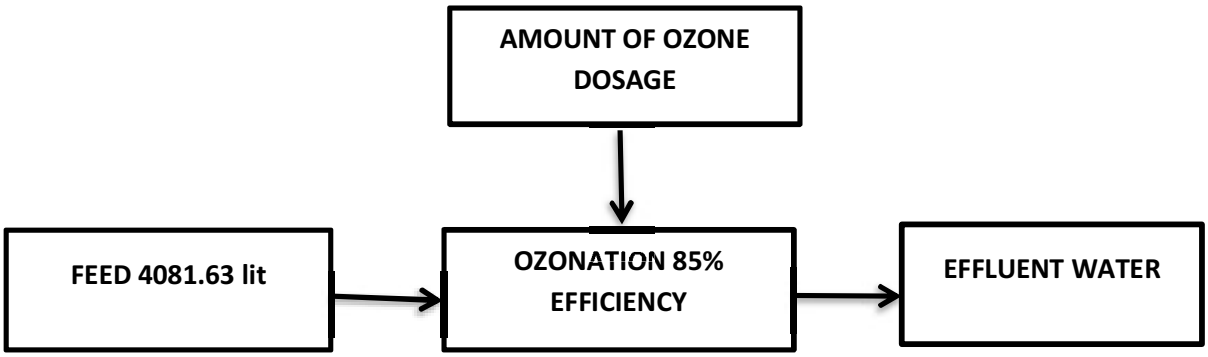


Figure 10; mass balance over ozonation

Overall material balance for Ozonation process,

Feed water = amount of ozone dosage supplied + effluent water

4081.63 lit = X + Y

Material balance for ozone supplied,

Ozone in water = amount of ozone dosage supplied + effluent water

Ozonation working under 85% Efficiency,

Effluent water (Y) = 4081.63 × 0.85

Y = 3469.38 lit

Amount of ozone dosage supplied (X) = 4081.63 × 0.15

X = 612.24 lit

Input(4081.63 lit) = effluent water (3469.38 lit) + amount of ozone dosage supplied (612.24 lit)

Product efficiency,

For 5000 lit feed of effluent water,

Process yield of effluent = $4081.63/5000 \times 100$

= 81.63%

Efficiency of effluent = 81.63%

CHAPTER 6

COST ESTIMATION

6.1 Equipment Cost:

Table 6.1 Equipment Cost Estimation

S.NO	Name Of The Equipment	Cost In Dollar
1	Mechanical Fine Screen	$ 3,500
2	Sedimentation Tank (40,000 L Capacity)	$ 2,400
3	Maglev Turbo Blower	$ 6,800
4	Ozone water Treatment Plant	$ 1,3000
5	UV Disinfection Chamber System	$ 16,000
6	Zincalume Bolted Storage Tank (35,000 L Capacity)	$ 15,000
7	Aeration Tank (35,000 L Capacity)	$ 11,000
Total		$ 67,700

6.2 Direct cost:

6.2.1 Instrumentation and Control

20% of the purchased equipment = 0.20×67,700

= 13,540 $

6.2.2 Piping

30% of the purchased equipment = 0.30×67,700

= 20,310 $

6.2.3 Building, Process and Auxiliary

40% of the purchased equipment = 0.40×67,700

= 27,080 $

6.2.4 Service facilities and Yard improvement

50% of the purchased equipment = 0.50×67,700

= 33,850 $

6.2.5 Land

5% of the purchased equipment = 0.05×67,700

= 3,385 $

6.2.6 Construction, Expense and contract

25% of the purchased equipment = 0.25×67,700

= 16,925 $

Direct cost = 13,540+20,310+27,080+33,850+3,385+16,925

= 1,15,090 $

Total direct cost=1,15,090 $

6.3 Indirect Cost:

Water connection = 5,500 $

Electricity bill = 15,000 $

Utilities expense = 2,200 $

Miscellaneous cost = 4,000 $

Total Indirect cost =26,700$

6.3.2 Fixed Capital Investment

Fixed capital investment = Direct cost + Indirect cost

= 1,15,090 + 26,700

= 1,41,790 $

6.3.3 Working capital cost

20% of the total capital investment = 0.20×1,41,790

= 28,358$

6.3.4 Total capital cost

Total capital cost = Fixed capital investment + working cost

= 1,41,090 + 28,358

= 1,69,440 $

6.4 Total product cost:

Total essential Treated Water produced = 1250 L/hr

= 1250×24

= 30,000 L /day

Cost of essential Treated Water produced = 18,350$ /day

6.4.1 Operating labor

5% of the total product cost = 0.05×18,350

= 917.5$

6.4.2 Maintenance and Repair

6% of the total product cost = 0.06×18,350

= 1,101 $

6.4.3 Laboratory charge

10% of the total product cost = 0.1×18,350

= 1,835 $

6.4.4 Depreciation

1% of the fixed capital investment = 0.01×1,41,790

= 1,417.9 $

6.4.5 Local taxes

2% of the fixed capital investment = 0.02×1,41,790

= 2,835.5 $

6.4.6 Insurance

1% of the fixed capital investment = 0.01×1,41,790

= 1,417.9 $

6.4.7 Plant over head cost

7% of the total product cost = 0.07×18,350

= 1,284.5 $

Total cost of the production per year = 917.5+1,101+1,835+1,417.9+2,835+1,417.9+1,284.5

= 10,808.8$

Total cost of production per year=10,808.8 $

6.5 Gross Earning:

Gross earning = Total income – Total production cost

= 18,350 – 10,808.5

= 7,541.5$

6.6 Payback period:

Playback period = Total capital cost/ gross earning

= 16,944/7,541.5

= 2.2 years

Table 6.2 Total cost estimation

Fixed capital cost	**1,41,790 $**
Direct cost	**1,15,090 $**
Total income	**7541 $**
Cost of product	**18,350 $**
Taxes	**2,835.5 $**
Total production cost	**10,88.8 $**

CHAPTER 7

RESULTS AND DISCUSSION

Parameters analysis on Domestic sewage water before and after treatment:

Thus the overall output is sucessed. Comparing to the sand filtration, we use ozone based oxidation process which takes minimal time than the existing process. The BOD and COD level are greatly reduced. Its given in the below result chart.

Table 7.1 Domestic wastewater analysis report

S.No	Test parameters	Before treatment	After treatment	Unit
1.	pH @ 25℃	7.96	7.52	-
2.	BOD	995	124	mg/lit
3.	Total dissolved solids (TDS)	9200	4350	mg/lit
4.	Total alkalinity as CaCO3	8900	1220	mg/lit
5.	Total hardness as CaCO3	13600	1350	mg/lit
6.	COD	2666.4	680	mg/lit
7.	Chlorine as –CI2	6.82	4.17	mg/lit
8.	Total Suspended Solid (TSS)	13000	550	mg/lit
9.	Ammonia as NH4	6.25	2.50	mg/lit
10.	Dissolved oxygen (DO)	0.94	1.26	mg/lit
11.	Turbidity	270	23	mg/lit

REFERENCES

1. Dean J. G., F. L. Basqui and Lanouette, 1972, Removing heavy metals from wastewater Env. Sci. Tech. 6:518
2. Huang C. P. 1977, Removal of heavy metals from industrial effluents J. Env . Eng. Division, ASCE 118 (EE6): 923-947.
3. Loomba, K. and G. S. Pandey 1993, Selective removal of some toxic metals ions (Hg(II), pb (II) and Zn(II)) by reduction using steel plants granulated slag. Indian J. Env., Health A:20:105-112.
4. Shrivastava, A.K., A Review on copper pollution and its removal from water bodies by pollution control Technologies, IJEP 29(6): 552-560, 2009.
5. Journal of environmental Management, vol. 88, issue 3, August 2008, pp. 437-447.
6. Industrial wastewater reuses potential – internet (web)
7. Waste Management Strategies for industries.
8. U.S. Environmental protection Agency, Design criteria for Mechanical, Electric and Fluid system and Washington, D. C.,1974.
9. Raj kumar Agrawal and Piyush Kant Pandey, Productive recycling of basic oxygen furnace sludge in integrated steel plant. Journal of scientific and industrial Research, vol. 64, sept. 2005, pp. 702-706.
10. B. Das, S. Prakash, P.S.R. Reddy, VN Mishra, An overview of utilization of slag and sludge from steel industries, Resources, Conservation and Recycling Vol. 50, Issue1, March 2007, pp. 40-57.
11. Richard D. Hook, Steel Mill Sludge Recovery, Journal. Water pollution control Federation, vol.33, No. 10 (Oct. 1961) pp.1.
12. P. K. Bhunia, M. K. Stenstrom, optimal design and operation of wastewater treatment plant, 1986. [20] Ulf Jeppson, Modeling aspects of wastewater treatment process,
13. M. Drolka et al ., model and wastewater treatment, chem.. Biochem Eng. Q.15 (2) pp. 71-74 (2001) [22] JPN Rai et al ., mathematical model for phytoremediation of pulp and paper industries wastewater, JSIR, 64, 2005,PP 717-721.
14. A. O. Ibeje, B. C. Okoro, mathematical modeling of cassava wastewater treatment using anaerobic Baffled Reactor, AJER, 2(5).2013,pp. 128-134.

15. Alqahtani, R., Nelson, M. I. & Worthy, A. L., A mathematical Model for the biological treatment of industrial wastewater in a reactor cascade. CHEMECA 2011(pp. 1-11).
16. L. D. Robescu et. al., Mathematical modeling of Sharon Biological Wastewater treatment Process, U. P. B. Sci. Bull. Series D, 74(1), 2102, pp. 229-236.
17. Anonymous. 2004. NATP – MM project report on 'Use of Urban and Industrial Effluent in Agriculture' CSSRI, Karnal 132001, India.
18. Bhamoriya V. 2004. Wastewater Irrigation in Vadodara, Gujarat, India: Economic Catalyst for Marginalized Communities. In: Scott CA, Faruqui NI and Raschid-Sally L. (Eds). Wastewater Use in Irrigated Agriculture: Confronting Livelihhod and Environmental Realities. CAB International in Association with IWMI: Colmbo, Sri Lanka, and IDRC: Ottawa, Canada.
19. Bhardwaj RM. 2005. Status of Wastewater Generation and Treatment in India, IWG-Env Joint Work Session on Water Statistics, Vienna, 20-22 June 2005.
20. Billore, S.K., Singh, N., Sharma, J.K.,Nelson, R.M., Dass, P. (1999). Horizontal subsurface flow gravel bed contructed wetland with Phragmites karka in Central India. Water Science and Technology. 40: 163-171.
21. Billore, S.K., Singh, N., Ram, H.K., Sharma, J.K., Singh, V.P., Nelson, R.M., Dass, P. (2001). Treatment of molasses based distillery effluent in a contructed wetland in Central India. Water Science Technology. 44: 441-448.
22. Billore, S.K., Ram, H., Singh, N., Thomas, R., Nelson, R.M., Pare, B. (2002). Treatment performance evaluation of surfactant removal from domestic wastewater in a tropical horizontal subsurface constructed wetland. In: Proceedings of the 8th International Conference on Wetland Systems for Water Pollution Control, University of Dar-es-Salaam, Tanzania and IWA, pp. 393- 399.

ANALYSIS OF CUSTARD APPLE SEED AS A POTENTIAL COAGULANT FOR WASTE WATER TREATMENT

A PROJECT REPORT

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In partial fulfilment for the award of the degree of

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In

CHEMICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

MARCH 2020

DECLARATION

We **VIVEK.R, NAMEER.A, THIRUMALAIVASAN.G, KISHORE KUMAR.A,** hereby declare that the project report titled "**ANALYSIS OF CUSTARD APPLE SEED AS A POTENTIAL COAGULANT FOR WASTE WATER TREATMENT"** done by us under the guidance of **Mrs. S.NIVEDHA, Assistant professor** is submitted in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Chemical Engineering. Certified further that, to the best of our knowledge, the work reported here in does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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DATE :

PLACE :

We regards our sincere thanks to our project co-ordinator of the department **Mrs. P.Bharani M.Tech.,** who has been the key spring of motivation to us throughout the completion of project work.

We would like to extend our sincere thanks to **all our department staff members and our parents** for their advice and encouragement to do the project work with full interest and enthusiasm.

ABSTRACT

From this report the potential of custard apple seed as a natural coagulant for water treatment. It was aimed at identifying custard apple seed as a possible replacement for alum and other synthetic polyelectrolytes in treating water. Laboratory scale studies using jar test experiments were performed on medium turbid water to determine the effect of dosage, pH and stirring time. Results obtained showed that at dosage of 0.5g/ml, pH of 7.0 and stirring time of 8 minutes optimal removal was obtained. The removal of turbidity, BOD, COD, TDS, TSS, TS, Alkalinity and Chloride are 24.5NTU, 347.2mg/l, 408.4mg/l, 3334mg/l, 6433mg/l, 9767mg/l, 948.7ppm, 3432ppm. When used in combination with alum (20%), it caused unfavourable changes in the pH and optimal removal was obtain. The removal of turbidity - 0.89 NTU, Colour-95%, pH-6.50,BOD-343.4mg/l, COD-405.31mg/l, TDS-3336mg/l, TSS-6423mg/l, TS-9759mg/l, Alkalinity-948.45ppm, Chloride-3439.19ppm. The results showed that Custard apple seed can be used as a natural coagulant for water treatment.

Key words; Coagulant, BOD, COD, TDS, TSS, TS, Turbidity

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LIST OF ABBREVATIONS

ABREVATIONS	DEFANITIONS
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
TS	Total Solids
TSS	Total Suspended Solids
TDS	Total Dissolved Solids
Ph	Power of Hydrogen
NTU	Nephelometric Turbidity Units
US	United State
WHO	World Health Organisation
TCU	True Color Unit
RMT	Rapid Mixing Time
SMT	Slow Mixing Time
SMV	Slow Mixing Velocity
RMV	Rapid Mixing Velocity
MO	Moringa Oleifera
UV	Ultra Violet
MOCR	Moringa Oleifera Cake Residue
WW	Waste Water
GR	Geberng River
DO	Dissolve Oxygen
PEC	Purchase Equipment Cost
TIC	Total Indirect Cost
TDC	Total Direct Cost
FCI	Fixed Capital Investment
TCI	Total Capital Investment
TPC	Total Product Cost
WC	Working Capital

CHAPTER 1

INTRODUCTION

1.1. POLLUTION:

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light Pollutants, the components of pollution, can be either foreign substances or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution. In 2015, pollution killed 9 million people in the world.

Major forms of pollution include:

- ✓ Water pollution
- ✓ Light pollution
- ✓ Noise pollution
- ✓ Thermal pollution
- ✓ Air pollution

Among these forms of pollution, We are here to discuss about water pollution.

1.1.1. WATER POLLUTION:

Water pollution results when contaminants are introduced into the natural environment. For example, releasing inadequately treated wastewater into natural water bodies can lead to degradation of aquatic ecosystems.

In turn, this can lead to public health problems for people living downstream. They may use the same polluted river water for drinking or bathing

or irrigation. Water pollution is the leading worldwide cause of death and disease, e.g. due to water-borne diseases.

Water pollution one of the world's most pressing issues. Unfortunately, the problem is constantly exacerbated by consumers. Since very few people are prepared to begin buying fewer things from grocery stores, fast food restaurants, and elsewhere, the only practical way to cut down on the bulk of water pollution that the world is currently plagued by is for restaurants to wave goodbye to plastic straws, manufacturers to get rid of plastic packaging, and for businesses to not support manufacturers that do, in fact, use irresponsibly-sourced packaging.

Even though most people are fully aware of the fact that planet Earth is full of polluted ocean water, objectively few people understand the specifics of the pollution problem society is currently facing. Quite simply, industrial wastewater is water that has been used as part of making a commercial product. Also referred to as "waste water," industrial wastewater differs from domestic wastewater or municipal wastewater (also called sewage).

Domestic Wastewater: Domestic wastewater is wastewater that has been generated from households. It's the water that runs down your kitchen sink and bathtub drain. It's what you flush down the toilet (also known as black water). It's the leftover water from your washing machine and your dishwasher.

Municipal Wastewater: Municipal wastewater is similar to domestic wastewater in that it incorporates household wastewater, but it usually also includes wastewater from public facilities such as malls and restaurants, and commercial and institutional facilities in urban areas.

Industrial Wastewater: Industrial wastewater is a by-product of industrial or commercial activities. Whether it's the food we eat, the beverages we drink, the clothes we wear, or the paper and chemical products we use, water is required for nearly every step of production across a multitude of different industries. The resulting wastewater must be carefully managed.

Industry is a huge source of water pollution, it produces pollutants that are extremely harmful to people and the environment. Many industrial facilities use freshwater to carry away waste from the plant and into rivers, lakes and oceans. Regardless of how wastewater is treated, the "end product" is called effluent. To comply with environmental protection laws, certain things must be removed from the wastewater. This includes organic matter, inorganics. The treated wastewater can then be safely discharged into water bodies, applied to land, or even reused in plant operations.

Types of industrial wastewater:

1. Inorganic industrial wastewater
2. Organic industrial wastewater

Inorganic industrial wastewater:

Inorganic industrial wastewater is produced mainly in the coal and steel industry, and in the non-metallic mineral industry, and in commercial enterprises and industries for surface processing of metals. These wastewater contains a large amount of suspended matters, which can be eliminated by sedimentation, often together with chemical flocculation through the addition of iron or aluminium salt, flocculation and some kinds of organic polymers.

The purification of warm waste gases from blast furnace and converters, refuse and sludge incineration plants and aluminium work results in wastewater containing mineral and inorganic substances in dissolved and undissolved form.

The pre-cooling and subsequent purification of the blast furnace gases requires upto $20m^3$ water per t of iron pigment. On its way into the gas cooler the water absorbs the fine particles of ore, iron and coke, which do not easily settle. Gases dissolves in it, especially carbon dioxide and compounds of alkali and alkaline earth metals, if they are water soluble or if they are dissolved out of the solid substances by gases washed out along with them.

In the separation of coal from dead rock, the normal means of transport and separation is water, which then contains large amounts of coal and rock particles and is called coal washing water. Coal washing water is recycled after removal of the coal and the rock particles through flotation and sedimentation processes.

Other wastewater from rolling mills contains mineral oil and requires additional installations, such as scum boards and skim-off apparatus, for the retention and removal of mineral oils .Residues of emulsified oil remaining in the water also need chemical flocculation.

In many cases, wastewater is produced in addition to solid substances and oils , also contains extremely harmful solutes .These include blast furnace gas washing wastewater containing cyanide, wastes from the metal processing industry containing acids or alkaline solutions ,wastewater from eloxal works and from the waste gas purification of aluminium works, which in both cases contains fluoride. Small and medium sized non-metallic minerals plants and metal processing plants are so situated that they discharge their wastewater into the municipal wastewater systems and have to treat or purify their effluents before discharge, in compliance with local regulations.

Organic industrial wastewater:

Organic industrial wastewater contains organic waste flow from those chemical industries and large scale chemical works, which mainly use organic substances for chemical reactions.

The effluents contains organic substances having various origins and properties. These can only removed by special pretreatment of the wastewater, followed by the biological treatment. Most organic industrial wastewater are produced by the following industries and plants:

- The factories manufacturing pharmaceuticals, cosmetics, organic dye-stuffs, glue and adhesives, soaps, synthetic detergents, pesticides and herbicides.
- Tanneries and leather factories.
- Textile factories.
- Cellulose and paper manufacturing plants.
- Factories of oil refining industries.
- Brewery and fermentation factories.
- Metal processing industry.

As examples, some special types of wastewater produced by the industries mentioned above are briefly introduced as follows.

1.1.1.1. Wastewater produced from the pharmaceuticals industries:

The quality of the wastes from the production of pharmaceuticals varies a great deal, owing to the variety of basic raw materials, working processes and water products. It is a characteristic of the pharmaceutical industry that very many product as well as intermediate products are manufactured in the same plant. Thus different kinds of effluent with widely varying qualities flow from the different production areas.

For large chemical industries it is also usual to manufacture pharmaceutical product together with other chemical products. Sometimes waste substances include

the extraction residues of natural and synthetic solvents, used nutrients solutions, specific poisonous substances, and many other organics.

The wastewater produced by the pharmaceutical industry has a very bad quality for wastewater treatment. Usually the concentration of COD is around 5000-15000mg/L, the concentration of BOD is relative low, and the ratio of BOD/COD is lower than 30% which means the wastewater has a poor biodegradability. Such wastewater has bad color and high (or low) pH value, and it needs a strong pretreatment method, followed by a biological treatment process with a long reaction time.

1.1.1.2. Wastewater produced by tannery plants:

A tannery is one of the most water intensive plants, and its production process consists several steps. The quality of water depends only to a slight degree on the type of hides and the mechanical and chemical methods used in tanning. In a tannery with chrome and bark tanning, the wastewater resulting from the different processes are as follows:

- ✧ Soaking and washing 22.5%
- ✧ Liming 17.5%
- ✧ Rinsing 5.5%
- ✧ Pluming and bating 19.0%
- ✧ Chrome tanning 2.0%
- ✧ Bark tanning 2.0%
- ✧ Washing and drumming 31.5%

In fact the wastewater flow is very uneven. The peak flow can be 250% of the hourly average flow rate.

The wastewater produced by a tannery (including preparation of the hides) has a fairly acid pH and high chloride content (upto 5g CI/L). It contains a high concentration of COD (about 1500-2500mg/L), a high amount of settable substances

(10-20g/L) and emulsified fat, and tends to form foam. The dichromate content can reach a peak value of 2000mg/L. So the tannery wastewater is a killer the water environment if it is discharged without good treatment.

1.1.1.3. Wastewater produced by brewery industry:

Barley is the most important grain used for brewing beer, with the addition of rice, oats, rye, wheat and millet. The manufacture of beer consists of three process, which are preparation of beer wort and fermentation.

A part of the wastewater produced by the brewery industry comes from the processes mentioned above, which includes the washing and rinsing water to clean the barley, all machines and filters, especially bottles and barrels. This type of wastewater contains the high concentration of suspended solids and detergents. The other part of wastewater is produced by the fermentation process, and it has a very high concentration of COD and BOD caused by soluble and insoluble organics. The characteristics of mixed brewery wastewater are approximately three to four times more concentrated than sewage. There are no toxic contaminants in brewery wastewater are biodegradable. So after the removal of suspended solids, usually an anaerobic biological treatment process is used to reduce the organic concentration of the wastewater, and then followed by an aerobic biological treatment process to make the quality of effluent meet the discharge standards.

1.1.1.4. Effects on the Ecosystem: Industrial water pollution can have far reaching effects on the ecosystem. The water used in various industrial processes comes in contact with toxic chemicals, heavy metals, organic sludge, and even radioactive sludge. So, when such polluted water is thrown into the ocean or other water bodies without any treatment, they become unfit for any human and agricultural use.

1.1.2. Thermal Pollution: The radioactive sludge deposited at the bottom of water bodies can remain highly radioactive for many decades, and pose serious health risks for people living nearby. Nuclear reactors are also a major source of thermal pollution along with power plants. Thermal pollution refers to an increase in ambient water temperature. It can have an adverse effect on aquatic or marine life, as some organisms are extremely sensitive to slight changes in temperature.

1.1.2.1. Effect of Eutrophication: When the nutrient content of water undergoes changes, it can disturb the delicate balance of the ecosystem. For example, when the nutrient content of water increases, which is known as eutrophication, it can promote algal bloom. Algal bloom can deplete the oxygen content of water. Though algae produce oxygen in the daytime with the help of photosynthesis, at night, they use the oxygen dissolved in water. Algal bloom is often followed by the death of large quantity algae, which are decomposed by bacteria by using oxygen. Thus, the entire process of algal bloom, and the consequent bacterial decomposition of algae deplete the amount of dissolved oxygen in water. Sometimes, this process can reduce the oxygen content of water to such an extent that it can no longer support aquatic life. Such hypoxic areas of ocean, where marine life cannot survive are known as dead zones.

1.1.2.2. Increase the Murkiness of Water: Industrial wastewater can increase the murkiness of water. This in turn, can prevent sunlight from reaching the bottom of the water bodies. As a result, bottom-dwelling plants can fail to photosynthesize. Excessive murkiness of water can also block the gills of fish, and thus, make it difficult for them to take up dissolved oxygen from the surrounding water.

1.1.2.3. Effect of Chemicals: The common industrial pollutants responsible for causing water pollution are, sulfur, asbestos, poisonous solvents, polychlorinated biphenyl, lead, mercury, nitrates, phosphates, acids, alkalies, dyes, pesticides, benzene, chlorobenzene, carbon tetrachloride, toluene, and volatile organic chemicals. Chemicals like sulfur are harmful for marine life, while asbestos is known to be a potential carcinogen. Drinking water contaminated with asbestos may increase the risk for benign intestinal polyps. Nitrates and phosphates are basically found in fertilizers, and they can contribute to the process of eutrophication, which can cause the formation of dead zones.

1.1.2.4. Effects on human: Presence of high levels of carbon tetrachloride in drinking water can cause liver problems. Another industrial pollutant benzene is suspected to be associated with diseases like anemia and low blood platelets, and an increased risk for cancer. The chemical chlorobenzene found in insecticides and dyes can adversely affect the liver, kidneys, and the central nervous system. Toluene is basically a pollutant generated by the oil and petroleum industry, which too can affect the liver, kidneys, and the central nervous system. Volatile organic chemicals are basically solvents used in a wide range of industrial and household products. When not disposed properly, these chemicals can pollute the groundwater. They can cause a wide range of health problems like headaches, nausea, liver damage, and memory impairment.

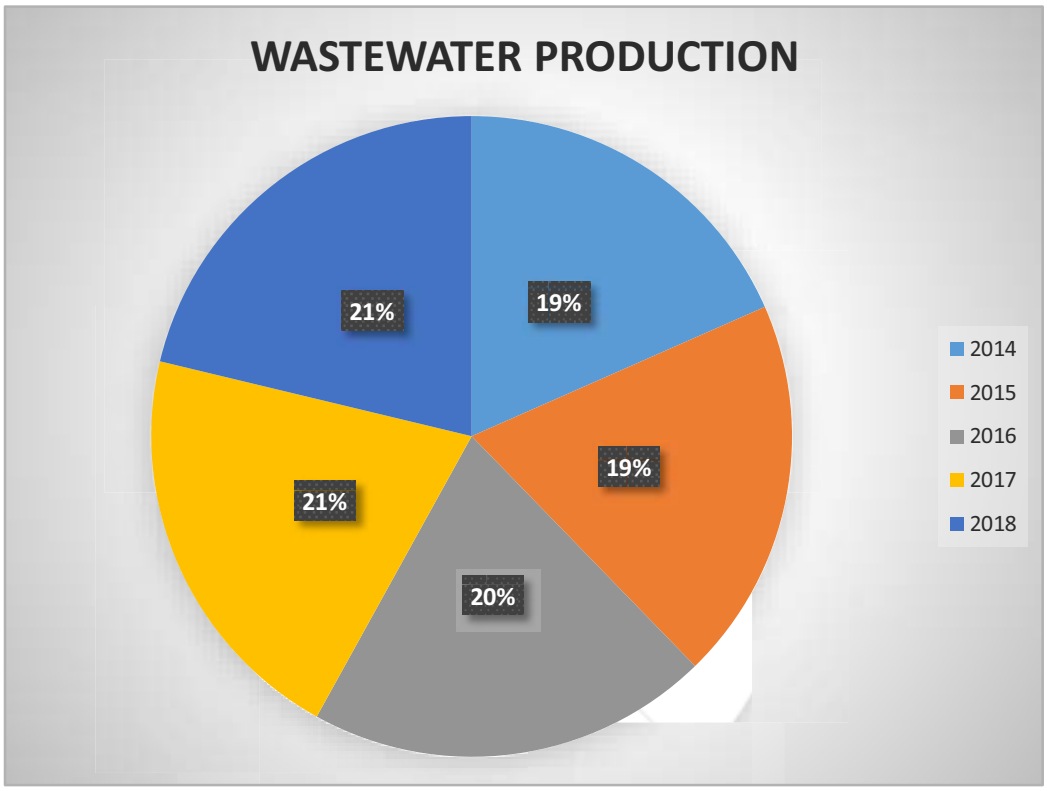


Fig: 1.1 waste water production percentage for past five years

1.2. Wastewater treatment:

Wastewater treatment uses microbes to decompose organic matter in sewage. If too much untreated sewage or other organic matter is added to a lake or stream, dissolved oxygen levels will drop too low to support sensitive species of fish and other aquatic life. Wastewater treatment systems are designed to digest much of the organic matter before the wastewater is released so that this will not occur. Treatment systems use physical, chemical, and biological processes:

- **Primary treatment** physically removes large solids using grates, screens, and settling tanks.
- **Secondary treatment** promotes growth of bacteria and other microbes that break down the organic wastes. These bio-degradation processes also take place in streams, lakes, and oceans, but the purification systems in nature can

easily be overloaded with input of too much organic waste. Secondary treatment prevents this type of pollution by degrading most of the organic matter before the water is released into the environment.

- **Tertiary treatment** is used only where it is needed to protect the receiving waters from excess nutrients. In tertiary treatment, the concentrations of phosphorus or nitrogen are reduced through biological or chemical processes.
- **Disinfection** kills disease-causing organisms, most commonly through chlorination.

Sludge, the collection of solids that are removed during wastewater treatment, requires processing to reduce odor and water content. Depending on the disposal method, the sludge also may undergo treatment to decompose organic matter or kill disease-causing organisms.

1.3. Coagulation:

Coagulation is an primary process of any kind of water treatment plant, that process must be performed using with cost effective and commonly used coagulants. As early as 2000 BC the Egyptians used almonds smeared around vessels to clarify river water. The use of alum as a coagulant by the Romans was mentioned in around 77 AD. By 1757, alum was being used for coagulation in municipal water treatment in England.

In modern water treatment, coagulation and flocculation are still essential components of the overall suite of treatment processes – understandably, because since 1989 the regulatory limit in the US for treated water turbidity has progressively reduced from 1.0 NTU in 1989 to 0.3 NTU today. Many water utilities are committed to consistently producing treated water turbidities of less than 0.1 NTU to guard against pathogen contamination.

Coagulation is also important in several wastewater treatment operations. A common example is chemical phosphorus removal and another, in overloaded wastewater treatment

plants, is the practice of chemically enhancing primary treatment to reduce suspended solids and organic loads from primary clarifiers.

1.3.1. Coagulants:

The commonly used metal coagulants fall into two general categories: those based on aluminum and those based on iron. The aluminum coagulants include aluminum sulfate, aluminum chloride and sodium aluminate. The iron coagulants include ferric sulfate, ferrous sulfate, ferric chloride and ferric chloride sulfate. Other chemicals used as coagulants include hydrated lime and magnesium carbonate.

The effectiveness of aluminum and iron coagulants arises principally from their ability to form multi-charged poly-nuclear complexes with enhanced adsorption characteristics. The nature of the complexes formed may be controlled by the pH of the system.

General and 7 most commonly used coagulants in water treatment plant is under:

- Alum (aluminum sulfate), $Al_2(SO_4)_3$. Still, the most common coagulant in the United States, it is often used in conjunction with Cationic polymers.
- Polyaluminum chloride, Al(OH)x(C1)y. This is efficient in some waters, requiring less pH adjustment and producing less sludge.(simply its called PAC)
- Ferric chloride, $FeCl_3$. This may be more effective than alum in some applications.
- Ferric sulfate, $Fe_2(SO_4)_3$. It is effective in some waters and more economical in some locations.
- Ferrous Sulfate, $FeSO_4$. It costs bit more compare with ferric chloride but result would be better than that
- Sodium Aluminate,$Na_2Al_2O_4$
- Cationic polymers can be used alone as the primary coagulant or in conjunction with aluminum or iron coagulants.

Now a Days most of the plants are using Cationic polymer, the cost is expensive compare with inorganic coagulants. But it can be use with wider pH range and produce less sludge. The choice or selection of coagulant chemical depends upon the nature of the suspended

solid to be removed, the raw water conditions, the facility design, and the cost of the amount of chemical necessary to produce the desired result.

Natural coagulant: Natural coagulant is a naturally occurred; plants based coagulant that can be used in coagulation-flocculation process of wastewater treatment for reducing turbidity. The objectives of this study were to assess the possibility of using natural coagulants as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the coagulation process. Based on the experimental results, it was concluded that natural coagulants which have been obtained from Dolichas lablab (Indian bean), Azadirachta indica(Neem), Moringa oleifera(Murungai), Hibiscus Rosa sinensis(Sembaruthi) have showed an merely equivalent coagulation comparing to commercial alum. The turbidity removal efficiency for Dolichas lablab, Azadirachta indica, Moringa oleifera, Hibiscus Rosa sinensis respectively were 37.45%, 63.01%, 31.47%, 12.95% against 75.01% obtained from alum.

Now we got with a new try on custard apple seed with the removal of the kernels and extracted the oil by using some chemicals and using the cake as a coagulant to treat the effluent produced from the various source of industry.

1.4. *Annona reticulata:*

Annona squamosa, popularly known as custard apple, is one of the widely available fruits in the world. Lopsided or sometimes heart shaped, the fruit is sweet in taste and goes by various local names. The thin but hard peel of the fruit gives way to a sweet and juicy pulp containing dark colored seeds.

1.4.1. Benefits Of Custard Apple Seeds

Here are some of the uses of custard apple seeds! Get ready to be amazed!

1. Eradicates Head Lice: Just take some, grind into a powdered form and mix with a little water to form a paste. Apply on the head and let it rest for 10 minutes. Wash

off with plain cold water. This process, if repeated twice a week for a month will give wonderful results and leave your head absolutely lice free.

2. Insect Repellent: The custard apple seeds can come to your rescue. Mix some powdered seeds in water and leave it for a couple of days. Your personal homemade insect repellent is now ready. Sprinkle the mixture everywhere around the house, especially in the infested areas. Results will be instantaneous and outstanding.

3. Pesticide And Weedicide: The same mixture can also be used as pesticide for your home garden. Sprinkle some of the infested plant on a regular basis for 10 to 15 days for the complete removal of leaf eating insects.

4. Pharmaceutical Usage: The seeds of this fruit are widely used by pharmaceutical companies due to its medically verified abortifacient properties. It is used for making medicines designed to induce abortion.

5. Commercial Farming Pesticides: The seeds of custard apple are also mixed with neem seeds to make another potent toxic pesticide used in commercial farming. The pesticide thus made from these seeds is natural and harmless to ecology. The use of pesticide made from custard apple seeds is quite beneficial for the health of mankind.

6. Bio- Gas Production: Countries like Germany and some other European nations use these little wonders for the commercial purpose of production of bio gas. The seeds of this fruit contain trapped fatty acids rich in methyl-ester that triggers the production of the gas.

7. **Other Unique Use:** The seeds of custard apple are also used as a fish bait in some countries due to its toxic nature.

1.4.2. Warning

The custard apple fruit is great, but the seeds are quite toxic in nature and accidental consumption can cause abortion as they are mildly poisonous. The insecticides prepared from these seeds should be kept away from eyes as they have the potency of even blinding a person temporarily. So while you enjoy a plate full of this healthy fruit as your evening snack, first make sure to remove all the seeds carefully.

Fig: 1.2 custard apple

Table: 1.1 Scientific Classification:

DOMAIN	*EUKARYOTA*
KINGDOM	*PLANTAE*
SUBKINGDOM	*TRANCHEOBIONTA*
DIVISION	*MAGNOLIOPHYTA*
SUPERDIVISION	*SPERMATOPHYTA*
CLASS	*MAGNOLIPSIDA*
SUBCLASS	*MAGNOLIIDAE*
ORDER	*MAGNOLIALES*
FAMILY	*ANNONACEAE*

GENUS	*ANNONA L.*
SPECIES	*ANNONA SQUAMOSA L.*
CLADE	*ANGIOSPERM*

1.4.3. Composition of Custard apple seeds:

Custard apple contains many nutrients and minerals that are beneficial for healthy life. The different nutrients with its health benefits are given as:

Vitamin C: Custard apple contains anti-oxidant vitamin C, which fights free radicals thereby preventing diseases.

Vitamin A: Vitamin A in the fruits is beneficial in keeping skin and hair healthy. This vitamin is good for eyes too.

Potassium: Potassium in the sweet fruits makes you active and removes the lethargies. Potassium also helps to fight muscle weakness.

Magnesium: Magnesium helps to maintain water balance in the body. It is good for arthritic patients by removing acids from joints.

Copper: Copper in custard apple works against constipation.

Fiber: It has plentiful of fiber, which is helpful in smooth digestion and eases constipation.

CHAPTER 2

LITERATURE REVIEW

I.M. Muhammad, S. Abdulsalam, A. Abdulkarim,et al.,(2015)

This paper reports the potential of watermelon seed as a natural coagulant for water treatment. It was aimed at identifying watermelon seed as a possible replacement for alum and other synthetic polyelectrolytes in treating water. Laboratory scale studies using jar test experiments were performed on medium turbid water to determine the effect of dosage, pH stirring time and speed on coagulation. Results obtained showed that at dosage of 0.1g/L, pH of 7.0, stirring time of 8 minutes and mixing speed of 100rpm, optimal removal of turbidity was obtained. The reduction in turbidity was below the world health organizations (WHO) recommended value of 5NTU, however the best colour removal was not up to the WHO recommended value of 40TCU. When used in combination with alum, it caused unfavourable changes in the pH of the treated water howeverwith 20% alum as coagulant aid, the best colour and turbidity removal at acceptable pH was obtained, with residual turbidity of 0.89 NTU and residual colour of 15TCU at a pH of 6.50.

James M. Ebeling, Sarah R. Ogden, et al., (2004)

An evaluation of two commonly used coagulation-flocculation aids was conducted to determine optimum coagulation for treating the backwash effluent from microscreen filters in an intensive recirculating aquaculture system. Test were carried out to evaluate the dosages and conditions required to achieve optimum waste capture. The orthophosphate removal efficiency for alum and ferric chloride were greater than 90% at a dosage of 60 mg/L. optimum turbidity removal was achieved with a 60-mg/L dosage for both alum and ferric chloride. Both alum and

ferric chloride demonstrated excellent removal of suspended solids from initial total suspended solids values of approximately 320 mg/L to approximately 10 mg/L at a dosage 60 mg/L. Flocculation and mixing speed and duration played only a minor role in the removal efficiencies for both orthophosphates and suspended solids. Both coagulation-flocculation aids also exhibited excellent settling characteristics, with the majority of the floc quickly settling out in the first 5 min.

Abdel Monem A. El-Bassioni, Ibrahims G. Rashed, et al., (2005)

Coagulation-flocculation followed by sedimentation, filtration and disinfection, often by chlorine, is used worldwide in the water treatment technology before distributing treated water to consumers. The aim of the present work is to study the parameters affecting on the coagulation, flocculation and sedimentation by a non-traditional technology. Synthetic turbid water was treated with alum, Ferric chloride, ferric sulfate and cationic polyelectrolyte in the jar test to determine the critical dosage of the coagulant before applying in the proposed system. The proposed system is based on inline mixing and exploiting the feed pump to perform the rapid mix. Feed inters tangentially to a cylindrical tank where the circular motion facilitates the slow mix in an annular space between the well of the tank and an inside jacket. The flow is reversed inside the jacket upward where sedimentation occurs. The clarified water passes over a weir to a filtration unit. An experimental program were conducted at various turbidity levels, retention time, slope of feed angle, slope of inner jacket, coagulant injection point from the mixing pump, flow rate and slow mixing time. The results obtained showed that the proposed system reduces turbidity to about 3.2,2.5 and 2 NTU for retention times 120, 150 and 160 minutes respectively, where in the conventional technology the retention time is about 210 minute.

Dragana Kukić, Mirjana Antov, Marina Šćiban, et al., (2018)

In this paper, the possibility of applying natural coagulants obtained from common beans for the removal of colloidal particles from wastewater was investigated. Three types of wastewater were used in the experiments: stillage from bioethanol production, wastewater from sugar production, and synthetic turbid water. Natural coagulants were extracted from crushed beans using 0.5 M NaCl. Jar tests were conducted with different doses of coagulant at different pH values. After sedimentation, coagulation activity was determined by turbidity measurements. Results showed that the highest coagulation activity of the natural coagulants from common beans was achieved in stillage, at 98.8% (at pH 9 with applied dose of coagulant of 5 mL/L), while the coagulation activity in the synthetic turbid water was 90.1%.

Isabela Maria Reck , Aline Takaoka Alves Baptista , Rebecca Manesco Paixão , et al., (2019)

The aim of the present study was to evaluate the efficiency of a new magnetic coagulant, obtained from Moringa oleifera seeds protein functionalized with iron oxide nanoparticles to remove four anionic synthetic dyes with coagulation/flocculation assays followed by magnetic sedimentation. The results showed that the presence of a magnetic field during sedimentation considerably accelerates the separation and increases the dye removal efficiency. Amaranth dye removal increased from 45 to 86% and Sunset Yellow from 15 to 69% with the presence of magnetic field, while Reactive Black 5 and Brilliant Blue reached 94% and 52% removal, respectively. For AM and SY dyes, the best protein concentration is 150 mg L−1 , for RB5 dye is 115 mg L−1 , and for BB dye is 75 mg L−1 . The sedimentation time decreased from 30 to 5 min with magnetic sedimentation. The residual value of AM dye decreased from 10.76 mg L−1 to approximately 2.71 mg

L−1, and with SY the residual concentration decreased from approximately 16.79 mg L−1 to 6.36 mg L−1.

Eman N. Ali, Suleyman A. Muyibi, Hamzah M. Salleh, et al., (2009)

Developing countries and third world countries are facing potable water supply problems because of inadequate financial resources. The cost of water treatment is increasing and the quality of river water is not stable due to suspended and colloidal particle load caused by land development and high storm runoff during the rainy seasons especially in a country like Malaysia. During the rainy seasons the turbidity level increases and the need for water treatment chemicals increase as well, which leads to high cost of treatment which the water treatment companies cannot sustain. As a result, the drinking water that reaches the consumer is not properly treated. Therefore, it is of great importance to find a natural alternative for water coagulant to treat the turbidity. It has been found that Moringa oleifera is the best natural coagulant discovered yet, that can replace aluminium sulphate (Alum) which is used widely all around the world. This study is focusing on Moringa oleifera seeds to find the active constituents which are responsible about the coagulation mechanism and improving the coagulation property. This will help in producing this alternative locally as Moringa oleifera is grown in Malaysia and other tropical countries and can be of great benefit for water treatment.

Shirin Nouhi1, Habauka M. Kwaambwa, PhilippGutfreund, et al., (2008)

Trees of Moringa oleifera are the most widely exploited species of Moringa and proteins extracted from its seeds have been identified as the most efficient natural coagulant for water purification. Largely for climatic reasons, other Moringa species are more accessible in some regions and this paper presents a comparative study of the adsorption to diferent materials of the proteins extracted from seeds of Moringa

peregrine and Moringa oleifera to explore their use as flocculating agents in regions where each is more readily accessible. Results showed that Moringa peregrina seed proteins had higher adsorption to alumina compared to silica, in contrast to opposite behaviour for Moringa oleifera. Both species provide cationic proteins that can act as effective coagulants for the various impurities with different surface potential. Despite the considerable similarity of the amino acid composition, the seed proteins have significantly different adsorption and this presents the opportunity to improve processes by choosing the optimal species or combination of species depending on the type of impurity or possible development of separation processes.

Karina Cardoso Valverde , Priscila Ferri Coldebella , Marcela Fernandes Silva, et al.,(2018)

The present study aims to optimize the operational conditions in surface water coagulation/flocculation and sedimentation step, besides evaluating the association between seeds of Moringa oleifera Lam. (M. oleifera) and the synthetic coagulant aluminium sulphate for surface water treatment. Te assays were performed in Jar Test using surface water from Pirapo River basin, Maring ´ a, ´ PR. It was observed that the operational conditions affect the coagulation/flocculation and sedimentation process efficiency. Optimal operational conditions for coagulants association are as follows: rapid mixing velocity (RMV) of 105 rpm, rapid mixing times (RMT) of 1 min, slow mixing velocity (SMV) of 30 rpm, slow mixing times (SMT) of 15 min, and sedimentation time (ST) of 15 min; this enables an improvement in the process, contributing to a reduction in synthetic coagulant aluminium sulphate demand of up to 30%, combined with an increase in M. oleifera dosage, not affecting the coagulation/flocculation and sedimentation process efficiency, considering the water pH range between 7 and 9.

SULEYMAN A. MUYIBI and LILIAN M. EVISON (1995)

In this study, the effects of 5 process variables on softening hard water and coagulation of surface water with a M. oleifera seed extract were investigated. Multiple regression analysis showed a strong correlation (R2 (adj.) = 0.99 between M. oleifera seed dosage and the initial hardness of synthetic hard water. Since M. oleifera is known to be a polyelectrolyte, the softening mechanism is likely to be adsorption. An adsorption isotherm developed was approximately linear and conformed to the Langmuir type. For the coagulation studies, the water samples were from three rivers in Kano, Nigeria over a three month period during the rainy season (June-August 1994). The turbidity of the water sample varied from 105-350 NTU. When used as primary coagulant, M. oleifera was able to achieve up to 99% turbidity removal for two of the water samples at the optimum dosage of 250 mg/1. For the third water sample, the optimum dosage was 450 mg/l which is assumed to be due the high value of the colour of the water. Saving in alum usage of up to 40% was achievable when M. oleifera was used in conjunction with alum.

Francis Kweku Amagloh and Amos Benang (2009)

The high cost of treated water makes most people in the rural communities to resort to readily available sources which are normally of low quality exposing them to waterborne diseases. It is in this light that this research was carried out to confirm the effectiveness of powder extracted from mature-dried Moringa oleifera seeds which is commonly available in most rural communities of Africa. This was done using Completely Randomised Design with loading doses of 4, 6, 8, 10, and 12 g/L of the powder processed from Moringa seeds, and aluminium sulphate (alum) as coagulant. A control (water from the pond with only distilled water without alum

and Moringa treatments) was also included. The turbidity, pH, and conductivity and total coliform were determined for all the samples. The turbidity for the samples ranged from log100.30 to log101.36NTU while the conductivity ranged from log102.29 to log102.72 μS/cm. The 12 g/L treatment of Moringa and 10 and 12 g/L alum treatments gave values that are acceptable according to the World Health Organisation (WHO) guidelines for safe drinking water. The control sample gave the higher extremes values which are unacceptable. The pH values (7.29 to 7.89) obtained for the treatments were in the recommended range set by WHO. The Most Probable Number per 100 ml for total coliform counts had values from 2 to 17 at 95% confidence limits. The Moringa treatment gave lower counts. Findings of this research lend support to earlier works recommending the use of Moringa for water treatment.

Munirat Abolore Idris, Mohammed Saedi Jami, Ademola Monsur Hammed,et al .,(2012)

This review focus on the use of Mornga oleifera seed extract and it application in the environment. It is usually referred to as the miracle tree because of its vast usefulness of its various parts. It is a source of protein, calcium, iron, carotenoids and phytochemicals utilized for several usage in developing countries. The plant parts have been used in various application such as medicine, cosmetics, food supplements and water purification. This review presents the various application of Moringa oleifera seed extract as an adsorbent, coagulant, dewatering agent and as a disinfectant. This review also highlight the various methods used in processing the seed extracts, different phytochemical and chemical constituents present in the seed extract. Other aspects that require further investigation were also highlighted in this review.

Md. Asrafuzzaman, A. N. M. Fakhruddin, and Md. Alamgir Hossain, (2011)

Turbidity imparts a great problem in water treatment. Moringa oleifera, Cicer arietinum, and Dolichos lablab were used as locally available natural coagulants in this study to reduce turbidity of synthetic water. The tests were carried out, using artificial turbid water with conventional jar test apparatus. Optimum mixing intensity and duration were determined. After dosing water-soluble extracts of Moringa oleifera, Cicer arietinum, and Dolichos lablab reduced turbidity to 5.9, 3.9, and 11.1 nephelometric turbidity unit (NTU), respectively, from 100 NTU and 5, 3.3, and 9.5, NTU, respectively, after dosing and filtration. Natural coagulants worked better with high, turbid, water compare to medium, or low, turbid, water. Highest turbidity reduction efficiency (95.89%) was found with Cicer arietinum. About 89 to 96% total coliform reduction were also found with natural coagulant treatment of turbid water. Using locally available natural coagulants, suitable, easier, and environment friendly options for water treatment were observed.

M. A. A. W. Moramudaii, P. Fernando and P. A. J. Yapa (2001)

Ability of seed extracts of Moringa oleifera to clarify turbid waters and wastewaters was investigated. Mature seed extracts of Moringa were comparatively more effective than immature seed extracts. Mature seed powder at 50 mg/20 ml reduced the turbidity (NTU) by 95% within 2h. It was the aqueous extract of Moringa seeds that was really effective in clarifying turbid waters, not the insoluble fraction. A positive relationship between the protein content and purifying ability of seed extract was observed. It was also found that extracts of mature Moringa seeds have an ability to clarify textile dye solutions. All four solutions of textile dyes namely Terasil Blue 3RL-02, Terasil Navy ORL-C, Terasil Red Rand Terasil yellow 40 were clarified by Moringa seed extracts. Studies on pH and the conductivity showed that pH is slightly reduced and conductivity is rapidly increased when they were treated with Moringa

seeds whilst conductivity was found to be dependent on treatment time and temperature. The clarifying ability of Moringa seed was also investigated against paper factory effluent but 'no significant effect was observed. Mature seed extracts of Moringa significantly reduced the bacterial growth of polluted waters. The effectiveness was directly proportional to the amount of seeds used. An antimicrobial activity was found in crude aqueous extracts of Moringa seeds.

N.E. Nwaiwu and A.A. Bello(2011)

The aim of this study is to find out the optimum combination for MO and alum using alum as a coagulant aid in household treatment of natural pond surface water for domestic use. The physico-chemical properties investigated for in the raw, settled and filtered water were Ph, Total Dissolved Solids (tds), turbidity, colour and total suspended solids (tss). The various coagulant combinations with which the raw water from the pond was treated include Moringa oleifera (MO) seed powder only (i.e., 100% MO), aluminium sulphate (alum) only (i.e., 100% alum), 20% alum and 80% Moringa oleifera seed powder, 40% alum and 60% Moringa oleifera seed powder, 50% alum and 50% Moringa oleifera seed powder; 60% alum and 40% Moringa oleifera seed powder; and 80% alum and 20% Moringa oleifera seed powder. Five of the seven used coagulant combinations gave acceptable turbidity reduction i.e., below 10NTU. When Moringa oleifera seed powder was used as the sole coagulant, a filter was needed to obtain an acceptable turbidity value of 7.8NTU but there was no need for pH adjustment or correction. Moringa oleifera seed powder can be used in treating household drinking water either as a sole coagulant or in combination with alum (using the alum) as a coagulant aid. The settling time for the MO seed powder is longer than that of the combined coagulants if the same results are to be obtained. The recommended ratio for the combined coagulant dose is 60% MO seed powder and 40% alum.

Sonal Choubey , S.K.Rajput , K.N.Bapat (2012)

Many medicinal, industrial and allelopathy see of common weeds have been reported. The natives of Chhattisgarh use many common weeds to treat their health problems. Nearly three herbs namely Moringa oleifera, Cicero arietinum, and Dolichols lablab were chosen for this study. The efficiency of the extracts of Moringa oleifera, Cicero arietinum, and Dolichols lablab made them used as natural coagulants for the clarification of water Turbidity

Emelie Arnoldsson, Maria Bergman, Nelson Matsinhe, (2008)

In this study, a comparison between Moringa Oleifera MO and aluminium sulphate was conducted for coagulation of turbid water using jar test. The optimum coagulant dosage was investigated for different levels of turbidity, and the impact on treated water properties monitored. Use of MO together with direct filtration was also investigated. Coagulation with aluminium sulphate led to more efficient treatment but MO could also produce water of acceptable quality. On the other hand, treatment with MO did not change the chemistry of treated water and was more efficient for high initial turgidities. Highest removal efficiencies were obtained when MO was extracted using tap water as compared to distilled water and oil extraction. Coagulation with aluminium, followed by direct filtration led also to better performances but in both cases the treated water met WHO water guidelines. Prolonged sedimentation helped improve MO treatment efficiency for low initial turgidities. MO is found to be a sustainable solution for coagulation in drinking water treatment. The possibilities of using MO together with direct filtration are good and provide a realistic alternative to conventional methods for small to medium size water supplies.

R A Barakwan, A R Syavira, and Y Trihadiningrum (2009)

Coagulation process using aluminium sulphate (Al_2SO_4) or alum as coagulant at a drinking water treatment plant generates a large volume of alum sludge. The alum sludge contains high concentrations of aluminium and organic matter, which are harmful to the environment. Organic contaminants can decrease the conductivity and mobility of ions in electrolyte, so it can reduce the effectiveness of electrolysis to remove the aluminium. Aims of this study are: (1) to determine the aluminium and COD removal in electrolysis process using carbon-silver electrodes and (2) to measure the efficiency of COD removal by H_2O_2 oxidation and UV light exposure. The sludge was acidified to pH 3 and 4 and centrifuged prior to electrolysis. The electrical current was 300 mA, based on polarization test using carbon silver as anode and cathode electrodes. Electrolysis was carried out in a batch recirculation one compartment reactor for 10 hours. Deposited matter of alum at cathode was weighed and analysed by Inductively Coupled Plasma. The electrolysis pre-treatment was meant to remove high organic contaminants in electrolyte. The pre-treatment was carried out by oxidation with addition of H_2O_2 with a ratio of [H2O2]/ [COD] = 1/2 and 254 nm UV light exposure for 4 hours. This study resulted in low aluminium deposit of 3.19 mg at the cathode with COD removal of 11.11% at initial pH 3 using electrolysis. The highest COD removal efficiency by oxidation with addition of H_2O_2 and UV light exposure was 75%. It can be concluded that H_2O_2 oxidation and UV light exposure could be applied prior to electrolysis for optimizing aluminium removal.

Erina Rahmadyanti, Elizabeth Titiek Winanti, Indiah Kustini. (2018)

Investigating effectiveness of Moringa oleifera seed as environmentally-friendly phytocoagulant to reduce pollutant in batik industry wastewater has been conducted for period of times. This study found that processing coagulation flocculation

independently was proved ineffective for batik industrial wastewater treatment. pH was variable that met effluent standards set by government, while other two variables, BOD and COD, did not meet the standard set, as both increased along with the increasing dose of Moringa oleifera. The increase of BOD and COD was probably caused by the oil content which was not extracted from the seeds. Although TDS variable showed significant reduction between 66%-92%, it did not meet effluent standard set by government. This study suggested that future research should add an independent variable, such as variations of rapid stirring, pH variations, or oil extraction. In addition, combining several processing methods and adding different dose of Moringa oleifera seeds can be also another option. These are to possibly see the effectiveness of the flocculation-coagulation process independently as well as the combination of them in the wastewater treatment of batik industry.

N. Ali Eman,C. S. Tan, E. A. Makky. (2014)

Most of water treatments require higher expenditure. Chemical coagulant requires higher cost and has some drawback after treatment such as pH changes. Moringa oleifera cake residue (MOCR) is one of the alternatives to replace chemical coagulant. A jar test apparatus was used to monitor water treatment. Water quality of Gebeng River (GR) and waste water (WW) was examined before and after treatment. Different parameters using (MOCR) was investigated. Preliminary laboratory results showed the great potential of the (MOCR) to be used in water treatment. MOCR shows an excellent reduction in turbidity (97 % was removed). The bacteria were reduced from 1.7 × 105 to 8 × 103 CFU/ml. Dissolved oxygen (DO) was improved that elevated from 1.06 ± 0.04 to 5.09 ± 0.03 mg/L. However, chemical oxygen demand (COD) and biological oxygen demand (BOD) were increased from 520.5 ± 0.71 to 865.0 ± 2.12 mg/L and from 120.5 ± 2.12 to 270.5 ±

2.12 mg/L respectively. Nevertheless, there is no significant alteration of pH, conductivity, salinity and total dissolved solid (TDS) after treatment. The iron (Fe) was fully removed while copper (Cu) and cadmium (Cd) were successfully removed up to 98%. The reduction of lead (Pb) also achieved 82.17%. Also, (MOCR) can be stored for long time up to 6 months without affecting the biological properties .

Jhon J. Feria-Díaz , Liliana Polo-Corrales , and Elvis J.Hernandez-Ramos.(2016)

Coagulation-flocculation is a physical-chemical process responsible for producing the largest amount of sludge in the purification of natural raw water. Conventionally, aluminum sulfate or alum has been used as a coagulant. However, disposal of the sludge produced has been problematic for the environment due to excess aluminum. Currently, the convenience of using natural coagulants such as seed extracts from Moringa oleifera (MO) is being studied, although, the properties of sewage sludge produced and its possible reuse are unknown. In this paper the physical-chemical, nutritional and dangerous characteristics from MO sludge were evaluated by using standard methods to verify its potential use in agricultural soils. Results indicated that pH, electrical conductivity, ion exchange capacity, organic matter and micronutrients from sludge were suitable for application to soils with agricultural potential; but deficiency of macronutrients and presence of fecal coliforms limits it to be used as soil improver and not as fertilizer. Sludge stabilization with hydrated lime at doses greater than or equal to 3% was effective to ensure the elimination of pathogenic microorganisms and to obtain a Class A sludge, unrestricted for agricultural use and suitable for acid soils.

CHAPTER -3

MATERIALS AND METHODS

3.1 Materials

- Custard apple seed (*Annona reticulate*)
- Distilled water
- Waste water
- Raw water

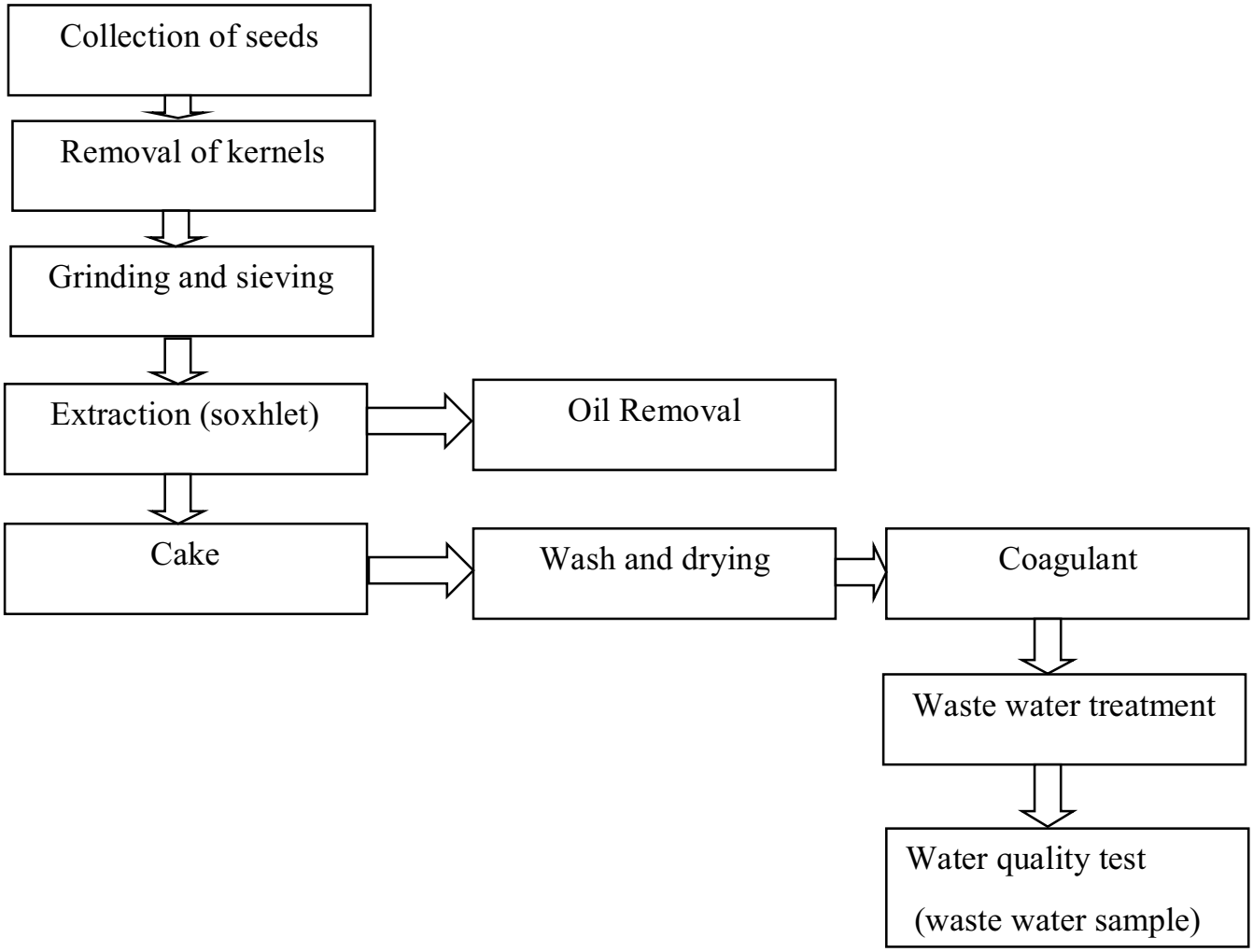
3.2 Chemicals Used

Table 3.1 list of chemicals

S.No	Chemicals used	Manufacturer
1	Methanol	Nice chemicals
2	Sulphuric acid(H_2SO_4)	Nice chemicals
3	Sodium thiosulphate	Nice chemicals
4	Calcium chloride	Nice chemicals
5	Magnesium sulphate	Nice chemicals
6	Manganese sulphate	Nice chemicals
7	Alkali iodide azide	Nice chemicals

8	Ferric chloride	Nice chemicals
9	Phosphate solution	Nice chemicals
10	Starch	Nice chemicals
11	Sodium hydroxide	Nice chemicals

3.3 Flow Diagram



3.3.1 Collection of seeds

The seeds are collected from custard apple .It is scientifically called as *Annona reticulate* .It is a small deciduous or semi-evergreen tree in the plant family *Annonaceae* and part of the *annonas* group .It is best for its fruit ,called custard apple, a common name shared with fruits of several other species in the same genus: A.cherimola and A.squamosa. Its common name include wild-sweetsop ,bull's heart ,bullock's heart ,or ox-heart.

The custard apple tree grows optimally in tropic conditions, it is also found in subtropical regions. It requires humid conditions. The annual temperature necessary ranges from 17 to 27 ^{0}C.Annona reticulate grows on many soil types with pH ranging from 5 to 8

The seeds of a custard apple are dark brown in color and are found inside the pulp of the fruit .There is a thick ,it is a thick ,cream-white layer of custard like ,some what granular ,flesh beneath the skin surrounding the concolorous moderately juicy segment .It is hard ,dark brown or black ,glossy seed ,oblang ,smooth which is less than 1.25 cm long .The seed count ranges from 55 to 76 in a fruit

3.3.2 Preparation of seed

The collected seed is crushed and the kernels is removed because the kernels are quit toxic in nature and accidental consumption can cause abortion as they are mildly poisonous. In order to remove the moister content present in the seed it is dried under sunlight for a day. Then the dried seed is grinded using blender. The blender is a kitchen and laboratory appliance used to grind food or other substance. A stationary blender consist of a blender container with a rotating metal blade at the bottom, powered by an electric motor. The blender will give the grined particle of

the seed which is then sieved by using sieve equipment. Then the resulting particles is sieved to mesh size of 150µm. The product obtained were stored in a container for further use.

3.3.3 Extraction

The product obtained were extracted by soxhlet extractor. The soxhlet extractor uses the solvent reflux and siphon principle to continuously extract the solid matter by pure solvent, which saves the solvent extraction efficiency. The soxhlet extraction is used when the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent.

Normally a solid material containing some of the desired compound is placed inside a thimble made from thick filter paper, which is loaded into the main chamber of the Soxhlet extractor. The soxhlet extractor is placed onto a flask containing the extraction solvent. The Soxhlet is then equipped with a condenser. The solvent is heated to reflux. The solvent vapour travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any solvent vapour cools, and drips back down into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent. Some of the desired compound will then dissolve in the warm solvent. When the Soxhlet chamber is almost full, the chamber is automatically emptied by a siphon side arm, with the solvent running back down to the distillation flask. This cycle is allowed to repeat many times. After many cycles the desired compound is concentrated in the distillation flask

The oil is concentrated in the distillation flask and the solid material in the thimble made from thick filter paper. The oil is removed and this oil can be used for

many other purpose such as hair growth, soap manufacturing, cosmetics etc. then the solid(cake) in the thimble is used for further process.

3.3.4 Preparation of coagulant

The resultant cake is washed with distilled water to remove the impurities and the methanol content in the cake. After washing the cake with distilled water then the cake is dried in hot oven for half an hour.

3.4 Experimental setup

3.4.1. collection of tannery effluent

The tannery effluent was collected from common effluent treatment plant(CETP) Erode, Tamilnadu. Tannery effluent are highly complex and are characterized by high contents of organic matter, inorganic matter and nitrogenous compounds, chromium, sulphides, suspended solids and dissolved solids

3.4.2. collection of seeds

The seed is collected from custard apple. The custard apple was collected from a local shop in Namakkal, Tamilnadu. 5 kilo gram of custard apple was bought, which contain upto 200 gram of seeds

Fig 3.1 custard apple seeds

3.4.3. Removal of kernels

The collected seeds were kept under sunlight for a day for efficient crushing. The collected seeds were crushed and kernel is removed. The kernel is to be removed because seeds are quite toxic in nature and accidental consumption can cause abortion as they are mildly poisonous. The seeds contain cyanogenic glycosides, making them mildly poisonous. About 200 apple seeds or about 20 apple cores receive a fatal dose in human body. The kernels was removed by crushing and the remaining black part were taken.

Fig 3.2 custard apple seed shell

3.4.4. Grinding and sieving

The kernels removed seed were grinded using blender. Blender is a laboratory appliance used to grind substance. Blender consist of a blender container with a rotating metal blade at the bottom, powered by an electric motor. The kernels removed or the black part of the seed of 115gram is grinded in the blender and 112.58gram of grained particle is obtained

Using sieve equipment the grained particle were sieved. The mesh size 150µm was taken. 75.58gram was wastage and 37 gram of seed powder were obtained

Fig 3.3 blender

fig 3.4 powder form of custard apple shells

3.4.5. Soxhlet Extraction

The grained particle of mesh size 150µm were used for extraction process.15 gram of grained seed were used as solid and 150ml of methanol were used as solvent for extraction process.

Grained seed of 15gram were placed inside a thimble made from thick filter paper, which is loaded into the main chamber of the Soxhlet extractor. The soxhlet extractor is placed onto a flask containing methanol as extraction solvent. The Soxhlet is then equipped with a condenser. The methanol is heated to reflux. The methanol vapour travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any methanol vapour cools, and drips back down into the chamber housing the grained seed. The chamber containing the grained seed slowly fills with warm methanol. Some of the desired compound will then dissolve in the warm methanol. When the Soxhlet chamber is almost full, the chamber is automatically emptied by a siphon side arm, with the methanol running back down to the distillation flask. This cycle is allowed

to repeat for 15 times. After 15 cycles the desired compound is concentrated in the distillation flask. Then the oil was removed and the cake is used for further process

Fig 3.5 soxhlet extraction

3.4.6. washing and drying

The oil is removed by soxhlet extractor and the cake was used for further process. The cake was taken from the thimble slowly and the cake were washed with the distilled water for 3 times, thus the impurities and the methanol presents were removed

Then it was dried in hot oven for 20 minutes at 50 ^{o}c. Thus the cake can be used as coagulant. Then the cake were treated with waste water.

Fig 3.6 coagulant

fig 3.7 dryer

3.4.7. Jar test

The jar test apparatus was used to carry out coagulation and flocculation on the water samples. Five 400 ml beakers were used to study the effect of coagulant dosage on coagulation, the effect of pH on coagulation, effect of stirring time and effect of coagulant + coagulant aid on water treatment. The following parameters were then measured on the filtrate after the coagulation was completed; pH, turbidity, color, TDS, BOD, COD, alkalinity, chloride, TSS and TS. Five different weights of the coagulant were placed in each beaker, the first having 0.5g, and the remaining five varying from 1-2.5g at 0.5g interval in order to determine the optimum dosage. Then 250 ml of raw water sample taken into each 400 ml beakers and placed in the jar test kit and stirring speed will be 150 rpm rapid mix for 5 minutes. After this was completed the samples were allowed to settle and using filter paper to filter the samples. From the results obtain the dosage with the best results in color and turbidity removal was taken as the optimum.

The above procedure was used again, however a dosage of 0.5g was maintained in all five beakers. The pH was varied from 6-8 by the addition of few drops of NaOH into a beakers to make it alkaline. A few drops of H_2SO_4 solution

was also added in the first beaker to make it slightly acidic. The same speed and stirring time was used as above and the parameters listed above were measured after the coagulation and filter process. The pH at which the best turbidity and color removal were observed at was taken to be the optimum pH for coagulation. The same was done to determine the optimum stirring time, using the optimum speed to determine the best stirring time. The stirring time was varied at 2 mins, 5 mins, 8 mins, 10 mins and 15 mins for each beaker. After the coagulation-flocculation process was completed, the samples were then filtered and the filtrate was used for the tests.

Fig 3.8 jar test

Fig 3.9 purified water image

3.4.8. Water quality tests

3.4.4.1. pH

The pH of the samples was taken using an electric pH meter.

3.4.4.2. BOD

BOD measures the biodegradable organic carbon and it determine the organic content of wastewater, BOD measure the dissolved oxygen used microorganism. The microorganisms they break down the organic matter at 20c over

a 5 days period. Clean water has a BOD value of less than 1mg/lit and wastewater has between 150-1000 mg/lit.

BOD was measured before and after the raw water sample was adding 1ml, 2ml, 3ml, 4ml in different 4 BOD bottles and adding distilled water 299ml, 298ml, 297ml, 296ml in each BOD bottles to dilute the sample. After completing the above procedure below chemicals are added in each bottles,

1) $CaCl_2$ = 1ml
2) Phosphate buffer solution = 1ml
3) Magnesium Sulphate = 1ml
4) Feric Chloride = small pinch added
5) Alkali Iodied Azide = 1ml
6) H_2SO_4 = 1ml

After completing the above procedure 200 ml of sample taken out from each BOD bottles and adding few drops of indicator (starch), sample was turn into dark blue color and titrated against sodium thiosulphate. The end point will be colorless. After readings are noted and tabulated. The remaining 100 ml sample kept in BOD bottles and put in BOD incubator at 5 days. After 5 days 100 ml sample taken out and adding indictor and titrated against sodium thiosulphate. After titration readings are noted and tabulated. BOD of the sample was calculated using the equation;

$$\textbf{BOD} = (T_1 - T_2) \times \textbf{dilution factor}$$

T_1 = Before titration reading

T_2 = After titration reading

Fig 3.10 BOD incubator

3.4.4.3 Total Solids

A clean and dry china dish was weighted empty and 20ml of sample water added in to the china dish. The respective weights were recorded and the china dish together with the sample water were then placed on a water both at 100^{o}C to evaporate the water. When all the water evaporated, the china dish was allowed to cool down and reweighed together with the residue. The total solids present was then calculated using the equation:

TS = ((A – B) × 1000) / volume of the water sample)

A = weight of china dish together with water sample

B = weight of empty china dish

3.4.4.4 Total Suspended Solids

A clean and dry china dish and filter paper was weighted empty. The 20ml of sample water was filter using dry filter paper. After the filtration filter paper will be placed in china dish and put in to hot oven at 40^{o}C to dry the sample. After the drying china dish was allowed to cooling and take the weight. Total suspended solids of the water sample calculated using the equation:

TSS = ((C – D) × 1000) / volume of the water sample)

C = weight of after drying the china dish with filter paper

D = weight of chins dish + filter paper

3.4.4.5 Total Dissolved Solids

This was obtained by taking the difference between TSS and TS and using the following equation:

TDS = TS – TSS

3.4.4.6 Turbidity

The absorbance of the water sample was measured using spectrometer. Based on the absorbance value using following formula to calculate the turbidity value.

Turbidity = ((1+ (absorbance – 0.001) × (101 - 1)) / (0.109 – 0.001))

Fig 3.11 spectrometer

3.4.4.7 Alkalinity

Titration;1 – standardization of HCl

The burette is washed well with distilled water and rinsed with the small amount of HCl solution. It is then filled with the same solution up to zero mark without any air bubbles. The pipette is washed with distilled water and rinsed

with the small amount of standard NaOH solution. 20ml of this solution is pipetted out in to a clean conical flask. 2 to 3 drops of phenolphthalein indicator is added, the color turn to pink color. It is then titrated against the HCl solution taken in the burette. The end point is the disappearance of pink color. The titration is repeated for concordant values.

Titration;2 – A(with phenolphthalein indicator)

The burette is washed and rinsed with the given hydrochloric acid, then the burette is filled with standard hydrochloric acid. 20ml of water sample is pipetted out in a clean conical flask. A drop of phenolphthalein indicator is added. Pink color is observed. This solution is titrated against the standard HCl acid, already taken in the burette, until pin color is disappeared. The end point is noted that is phenolphthalein end point and it is denoted [P].

Titration;3 – B(with methyl orange indicator)

A few drops of methyl orange indicator is added to the same solution after the phenolphthalein end point. The titration is continued till the color changes golden yellow from reddish orange. The total titrated value is noted and is denoted [M]. The titration is repeated for concordant values.

From the values the amount of each alkalinity present in given water sample is calculated.

Total Alkalinity = Hydroxide + alkalinity

3.4.4.8 Chloride

Titration;1 – standardization of $AgNO_3$

The burette is washed well with distilled water and rinsed with the small amount $AgNO_3$ solution. It is then filled with the same solution upto the zero mark without any air bubbles. The pipette is washed with distilled water and rinsed with the small amount of standard NaCl solution 20ml of this solution is pipetted out in a clean conical flask. 1ml of 20% K_2CrO_4 indicator solution is added and titrated against $AgNO_3$ solution is taken in the burette. The end point is the change of color from yellow to reddish brown. The titration is repeated for concordant values.

Titration;2 – estimation of chloride ion

20ml of the given water sample is pipetted out into a clean conical flask. 1ml of 2% of K_2CrO_4 indicator solution is added. It is then titrated against standard $AgNO_3$ solution taken in the burette. The end point is the change of color from yellow to reddish brown. The titration is repeated for concordant values.

Amount of Chloride ion present in 1 litre of water sample = A × B × 1000

A = equivalent weight of chloride ion

B = strength of the chloride

3.4.4.9 color

Percentage of color removal was measured to find the absorbance of the Water sample using spectrometer. After finding the absorbance using the below equation to find the color of sample.

Color = (before sedimentation – after sedimentation) / before sedimentation

3.4.4.10 COD

COD was measured by using COD Digester. 1ml of water sample is taken into conical flask and adding 99ml of distilled water to dilute the sample. After dilute 10ml of sample taken into COD flask and adding chemicals sulfuric acid, potassium dichromate.

10ml of distilled water taken into another COD flask(Blank). After completing the above procedure two COD flasks are placed in COD Digester at 90 mins. Maintaining 150ºC in COD Digester. After 90 mins taken the water sample adding indicator (ferrain) and titrated against ferrous ammonium sulphate. Readings are noted and COD was calculated using following equation;

$$\mathbf{COD = ((H - I) \times 0.1 \times 8000 \times 1000) / 10}$$

H = Blank

I = Sample

Fig 3.12 COD Digister

CHAPTER 4

RESULT AND DISCUSSION

4.1 Tannery industry waste water sample analysis result for before and after treatment:

Table (4.1) shows the physicochemical properties of the water sample used in this study.

Table (4.1) water sample parameters before and after treatment

S.no	Parameters	Before treatment	After treatment
1.	Turbidity@ NTU	107.4	24.4
2.	pH	7.87	6.98
3.	BOD(mg/l)	1500.45	343.4
4.	COD(mg/l)	17774.2	405.31
5.	TDS(mg/l)	8000	3336
6.	TSS(mg/l)	57000	6423
7.	TS(mg/l)	65000	9759
8.	Alkalinity	11480	948.45
9.	Chloride	9870	3439.19

4.2 Effect of dosage on coagulation

Table (4.2) shows the results of the effect of coagulant dosage on coagulation. The dosages were varied from 0.5g/ml – 2.5g/ml for each sample treated. The settling time of 15 minutes was used and the samples filtered as longer time periods were observed for complete settling to take place.

Table (4.2): Effect of coagulation dosage result

S/no	Dosage(g/ml)	Temperature(^{o}C)	pH	TDS (mg/l)	Turbidity (NTU)	%of Color removal
1	0.5	27.4	7.86	3480	28.4	86
2	1	27.5	7.85	3498	50.6	69

3	1.5	27.4	7.86	3540	83.3	58
4	2	27.5	7.87	3667	95.2	43
5	2.5	27.3	7.85	3740	99.5	35

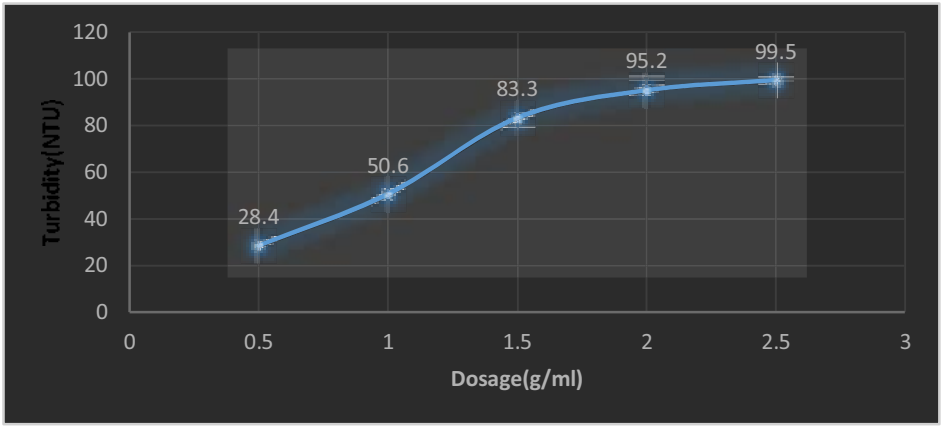


Figure 4.1: plot of turbidity against dosage showing the effect of dosage on turbidity removal

At varying coagulant dosages, the effect on constituent parameters is shown above in table (4.2). At varying dosage no significant changes were observed on pH and temperature for the water sample treated with custard apple seed cake as coagulant, however, there was a notable decrease in the turbidity and turbidity of the water sample after treatment. The greatest decrease was seen at the dosage of 0.5g/ml of raw water which reduced the turbidity from 107.4 to 28.4 and TDS 8000 to 3480. The optimal dosage for a specific water is defined as the dosage which gives the lowest turbidity in the treated water therefore the optimum dosage is 0.5g/ml. At this dosage the efficiency of the coagulant in removing color was also highest 86%.So we are find remaining parameters for only 0.5g/ml. Table (4.2.1) shows the remaining parameters value.

Table (4.2.1): effect of coagulation dosage result for 0.5 g/ml

S.no	Parameters	Values
1	TSS	7089

2	TS	10569
3	BOD	394.5
4	COD	460.2
5	Alkalinity	1040
6	Chloride	3840

At the dosage level 0.5g/ml some greatest decrease was observed on TSS, TS, BOD, COD, Alkalinity and Chloride shown in table 4.2.1.

4.3 Effect of pH on coagulation:

Table (4.3) shows the results obtain when the pH of the raw water sample was varied to study the effect of pH on coagulation.

Table (4.3): effect of pH on coagulation results at dosage of 0.5g/ml of custard apple seed cake

S.no	pH	Temperature(°C)	Turbidity(NTU)	TDS(mg/l)	%of color removal
1	6.0	27.5	29.13	3398	54
2	6.5	27.4	26.35	3384	59
3	7.0	27.6	25.41	3362	68
4	7.5	27.5	27.32	3381	64
5	8.0	27.6	29.75	3374	48

In the coagulation process, pH is very important since the coagulation occurs within a specific pH range for the coagular. In this study small range of pH between 6.0 for slightly acidic medium and 8.5 for slightly alkaline medium was selected. Figure (4.2) show the pattern followed by the effect of pH on water turbidity using custard apple seeds coagulant.

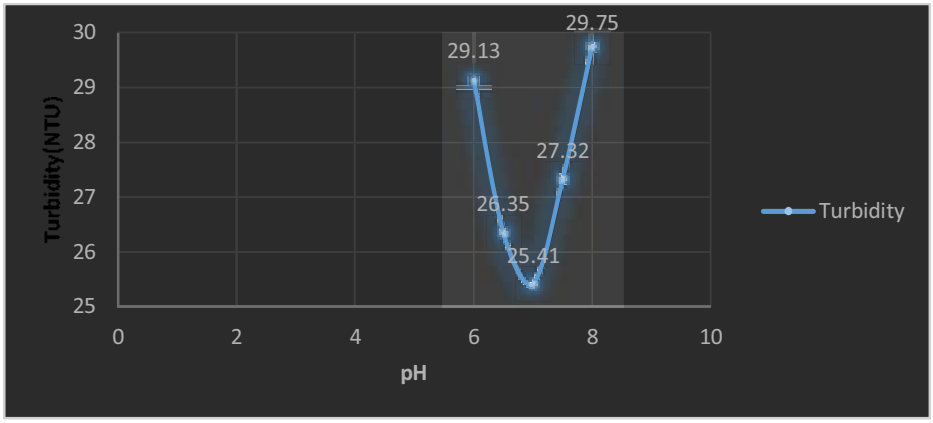


Figure 4.2: plot of turbidity against pH showing the effect of pH on turbidity removal

It can be deduced from figure 4.2 that, pH of between 7 to 7.5 provides better response in turbidity.

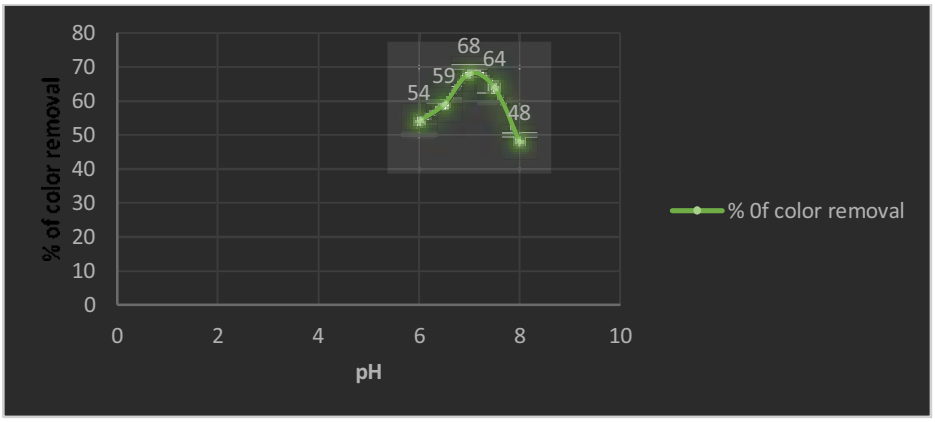


Figure 4.3: plot of % of color removal against pH, showing the effect of pH on % of color removal

pH adjustment may cause a change in the ionization of the color molecule. At pH 7 give the decrease in the amount of turbidity and high amount of color removal shown on the table 4.3. So we are finding the remaining parameters for only pH 7 that show on the table 4.3.1.

Table (4.3.1): effect of pH results for pH 7

S.no	Parameters	Values
1	TSS	6440
2	TS	9358
3	BOD	364.2
4	COD	430.4
5	Alkalinity	963.5
6	Chloride	3482

At the pH 7 greatest decrease was observed on TSS, TS, BOD, COD, Alkalinity, Chloride shown on the table 4.3.1

4.4 Effect of stirring time on coagulation at constant dosage

Table (4.4) shows the results obtain when the effect of stirring time on coagulation was studied by varying the stirring time at a constant coagulation dosage.

Table (4.4): Effect of stirring time on coagulation at coagulant dosage of 0.5g/ml

S.no	Time (min)	pH	Temperature (ºC)	Turbidity(NTU)	TDS(mg/l)	%of color Removal
1	2.0	7.86	27.4	25.9	3341	81
2	5.0	7.84	27.5	25.3	3349	78
3	8.0	7.85	27.6	24.5	3334	89
4	10.0	7.86	27.7	24.9	3351	76
5	12.0	7.87	27.9	25.4	3343	63

It can be seen from Table 4.4 that, the effect of stirring time on coagulation and as with the effect of dosage, the results obtained showed no significant changes

in pH or temperature. The temperature remained constant, over a range of stirring time. Stirring time of 2-12min was used to show this.

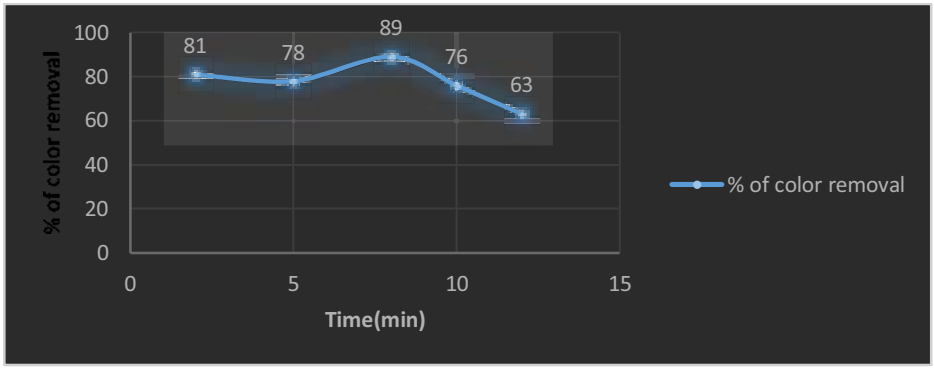


Figure 4.4 plot of % of color removal against time, showing the effect of time on % of color removal

At stirring time 8 min give the lowest amount of turbidity and high amount of color removal shown on the table 4.4. So we are finding the remaining parameters for only at stirring time 8 min. That shown on the table 4.4.1

Table (4.4.1): effect of stirring time results for 8 minute

S.no	Parameters	Values
1	TSS	6433
2	TS	9767
3	BOD	347.2
4	COD	408.4
5	Alkalinity	948.7
6	Chloride	3432

At the stirring time 8 gives greatest decrease observed on TSS, TS, BOD, COD, Alkalinity, Chloride shown on the table 4.4.1.

4.5 Effect of the combination of coagulant and coagulant aid on water sample treatment

Table 4.5 shows the result obtained after coagulation when alum was used as a coagulant aid and custard apple seed cake being used as the primary coagulant.

Table (4.5): Effect of coagulant + coagulant aid on water sample treatment

S.no	Coagulant +Alum (wt,%)	pH	Temperature (°C)	Turbidity (NTU)	TDS (mg/l)	%of color removal
1	100%C	7.82	27.8	25.4	3348	82
2	80%C+20%A	6.98	27.6	24.4	3336	95
3	60%C+ 40%A	6.72	27.8	25.5	3339	92
4	80%C+20%A	6.33	27.9	26.1	3342	93
5	20%C+80%A	5.74	27.6	24.8	3346	90
6	100%A	5.62	27.8	25.3	3345	94

Where:

A = Aluminium sulphate

C = Natural coagulant

The various coagulant combinations in Table 4.5 was used to treat the water sample. Results shown in Table 4.5, indicated significant changes in pH. With an initial raw water pH of 7.87, the sample with 100% custard apple seed cake, the pH recorded was 7.82.This is consonance with the results of raw water. However steady increase in alum concentration showed a steady decline from neutral to acidic Fig (4.6). At alum concentrations of only 40% the pH value had a significant shift towards acidic region. At concentrations of 60% and above, the pH was observed to become very

acidic. Which showed that at alum of only 20% significant drop in pH was observed and 80% the treated water was already acidic.

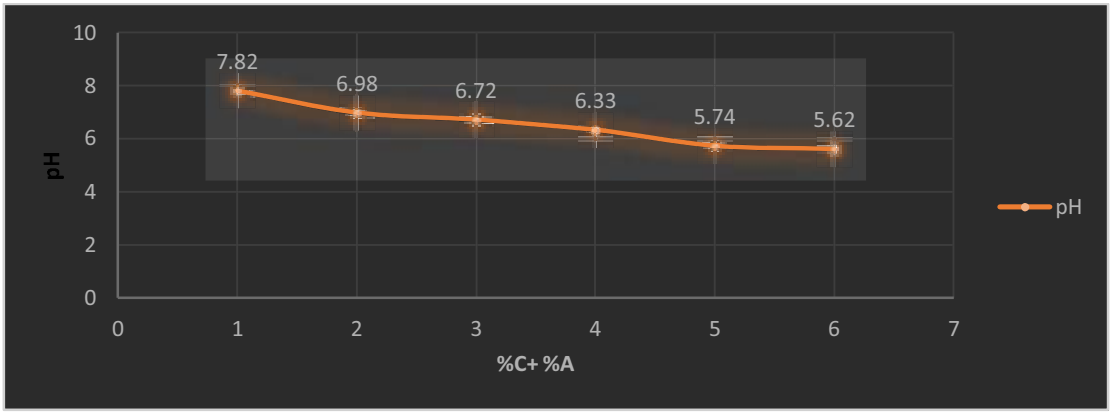


Figure 4.5 showing the effect of coagulant combination on pH of sample water

When the quantity of custard apple seed cake was more than the quantity of alum in any water sample treated, this indicates that when using custard apple seed cake alongside alum in water purification, the optimum combination should not necessitate further chemical addition for pH correction. This means that the quantity of alum in the combination should not exceed the quantity of custard apple seed cake. The quantity of alum should be based on and should be a percentage of the custard apple seed cake dosage suited for the water in question. Therefore a concentration of 20% alum is acceptable. So we are finding the remaining parameters for only 80%C+20%A.

Table (4.5.1): effect of combination of coagulant and coagulant aid (80%C+ 20%A)

S.no	Parameters	Values
1	TSS	6423
2	TS	9759
3	BOD	343.4
4	COD	405.31

5	Alkalinity	948.45
6	Chloride	3439.19

At the combination of coagulant and coagulant aid (80%C + 20%A) greatest decrease observed on TSS, TS, BOD, COD, Alkalinity, Chloride shown on the table 4.5.1.

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CHAPTER 5

DESIGN CALCULATION

5.1 Design calculation for coagulation tank

Design a mechanical rapid mix (coagulation tank) unit per a design flow to be treated equal to 300 m^3/hr. Assume suitable permissible values for various parameters of design. Assume a temperature of 20°C.

Solution:

Let us adopt the following values of various design parameters (Assume)

a) Detention time = 30 s (normally 20 to 60 s)
b) Velocity gradient = 600 s^{-1} (normally above 300 s^{-1})
c) Rotational speed of impeller = 122 rpm (normally above 100 rpm)
d) Ratio of tank height to dimension = 1.5:1
e) Ratio of impeller dia to tank dia = 0.4:1

1. Determination of dimension of the tank:

Volume of tank = Flow × Detention time

$= 300 \times (30/(60\times60))$

$\mathbf{V = 2.5\ m^3}$

Volume = area × depth

$\mathbf{V = ((\pi/4) \times D^2) \times 1.5D}$

$2.5 = (\pi/4) \times 1.5\ D^3$

D = 1.3 m

Depth of tank H = 1.5 × 1.3 = 1.95 m

Providing a free board of 0.2 m total depth of tank = 1.95 to 2 = 2.15 m

H = 2.15 m

D = 1.3 m

2. Compensation of power requirements:

Power = $\mathbf{G^2 \mu V}$

$\mu = 1.0087 \times 10^{-3}$ at 20°C

$P = 600^2 \times (1.0087 \times 10^{-3}) \times 2.5$

P = 908 watts

Power per unit volume (1 m^3) = 908/2.5 = 363 watts/m^3

Power per unit flow of water = 908/350 =3.30 watts/hr of flow

3. Determination of dimension of flat blades and impeller:

Dia of impeller = 0.4 × tank dia

D = 1.3 m

$D_{impeller} = 0.4 \times 1.3 = 0.52$ m

Velocity at the tip of impeller

$= \mathbf{2\pi rN/ 60}$

$V_p = 2\pi \times (0.52/2) \times (125/60)$

$\mathbf{V_p = 3.4\ m/s}$

$\mathbf{P = (1/2)\ C_D \times P \times A_b \times V_r^3}$

A_b = area of blades

V_r = relative velocity of blades =(1-k)V_p

V_p = velocity at the tip of impeller

P = density of water = 998 kg/m^3 at 20°C

K = 0.25(constant)

$V_r = (1- 0.25) \times 3.4 = 2.55$ m/s

$C_D = 1.8$ for blade

$908 = (1/2) \times 1.8 \times 998 \times A_b \times (2.55)^2$

$\mathbf{A_b = 0.06097\ m^2}$

Providing 6 blades area of each blade

$$= (1/6) \times 0.06097 = \mathbf{0.01\ m^2}$$

Provide blade of size (0.09 × 0.12 m**)**

CHAPTER 6

MATERIAL BALANCE

6.1 Material balance for production of Coagulant

6.1.1. Grinding of custard apple seeds

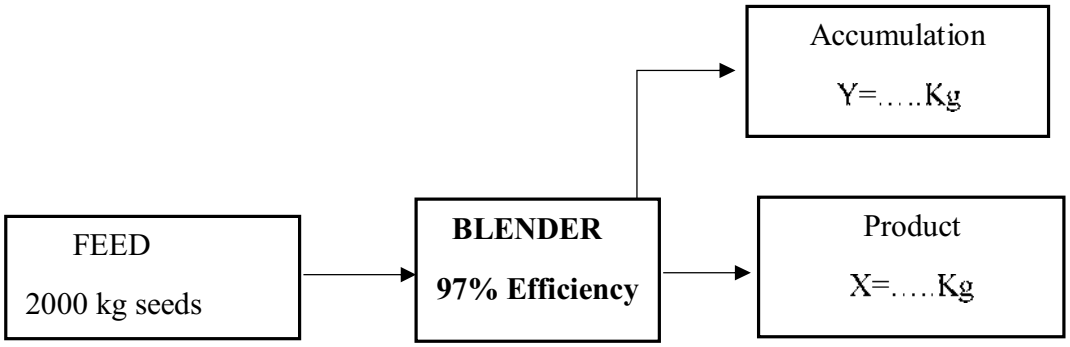

Figure 6.1, Material balance for Blender

Overall material balance for grinding process;

Feed = product + accumulation

2000 Kg = X + Y

Blender working under 97% efficiency;

Product(X) = 2000 × 0.97

X = 1940 Kg

Accumulation(Y) =2000 × 0.03

Y=60Kg

INPUT (2000Kg) = Product (3110.2 Kg) + Accumulation (60Kg)

6.1.2 Sieving of custard apple seed powder

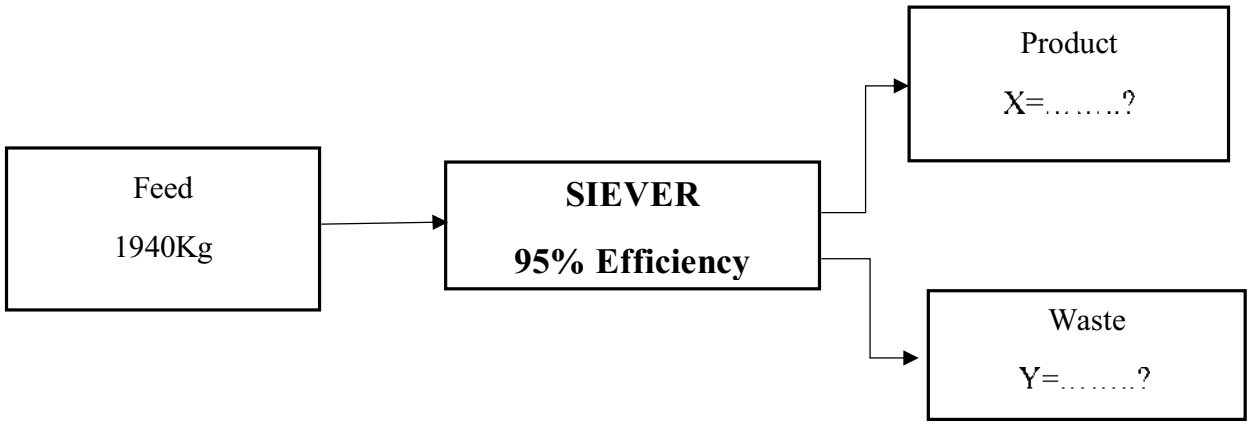

Figure 6.2, material balance for sieving process

Overall material balance

Input = Output + Accumulation

1940 Kg = X + Y

Siever working under 95% efficiency

X = 1940×0.95

=1843Kg

Y = 1940×0.05

=97Kg

Input (1940 Kg) = Product (1843 Kg) + Waste (97 Kg)

6.1.3 Extraction of custard apple seed powder

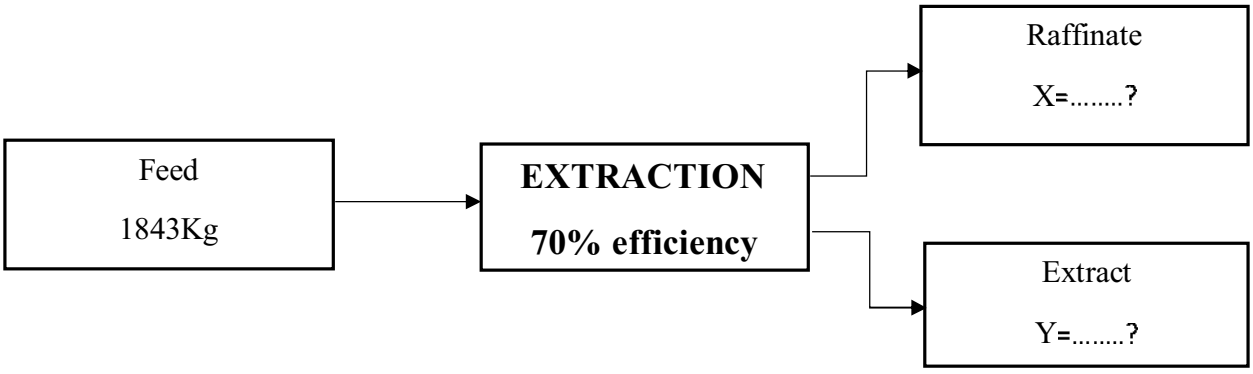

Figure 6.3, material balance for extraction process

Overall material balance for filtration process;

Feed = Extract + Raffinate

1843 Kg = Y + X

Extraction working under 70%efficiency;

Extract(Y) = 1843× 0.70

Y = 1290.1 Kg

Raffinate(X) = 1843× 0.30

= 552.9 Kg

INPUT (1843Kg) = Extract (1290.1Kg) + Raffinate (552.9Kg)

6.1.4 Drying

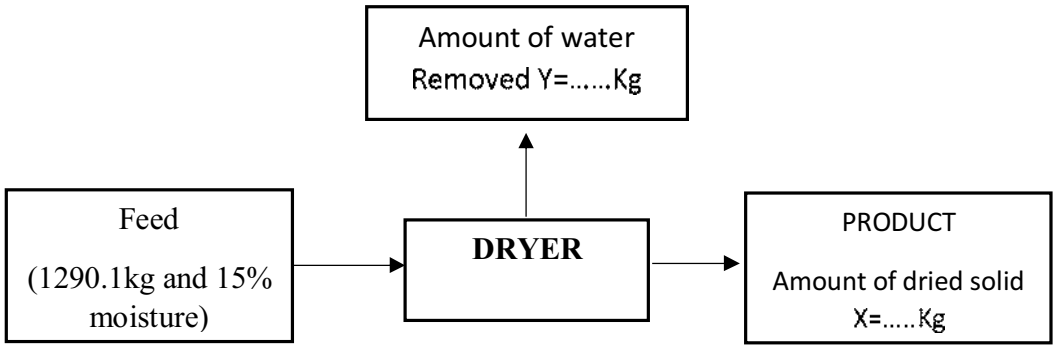

Figure 6.4, Material balance for rotary dryer

Weight of water in feed = 1290.1 × 0.15

= 193.515 Kg

Weight of solid in feed = 1290.1× 0.85

= 1096.85 Kg

While in drying the amount of moisture removed is more than that of the solids,

Therefore,

Amount of solid in feed = Amount of solid out

Therefore if the product contain 1% moisture apart from that 99% will be solid

Weight of solid in product,

$$0.99X = 1096.85$$

$$X = 1107.92 \text{ Kg}$$

Difference in the weight of solid in product and feed will give the water content in product

Weight of solid in product = (wt. solid in product — wt. of solid in feed)

$$= 1107.92 - 1096.85$$

$$= 11.07 \text{ Kg}$$

Weight of water removed(Y) = (wt. of water in feed — wt. of water in product)

$$= 193.515 - 11.07$$

$$= 182.445 \text{ Kg}$$

Percentage of water removed = $(182.445 \div 193.515) \times 100$

$$= 94.27\%$$

Input (1290.1Kg) = Water Removed (182.445Kg) + Dry Solids (1107.92Kg)

CHAPTER 7

Economic analysis

7.1 The economic analysis was estimated by calculating the following data:

1. Purchase Equipment Cost (PEC)

2. Total Direct Cost (TDC) and Total Indirect Cost (TIC)

3. Fixed Capital Investment (FCI)

4. Total Capital Investment (TCI)

5. Total Product Cost (TPC)

6. Profit or Loss

7. Pay Back period

7.1.1 Purchase Equipment Cost (PEC)

The cost was converted to Indian rupees (Rs) from Dollars (USD) using the following assumption:

The currency conversion factor of 75.62 Rupees (Rs) for one dollar (USD) was used. (Currency convertor, 21th March 2020)

Conversion = Price in Dollar (USD) x Currency Conversion factor

= USD x Rs 75.62

7.1: Equipment and their cost

S.no	Equipment	Amount	Price(USD)
1	Crusher	1	$ 35,000
2	Grinder	1	$ 40,000
3	Screening	1	$ 25,000
4	Extractor	1	$ 68,000
5	Rotary dryer	1	$ 27,000
6	Reactor	2	$ 44,000
7	Settling chamber	2	$ 20,000
8	Filter	2	$ 10,000
9	Storage tank	1	$ 40,000
10	Recycling unit	1	$ 33,000
11	Circulation pump	6	$ 3000

Table 7.2: Conversion table for purchased equipment

S.no	Equipment	Conversion of USD to Rs	Total Price of Equipment (Rs)
1	Crusher	35,000×75.62	2,646,700
2	Grinder	40,000×75.62	3,024,800
3	Screening	25,000×75.62	1,890,500
4	Extractor	68,000×75.62	5,142,160
5	Rotary dryer	27,000×75.62	2,041,740
6	Reactor	44,000×75.62	3,327,280
7	Settling chamber	20,000×75.62	1,512,400
8	Filter	10,000×75.62	756,200
9	Storage tank	40,000×75.62	3,024,800
10	Recycling unit	33000×75.62	2,495,460
11	Circulation pump	3000×75.62	226,860
		Total	26,088,900

The PEC was obtain by adding all equipment cost and the value is **Rs 26,088,900**

7.1.2 Total Direct Cost (TDC) and Total Indirect Cost (TIC)

The TDC and the TIC were calculated by using the following formula

a) Direct costs

Direct Cost = Percentage used x Purchased Equipment Cost

b) Indirect costs

Indirect Cost = Percentage used x Total Direct Cost

Table 7.3: Total Direct Cost calculations

Direct cost	**% taken**	**PEC(Rs)**	**Calculation**	**Costs(Rs)**
Purchase and equipment installation	0.45	26,088,900	0.45×26,088,900	11,740,005
Instrumentation and control	0.15	26,088,900	0.15×26,088,900	3,913,335
Piping	0.25	26,088,900	0.25×26,088,900	6.522,225
Electrical equipment and materials	0.12	26,088,900	0.12×26,088,900	3,130,668
Building & Services	0.30	26,088,900	0.30×26,088,900	7,826,670
Yard Improvement	0.11	26,088,900	0.11×26,088,900	2,869,779
Land	0.08	26,088,900	0.08×26,088,900	2,087,112
			Total direct cost	51,134,244

The TDC was obtained by adding all the direct cost and the value is **Rs 51,134,244**

Table 7.4: Total Indirect Cost calculations

Indirect costs	**% taken**	**PEC(Rs)**	**Calculation**	**Cost(Rs)**
Engineering and supervision	0.15	26,088,900	0.15×26,088,900	3,913,335
Construction expenses	0.32	26,088,900	0.32×26,088,900	8,348,448
Contractors fee	0.14	26,088,900	0.14×26,088,900	3,652,446
Contingency	0.22	26,088,900	0.22×26,088,900	5,739,558
			Total indirect cost	21,653,787

The TIC was obtained by adding all the indirect cost and the value is **Rs 21,653,787**

7.1.3 Fixed Capital Investment (FCI)

The FCI was obtained by using the equation

Fixed Capital Investment = Total Direct Cost + Total Indirect

Cost FCI = TDC + TIC

= 51,134,244 + 21,653,787

=72,788,031 Rs

The FCI of the process plant is **Rs** 72,788,031

7.1.4 Total Capital Investment (TCI)

The TCI has the following equation:

Total Capital Investment = Fixed Capital Investment + Working

Capital TCI = FCI + WC

Assumption: The percentage of the WC assumed was 10% of the TCI. When the WC represents a percentage of 10%,

TCI = FCI + 0.01 TCI

TCI = (FCI/ 0.9)

TCI = Rs (72,788,031 / 0.9) = **Rs 80,875,590**

WC = Rs (0.1 x72,788,031) = Rs 7,278,803

7.1.5 Total Product Cost (TPC)

Table 7.5: Total Product Cost (TPC) calculations

Total product cost	**Calculation**	**Rs**
Raw materials(chemicals)	Rs ,100,000×1 day	100,000/days
Fixed Charges	10 % TPC	0.1 TPC
Plant Overhead Cost	10 % TPC	0.1 TPC
Administrative Cost	3%TPC	0.03 TPC
Distribution & Selling	5%TPC	0.05 TPC
General expenses	8%TPC	0.06 TPC
	Total product cost	**100,000+0.34TPC**

TPC = Rs (100,000+0.34TPC)

TPC = Rs 151,515/day

The value obtained for the TPC was Rs **151,515/day**.

7.1.6 Profit/Loss

Profit/Loss = Revenue – TPC

The revenue of the process plant will be considered Rs 350,000

The Profit encountered by the process plant is = Rs (350,000 –151,515) = **Rs 198,485**

7.1.7 Pay Back period

The payback period of the process plant was determined by using the equation:

$$\text{Pay back period} = \frac{\text{Total capital investiment}}{\text{profit/loss per year}}$$

When:

(i). TCI of the plant is Rs **80,875,590**

(ii). And the Profit obtained per year is Rs 71,454,600

The payback of the process plant = (80,875,590/71,454,600)

= 1.13 years

Table 7.6: Economic analysis calculations

Purchase Equipment Cost	**Rs 26,088,900**
Fixed Capital Investment	**Rs 72,788,031**
Total Capital Investment	**Rs 80,875,590**
Total Product Cost	**Rs 151,515/day**
Profit	**Rs 198,485**
Pay Back period	**1.13 years**

CHAPTER 8

CONCLUTION

From this report an optimum pH of 7.0, optimum dosage of 0.5g/ml and stirring time of 8 minutes were obtained respectively. Also, when custard apple seed cake was used in combination with alum higher colour, turbidity, pH, TSS, TDS, TS, BOD, COD, Alkalinity and Chloride removal were observed. However the recommended ratio for the combined coagulant dose was 80% custard apple seed cake powder and 20% alum as best water treatment was obtained. This therefore establishes that custard apple seed cake powder as a natural coagulant can be more efficient when used with 20% alum as a coagulant aid. From the results obtained, custard apple seed has been found to be a potential natural coagulant for tannery effluent treatment. Medium turbid water from tannery effluent was used as case study and a good efficiency of about 89% was obtained.

CHAPTER 9

REFERANCE

1. **Global Journal of Researches in Engineering**: C Chemical Engineering Volume 15 Issue 1 Version 1.0 Year 2015, **Water Melon Seed as a Potential Coagulant for Water Treatment** By **I.M. Muhammad, S. Abdulsalam, A. Abdulkarim & A.A. Bello**
2. Muyibi, S.A., Ali, E.N. and Salleh, H.M. (2009) 'Moringa oleifera seeds as natural coagulant for water treatment', Thirteenth International Water Technology Conference, vol. 13, no. 2, pp. 1-10.
3. Deshpade L. (2010). Water quality analysis laboratory methods.National Environmental Engineering Research conference, New Delhi. pp. 137 – 139.
4. WHO (2004).Guidelines for drinking water quality 3rd Edition vol. 1 pp 371 – 372.
5. P. A. Lo Monaco, A. T. Matos, I. C. Ribeiro, F. d. Nascimento, and A. P. Sarmento, "Utilização de Extrato de Sementes de *Moringa* como Agente Coagulante no Tratamento de Água para Abastecimento e Águas Residuárias," *Ambi-Agua*, vol. 5, no. 3, pp. 222–231, 2010.View at: Publisher Site | Google Scholar
6. K. C. Valverde, L. C. K. Moraes, M. C. Bongiovani, F. P. Camacho, and R. Bergamasco, "Coagulation diagram using the Moringa oleifera Lam and the aluminium sulphate, aiming the removal of color and turbidity of water," *Acta Scientiarum - Technology*, vol. 35, no. 3, pp. 485–489, 2013.View at: Publisher Site | Google Scholar
7. S. Kawamura, "Effectiveness of natural polyelectrolytes in water treatment," *Journal - American Water Works Association*, vol. 83, no. 10, pp. 88–91, 1991.View at: Google Scholar

8. Madhavi T.F. and Rajkumar R. (2013).Utilization of natural coagulant for reduction of turbidity from waste water. International J. Chem. Tech. Research., 5(3): 1119 – 1123.
9. Vlyssides A.G., Karlis P.K., Rori N., and Zorpas A.A. (2002).Electrochemical treatment in relation of pH of domestic waste water using electrodes. J. Hazard Mater., 95: 215 – 226.
10. Adejumo, M., Oloruntoba, E.O. and Sridhar, M.K. (2013) 'Use of Moringa oleifera (lam.) Seed powder as a coagulant for purification of water from unprotected sources in Nigeria', European Scientific Journal, vol. IX, no. 24.
11. Arnoldsson, E., Bergman, M., Matsinhe, N. and Persson, K. (2008) 'Assessment of drinking water treatment using Moringa oleifera natural coagulant', VATTEN, pp. 137–150.
12. Daniyan, Y.S., Enemaduku, A.M. and Eru, E.O. (2011) 'The use of moringa seed extract in water purification', International journal of research in Ayrveda & pharmacy, vol. 2, no. 4, pp. 1265-127.
13. Deshpande, L. (2010) 'Water quality analysis laboratory methods', National Environmental Engineering Research Conference
14. Doerr, B. (2005) 'Moringa water treatment: ECHO technical note', Education Concerns for Hunger Organization (ECHO), North Fort Myers, Fla.
15. Ebeling, J.M., Ogden, S.R., Sibrell, P. And Rishel, K. (2004) 'Application of chemical coagulation aids for the removal of suspended solids (TSS) and phosphorus from the microscreen effluent discharge of an intensive recirculating aquaculture system', North American Journal of Aquaculture, no. 66, pp. 198–207.

16. Ghebremichael, K.A. (2004) Moringa seed and pumice as alternative natural materials for drinking water treatment, Unpublished PhD thesis, KTH Land and Resource Engineering

17. Adejumo, M., Oloruntoba, E.O. and Sridhar, M.K. (2013) 'Use of Moringa oleifera (lam.) Seed powder as a coagulant for purification of water from unprotected sources in Nigeria', European Scientific Journal, vol. IX, no. 24.

18. Arnoldsson, E., Bergman, M., Matsinhe, N. and Persson, K. (2008) 'Assessment of drinking water treatment using Moringa oleifera natural coagulant', VATTEN, pp. 137–150.

19. Daniyan, Y.S., Enemaduku, A.M. and Eru, E.O. (2011) 'The use of moringa seed extract in water purification', International journal of research in Ayrveda & pharmacy, vol. 2, no. 4, pp. 1265-127.

20. Deshpande, L. (2010) 'Water quality analysis laboratory methods', National Environmental Engineering Research Conference, New Delhi.

21. Doerr, B. (2005) 'Moringa water treatment: ECHO technical note', Education Concerns for Hunger Organization (ECHO), North Fort Myers, Fla.

22. Ebeling, J.M., Ogden, S.R., Sibrell, P. And Rishel, K. (2004) 'Application of chemical coagulation aids for the removal of suspended solids (TSS) and phosphorus from the microscreen effluent discharge of an intensive recirculating aquaculture system', North American Journal of Aquaculture, no. 66, pp. 198–207.

23. Ghebremichael, K.A. (2004) Moringa seed and pumice as alternative natural materials for drinking water treatment, Unpublished PhD thesis, KTH Land and Resource Engineering.

ISOLATION OF CHITIN FROM SHELL WASTE OF *Scylla serrata* AND FORMULATION OF CHITIN DERIVATIVE (CHITOSAN)

PROJECT REPORT

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DECLARATION

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ABSTRACT

Extraction and depolymerisation of chitin and chitosan from Scylla Serrata was carried out using various chemical procedures. Scylla serrata is one of the most used and predominant marine animal and its waste is one of the agricultural waste. So in order, as a management method, this process is being used. Sodium hydroxide and hydrochloric acid solutions were used for deproteination and demineralization. Respectively, acetone was used for decolourisation. The chitin was deacetylated using sodium hydroxide at 100°C and the influence of the concentration of the reagent and duration of the reaction was investigated. The degree of deacetylation (DD) of the chitosan was evaluated by FTIR and UV spectroscopy. From these results taken from the FTIR, UV spectroscopy and HPLC indicates several ideas and presence of the Chitin and Chitosan in the given feed of the shell powder of the Crab or Scylla serrata. From the FTIR it represents the presence of functional groups like Amide, Azide, C=O, C-H etc as the primary functional groups which are important in the presence of the primary product of Chitosan. From the UV spectroscopy it is also concluded that the functional groups having great peaks and it is also concluding the more percentage of presence of the amine in the product. All this analysis concludes that higher concentration has high quality.

Key words: Biomaterial, Chitin, Crab shells, and Deacetylation.

IN -VITRO ANTI-DIABETIC ACTIVITY AND GC-MS ANALYSIS OF *PHYALLANTHUS NIRURI* EXTRACTS

A PROJECT REPORT

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ABSTRACT

Phyllanthus Niruri means (Keezhanelli) is used in herbal medicine for treatment of diabetes. The objective of this study was to investigate the Anti-Diabetic analysis of *phyllanthus niruri* using *In-vitro* α-amylase assay on methanolic and chloroform extract. Methanolic and Chloroform extracts of the plants were prepared by Soxhlet extraction. Distillation is partial separation that increase the concentration of sample in the solvent extract. The bio active components of methanol and chloroform extracts were evaluated by GC-MS analysis**.** Preliminary phytochemical screening of different extracts of *phyllanthus niruri* revealed the presence of alkaloids, proteins, amino acid, flavonoids, tannins, phenolic compounds, saponins and phytosterols.972.91 µl of chloroform extract have IC_{50} and 449.03 µl methanolic extracts have IC_{50}. Methanolic extracts of the plant showed maximum anti diabetic activity as compared the chloroform extracts. Methanolic extract of *phyllanthus niruri* showed the presence of nine bioactive components. Humulin and Betulin is present in the *phyllanthus niruri* methanolic extracts with peak area highest percentage (11.82 %) and used to control Insulin level in blood cell.The findings indicate that all the above plant extracts possess anti-diabetic properties too varying degrees. They can used to developed natural drugs which may be used in lieu of commonly used strong allopathic drug which possess a number of harmful side effects.

Key words:

Phyllanthus niruri, Anti-diabetic activity, GC –MS Analysis, Soxhlet extraction*, In Vitro* α - amylase assay.

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LIST OF ABBREVIATIONS

ABBREVIATION	MEANING
IC_{50}	Inhibitory Concentration
SE	Soxhlet Extraction
PLE	Pressurized Liquid Extraction
G	Gram
DMS	Dimethyl Sulfoxide
RNA	Ribonucleic Acid
^{o}C	Celsius
K	Kelvin
L	Liter
Kg	Kilogram
Rpm	Revolutions Per Minute
Ml	Milliliters
m^3	Cubic Meter
Cm	Centimeter
cm^3	Cubic Centimeter
Mm	Millimeter
S	Second
OD	Observed Deviation
GC	Gas Chromatography
MS	Mass Spectrometry
µm	Micro Meter
S	Second
min	Minutes

CHAPTER-I

INTRODUCTION

CHAPTER-I

INTRODUCTION

Worldwide, the number of people living with and dying of diabetes and its associated complications is very high and still increasing. Diabetes is chronic disorder caused by partial or complete insulin defiency, resulting hyperglycemia leading to acute and chronic complications. Diabetes is defined as inappropriate regulation of protein, carbohydrate and lipid metabolism by insulin and results in increasing fasting and postprandial plasma glucose. The total number of people with diabetes is projected to increase from 171 million in 2000 to 366 million in 2030. India is second largest country with the highest number of diabetics worldwide in 2019.

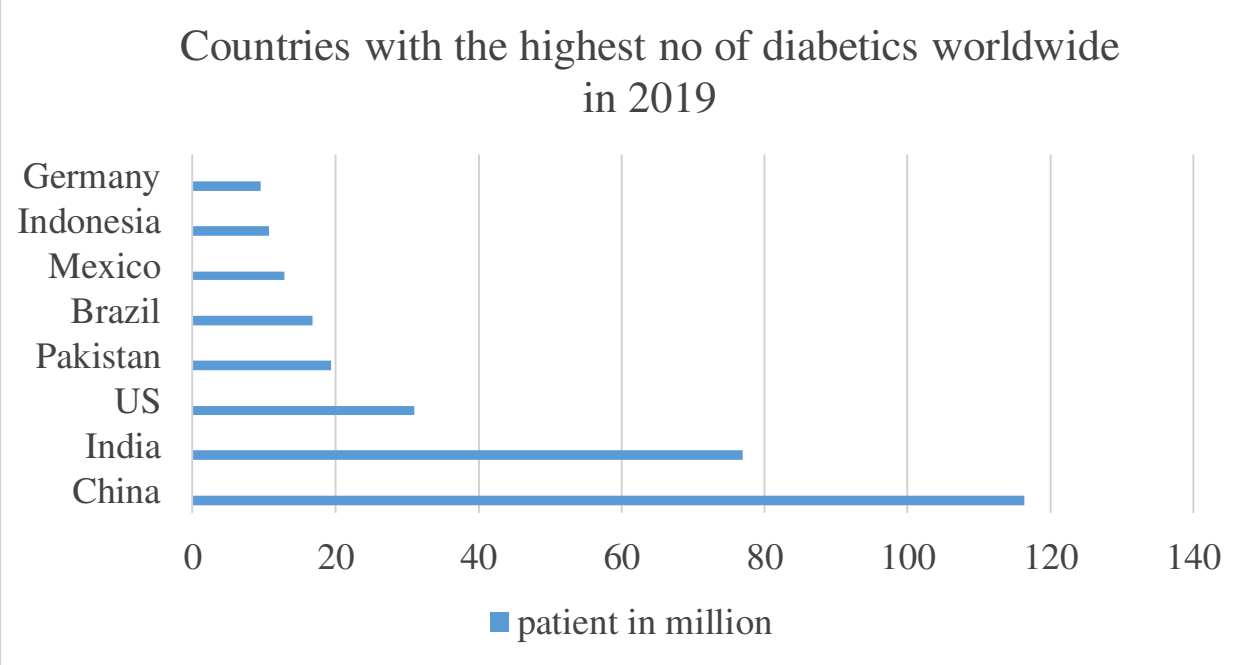


Figure 1.1 Worldwide diabetics' graph

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion. Food habits and genetic factors are responsible for diabetes. A study revealed that urbanization of rural India has doubled the rate of diabetes. In India, between 1995 and 2025, the number of people with diabetes is projected

to rise from 19 to 57 million. As per the National Urban Diabetic Survey, the incidence of diabetes was found to be high (Hyderabad 16.6%, Chennai 13.5%, Bangalore 12.4%, Kolkata 11.7%, Delhi 11.6%, and Mumbai 9.3%). Of all these diabetic populations, 80% account for Type 2 diabetes. Clinical studies on different species of animals have shown that consuming less food (caloric restrictions) reduces the risk of diabetes and heart disease. Current treatment for Type 2 diabetes remains inadequate, prevention is preferable.

Three major diabetes types can develop: Type 1, Type 2 and gestational diabetes.

Type I diabetes: Also known as juvenile diabetes, this type occurs when the body fail to produce insulin. People with this type of diabetes are insulin-dependent, which means they must take artificial insulin daily to stay alive.

Symptoms:

- Extreme hunger
- Increased Thirst
- Unintentional weight loss
- Frequent urination
- Blurry vision
- Tiredness

Type 2 diabetes: Type II diabetes affects the way the body uses insulin. While the body still makes insulin, unlike in type I, the cells in the body do not respond to it as effectively as they once did. This is the most common type of diabetes, according to the National Institute of Diabetes and Digestive and Kidney Diseases, and it has strong links with obesity.

Symptoms:

- Increased hunger
- Increased thirst
- Increased urination
- Blurry vision
- Tiredness
- Sores that are slow to heal

Gestational diabetes: This type occurs in women during pregnancy when the body can become less sensitive to insulin. Gestational diabetes does not occur in all women and usually resolves after giving birth. Less common types of diabetes include monogenic diabetes and cystic fibrosis-related diabetes.

CAUSES OF DIABETES

Different causes are associated with each type of diabetes.

Type 1 diabetes

Doctors don't know exactly what causes type 1 diabetes. For some reason, the immune system mistakenly attacks and destroys insulin-producing beta cells in the pancreas. Genes may play a role in some people. It's also possible that a virus sets off the immune system attack.

Type 2 diabetes

Type 2 diabetes stems from a combination of genetics and lifestyle factors. Being overweight or obese increases your risk too. Carrying extra weight, especially in your belly, makes your cells more resistant to the effects of insulin on your blood sugar.

This condition runs in families. Family members share genes that make them more likely to get type 2 diabetes and to be overweight.

Gestational diabetes

Gestational diabetes is the result of hormonal changes during pregnancy. The placenta produces hormones that make a pregnant woman's cells less sensitive to the effects of insulin. This can cause high blood sugar during pregnancy. Women who are overweight when they get pregnant or who gain too much weight during their pregnancy are more likely to get gestational diabetes.

Alternative medicine particularly herbal medicines are available for the treatment of diabetes. Common advantages of herbal medicine are effectiveness, safety, affordability and acceptability. Medicine plants and their products have been used in the Indian traditional system of medicine and have shown experimental or Clinical anti-diabetic activity.

Furthermore, World Health Organization has also recommended the evaluation of traditional of traditional plant treatments of diabetes. *Phyllanthus Niruri* is an herbal plant indigenous to India and is locally known as. It is commonly found in tropical regions and in other countries. *Phyllanthus Niruri* is popularly Folk medicine for treating kidney and gallbladder stones, Liver related disease such as jaundice and liver cancer, viral infection such as hepatitis and tuberculosis, malaria diabetes and fever .In scientific studies, *Phyllanthus Niruri* was found to exhibit antispasmodic, hypotensive, analgesic, anti-hepatotoxic, anti-hepatitis, anti-mutagenic, antiviral and antibacterial properties.

1.2. *Phyllanthus niruri*

Phyllanthus niruri is a widespread tropical plant commonly found in coastal areas, known by the common names gale of the wind, stonebreaker or seed-under-leaf. It is a relative of the spurges, belonging to the genus *Phyllanthus* of the family Phyllanthaceae. *Phyllanthus*

niruri, also known as Bhumyamalaki, Keezhanelli (Malayalam, Tamil) has been used in Ayurveda, Siddha for problems of the stomach, genitourinary system, liver, kidney, and spleen, and to treat chronic fever.

Amazonian tribes historically used *Phyllanthus niruri* to treat kidney stones and gallstones, naming it Chanca piedra or Quebra-pedra, respectively, Spanish and Portuguese terms for stonebreaker. *Phyllanthus niruri* is nowadays marketed as an herbal remedy under the name Chanca piedra.

1.2.1. SCIENTIFIC CLASSIFICATION

Figure 1.2 *Phyllanthus Niruri*

Kingdom	Plantae
Sub Kingdom	Viridiplantae
Super Division	Embryophyta
Class	Magnoliopsida
Superorder	Rosanae
Order	Malpighiales
Family	Phyllanthaceae
Genus	Phyllanthus
Species	Phyllanthus niruri

Table 1.1 scientific classification of *p.niruri*

Domain: Eukaryote

Phyllanthus niruri is eukaryote, an organism with complex cells or single cell with complex structures. In these cells the genetic material is organized into chromosomes in the cell nucleus.

Kingdom: Plantae

Plantae is the plant kingdom which contains all plants on earth. Plants are mainly multicellular, non-motile, predominantly photosynthetic eukaryotes of the kingdom Plantae.

Sub Kingdom: viridiplantae

Viridilplantae (green plants) are the clade which includes the green algae and land plants.

Super Division: Embryophyta

The Embryophyta, or land plants, are the most familiar group of green plants that form vegetation on earth. It is a subkingdom of plantae that includes all plants producing an embryo and developing vascular tissue and comprises the embryophytes.

Class: Magnoliopsida

Magnoliopsida is a valid botanical name for a class of flowering plants. Magnoliopsida or dicotyledens is the name of a class of plants in taxonomy. They are also called dicots.the veins of their leaves are usually net like and their roots contain a taproot (main root).Lateral roots then grow off from the taproot.

Superorder: Rosanae

A phylogenetic classification of the land plants to accompany APG III. It is a superorder of plants.

Order: Malpighiales

The malpighiales comprise one of the largest order of flowering plants, containing about 16000 species. Plants in the malpighiales are characterized by having simple leaves and reduced unisexual flowers.

Family: Phyllanthaceae

Most plants in the Phyllanthaceae family are tropical in distribution. The family is mostly herbs, but contains shrubs and trees as well. Members of this family also have simple alternatively arranged leaves.

Genus: Phyllanthus

Plants in the genus phyllanthus are characterized by having flowers on their leaves.

Species: phyllanthus niruri

Phyllanthus niruri means leaf flower translates to break stone. . It grows 50–70 cm (20–28 in) tall and bears ascending herbaceous branches. The bark is smooth and light green. It bears numerous pale green flowers which are often flushed with red. The fruits are tiny, smooth capsules containing seeds.

1.3. Nutrient composition

The phyllanthus niruri contain alkaloids, lignans, amarin, gernanin, corliagin and rutin.

1.4. Health benefits

1. It has Anti-Oxidant properties

According to a 2005 *In Vitro* study, an extract made from phyllanthus niruri leaves showed strong antioxidant activity. Antioxidants fight free radicals in the body that may cause cell damage and disease. Antioxidants are compounds that inhibit oxidation. Oxidation is a chemical reaction that can produce free radicals, thereby leading to chain reactions that may damage the cells of organisms. Antioxidants such as thiols or ascorbic acid terminate these chain reactions.

2. It has Anti-Plasmodical properties

According to 2013 studied by obidike Ifeoma, phyllanthus niruri extract has Anti-Plasmodical abilities against *H. pylori* bacteria. *H. pylori* bacteria are common in the digestive tract and are usually harmless. But in some cases, they can lead to peptic ulcers, abdominal pain, and nausea.

3. It has anti-inflammatory properties

Inflammation can cause many problems throughout the body, including skin conditions like psoriasis and chronic pain. According to a 2013 studied by cinithira, phyllanthus niruri may help reduce inflammation.

For the study, researchers injected carrageenan into the left hind paws of rats to cause inflammation. The rats were then treated with phyllanthus niruri extract, which was found to significantly reduce the inflammation.

4. It may help protect against ulcers

Findings from the same also suggest that phyllanthus niruri extract can help prevent ulcers. It's thought to reduce gastric acid secretion and protect the stomach. It also showed potent anti-inflammatory effects against gastric ulcers.

5. It may help lower blood sugar

Phyllanthus niruri may also have Anti-Diabetic properties. According to a 2011 study Trusted Source, the plant's aerial parts may help prevent glucose absorption and improve glucose storage. This may help maintain blood sugar levels.

6. It may help prevent kidney stones

Phyllanthus niruri may be best known as a kidney stone remedy. According to 2010 research, many studies have shown that it's a powerful kidney stone deterrent.

Phyllanthus niruri can help relax the ureter after lithotripsy to help stones pass. Lithotripsy is a procedure used to break up stones in the urinary tract. It may also prevent stones from forming in the first place by stopping the crystals that form them from clumping together.

7. It may improve liver health

According to a 2017 study Trusted Source on rats, phyllanthus niruri may help treat nonalcoholic fatty liver disease and atherosclerosis. Both conditions may cause insulin resistance. The study found phyllanthus niruri decreased insulin resistance and reduced the amount of fatty acids in the liver.

A 2006 study Trusted Source on mice also found that the antioxidants in phyllanthus niruri may help protect the liver from acetaminophen toxicity.

8. It may help treat acute hepatitis B

Phyllanthus niruri may help treat acute hepatitis B infections due to its anti-viral and liver-protecting abilities. In a 2010 study Trusted Source, 60 people with the condition received either a placebo or a product made of seven herbal medicines including 100 milligrams of phyllanthus niruri. The herbal medicine group experienced faster recovery than the placebo group. However, they reported side effects like upper abdominal pain and diarrhea.

Phyllanthus niruri may not help chronic hepatitis B, though. A 2011 review of 16 randomized trials on people with chronic hepatitis B didn't find any significant evidence in support of the treatment.

9. It may be anti-cancerous

Phyllanthus niruri and other phyllanthus species may help prevent the metastasis of some lung and breast cancers. A 2011 study Trusted Source showed the polyphenols in the herb help prevent the invasion, migration, and adhesion of cancer cells.

A 2012 study Trusted Source on human colorectal and liver cancer cell lines also found that phyllanthus niruri helped slow cancer cell growth and encouraged cancer cell death.

CHAPTER-II
LITERATURE REVIEW

CHAPTER-II

LITERATURE REVIEW:

Obidike Ifeoma et al,. To investigate the antiplasmodial activity of Phyllanthus niruri (P. niruri) methanol extract (ME) and its fractions in mice. P. niruri methanol extract and its chloroform, ethanol and aqueous portions were tested against chloroquine-sensitive Plasmodium berghei berghei in early, established and repository models of infection using Knight and Peter's 4-day suppressive model, Ryley and Peters curative model and Peters prophylactic model respectively. Chemosuppression of parasitaemia (37.65%-50.53 %) was elicited by 100-400 mg/kg (b.w.) of ME. At doses of 100 mg/kg b.w., the chloroform fraction (F1) significantly ($P<0.01$) suppressed parasitaemia by 85.29%, while ethanol and aqueous fractions (F2 and F3, respectively) elicited 67.06% and 51.18% chemosuppression. The most active fraction, F1 was selected for further antiplasmodial screening. In established infection, ME reduced parasitaemia (15.81% - 62.96%) while F1 significantly ($P<0.01$) reduced parasitaemia (44.36%-90.48%), with effects comparable to that of chloroquine (96.48%). The prophylactic antiplasmodial activity of ME (92.50% suppression) was also significant ($P<0.01$) and was more effective than pyrimethamine (85.00%). Additionally, cell membrane integrity of non-parasitized erythrocytes incubated with 125-500 mg/mL F1 was maintained.These findings indicate the antiplasmodial efficacy of P. niruri methanol extract, and the localization of this effect in its chloroform fraction.

Gulam Mohammed Husain et al,. The aim of the present study was to evaluate the efficacy of a standardized methanol extract of Quassia amara L. (Family: Simaroubaceae) in nicotinamide–streptozotocin-induced diabetic rats. Non insulin dependent diabetes mellitus was induced by streptozotocin in rats pre-treated with nicotinamide. Diabetic rats were treated with oral doses of Quassia amara extract (QaE; 100 and 200mg/kg) or glibenclamide (10mg/kg; as standard). QaE and glibenclamide were administered as a suspension in 0.3% carboxy methyl cellulose for 14days. Control animals received an

equal volume of vehicle. Blood samples were collected by retro-orbital puncture on day 14 , 1h after last treatment. Plasma glucose, insulin and lipid parameters (total cholesterol, LDL-C, HDL-C and triglycerides) were measured using commercially available biochemical kits. The oral glucose tolerance test was performed to evaluate the effect of the extract on peripheral glucose utilization in normal rats. Both doses of QaE significantly ($p<0.01$) reduced elevated fasting blood glucose levels in diabetic rats. In the oral glucose tolerance test, QaE treatment significantly increased ($p<0.05$) the glucose tolerance compared with the vehicle. QaE and glibenclamide, effectively normalized dyslipidemia associated with streptozotocin-induced diabetes. The findings of the present study indicate that Quassia amara extract may be potentially valuable in the treatment of diabetes and associated dyslipidemia.

Nur Aqilah Kamarudin1 et al,. Phyllanthus niruri, Orthosiphon stamineus and Labisia pumila are the three herbs listed in Malaysian National Key Economic Areas (NKEA). This study was conducted to determine the herbs extract yields and activities on antioxidant and cytotoxicity properties. Methods/Statistical Analysis: Cold maceration and soxhlet were the extraction methods employed and water, ethanol and 50% ethanol (v/v) were chosen as solvents. Findings: The results showed 50% ethanol (v/v) was the best solvent for all three herbs in terms of extraction yield. For cold maceration, the extract yields were 14.3%, 17.4% and 7.6% for P. niruri, O. stamineus and L. pumila, respectively. Whilst for soxhlet method, the same trend was observed where 50% ethanol (v/v) gave the highest extract yield of 21.2%, 14.3% and 6.8% for P. niruri, O. stamineus and L. pumila, respectively. Total phenolic content and antioxidant capacity were also highest using 50% ethanol and soxhlet method for all herbs. Application/Improvements: This shows that the food-grade solvents at a certain concentration are suitable for the best extraction of selected herbs.

A. Kumaran et al,. In this study, the antioxidant activity of methanol extracts of five plants from the genus Phyllanthus was evaluated by various antioxidant assays, including total antioxidant, free radical scavenging, superoxide anion radical scavenging, hydrogen

peroxide scavenging, nitric oxide scavenging, reducing power and metal ion chelating activities. The various antioxidant activities were compared to standard antioxidants such as butylated hydroxytoluene and ascorbic acid. All the extracts showed strong antioxidant activity in all the tested methods. Among the five plants Phyllanthus debilis has been found to possess the highest activity in all tested models, the activity decreased in the order*Phyllanthusdebilis*,*Phyllanthusurinaria*,*Phyllanthusvirgatus*,*Phyllanthusmaderaspatensis,Phyllanthus amarus*. In addition to the antioxidant activity of these plants, the total phenolic compounds, flavonoids and flavonols were measured in the extracts. A correlation between the antioxidant activity and total phenolic content was observed.

Masturah Markom et al,. Effects of solvent types and extraction methods (solvent extraction (SE), supercritical fluid extraction (SFE) and pressurized water extraction (PWE)) were investigated for effective recovery of bioactive hydrolysable tannins from *Phyllanthus niruri* Linn. Various organic and aqueous solvents screened by Soxhlet method showed that the gallic acid and ellagic acid contents increased with water content whereascorilaginyield reached maximum value at 30% (v/v) ethanol in water.At a fixed temperature, solvent extraction by Soxhlet is the best method for galli can dellagic acid extractions, whereas pressurized methods are better for the corilagin extraction. Even though exhaustive extraction is achieved fastest by PWE, SFE with the addition of ethanol–water cosolvent is superior in terms of low liquid solvent consumption and component fractionation produced. Solvent polarity, solvent-to-solid ratio and contact time play significant roles in determining the most efficient method for tannin extraction.

Malinee Wongnawa et al., This study investigated the glucosidase inhibitory effect and determined the concentration of some inorganic constituents in *P. amarus* ash. Oral glucose and sucrose tolerance test were performed on normal mice. *In vitro* glucosidase inhibitory activity was evaluated by using yeast a-glucosidase. The element concentrations were measured by inductively coupled plasma (ICP) spectroscopy. Single oral administration of *P. amarus* ash did not show antihyperglycemic effect after glucose administration, but decreased blood glucose level after sucrose administration. The

ash showed glucosidase inhibitory activity *in vitro* with IC_{50} of 982 mg/mL. The concentrations of K, Ca, Mg, Mn, Fe, Zn, Cu, Pb, Cr, Ni and Co in *P. amarus* ash were 35049.80±340.64, 3337.24±52.10, 1368.52±13.29, 90.81±1.34, 87.68±1.15, 18.28±0.22, 4.69±0.07 , 1.07±0.15, 0.29±0.03, 0.20±0.04 and 0.10±0.02 mg/g, respectively. These results indicate that the antihyperglycemic effect of *P. amarus* ash might be partly due to the glucosidase inhibitory activity of the inorganic constituents.

Hind Laoufi et al,. The purpose of present study was to investigate the effects of extracts of *O. angustissima* a traditional medicinal plant, on α-amylase and α-glucosidase activities *in vitro.* The air-dried aerial parts of *O. angustissima* flowers, leaves and stems were extracted with distilled water (AE) and aqueous methanol (MeOH-H_2O); ethyl acetate (EtAOc) and n-butanol extracts (n-BuOH) were obtained from MeOH-H_2O crude extracts per liquid/liquid strongest activity in case of α- glucosidase was shown by MeOH-H_2O and n-BuOH extracts of *O. angustissima* with IC_{50} value 0.94 and 0.99 mg/mL, respectively, whereas AE and EtOAc extract showed 1.10 and 1.17 mg/mL as IC_{50} value respectively compared with the standard acarbose having IC_{50} value 0.046 mg/mL. Whereas the higher activity in case of α-amylase inhibition, was found in MeOH-H_2O extract (IC_{50} = 2.01 mg/mL) followed by AE (2.52 mg/mL) and n-BuOH extract (2.88 mg/mL) respectively, compared with extraction. The results of the both enzyme inhibition activity was found in a dose-dependent manner, The acarbose having IC_{50} value of 0.044 mg/mL. All extract from this plant possess moderate α-amylase inhibition with potent α-glucosidase inhibitory activity which may offer better therapeutic strategy to minimized postprandial hyperglycemia and its complications.

Gladis Raja Malar Chelladurai et al,. Our present investigation deals with thphytochemical screening, estimation of totalflavonoids, terpenoids and tannin contents to evaluate the anti-diabetic activities of *Salacia oblonga* stem followed by GC-MS analysis. It explores the natural compounds and the potential α-amylase and α-glucosidase inhibitory actions of stem extracts. The aqueous stem extract was selected from other extracts (ethanol, acetone, petroleum ether and chloroform) for the *in vitro* study of anti-

diabetic activity by alpha amylase and alpha glucosidase inhibitory assays. The stem extract was also analyzed by gas chromatography mass spectrometry to identify the natural chemical components. Phytochemical analysis of aqueous stem extract showed major classes of secondary metabolites such as phenols, flavonoids, alkaloids, terpenoids, tannins, saponins. The total flavonoid, terpenoid, and tannin contents were quantified as 19.82±0.06 mg QE/g, 96.2±0.20 mg/g and 11.25±0.03 mg TAE/g respectively. The percentage inhibition of assays showed maximum inhibitory effects (59.46±0.04% and 68.51±0.01%) at a concentration of 100 mg/ mL. The IC_{50} values of stem extract was found to be 73.56 mg/mL and 80.90 mg/mL for alpha amylase and alpha glucosidase inhibition. Fifteen chemical constituents were found by GC-MS analysis. This study suggest the aqueous stem extract of *Salacia oblonga* might be considered as potential source of bio active constituents with excellent antidiabetic activity.

Iniyan G. Tamil et al,. The objective of this study was to evaluate the α-amylase inhibitory activity of different extracts of Phyllanthus amarus against porcine pancreatic amylase in vitro. Materials and The plant extracts were prepared sequentially with ethanol, chloroform, and hexane. Each extract was evaporated using rotary evaporator, under reduced pressure. Different concentrations (10, 20, 40, 60, 80, and 100 µg/mL) of each extract were made by using dimethyl sulfoxide (DMSO) and subjected to α-amylase inhibitory assay using starch azure as a substrate. The absorbance was read at 595 nm using spectrophotometer. Using this method, the percentage of α-amylase inhibitory activity and IC50 values of each extract was calculated.The chloroform extract failed to inhibit α-amylase activity. However, the ethanol and hexane extracts of P. amarus exhibited appreciable α-amylase inhibitory activity with an IC50 values 36.05 ± 4.01 µg/mL and 48.92 ± 3.43 µg/mL, respectively, when compared with acarbose (IC50 value 83.33 ± 0.34 µg/mL). Conclusion: This study supports the ayurvedic concept that ethanol and hexane extracts of P. amarus exhibit considerable α-amylase inhibitory activities. Further, this study supports its usage in ethnomedicines for management of diabete.

Cínthia R et al,. *Phyllanthus niruri* L., Euphorbiaceae, spray-dried standardized extract was studied for its anti-infl ammatory and antinociceptive activities in adult albino rats and mice. The anti-infl ammatory effect of spray-dried standardized extract was observed in carrageenan-induced paw edema and thioglycolate-induced leukocyte migration, while antinociceptive effects were observed using Randall & Selitto, tail fl ick, and hot plate tests. This study showed that intraperitoneal spray-dried standardized extract at 100, 200, 800, or 1600 mg/kg reduced the vascular response in the infl ammatory process of paw edema induced by 1% carrageenan. Oral spray-dried standardized extract at 100 or 200 mg/kg inhibited leukocyte migration to the site of infl ammation induced by 3% thioglycolate. In rats, at 100 and 200 mg/kg intraperitoneally, the extract exhibited a marked peripheral analgesic effect in a Randall & Selitto assay and showed signifi cant central analgesic activity in a hot plate and tail fl ick assay. In conclusion, this study suggested that *Phyllanthus niruri* spray-dried standardized extract has potent infl ammatory and antinociceptive activities and that these activities are not modifi ed by standard drying process, making it feasible to use the dry extract standardized to obtain a phytotherapic preparation and thus validating its use for the treatment of pain and infl ammation disordered.

Ezenyi Ifeoma Chinwude et al,. To evaluate the antiplasmodial properties of fractions of chloroform portion of (P. niruri) methanol extract and identify a suitable chemical marker present the structure of an antiplasmodial phytochemical sitosteryl-6- resonance and mass spectroscopies. Glucoside-6 -palmitate by the mean and mass spectrometry· Cell biology techniques were used to validate the bioactivity and the safety of the pant, thus justifying pharmaceutical standardization of authors have isolated and elucidated. It showed no significant cytotoxicity. antiplasmodial activity against isolated and identified as sitosteryl-using gradient systems of hexane, ethylacetate and methanol.There are activity and identify sitosteryl glucoside palmitate as a chemical marker of activity. It was evaluated using Phyllanthus niruri g/mL against parasites were further screened for

peripheral analgesic activity, while cytotoxicity Fractions Chloroform portion of -Oinduced writhing in mice, decreasing the number of writhes by ur findings illustrate anti-plasmodial column fractions of 12THP-14- were very active 1 cells. Plasmodium falciparum100P. niruriF6ractions - mg/kg aspirin β-D-(ICglucoside methanol extract was separated from silica gel 1250< and 10 µg/m(1365-6. exhibited significant 22'LHB-)% against palmitate by)3. and From fraction The fractions were screened for Plasmodium falciparumcM291HP. niruri. , Fractions with 1312C, a compound was (nuclear magnetic 66P<. with analgesic 670.%01 and) reduction IC6550 and .22<10%.

Saima Amjad et al,. It is now recognised that one of the most far reaching developments in the management of diabetes (Diabetes mellitus) is the targeted delivery of herbal nanoparticles using nano-pumps, smart cells, nanorobots, and nanotized herbal drugs (NHDs). The design, development and targeted delivery of NHDs has now become a frontier research area. Previous research on nano-herbal medicines such as the methanolic extract of Triphala churn nanoparticle, Costus pictus D. Don (insulin plant) silver nanoparticles, and Talinum portulacifolium solid lipid nanoparticles indicated the possibility of overcoming the drawbacks of conventional management of glucose and controlling the complications of diabetes such as delayed wound healing and the side effects of synthetic drugs. Curcumin loaded poly (caprolactone) nanofibers were also found to have beneficial effects for treating diabetic ulcers; hence, the scientific data available to support the exploration of various nanotized herbal drugs or phyto-constituents which are effective in diabetes treatment and have wound healing capability. This paper focuses on the integration of nanotechnology with herbal remedies for the effective management of diabetes.

Hang Fan et al,. Chicory (Cichorium intybus L.var. sativum L., Asteraceae) is a multipurpose plant cultivated as vegetable and coffee substitute in Europe and North America, also as folk medicine in China. The extracts from chicory roots showed

significant effect on inhibition against α-glucosidase. By a bioassay-guided approach, the chemical fraction with high α-glucosidase inhibition was found and its chemical profile was tentatively described by UPLC-Q-TOF/MS to include 28 compounds. Further chemical isolation yielded six compounds, their chemical structures were elucidated as 11β-13-dihydrolactucin (1), lactucin (2), 8-deoxylactucin (3), jacquinelin (4), 11β,13-dihydrolactucopicrin (5) and lactucopicrin (6), and among them, the compound 4 showed the strongest inhibitory activity against yeast α-glucosidase with IC50 value of 4.180 μM. The present results suggest that chicory roots can eventually exhibit anti-diabetic effect and the sesquiterpenes may be responsible for the activity.

DeepakKumara et al,. Potentilla fulgens is used extensively in traditional system of medicine and as a food additive for the treatment of diabetes mellitus and other ailments. The present study was aimed to isolate and identify the constituents with α-glucosidase inhibitory activity. The methanolic extract demonstrated potent inhibitory activity against α-glucosidase. Fractionation and purification by silica gel column chromatography and HPLC led to the isolation of five terpenes, namely, hyptadienic acid, tormentic acid, rosamultic acid, 2α,19α-dihydroxy-3-oxo-12-ursen-28-oic acid β-d-glucopyranoside ester and kajiichigoside F1 for the first time from this plant. Among these hyptadienic acid, which is an A-ring contracted triterpenoid, was found to be the most potent against α-glucosidase. This suggests that the A-ring contracted triterpenes may serve as a class of triterpenes with α-glucosidase inhibitory activity. Also, identification of enzyme inhibitory activity of these constituents explains the traditional use of P. fulgens in the management/treatment of diabetes. Quantitative estimation of the compounds was performed using HPLC and the method was validated

CHAPTER-III

MATERIALS AND METHODLOGY

CHAPTER-III

MATERIALS AND METHODLOGY

3.1. Materials Required

- Phyllanthus niruri
- Round bottom flask
- Conical flask
- Hot oven
- Storage container.

3.2. Equipment Required

- Soxhlet extractor
- Simple distillation
- Centrifuge
- Plate reader (565nm)
- Gas chromatography-Mass spectrometry.

3.3. Chemicals Required

- Methanol
- Chloroform
- Iodine-iodine indicator
- Acetyl buffer solution
- Alpha amylase solution

FLOW DIAGRAM

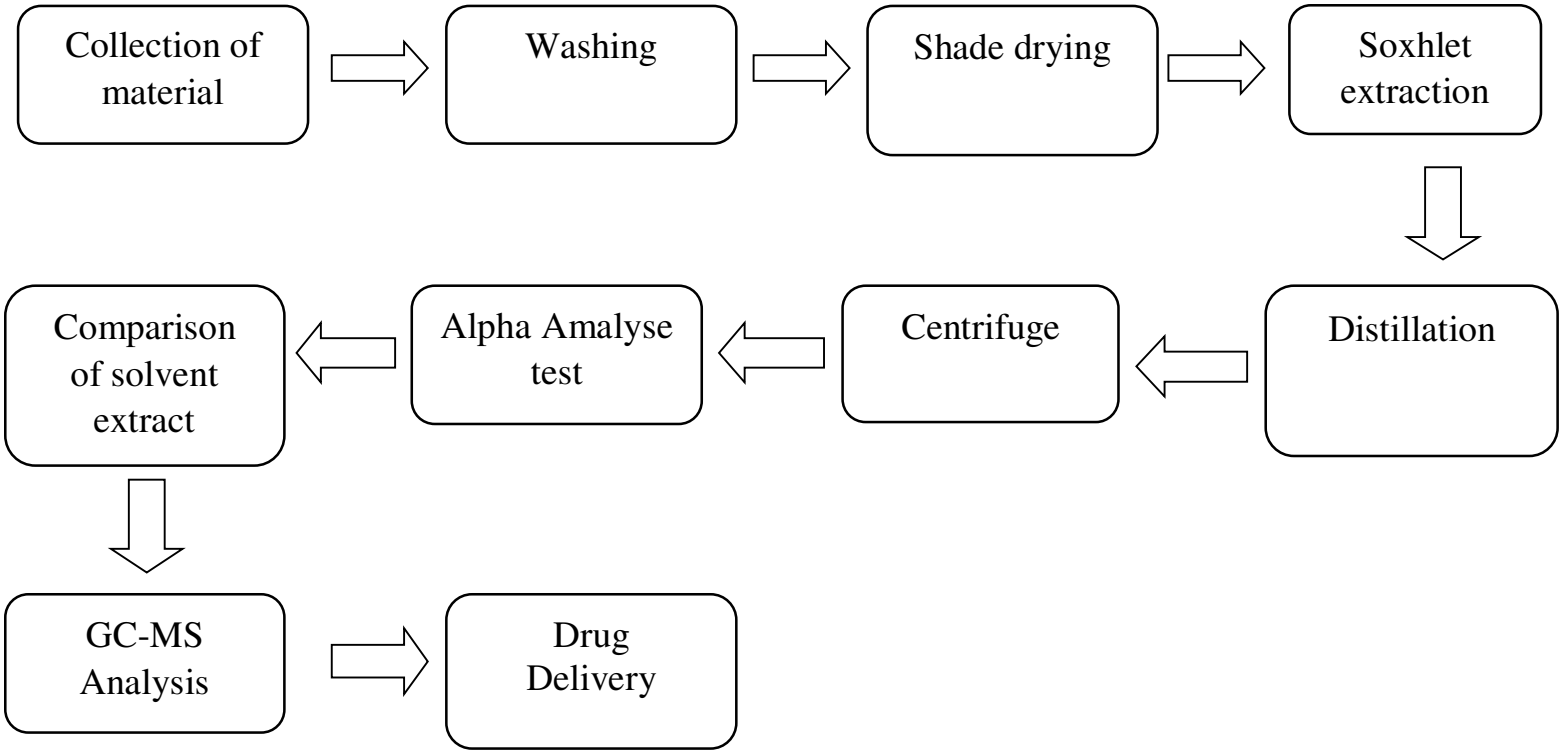


Figure 3.1 flow diagram

3.4. Method of Solid Liquid Extraction:

Solid liquid extraction is a separation process based on preferential dissolution of the preferential dissolution of one or more components of a solid mixture in a liquid solvent. The separation process of one or more components from a complex mixture requirement to several unit operations in food and chemical industries. Usually, the main objective of this operation is to extract a valuable component. The separation process can be classified according to the nature of the material submitted to separation, based on unit operations or classified by the type of phases in contact, such as solid liquid, liquid liquid, among others. Basically, the separation of substance from plants is classified as

solid-liquid extraction and can be carried out through conventional or non-conventional methods.

3.4.1. Conventional Extraction Methods

Conventional extraction method are defined as classical techniques based on the extraction capacity of different solvents and/or application of heat and shaking. The classical techniques for obtaining substance from plant are soxhlet extraction and maceration. Both techniques were already used to obtain extracts from plants by products. Masturah Markom and Masitah Hasan obtained *phyllanthus niruri* using soxhlet extraction, High pressure extraction and pressurized water extraction and result in extracted bioactive components.

The advantage of techniques is the simplicity of the systems and therefore, low cost to assemble the extraction unit. On the other hand, non-conventional techniques have drawbacks such as high extraction times, the use of large amounts of solvent, low selectivity, the need for solvent evaporation and decomposition of labile compounds. Thus, more environmentally friendly techniques that do not present health risks and provide high quality extracts may be applied.

3.4.1.1. Soxhlet Extraction

A Soxhlet extractor is a piece of laboratory apparatus invented in 1879 by Franz von Soxhlet. It was originally designed for the extraction of a lipid from a solid material. Typically, Soxhlet extraction is used when the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. It allows for unmonitored and unmanaged operation while efficiently recycling a small amount of solvent to dissolve a larger amount of material.

A Soxhlet extractor has three main sections: a percolator (boiler and reflux) which circulates the solvent, a thimble (usually made of thick filter paper) which retains the solid to be extracted, and a siphon mechanism, which periodically empties the thimble. The solvent is heated to reflux. The solvent vapour travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any solvent vapour cools, and drips back down into the chamber housing the solid material.

The chamber containing the solid material slowly fills with warm solvent. Some of the desired compound dissolves in the warm solvent. When the Soxhlet chamber is almost full, the chamber is emptied by the siphon. The solvent is returned to the distillation flask. The thimble ensures that the rapid motion of the solvent does not transport any solid material to the still pot. This cycle may be allowed to repeat many times, over hours or days.

During each cycle, a portion of the non-volatile compound dissolves in the solvent. After many cycles the desired compound is concentrated in the distillation flask. The advantage of this system is that instead of many portions of warm solvent being passed through the sample, just one batch of solvent is recycled.

After extraction the solvent is removed, typically by means of a rotary evaporator, yielding the extracted compound. The non-soluble portion of the extracted solid remains in the thimble, and is usually discarded.

Advantage of soxhlet extraction is that can be extracted multiple times. Compared with general soaking it has the advantage of small solvent dosage, high efficiency and complete extraction.

3.4.1.2. Maceration

In this process the whole or coarsely powdered crude drug is placed in a stoppered container with the solvent and allowed to stand at room temperature

for a period of at least 3 days with frequent agitation until the soluble matter has dissolved. The mixture then is strained, the marc (the damp solid material) is pressed, and combined liquids are clarified by filtration or decantation after standing. Maceration is the winemaking process where the phenolic materials of the grapetannins, coloring agents (anthocyanins) and flavor compounds are leached from the grape skins, seeds and stems into the must. To macerate is to soften by soaking, and maceration is the process by which the red wine receives its red color, since raw grape juice (with the exceptions of teinturiers) is clear-grayish in color.

3.4.1.3. Decoction

Decoction is a method of extraction by boiling herbal or plant material to dissolve the chemicals of the material, which may include stems, roots, bark and rhizomes. Decoction involves first mashing the plant material to allow for maximum dissolution, and then boiling in water to extract oils, volatile organic compounds and other various chemical substances. Decoction can be used to make tisanes, tinctures and similar solutions. Decoctions and infusions may produce liquids with differing chemical properties as the temperature and/or preparation difference may result in more oil-soluble chemicals in decoctions versus infusions. The process can also be applied to meats and vegetables to prepare bouillon or stock, though the term is typically only used to describe boiled plant extracts, usually for medicinal or scientific purposes.In this process ,the crude drug is boiled in a specified volume of water for a defined time; it is then cooled and strained or filtered. This process is typically used in preparation of Ayurveda extracts called “quath”or “kawath”. The starting ratio of crude drug to water is fixed ,eg.1:4or1:16;the volume is then brought down to one-fourth its original volume by boiling during the extraction procedure .Then ,the concentrated extract is filtered and used as such or processed further.

3.4.2 Non-conventional Extraction Methods

Extraction techniques that use pressurized fluids, ultrasound, enzymes, microwaves and electric pulse have shown promising result. Besides supplying the deficiencies of conventional Methods, some of these techniques can be considered as "green" or environmental friendly. Extraction using pressurized fluids, besides reducing the extraction time and the amount of used solvent, can be more selective for obtaining target compounds.

The process selectivity and velocity are consequences of the solvent physical and chemical properties ,which in some cases can be controlled by changing the extraction parameters .In ideal solid –liquid extraction process ,the target compound must have high solubility .In real process this is rarely achieved .For this reason ,several studies have sought to optimize condition as the solvent /feed ratio , particle size ,temperature ,pressure time and solvent flow rate to obtain the best performance in term of the target compound .Two extraction methods using pressurized fluids are commonly used: supercritical fluid extraction (SFE) and pressurized liquid extraction(PLE).Mostly for industrial purpose the non-conventional extraction methods are used due to high performance and they are environmental friendly techniques .For the extraction of ascorbic and carotenoids from tomato and celery supercritical fluid extraction is employed.

3.4.2.1 Super Critical Fluid Extraction:

Supercritical fluid extraction (SFE) is the process of separating one component (the extractant) from another (the matrix) using supercritical fluids as the extracting solvent. Extraction is usually from a solid matrix, but can also be from liquids. SFE can be used as a sample preparation step for analytical purposes, or on a larger scale to either strip unwanted material from a product (e.g. decaffeination) or collect a desired product (e.g. essential oils). These

essential oils can include limonene and other straight solvents. Carbon dioxide (CO_2) is the most used supercritical fluid, sometimes modified by co-solvents such as ethanol or methanol. Extraction conditions for supercritical carbon dioxide are above the critical temperature of 31 °C and critical pressure of 74 bar. Addition of modifiers may slightly alter this. The discussion below will mainly refer to extraction with CO_2, except where specified.

The process is when the system must contain a pump for the CO_2, a pressure cell to contain the sample, a means of maintaining pressure in the system and a collecting vessel. The liquid is pumped to a heating zone, where it is heated to supercritical conditions.

It then passes into the extraction vessel, where it rapidly diffuses into the solid matrix and dissolves the material to be extracted. The dissolved material is swept from the extraction cell into a separator at lower pressure, and the extracted material settles out. The CO_2 can then be cooled, re-compressed and recycled, or discharged to atmosphere.

3.4.2.2 Pressurized liquid Extraction:

PLE is based on the use of solvents at high temperature and pressure, but not above the critical point. The main objective of this techniques is to promote the extraction of compounds from solid or semisolid matrics in short time and using small amount of solvent.

The main advantage of PLE over conventional extraction methods is that pressurized solvents remain in the liquid state when taken to temperature higher than their boiling points. These conditions improve the solvation power of the liquids and the desorption kinetics from the solid matrix.

The PLE process can be divided in two stages .The first is a period when the extraction is controlled by the solubility, and the second is controlled by the diffusion of solutes in the solvent.

The main solvents used in PLE are methanol, isopropanol, acetone, hexane, and ether. Water and ethanol have been increasingly employed in the extraction of polyphenols, such as flavonoids and phenolic acids, because they are considered “green” solvents.

3.5 Simple Distillation:

Simple distillation is a procedure by which two liquids with different boiling points can be separated. Simple distillation (the procedure outlined below) can be used effectively to separate liquids that have at least fifty degrees difference in their boiling points. As the liquid being distilled is heated, the vapours that form will be richest in the component of the mixture that boils at the lowest temperature. Purified compounds will boil, and thus turn into vapours, over a relatively small temperature range (2 or 3°C); by carefully watching the temperature in the distillation flask, it is possible to affect a reasonably good separation. As distillation progresses, the concentration of the lowest boiling component will steadily decrease. Eventually the temperature within the apparatus will begin to change; a pure compound is no longer being distilled. The temperature will continue to increase until the boiling point of the next-lowest-boiling compound is approached. When the temperature again stabilizes, another pure fraction of the distillate can be collected. This fraction of distillate will be primarily the compound that boils at the second lowest temperature. This process can be repeated until all the fractions of the original mixture have been separated.

3.6 Rotary Evaporation:

A rotary evaporator is a device used in chemical laboratories for the efficient and gentle removal of solvents from samples by evaporation. When referenced in the chemistry research literature, description of the use of this technique and equipment may include the phrase "rotary evaporator", though use is often rather signaled by other language (e.g., "the sample was evaporated under

reduced pressure"). Vacuum evaporators as a class function because lowering the pressure above a bulk liquid lowers the boiling points of the component liquids in it.

Generally, the component liquids of interest in applications of rotary evaporation are research solvents that one desires to remove from a sample after an extraction, such as following a natural product isolation or a step in an organic synthesis. Liquid solvents can be removed without excessive heating of what are often complex and sensitive solvent-solute combinations.

Rotary evaporation is most often and conveniently applied to separate "low boiling" solvents such a n-hexane or ethyl acetate from compounds which are solid at room temperature and pressure. However, careful application also allows removal of a solvent from a sample containing a liquid compound if there is minimal co-evaporation (azeotropic behavior), and a sufficient difference in boiling points at the chosen temperature and reduced pressure.

Solvents with higher boiling points such as water (100 °C at standard atmospheric pressure, 760 torr or 1 bar), dimethylformamide (DMF, 153 °C at the same), or dimethyl sulfoxide (DMSO, 189 °C at the same), can also be evaporated if the unit's vacuum system is capable of sufficiently low pressure. (For instance, both DMF and DMSO will boil below 50 °C if the vacuum is reduced from 760 torr to 5 torr [from 1 bar to 6.6 mbar]) However, more recent developments are often applied in these cases (e.g., evaporation while centrifuging or vortexing at high speeds).

Rotary evaporation for high boiling hydrogen bond-forming solvents such as water is often a last recourse, as other evaporation methods or freeze-drying (lyophilization) are available. This is partly due to the fact that in such solvents, the tendency to "bump" is accentuated. The modern centrifugal evaporation technologies are particularly useful when one has many samples to do in parallel,

as in medium- to high-throughput synthesis now expanding in industry and academia.

Evaporation under vacuum can also, in principle, be performed using standard organic distillation glassware i.e., without rotation of the sample. The key advantages in use of a rotary evaporator are

1. that the centrifugal force and the frictional force between the wall of the rotating flask and the liquid sample result in the formation of a thin film of warm solvent being spread over a large surface.
2. The forces created by the rotation suppress bumping. The combination of these characteristics and the conveniences built into modern rotary evaporators allow for quick, gentle evaporation of solvents from most samples, even in the hands of relatively inexperienced users. Solvent remaining after rotary evaporation can be removed by exposing the sample to even deeper vacuum, on a more tightly sealed vacuum system, at ambient or higher temperature (e.g., on a Schlenk line or in a vacuum oven).

A key disadvantage in rotary evaporations, besides its single sample nature, is the potential of some sample types to bump, e.g. ethanol and water, which can result in loss of a portion of the material intended to be retained. Even professionals experience periodic mishaps during evaporation, especially bumping, though experienced users become aware of the propensity of some mixtures to bump or foam, and apply precautions that help to avoid most such events.

In particular, bumping can often be prevented by taking homogeneous phases into the evaporation, by carefully regulating the strength of the vacuum (or the bath temperature) to provide for an even rate of evaporation, or, in rare cases, through use of added agents such as boiling chips (to make the nucleation step of evaporation more uniform). Rotary evaporators can also be equipped with further

special traps and condenser arrays that are best suited to particular difficult sample types, including those with the tendency to foam or pump.

Figure 3.2 Rotary Evaporator

3.7 Centrifuge:

A centrifuge is a piece of equipment that puts an object in rotation around a fixed axis (spins it in a circle), applying a force perpendicular to the axis of spin (outward) that can be very strong. The centrifuge works using the sedimentation principle, where the centrifugal acceleration causes denser substances and particles to move outward in the radial direction. At the same time, objects that are less dense are displaced and move to the center. In a laboratory centrifuge that uses sample tubes, the radial acceleration causes denser particles to settle to the bottom of the tube, while low-density substances rise to the top.

There are three types of centrifuge designed for different applications. Industrial scale centrifuges are commonly used in manufacturing and waste processing to sediment suspended solids, or to separate immiscible liquids. An example is the cream separator found in dairies. Very high speed centrifuges and ultracentrifuges able to provide very high accelerations can separate fine particles down to the Nano-scale, and molecules of different masses.Large centrifuges are used to

simulate high gravity or acceleration environments (for example, high-G training for test pilots). Medium-sized centrifuges are used in washing machines and at some swimming pools to wring water out of fabrics.

Gas centrifuges are used for isotope separation, such as to enrich nuclear fuel for fissile isotopes.

Properties of solvent:

Methanol

Chemical formula	CH_3OH or CH_4O
Molar mass	32.04 g mol^{-1}
Appearance	Colourless liquid
Odour	Ethanol-like
Density	0.792 g/cm^3
Melting point	−97.6 °C (−143.7 °F; 175.6 K)
Boiling point	64.7 °C (148.5 °F; 337.8 K)
Solubility in water	miscible

Chloroform

Chemical formula	$CHCl_3$
Molar mass	119.37 g·mol^{-1}
Appearance	Colourless liquid
Odour	Misleadingly-pleasant ethereal odour, leading to olfactory fatigue
Density	1.489 g/cm^3 (25 °C)
Melting point	−63.5 °C (−82.3 °F; 209.7 K)
Boiling point	61.15 °C (142.07 °F; 334.30 K) decomposes at 450 °C
Solubility in water	8.09 g/L (20 °C)

3.8 Experimental Setup:

3.8.1 Collection of Material

In the experiment in laboratory the process was collection phyllanthus niruri from the uncultivated area of Theni, Tamil Nadu and then it is taken for other process of grinding also cleaned to the fresh water.

Figure 3.3 Raw Material Of *P.Niruri*

3.8.2 Shade drying:

Initially the phyllanthus niruri was cleaned by fresh water and then the remove the solid waste are also removed this method. The leaf of the plant cut off and dried at room temperature of one week.

Figure 3.4 Powder Form of *P.Niruri*

3.8.3 Soxhlet extraction:

100 ml solvent (methanol and chloroform) used to soxhlet extraction. The flask contain methanol will be evaporated and moved into the condenser, where it

converted into a liquid and trickled to the extraction chamber containing the plant material Flask containing the methanol extract was removed and methanol was evaporated by using distillation at 64.7 ^{o}c (Depending upon the boiling point).The weight of the residual extract was measured and percent yield was calculated. The extract were stored in air tight glass.

Figure 3.5 Soxhlet Extractor

3.8.4 Simple distillation:

Simple distillation is used to remove the solvent recovery and increase concentration of extract. Methanol extract is fed to the Clamp distillation flask and fit the temperature range is 64.7^{o}c (Depending upon the boiling point).methanol as solvent evaporated and condensed the tap water then recovered conical flask.

Figure 3.6Simple Distillation

3.8.5 Centrifuge:

Centrifugation is the process where a solid particle separated through spinning. When the methanol extract is fed upto the small container and setup speed range of 1500 RPM. Further processing, solid particle settle down container and remove it. Then, it was used to the analysis process.

Figure 3.7 Centrifuge

3.8.6 *In vitro* Anti-Diabetic Activity

***In vitro* Alpha amylase inhibitory assay**

In 100 ml of 20 mm of phosphate buffer (pH 6.9) containing 6.7 mM of sodium chloride, a starch solution (1% w / v) was prepared by stirring 1g starch. The enzyme solution was prepared by mixing in 100 ml of 20 mm of phosphate buffer (PBS, pH 6.9) containing 6.7 mM of sodium chloride 27.5 mg of porcine pancreatic amylase αamylase (PPA). In addition, 200 µl porcine pancreatic amylase was applied to 1000 µl of (50, 250, 500, 750 and 1000µg / ml) plant extracts and the mixture was incubated at 37°C for 20 min. Added 100 µl (1%) starch solution to the reaction mixture and incubated for 10 min at 37 °C. The reaction was stopped by adding 200 µl DNSA (1g of 3.5 di nitro salicylic acid, 30 g of sodium potassium tartarate and 20 ml of 2N sodium hydroxide to a final volume of 100 ml with distilled water) and held for 5 minutes in a boiling water tub. The reaction mixture was read at 540 nm, diluted with 2.2 ml of water and absorption. Blank tubes were prepared for each concentration by replacing the enzyme solution in distilled water with 200 µL. Command was prepared in a similar manner, without extract, reflecting 100% enzyme activity. The tests are replicated with the same protocol three times. (Ali *et al*., 2006).

3.8.7 GC-MS Analysis

Gas chromatography-mass spectroscopy (GC-MS) analysis of plant extracts is becoming a very valuable tool to detect the presence of various phytoconstituents before aiming large scale purification and to minimize replicative phytochemical studies.

GC-MS is one of the best techniques to identify the constituents of volatile matter, long and branched chain hydrocarbons, alcoholic acids, esters etc. The mass spectrometer analyzes the compounds eluted at different times and percentage of area occurred to identify the nature and structure of the compounds.

The large compound fragments into small compounds giving rise to appearance of peaks at different m/z ratios.

(a)Equipment: Thermo GC – Trace Ultra Version 5.0 gas chromatography system interfaced to Thermo MS DSQ II mass spectro-meter

(b) Column: DB 5 – MS capillary standard non-polar column with dimensions 30 m × 0.25 mm x 0.25 μm

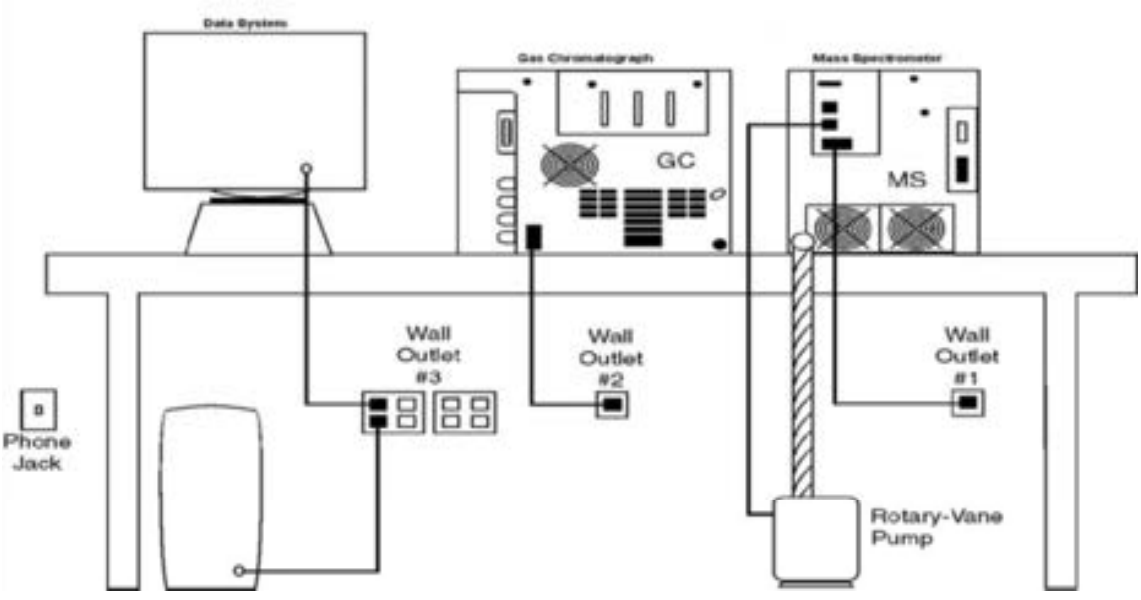
(c) Carrier Gas: Helium gas

(d) Test substance: *Phyllanthus niruri* plant extract were studied.

(e) Procedure for gas chromatography–mass spectrometry (GC-MS) analysis:

GC-MS analysis of methanol extract of phyllanthus niruri was performed using thermo gas chromatogram- trace ultra. Ver 5.0 and thermo mass spectrometer DSQ II. The experimental condition of GC-MS system were as follows, TR-5 ms capillary standard non-polar column, the dimension of 30 Mts, ID - 0.25 mm with a film thickness of 0.25 *mm composed of 95% Dimethyl polysiloxane. The carrier gas used as helium at a flow rate of 1 ML/min. 1 * ml sample injection volume was utilized.

Figure 3.8 GC-MS



In the gas chromatography part, the oven temperature was programmed 100-250 °c at the rate of 8/min. The holding time was 10 min at 250 °c. The specification of the capillary column used was DB 5 – MS capillary standard non-polar column with dimensions 30 m × 0.25 mm x 0.25 µm. The oven temperature was kept at 70°C and was programmed to reach 260°C at a rate of 6°C/min. The experiment was programmed with total run time of 37.53 min. Injection volume was 1µl.

GC-MS was analysed using electron impact ionization at 70eV and data was evaluated using total ion count for compound identification and quantification. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS library. Measurement of peak areas and data processing were carried out by Turbo-Mass-OCPTVS-Demo SPL software.

CHAPTER-IV

RESULT AND DISCUSSION

CHAPTER-IV

RESULT AND DISCUSSION

4.1 ALPHA-AMYLASE ACTIVITY

The effect of alpha-amylase activity on methanolic and choroformic extract of phyllanthus niruri are shown in table 1 and 2

Table 4.1: alpha-amylase assay for chloroform extract of phyllanthus niruri

Concentration	OD	IC_{50}	$\%IC_{50}$
50	0.183	22.82	972.91
250	0.194	30.20	
500	0.202	35.57	
750	0.215	44.30	
1000	0.224	50.34	

The half maximal inhibitory concentration (IC_{50}) measure of the chloroformic extract for the concentration 50,250,500,750,1000 mg/ml* is given the table. It is the measure of substance needed to inhibit the biological reaction. The chloroformic extract showed the IC_{50} values are 22.82, 30.20, 35.57, 44.30 and 50.34 for respective concentrations.

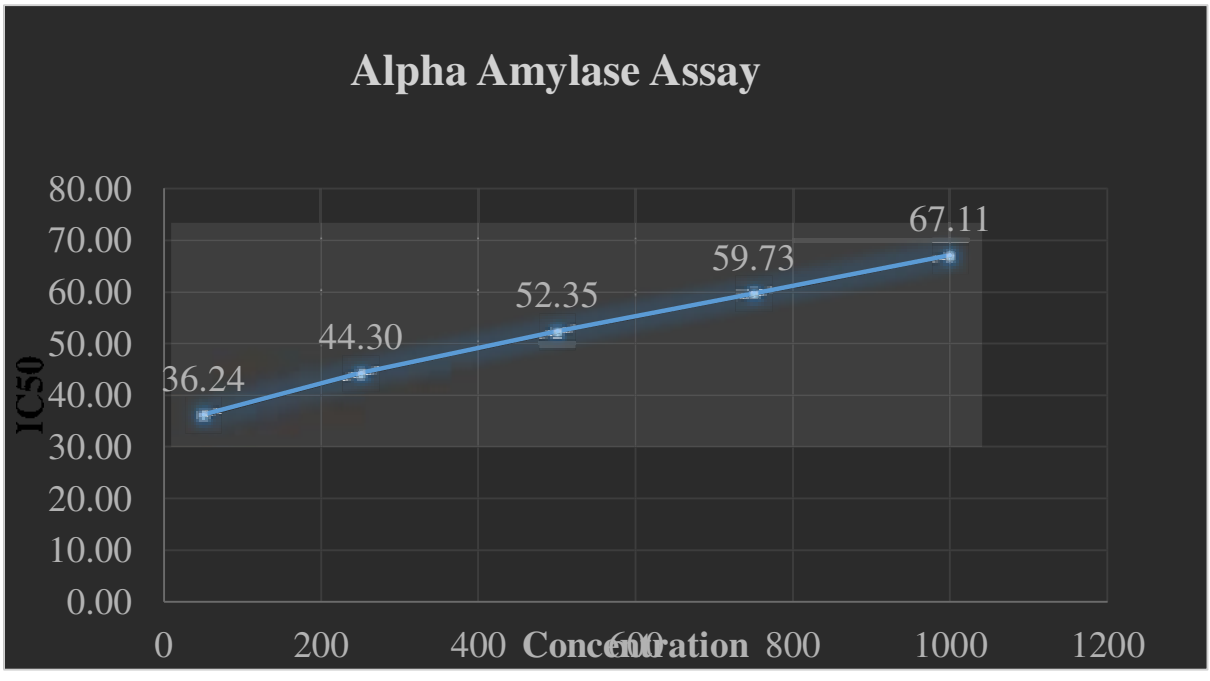
The half maximal inhibitory concentration (IC_{50}) measure of the methanolic extract for the concentration 50, 250, 500, 750, 1000 mg/ml is given above the table. The methanolic extract showed the IC_{50} values are 36.24, 44.30, 52.35, 59. 73, 67, 11 respectively.

Table 4.2: alpha-amylase assay for methanolic extract of phyllanthus niruri

Concentration	OD	IC_{50}	$\%IC_{50}$
50	0.203	36.24	449.03
250	0.215	44.30	
500	0.227	52.35	
750	0.238	59.73	
1000	0.249	67.11	

The inhibition rate of tested extracts are different. For our test we tested chloroformic and methanolic extract of phyllanthus niruri.In alpha-amylase inhibition assay, methanolic and chloroformic extracts (50, 250, 500, 750, 1000) showed 50% alpha amylase inhibition activity at the mentioned concentration.The half maximal inhibitory concentration (IC_{50}) of the chloroformic extracts was ploted as a function of concentration as shown in figure

Figure 4.1 Alpha-Amylase assay of methanolic extract



The figure indicate that the chloroformic extract showed appreciable inhibitory activity.The half maximal inhibitory concentration (IC50) of the methanolic extract was ploted as a function of the concentration as shown in figure 2

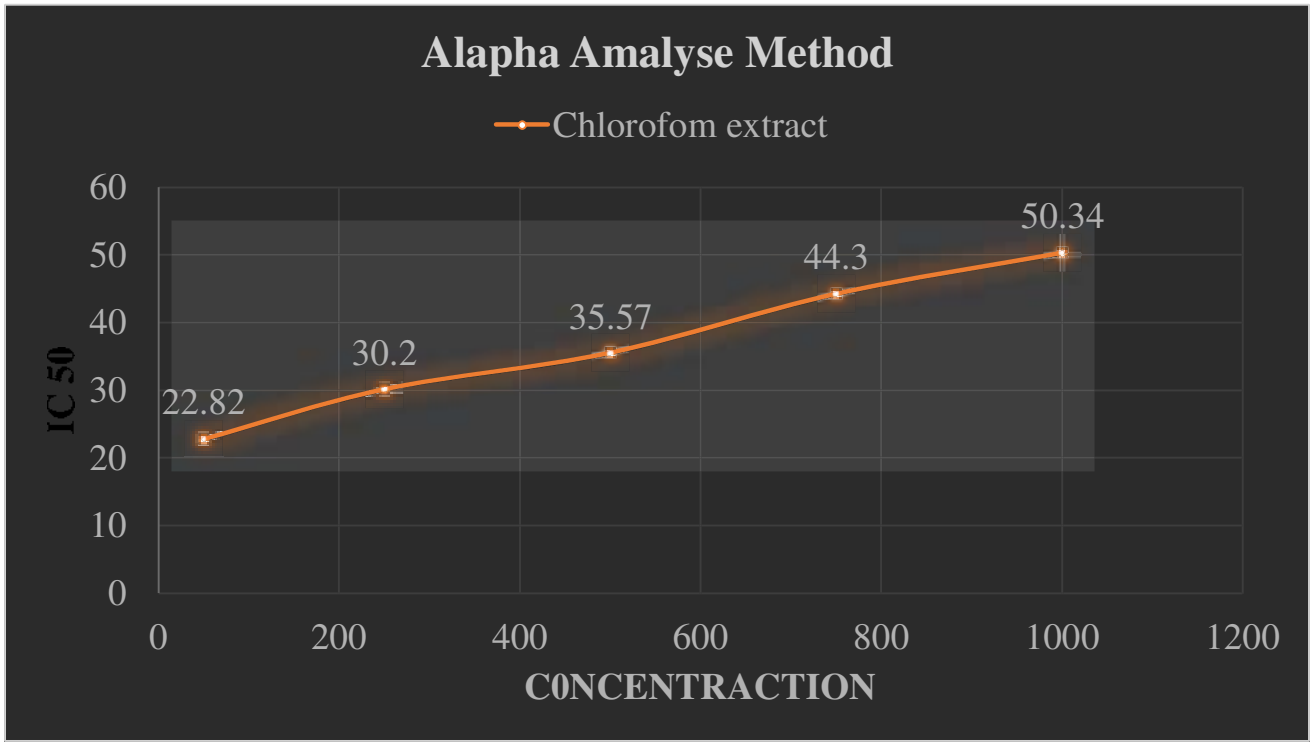


Figure 4.2 Alpha-Amylase assay of chlorom extract

The figure indicate that out of two extracts, methanolic extract of phyllanthus niruri exhibited good anti alpha amylase activity.compression of methanolic and chloroform extract with anti-diabetic activity are known below the figure.

The chloroformic extract of phyllanthus niruri at concentration of 1000 ml exhibit 50.34 inhibitory effect on Alfa-amylase activity with a %IC50 value of 972.91% .The highest inhibitory effect is showned in methanolic extract.

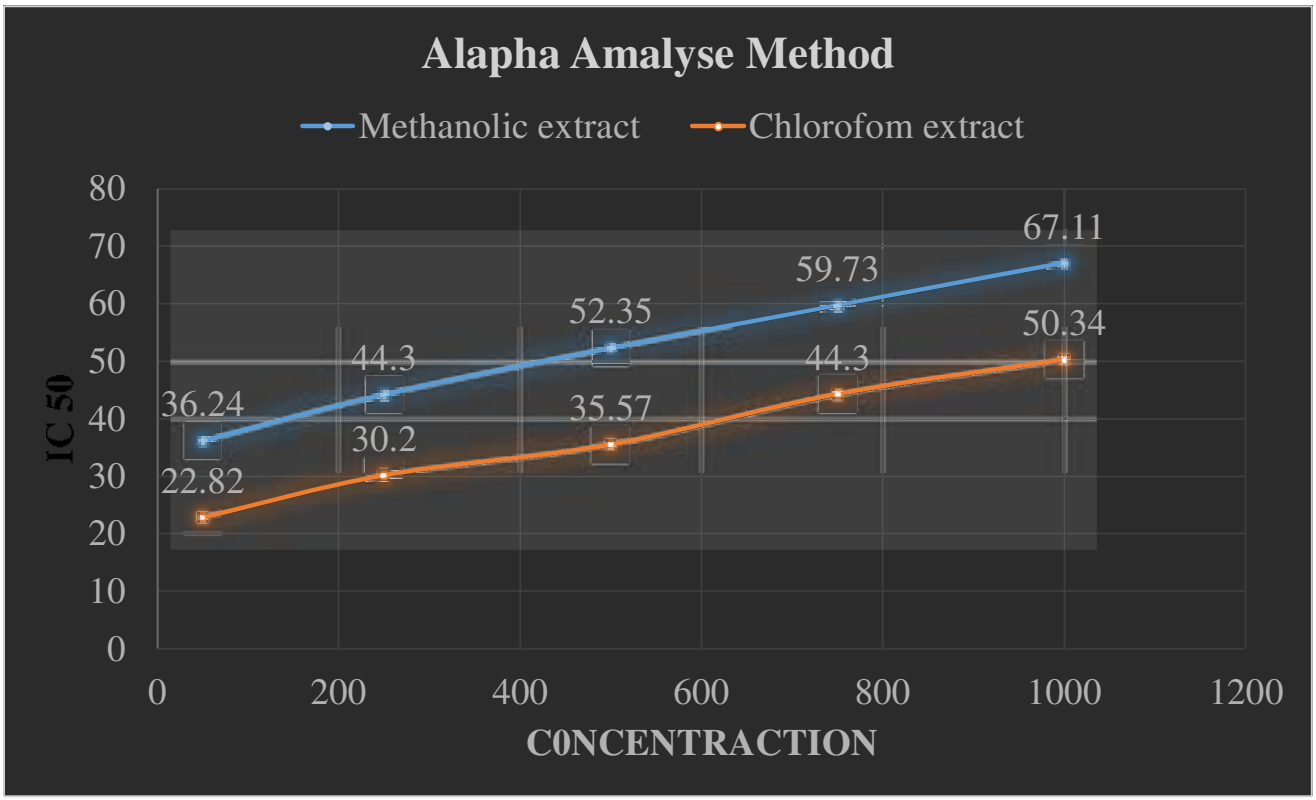


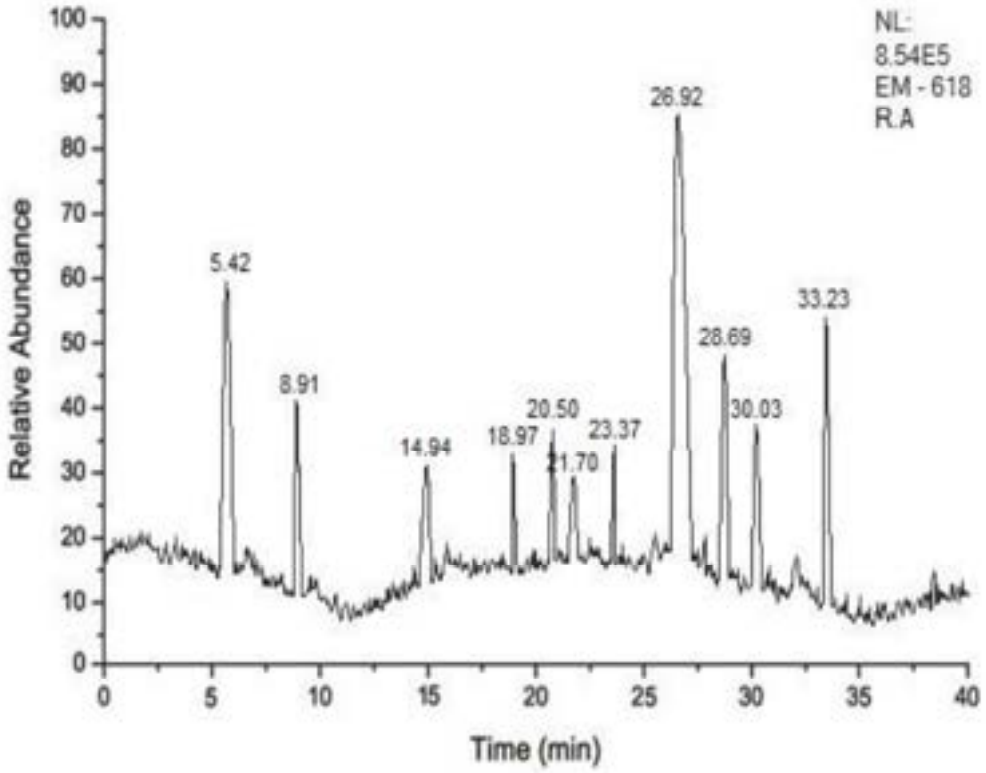
Figure 4.3 Compare methanol and chloroform extract

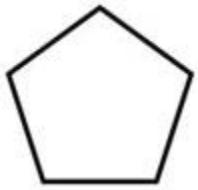
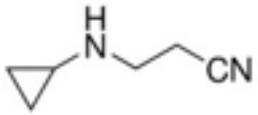
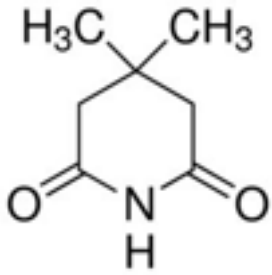
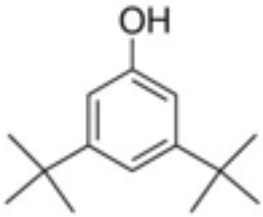
Gas chromatography–mass spectrometry

In the present study, we characterized the phytochemical profile of *phyllanthus niruri* plant extract using GC- MS. The gas chromatogram showed that the relative concentration of various compounds getting eluted at different retention times. The relative percentage of the chemical constituents was expressed as percentage by peak area normalization. The heights of the peak indicate that the relative concentrations of the components present in the plant extract. The mass spectrometer analysis used to identify the nature and structure of the compounds eluted at different retention times. The large fragments into small compounds giving rise to appearance of peaks at different m/z ratios. The mass spectra of plant extract are the fingerprint of phytocompounds of *phyllanthus niruri* plant extract which were identified and matched with those of standards available in the data library. Hence, the results of the GC-MS profile of *phyllanthus niruri* plant extract showed the presence of many phytocompounds. The observations recorded that the major constituents of *phyllanthus niruri* are presented in

4.4 GC-MS RESULT

EQUIPMENT	: THERMO GC - TRACE ULTRA VER: 5.0, THERMO MS DSQ II
COLUMN	: TR 5 - MS CAPILLARY STANDARD NON - POLAR COLUMN
DIMENSION	: 30 Mts, ID:0.25mm
FILM	: 0.25µm
CARRIER GAS	: He.
FLOW	:1ML/Min
TEMP PROG	: 100 - 250
RATE	: 8/Min
HOLDING TIME	: 10Min @ 250



RT	Name of the compound	Molecular Formula (MF)	Molecular weight (MW)	Peak area (%)	Structure
5.42	Cyclopentane, Pentyl-	$C_{10}H_{20}$	140.27	3.36	
8.91	3(Cyclopropylamino)propionitrile	$C_6H_{10}N_2$	110.15	1.68	
14.94	3,3-Dimethylglutarimide	$C_7H_{11}NO_2$	141.16	0.88	
18.97	Heptadecane	$C_{17}H_{36}$	240.50	0.17	
20.50	3,5-Di-tert-butylphenol	$C_{14}H_{22}O$	206.32	1.2	

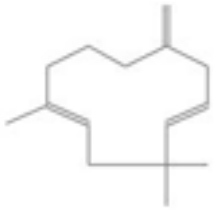
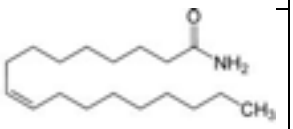
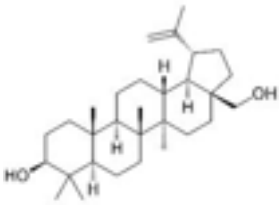
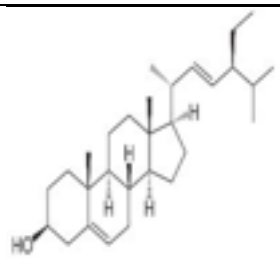
21.70	n-Hexadeconic acid	$C_{16}H_{32}O_2$	256.42	1.01	
23.37	9,12-Octadecadienoic acid	$C_{18}H_{32}O_2$	280.44	0.26	
26.92	β-humulene	$C_{15}H_{24}$	204.35	11.82	
28.69	9-Octadecenamide	$C_{18}H_{35}NO$	281.5	0.84	
30.03	Betulin	$C_{30}H_{50}O_2$	442.72	0.54	
33.23	Stigmasterol	$C_{29}H_{48}O$	412.7	0.48	

Table 4.3 properties of Bioactive Compound

The result pertaining to GC-MS analysis leads to the identification of the number of compounds from the GC fractions of *phyllanthus niruri* plant extract and these compounds were identified through mass spectrometry. GC-MS analysis of *phyllanthus niruri* plant extract showed the presence of eleven bioactive compounds that could contribute towards the medicinal properties to the plant. These constituents of Cyclopentane, Pentyl-,3(Cyclopropylamino) propionitrile, 3,3-Dimethylglutarimide, Heptadecane, 3,5-Di-tert-butylphenol, n-Hexadeconic acid, 9,12-Octadecadienoic acid, β-humulene, 9-Octadecenamide, Betulin, Stigmasterol.

CHAPTER-V
MATERIAL BALANCE

CHAPTER-V

MATERIAL BALANCE

Step 1- Drying of *phyllanthus niruri*

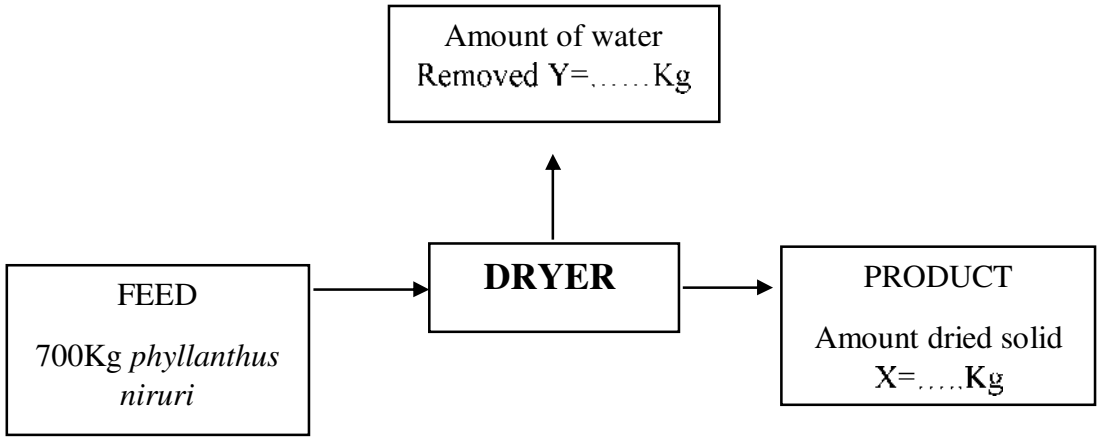


Figure 5.1, Material balance for shade drying

Weight of water in feed = 700 × 0.2

= 140Kg

Weight of solid in feed = 700 × 0.8

= 560 Kg

While in drying the amount of moisture removed is more than that of the solids,

Therefore,

Amount of solid in feed = Amount of solid out

Therefore if the product contain 2 % moisture apart from that 98% will be solid

Weight of solid in product,

$$0.98X = 560$$

$$X = 571.4287 \text{ Kg}$$

Difference in the weight of solid in product and feed will give the water content in product

Weight of moisture in product = (weight of moisture in product — weight of moisture in feed)

$$= 571.4287 - 560$$

$$= 11.4287 \text{ Kg}$$

Weight of water removed(Y) = (weight of water in feed — weight of water in product)

$$= 140 - 11.4287$$

$$= 128.5713 \text{ Kg}$$

Percentage of water removed = $(128.5713 \div 140) \times 100$

$$= 94.83\%$$

Input (700g) = Dry Solid (571.4287g) + Water Removal (128.57g)

Step 2: Sieving

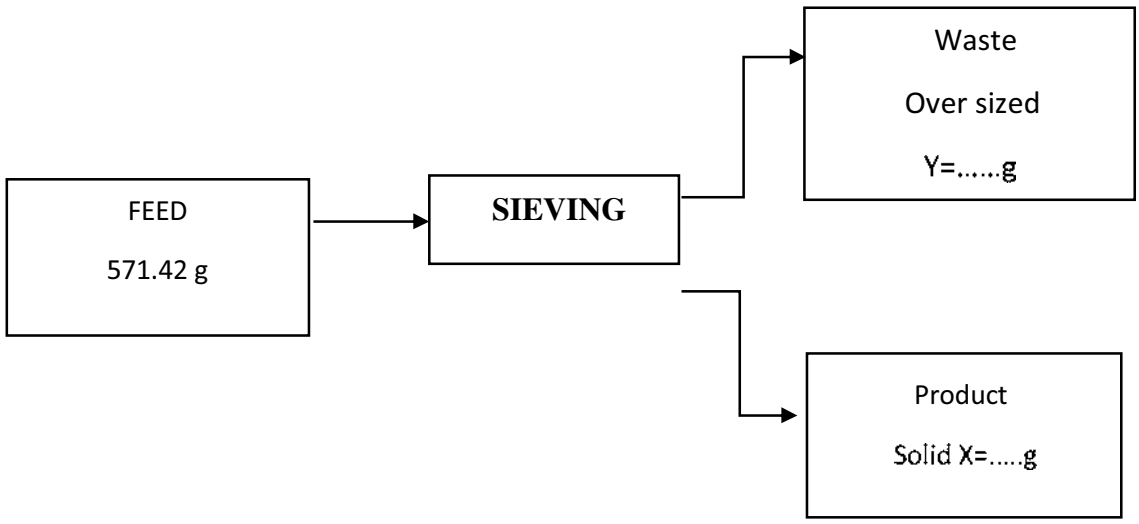


Figure 5.2, material balance for sieving process

Overall material balance

Input = Product (required size) + waste

571.42 g = X + Y

Working under 79% efficiency

X = 358.8Kg

Y = 212.62Kg.

Input (571.42 Kg) = Product (358.8 Kg) + Waste (212.62Kg)

Step 3: Extraction

100 g of *phyllanthus niruri* powder

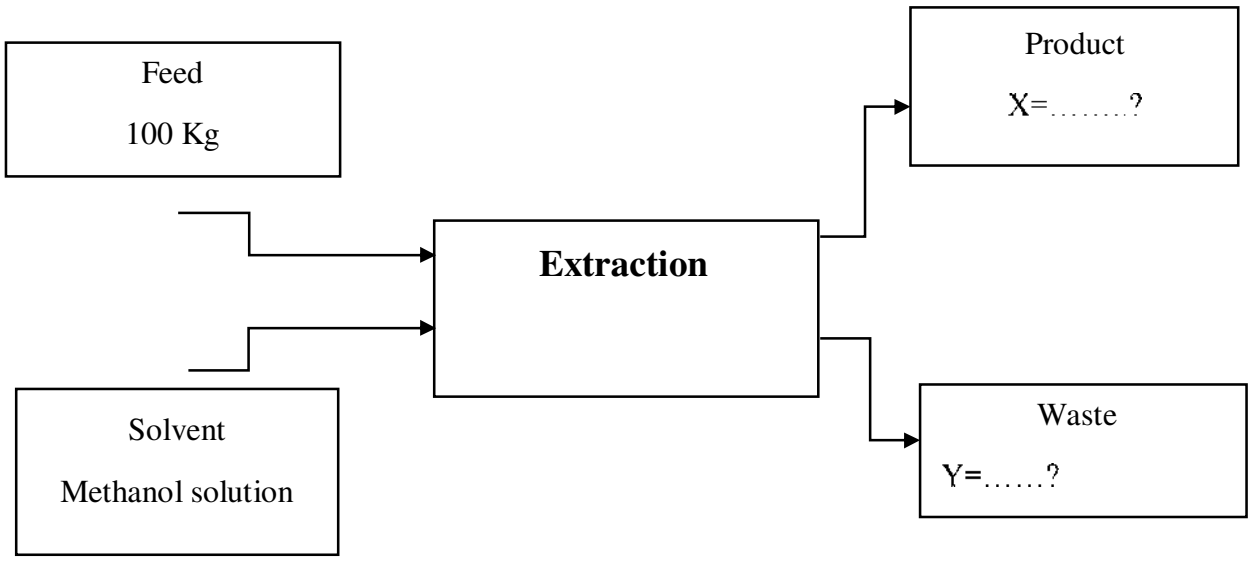


Figure 5.3, material balance for extraction process

Methanol as solvent:

Material Balance of solids:

Solids in seeds = solids in cake

$0.69 \times 100 = 0.877X$

$X = 78.68$ g

Oil in the cake is given as 0.8%

Oil in the cake = $0.008 \times 78.68 = 0.63$ g

Material balance of oil:

Oil in seeds = oil in cake + oil recovered

$18.6 = 0.63 +$oil recovered

Oil recovered = 18.6- 0.63=17.67g

Input (100g) = product (18.6g) + Waste (78.68g)

Chloroform as solvent:

Material Balance of solids:

Solids in seeds = solids in cake

$0.59 \times 100 = 0.852X$

$X = 69.2488$ g

Oil in the cake is given as 0.89%

Oil in the cake = $0.0089 \times 69.2488 = 0.61$g

Material balance of oil:

Oil in seeds = oil in cake + oil recovered

15.56 = 0.61 +oil recovered

Oil recovered = 15.56- 0.61=14.95g

Input (100g) = product (15.56g) + Waste (69.2488g)

Step 4: Distillation

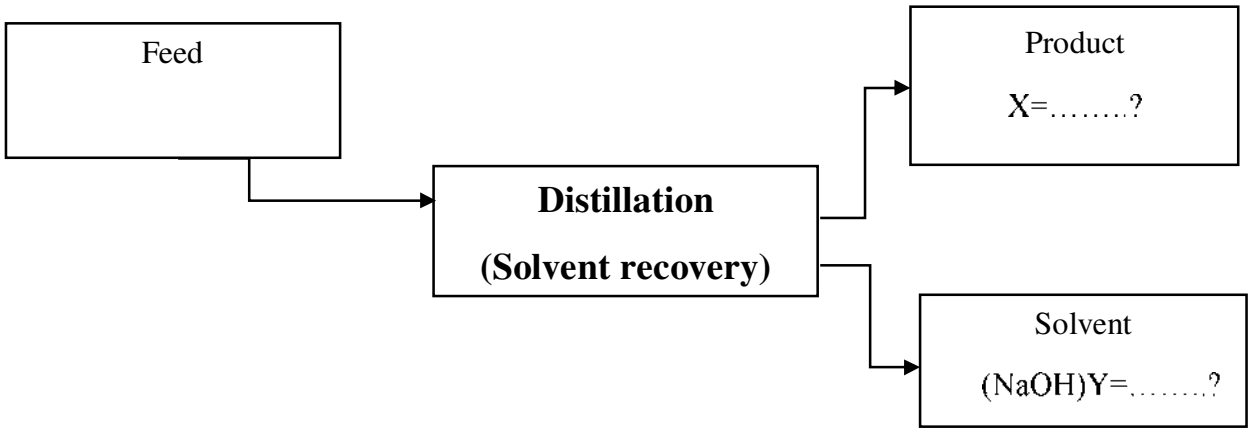


Figure 5.4, Material balance for distillation process

Overall material balance

Input = Output + Accumulation

There is no accumulation, then equation will be reduced by,

Input = Output

Methanol:

18.6 g = X + Y

Reactor working under 70% efficiency

X = 12.85 g

Y = 5.7 g

Input (18.6 Kg) = Product (12.85Kg) + Waste (5.76Kg)

Chloroform:

15.56 g = X + Y

Reactor working under 70% efficiency

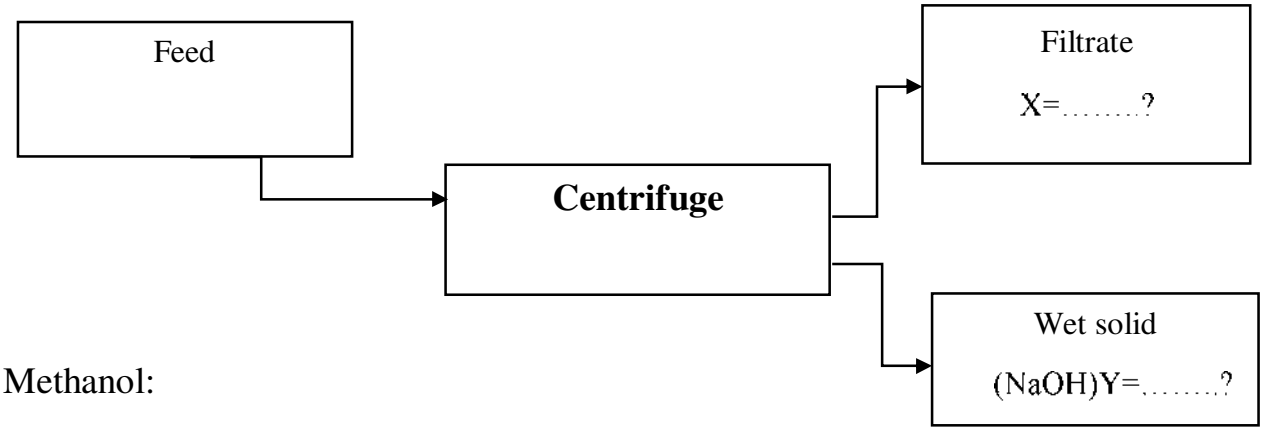
X = 8.76 g

Y = 6.8 g

Input (15.6 g) = Product (8.76 g) + Waste (6.8 g)

Step 6: Centrifuge

Figure 5.6 centrifuge



Methanol:

Solid in slurry = Solid + Filtrate

12.85 = 1.53+Filtrate

Filtrate = 11.32

Input (15.6 g) = Filtrate (11.32 g) + Wet solid (1.53g)

Chloroform:

Solid in slurry =solid +Filtrate

8.76 =1.03+Filtrarte

Filtrate =7.73

Input (8.76 g) = Product (7.73 g) + Waste (1.03 g)

CHAPTER-VI

ENERGY BALANCE

CHAPTER-VI

ENERGY BALANCE

Step 1: EXTRACTION

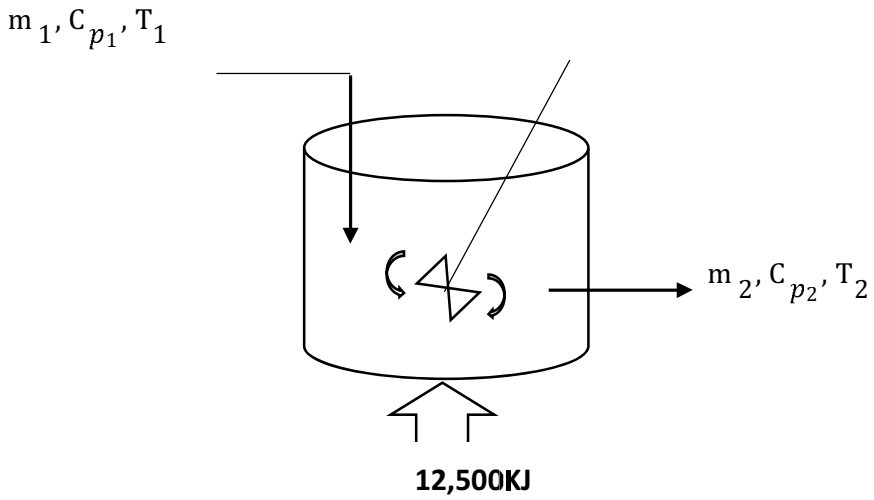


Figure 6.1, Energy balance of Extraction process

For this process, Exo-Thermic reaction heat can be dissipated or loss occur

Feed		PRODUCT	
m_1	1.19m/s	m_2	1.45 m/s
$C_{pmix\,1}$	0.923 KJ/Kg.^{0}C	$C_{pmix\,2}$	0.084KJ/Kg.^{0}C
T_1	45^{0}C	T_2	65^{0}C

Table no 6.1: Extraction

Overall energy balance:

Input = Output + Dissipated

Feed = 10,250 Kg

Specific heat of Methanol

$C_{p,methanol}$ =2.53 KJ/Kg. ^{0}C

$$C_{p_{solid}} = \frac{Q}{m\,\Delta t}$$

Q = Power × Time (sec)

= 1.8× 36000

= 64,800 KJ

Mass of solid = 1,500Kg

$$C_{Psolid} = \frac{64{,}800}{1{,}500 \times 45}$$

` = 0.96 KJ/ Kg. ^{0}C

$C_{pmix\,1}$ = X1×$C_{p\,methanol}$+ X2×C_{psolid}

= (0.923 × 2.53) + (0.084 × 0.96)

= 2.33 + 0.08064

= 2.41 KJ/Kg. ^{0}C

$$C_{p\ product} = \frac{64{,}800}{3500 \times (65-45)}$$

= 0.9257KJ/Kg. 0C

Overall energy balance

$m_{in} \times H_{in} = (m_{out} \times H_{out})$ + Q

From Thermodynamics H = C_P (T –T_{ref})

$m_{in}\times C_{pmix\,1}(T_{in} - T_r) = m_{out}\, C_{p,roduct}(T_{in} - T_{ref})$ + Q

1.19× 2.41 (45-0) = 1.45 × 0.9257 (65-0) + Q

129 = 87.247 + Q

Q = 129-87.247

Q =41.753KJ/Kg

Input (129KJ) = Output (87.247KJ) + Heat dissipated (41.753 KJ)

Step 2: Distillation

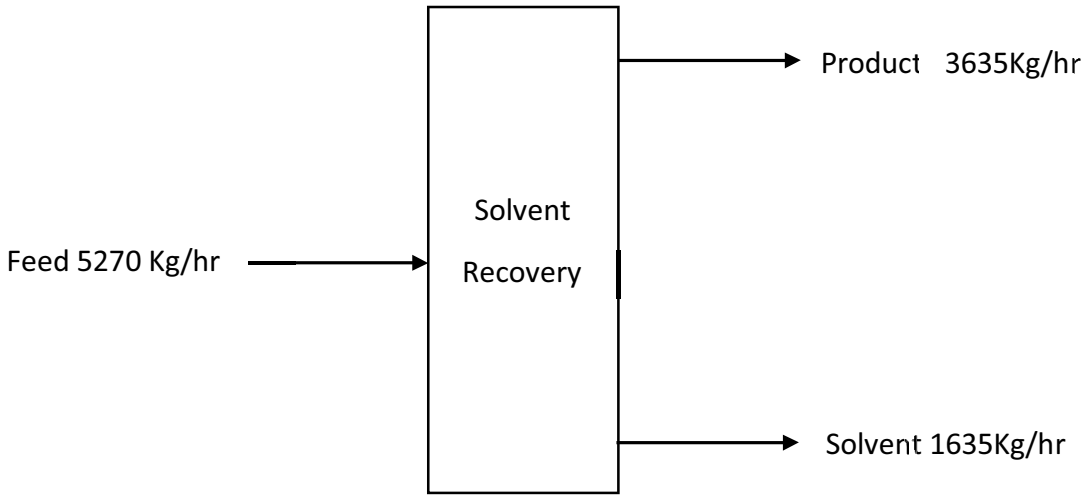


Figure 6.5, Energy balance of solvent recovery process

Feed		Product (Solvent)		Waste	
C_p	1.305 KJ/Kg.^{0}C	C_p	2.65 KJ/Kg.^{0}C	C_p	0.0013 KJ/Kg.^{0}C
HF	36.78 KJ/Kg	H_D	48.3 KJ/Kg	H_B	0.345 KJ/Kg

Table no 6.2: distillation process

Overall energy balance:

This process based distillation principle, Energy balance based on KW

Input = Solvent + Waste

$(F \times H_F) + Q_R = (D \times H_D) + (B \times H_B) + Q_C$

Feed = product + solvent

5270Kg = 3635Kg + 1635Kg

Feed = 5270 Kg/hr

Specific heat of feed

C_p of methanol in liquid mixture = 2.53 KJ/Kg.^{0}C

C_p of pigment = $\frac{6800}{1635*20}$

= 0.21 KJ/Kg.^{0}C

C_P of feed = $\frac{3635}{5270} \times 2.53 + \frac{1635}{5270} \times 0.21$

=1.81 KJ/Kg.^{0}C

C_p of methanol at 40^{0}C = 2.633KJ/Kg.^{0}C

C_p pigment =$\frac{6800}{1635\times40}$

= 0.1039 KJ/Kg.^{0}C

Enthalpy of feed

$H_F = \int_{T_{ref}}^{T} C_p \, dt$

$= \int_0^{20} 1.305 \, dt$

= 1.305 × 20

= 26.1 KJ/Kg

$H_D = \int_{T_{ref}}^{T} C_p \, dt$

$= \int_0^{40} 2.65\ dt$

$= 2.65 \times 40$

$= 106$ KJ/Kg

$H_B = \int_{T_{ref}}^{T} C_P\ dt$

$\int_0^{60} 0.1039$

$= 6.2$ KJ/Kg

Latent heat of acetone vaporization = 1100 KJ/Kg and let assume (L/D) = 3

$Q_C = V\ (0.62 \times 1100) + (0.21 \times 181)$

$V = L_0 + D$

$= (L_0/D + 1)\ D$

$= (3+1)\ D$

$= 4 \times 3635$

$= 14{,}540$

$Q_C = 14{,}540(682 + 41.875)$

$Q_C = 10.525 \times 10^6$ KJ/Kg

$Q_R = (D \times H_D) + (B \times H_B) + Q_C$

$Q_R = (3635 \times 106) + (1{,}635 \times 6.2) + 10.525 \times 10^6$

$= 385310 + 10248.6 + 10.525 \times 10^6$

$= 10.9205 \times 10^6$

Overall energy balance:

$$(F \times H_F) + Q_R = (D \times H_D) + (B \times H_B) + Q_C$$

$(5270\times 26.1) + 10.9205 \times 10^6 = (3635 \times 106) + (1{,}635 \times 6.2) + 10.525 \times 10^6$

$11.058\times10^6 = 10.9205 \times 10^6 + \text{Loss}$

$\text{Loss} = 11.058\times10^6 - 10.9205\times 10^6$

$= 1.3\times10^5$ KJ/hr

Input (2,689KW) = output (2,625 KW) + loss (64KW)

CHAPTER-VII

DESIGN CALCULATION OF EVAPORATOR

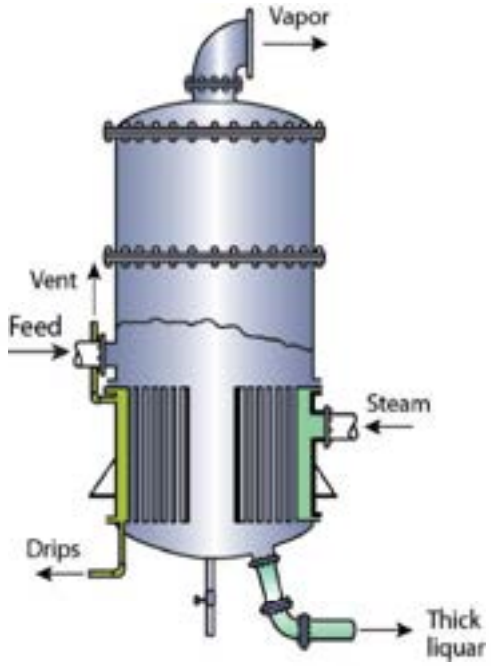
CHAPTER-VII

DESIGN CALCULATION OF EVAPORATOR

Design calculation for Evaporator:

Short-tube vertical evaporator:

A 6% aqueous solution of a high molecular weight solute has to be concentrated to 50% in a forward-feed double effect evaporator at the rate of 6000 $kg.h^{-1}$. The feed temperature is 40°C. Saturated steam at 3.5 $kg.cm^{-2}$ is available for heating. A vacuum of 600 mm Hg is maintained in the second effect. Calculate the area requirements, if calandria (short-tube vertical evaporator) of equal area are used. The overall heat transfer coefficients are 550 and 370 $kcal.h^{-1}m^{-2}°C^{-1}$ in the first and the last effect respectively. The specific heat of the concentrated liquor is 0.87 $kcal.kg^{-1}°C^{-1}$.



SOLUTION Figure7.1 Short Tube Vertical Evaporator

Part 1. Thermal design

Pressure in effect I to be decided.

Pressure in effect II = 760 - 400 = 360 mm Hg

Boiling point at this pressure = 60°C (from steam table)

(High molecular wt. solute, BPE is neglected)

Latent heat vapor generated in effect II at 160 mm Hg (0.2133bar) = 563kcal.kg^{-1} (λ_{S2})

Heating steam is at 3.5 kg.cm^{-2} gauge; Temp (T_S) =148 °C; Latent heat (λ_S) = 506 kcal.kg^{-1}

Feed rate = 6000 kg.h^{-1}, Solute content = 6%

Final concentration = 50%

Solid in = 6000 × 0. 06 = 360 kg.h^{-1}, water in = 6000-360= 5640 kg.h^{-1}

Product out (50% solid) = 360/0.5 kg.h^{-1} = 720 kg.h^{-1}

Water out with the product = 720 (1-0.50) kg.h^{-1} = 360 kg.h^{-1}

Total evaporation rate in two effects (m_{s1}+m_{s2}) = 5640- 360= 5280 kg.h^{-1} (3.A)

Allow equal areas to two effects, i.e., $U_{D1}\Delta T_1$=U_{D2} ΔT_2

$\Delta T_{tot} = \Delta T_1$-$\Delta T_2$=148-60 = 88°C

U_{D1}= 550, U_{D2}= 370 kcal.h^{-1}m^{-2} °C^{-1} => ΔT_1= 35.4 °C & ΔT_2= 52.6 °C
Temperature of the vapor leaving effect I (T_{b1}) =148 – 35.4 = 112.6 °C

Latent heat vapor generated in effect I at 112.6 °C = 531 kcal.kg^{-1} (λ_{s1})

Energy balance for effect I: m_f H_f+ m_s λ_s= (m_f-m_{s1}) H_1+m_{s1} H_{s1}

Enthalpy values: reference temperature = 112.6 °C (temp of solution leaving effect I)

H_f = (40 - 112.6) (1 kcal/ kg °C) = -72.6 kcal/ kg

H_1 = 0 kcal/ kg (w.r.t. the reference temperature of 112.6 °C)

λ_s= 506 kcal/ kg; λ_{s1}= 531 kcal/ kg

Therefore (6000) (-72.6) + m_s(506) = (6000-m_{s1})(0) + m_{s1}(531)

=>ms = 1.04m_{s1} + 806.869 (3.B)

Energy balance for effect II:

(m_f - m_{s1})H_1+ m_s λ_s = (m_f -m_{s1}- m_{s2}) H_2 + m_{s2} H_2

3) Enthalpy values: reference temperature = 60 °C (temp of solution leaving effect II)

H_2= (112.6 - 60) (0.94 kcal/ kg °C) = 49.4 kcal/ kg (Specific heat of the solution leaving the 1st effect is taken as the mean value of the sp. heat of feed and the concentrated liquor, i.e., ((1+ 0.87)/2)=0.94)

H_2 = 0 kcal/ kg (w.r.t. the reference temperature of 60 °C)

λ_{S1}= 531 kcal/ kg; λ_{S2}= 563 kcal/ kg

∴ (6000 - m_{s1}) (49.4) + m_{s1}(531) = (6000-m_{s1}- m_{s2})(0) + m_{s2}(563)

=>m_{s2} = 0.8607m_{s1} + 526.465 (3.C)

(3.C) Solving Eqs. 3. A, 3.B and 3.C for m_s, m_{s1} and m_{s2}:

m_s= 3487; m_{s1}= 2555and m_{s2} = 2725 kg/h

Areas:

$$A_1 = \frac{m_s\lambda_s}{U_{D1}\Delta T_1} = \frac{(3487)(506)}{(550)(35.4)} = 90.62m^2$$

$$A_2 = \frac{m_{s1}\lambda_{s1}}{U_{D2}\Delta T_2} = \frac{(2555)(531)}{(370)(52.6)} = 69.7m^2$$

The areas in the two effects are not equal. Revised calculation is required.

The revised temperature difference in 1st effect, $\Delta T_1=40^0$ C and $\Delta T_2=48^0$C taken for the calculation (you may also continue the calculation with this revised value $\Delta T_{1,\,new}=38.84^0$C

Temperature of the saturated vapor from the first effect =148-60= 108°C
Corresponding evaporator drum pressure = 1.2116 bar

Latent heat of the vapor leaving the 1st effect at 108 °C= 530 kcal/ kg (λ_{S1})
Corresponding pressure in the vapor drum = 1.3317 bar

Revised calculation: Energy balance for effect I (reference temperature 108 °C)

$\therefore$ (6000) (-72.6) + m_s (506) = (6000-m_{s1}) (0) + m_{s1} (530) (3.2)

=>m_s = 1.047m_{s1} + 860.86 (3.D)

(3.D) Revised calculation: Energy balance for effect II (reference temperature 60°C)

$\therefore$ (6000 - m_{s1}) (0.94) (108-60) + m_{s1} (530) = (6000-m_{s1}- m_{s2}) (0) + m_{s2} (563)

=>m_{s2} = 0.8612m_{s1} +641 (3.E)

(3.E) Solving 3.A, 3.D and 3.E, m_s= 3453; m_{s1}= 2492 and m_{s2} = 2787 kg/ h

Areas:

$$A_1 = \frac{m_s\lambda_s}{U_{D1}\Delta T_1} = \frac{(3453)(506)}{(550)(40)} = 79.4m^2$$

$$A_2 = \frac{m_{s1}\lambda_{s1}}{U_{D2}\Delta T_2} = \frac{(2492)(530)}{(370)(48)} = 74.3m^2$$

These areas are fairly close, use A1 = A2 = 76 m^2 plus overdesign. About 10% excess area will provide a reasonable overdesign.

Tube details:

Let us select 1¼ inch nominal diameter, 70 schedule, brass tubes of 14 ft in length
Outer tube diameter (do) = 45.16 mm

Inner tube diameter (di) = 34.46 mm

Tube length (L) = 14 ft = 4.2672 m

Surface area of each tube (a) = $\pi \times d_o \times L = \pi \times 45.16 \times 10^{-3} \times 4.2672 = 0.605 m^2$

Number of tubes required providing 10% overdesign (N_t) = A / = (115/0.605)~190

Tube pitch (triangular), PT = 1.25 × do = 1.25 × 45.16 = 56.45 ≈ 56mm

Total area occupied by tubes = $N_t \times (1/2) \times P_T \times P_T \times \sin\theta$ (where $\theta = 60°$)
$= 190 \times 0.5 \times (56 \times 10^{-3})^2 \times 0.866 = 0.2579\ m^2$

This area is generally divided by a factor which varies from 0.8 to 1 to find out the actual area. This allows for position adjustment of peripheral tubes as those can't be too close to tube sheet edge.

Actual area required = 0.2579/ 0.9 (0.9 is selected) = 0.2865 m^2

The central downcomer area is generally taken as 40 to 70% of the total cross sectional area of tubes. Consider 50% of the total tube cross sectional area. Therefore, downcomer area = $0.5 \times [N_t \times (\pi/4) \times do^2]$

$= 0.5 \times [190 \times (\pi/4) \times (0.04516)^2]$

$= 0.1521\ m^2$

Downcomer diameter = $\sqrt{[(4 \times 0.1521)/\pi]} = 0.4399 m$

Total area of tube sheet in evaporator = downcomer area + area occupied by tubes

$= 0.1521 + 0.2865$

$= 0.4386\ m^2$

Tube sheet diameter = $\sqrt{[(4 \times 0.4386)/\pi]} = 0.7472$ m

CHAPTER-VIII
COST ESTIMATION

CHAPTER -VIII

COST ESTIMATION

6.1 Equipment cost

S. No	Name of The Equipment	Cost
1	Soxhlet Extraction	₹53,140.12
2	Distillation	₹ 20,000
3	Rotary evaporator	₹ 34,000
4	Centrifuge	₹ 44,900
5	Sterilizer	₹ 15,500
6	Dryer	₹ 20,000
7	Storage tank	₹ 20,000
Total		**₹ 2,12,540**

Table no 8.1 equipment cost

6.2 Direct cost

S. No	Type of cost	Percentage of purchased equipment	Cost
1	Instrumentation and Control	30%	0.35×2,22,42,400 =₹6,672,720
2	Piping	10%	0.10×1,02,89,100 =₹1,02,8910
3	Building, Process and Auxiliary	25%	0.25×4,56,66,987 = ₹11,416,746
4	Service facilities and Yard improvement	15%	0.15×1,45,67,887 =₹21,85,183
5	Land	10%	0.10×5,76,45,300 =₹5,76,4530
6	Construction, Expense and contract	15%	0.15×1,11,45,900 = ₹1,671,885
Total Direct cost			**₹28,739,974**

Table no 8.2 :direct cost

6.3 Indirect cost

Water connection = ₹2, 55,900

Electricity bill = ₹3, 56,600

Utilities expense = ₹4, 46,600

Miscellaneous cost = ₹38,800

Total Indirect cost = ₹1,097,900

6.3.2 Fixed Capital Investment

= Direct cost + Indirect cost

= **₹28,739,974** + **₹1,097,900**

=₹29,837,874

6.3.3 Working capital cost

25% of the total capital investment

=0.25×29,837,874

= ₹7,459,468.5

6.3.4 Total capital cost

= Fixed capital investment + working cost

= 29,837,874 +7,459,468.5

= ₹37,297,342.5

6.4 Total product cost

Total compound recovery = 85Kg/hr

= 85×24

= 2040kg/day

Cost of total compound recovery = 17, 67,800 /day

6.4.1 Operating labour

6% of the total product cost

=0.06×17, 67,800

=₹106,068

6.4.2 Maintenance and Repair

7% of the total product cost

=0.07×17, 67,800

=₹123,746

6.4.3 Laboratory charge

14% of the total product cost

=0.14×17, 67,800

=₹247,492

6.4.4 Depreciation

0.09% of the fixed capital investment

= 0.009×29,837,874

=₹268,540.866

6.4.5 Local taxes

1.5% of the fixed capital investment

= 0.015×29,837,874

= ₹447,568.11

6.4.6 Insurance

1% of the fixed capital investment

= 0.01×29,837,874

=₹298,378.74

6.4.7 Plant overhead cost

9% of the total product cost

=0.09×1767800

=₹159,102

Total cost of the production per year

=106068+123746+247492+268540.866+447568.11+298378.74+159102

=₹1,650,895.716

Total cost of production per year =₹1,650,895.716

6.5 Gross Earning

=Total income – Total production cost

=17, 67,800 – 1,650,895.716

=₹116, 9042.84

6.6 Payback period

=Total capital cost/ gross earning

=37,297,34.25/116,9042.84

=3.1 years

6.7 Result

Fixed capital cost	**₹29,837,874**
Direct cost	**₹28,739,974**
Total Capital cost	**₹37,297,342.5**
Cost of product	**₹17,67,800**
Taxes	**₹825,447.5**
Total production cost	**₹1,650,895.716**

Table 8.3 Total cost estimation

CHAPTER-IX

CONCLUSION

CHAPTER-IX

CONCLUSION

The GC-MS analysis showed the existence of various compounds of medicinal importance. The screening of Phyllanthus niruri plant extract showed occurrence of high percentage area of bioactive compounds using GC-MS. In the present study, the phyto compounds of phyllanthus niruri plant extract were identified with molecular formula and structure, which may be used for drug development. Here we got methanolic extract (85 ml) is more efficient yield percent as compared with chloroform extract (70 ml).*Phyllanthus niruri* methanolic extract at concentration of 1000 ml showed IC50 value 67.11 of inhibitory effect on Alfa-amylase activity with a %IC50 value 449.03%.The chloroformic extract of phyllanthus niruri at concentration of 1000 ml exhibit 50.34 inhibitory effect on Alfa-amylase activity with a %IC50 value of 972.91%.

The highest inhibitory effect is showned in methanolic extract. β-Humulene is having higher peak area in gas chromatogram having 11.82 %. β-Humulene is a Terpene derived from terpinoids. It hydrolyses the hydrocarbons. Alpha amylase is an enzyme that hydrolyses polysaccharide to glucose and maltose.it is capable of exerting blood Glucose lowering effects.

Betulin is a triterpene which increase the insulin sensitivity. Triterpene is a therapeutic agent used for diabetis mellitus. It prevent the development of insulin resistance and normalize plasma glucose and lnsulin levels. It also delay the absorbance of carbohydrates in the intestine. This study may also enhance the traditional usage of phyllanthus niruri due to its bioactive compounds identified by GC-MS analysis. GC-MS analysis is a step towards understanding the nature of active principles in phyllanthus niruri. This study will also be helpful to further pharmacological study for researchers and drug development in pharmaceutical industry.

9.1 FUTURE PLAN

1. *In-vivo* antidiabetic activity: *phyllanthus niruri* has shown promise for the development of antidiabetic agents with fewer side effects. To investigate the mechanism of action of aqueous leaf extract prepared from phyllanthus niruri performed on living organisms.
2. Drug delivery: The present biological compounds utilize to deliver the desired body site. Drug delivery refers to the technology utilized to present the drug to the desired body site for drug release.

CHAPTER-X

REFERENCE

CHAPTER-X

REFERENCE

1. Ali Blebil Q., Syed Sulaiman AS., Mohamed Hassali A., Juman Dujaili A., Karuppiah Subramaniam and Nor Aziz, A., 2006, Evaluation of Smoking status among Diabetes Patients in the state of Penang Malaysia, Tropical journal of Pharmaceutical Research, 12(3), 445-448.
2. Arunachalam Sathiavelu[1]*,Sundaramoorthy Sangeetha[1], Rastogi Archit[1], Sathiavelu Mythili[1], *In-Vitro* Anti-diabetic activity of aqueous extract of the the medicinal plants *Nigella savita*, *Eugenia jambolana*, *Andrographis paniculata* and *Gymnema sylvestre*. School of Bio Science and Technology, VIT University, Vellore-632 014, Tamil Nadu, India.
3. Sunil Kumar, Vipin Kumar*,OM Prakash, Anti-diabetic, Hypolipidemic and histopathological analysis of *Dillenia indica* (L) Leaves extract on alloxan induced diabetic rats, Institute of Pharmaceutical Science, Kurukshetra University, Haryana ,India.
4. Masturah Markom[a,b],*, Masitah Hasan[a], Wan Ramli Wan Daud[b], Harcharan Singh[c], Jamaliah Md Jahim[b], Extraction of hydrolysable tannins from Phyllanthus Niruri Linn : Effect of solvents and extraction methods, Department Of Chemical Engineering, Malaya,50603 Kuala Lumpur, Malaysia.
5. Cinithia.R.C.Porto[1],Luiz A.L,Soares[1,2],Tatiane P.Souza[3],Pedro R.Petrovick[4],Ibson L.Lyra[5],Raimundo F.Araujo Junior[6],SilvanaMaria Zucolotto Langassner[7],Aurigena.A.A.Ferreira[8], Gerlane C.B.Guerra*[8] Department of Pharmaceutical science, University of Federal de Pernambuco, Brazil.
6. A.Kumaran,R.Joel Karunakaran*,*In-Vitro* Anti-oxidant of methanol extracts of five *phyllanthus* species from India, Department of Chemistry, Madras Christian College,Tambaram,Chennai 600 059,Tamil Nadu,India.

7. Arun T,Senthil kumar B, Purushothaman K, Aarthy A,GC-MS Determination of Bioactive Components of phyllanthus amarus (L) and its Anti-Bacterial Activity, Department of Bio Technology,Muthayammal College of Arts and science,Rasipuram-637 408,Tamil Nadu,India.
8. Maliheh Najari Beidokhti [a,*], Mia Vesterholm Anderson [a],Hoda M.Eid [b], Marya Luz Sanchez Villavicencio[b], Dan Staerk [a],Pierre S.Hadded [b],Anna K.Jager [a],Investigatoion of Anti-Diabetic Potential of *Phyllanthus niruri* L. Using assays for α Glucosidase,Muscle glucose transport, liver glucose production and adipogesis, Department of Drug Design and Pharmacology, Faulty of Health and Medical Sciences, University of copenhagen, Denmark.
9. Cínthia R. C. Porto,[1] Luiz A. L. Soares,[1,2] Tatiane P. Souza,[3] Pedro R. Petrovick,[4] Ibson L. Lyra,[5] Raimundo F. Araújo Júnior,[6] Silvana Maria Zucolotto Langassner,[7] Aurigena A. A. Ferreira,[8] Gerlane C. B. Guerra[*,8]Anti-infl ammatory and antinociceptive activities of *Phyllanthus niruri* spray-dried standardized extract,[1]Programa de Pós-graduação em Ciências Farmacêuticas, Universidade Federal do Rio Grande do Norte, Brazil,[2]Departamento de Ciências Farmacêuticas, Universidade Federal de Pernambuco, Brazil.
10. Obidike Ifeoma[1,2*], Okhale Samuel[3], Aboh Mercy Itohan[4], Salawu Oluwakanyinsola Adeola[1],Isolation, fractionation and evaluation of the antiplasmodial properties of *Phyllanthus niruri* resident in its chloroform fraction,[1,3,4]Department of Pharmacology and Toxicology, National Institute for Pharmaceutical Research and Development, P.M.B. 21, Abuja, Nigeria,[2]Combi Chem Bio Resource Centre, Organic Chemistry Division, National Chemical Laboratory, Pune 411008 India.
11. Hang Fan[1] · Jian Chen[1] · Han Lv[1] · Xiancan Ao[1] · Yuexian Wu[1] ,Bingru Ren[1] · Weilin Li[1] Isolation and identification of terpenoids from chicory roots and their inhibitory activities against yeast α-glucosidase, Institute

of Botany, Jiangsu Province and Chinese Academy of Sciences, Nanjing 210014, People's Republic of China.

12. Jude C. Chukwujekwu[1], Kannan R. R. Rengasamy[1], Carmen A. de Kock[2], Peter J. Smith[2] and Johannes van Staden[1]Alpha-glucosidase inhibitory and antiplasmodial properties of terpenoids from the leaves of *Buddleja saligna* Willd[1] Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, Scottsville, South Africa, [2]Department of Medicine, Division of Pharmacology, University of Cape Town, Cape Town, South Africa.
13. Sunil Kumar, Smita Narwal, Vipin Kumar, Om Prakash,α-glucosidase inhibitors from plants: A natural approach to treat diabetes,Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra - 136 119, Haryana, India.
14. *In vitro* antidiabetic activity of *Caesalpina digyna* (R.) methanol root extract ,M. B. Narkhede*[1], P. V. Ajimire[1], A. E. Wagh[1], Manoj Mohan[2] and AT Shivashanmugam[1]BSS College of Pharmacy, Malkapur (MS) ,[2]SRIPS COP, Coimbatore (TN) .
15. Bnouham M, Ziyyat A, Mekhfi H, Tahri A, Legsseyer A. Medicinal plants with potential antidiabetic activity- A review of ten years of herbal medicine research (1990-2000). Int J Diabetes and Metab, 2006; 14:1-25.
16. Bouheroum M, Zaiter L, Benayache S, Benayache F, Bermejo J, Leon F, Garcia V. Four flavonoides from the aerial part of Ononisangustissima species, Chemistry of Natural Compounds, 2009; 45(6):874-875.
17. Boutati EI, Raptis SA. Post prandial hyperglycemia in type 2diabetes: Pathophysiological aspect, teleogical notions and flags for clinical practice. DiabetesRes. Rev, 2004; 20:13-23.
18. Adedapo, A.A., Abatan, M.O. and Olorunsogo, O.O. 2004. Phytochemical analysis of the leaves of *Phyllanthus amarus* and

Euphorbia hirta. Tropical Veterinarian. 22, 19-25. Ali, H., Houghton, P.J. and Soumyanath, A. 2006.

19. Alpha-Amylase inhibitory activity of some Malaysian plants used to treat diabetes with particular reference to *Phyllanthus amarus*. Journal of Ethnopharmacology. 107, 449455.
20. Gowri, P.M., Tiwari, A.K., Ali, A.Z. and Rao, J.M. 2007. Inhibition of alpha-glucosidase and amylase by bartogenic acid isolated from Barringtonia racemosa Roxb. seeds. Phytotherapy Research. 21, 796-799.

COAGULATION BASED CHEMICAL TREATMENT OF INDUSTRIAL AND DOMESTIC EFFLUENTS

A PROJECT REPORT

Submitted by

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In partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

In

CHEMICAL ENGINEERING

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

MARCH 2020

DECLARATION

We **PURUSHOTHAMAN.V, AJITH.M, VINOTHKUMAR.R, VELAN.V,** hereby declare that the project report titled "**COAGULATION BASED CHEMICAL TREATMENT OF INDUSTRIAL AND DOMESTIC EFFLUENTS"** done by us under the guidance of **Mr.D.DHANARAJA, Assistant professor** is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Chemical Engineering. Certified further that, to the best of our knowledge, the work reported here in does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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SIGNATURE OF CANDIDATE

DATE :

PLACE :

Abstract

Industrial effluent treatment and disposal is a major problems in industries such as tannery and textile. The effluents coming from these industries are generally consists of high dissolved solids, COD (Chemical Oxygen Demand) and BOD (Biological Oxygen Demand) content. Therefore it has a great impact on environment upon disposal. The present experimental studies are done by single stage process of settling and ozone. Aluminium Sulfate (alum) is the coagulant used for the treatment due to its performance, cost effectiveness and availability. Coagulant treated effluents are then disinfected by ozonation process to kill the pathogens and microorganisms. Results concluded that the effluents after treatment can be reused.

Keywords: COD, BOD, Ozonation, Alum.

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List of abbreviations

BOD	-	Biological Oxygen Demand
COD	-	Chemical Oxygen Demand
TSS	-	Total Suspended Solids
TDS	-	Total Dissolved Solids
WHO	-	World Health Organization
DO	-	Dissolved Oxygen
CETP	-	Common Effluent Treatment Plant
UF	-	Ultrafiltration
UV	-	Ultraviolet
NTU	-	Numbers of Transfer Unit
MW	-	Molecular Weight
EFOM	-	Effect of Effluent Organic Matter
AOPs	-	Advanced Oxidation Processes
SMP	-	Soluble Microbial Product
POME	-	Palm oil mill effluent
Cd	-	Cadmium
TOC	-	Total organic compound
PAFC	-	Poly-Aluminium of ferric chloride
CF	-	Coagulation-flocculation
VFA	-	Volatility fatty acids
FCS	-	Fluorescence Correlation Spectroscopy
RSM	-	Response Surface Methodology
WWTPs	-	Wastewater Treatment Plants
PCP	-	Pentachlorophenol
PEC	-	Purchase equipment cost

TIC	-	Total indirect cost
TDC	-	Total direct cost
FCI	-	Fixed capital investment
TCI	-	Total capital investment
TPC	-	Total product cost

CHAPTER 1

INTRODUCTION

1.1 Industrial effluents

1.1.1 An overview on industrial effluents

- Effluent is an outflowing of water or gas to a natural body of water, from a structure such as wastewater treatment plant, industrial outfall, etc.,
- Industrial effluent control is of vital importance, particularly is developing countries where control is often very poor or non-existence. Good sewage treatment starts with good control of industrial effluents.
- Large amount of effluents must be released on the environment and it causes major environment issues.

1.1.2 The prime reasons for the control the industrial wastewaters:

- To protect workers working within the treatment system.
- To prevent fires and explosions due to inflammable or explosive chemicals.
- To ensure the industrial discharges do not affect the performance of treatment process.
- To protect the environment.
- The treatment of industrial effluents based upon the following factors.
- The type and nature of industrial wastewater.
- The potential effect on capacity of the treatment plant.
- The potential effect on biological treatment process.
- Researchers have conducted many researchers for managing the industrial effluents and to remove the toxic chemicals to make environment friendly.

- To reduction of BOD,COD levels, TSS, TDS levels etc., to make the effluent with low amount of contaminants,
- The use of chemicals in this process is restricted to reduce pollutants and improve the reduction of suspended solids, BOD and COD.

1.1.3 History of industrial effluents:

- From the Middle Ages until the early part of nineteenth century. The streets in many cities of Europe were fouled with excreta and garbage to extent that people often held to tolerate the atmosphere.
- The introduction of water-carriage systems of sewage disposal in early nineteenth is century is transferred filth from streets to rivers.
- The industrial revolution with establishment of factories on banks of rivers where water was freely available for power, and effluent disposal. As a consequence, the quality of rivers deteriorated to extent that they were unable to support aquatic life and aquatic ecosystem must be unbalanced.
- However, in most of developing world there has been no such recovery, in countries there where has been recovery it has not been easy nor has it been cheap, it has been supported by good engineering applications.
- In UK, where many watercourses has been deviated by effects of industrial revolution and has become a serious menace to public health causing cholera in 1866.
- The river protection act at 1876 was taken against the problem.
- Although 1876 act was comprehensive, it specified duties with respect to sewage treatment at a time. In 1912, the eighth report was published and it dealt with question of standards and tests to be applied to industrial and sewage effluents.

- It consists,
    - Effluent should have no more than 30 mg/l suspended solids.
    - Should, after filtering, absorb no more than
        - 5 mg/l do in 24 hours.
        - 10 mg/l do in 48 hours.
- In 1989, the WHO published health guidelines for the use effluents in agriculture and aquaculture that specified.
- In twentieth century, discharge standards were based on numerical limits on chemical parameters. In recent years there have been considerable advances on use of toxicity testing.

1.1.4 Environmental impacts on industrial effluents:

- The impacts of such degradation may result in decreased level of DO, physical changes to receiving waters, release of toxic substances, and bioaccumulation of aquatic life.
- It has both advantages and disadvantages it has been used for crop production for its nutrient contents.
- It can also impose negative impacts on communities and on ecosystems.
- The wastewater containing toxic wastes lead to adverse effect on groundwater quality. Eutrophication due to excessive amount of nutrients contributes to depletion of DO (environmental Canada, 1999).
- Another environmental impact of untreated wastewater effluent, which can be linked to health, is the phenomenon of bioaccumulation and bio magnification of contaminants.
- These substances tend to be stable, live long chemically, and are not easily broken down by digestive process (environmental Canada 1999).

- Such substance includes heavy metals.
- The release of toxic substances from wastewater into receiving water bodies has direct impacts on terrestrial plants and animals.

Acute impacts from effluents are generally due to due to high levels of ammonia and chlorine.

- Cumulative impacts are due to the gradual buildup of pollutants in receiving water.

1.1.5 Industrial effluents for treatment:

- Three different effluents were collected from different places, they are,
    a) Tannery effluents from CETP, erode.
    b) Dye effluent from MAT industry at Omalur.
    c) Domestic effluent from college campus.
- This effluent after treated with alum contains low toxic components.
- The COD, BOD, TSS, TDS, Turbidity level of effluents before and after treatment must be compared.

1.2. Alum:

- Alum is chemical substance used for the treatment process and it must be recycled and reused.

1.2.1 Properties of alum:

- Alum was used for treatment of effluents as coagulant and it must be reused for consecutive process.
    - Molar mass : 473.39 g/mol
    - Molecular formula: KAl (SO4)2. 12 H2O
    - Melting point : 92.5°c

- Boiling point : 200°c

- Alum is manufactured as liquid, from which the crystalline form and dehydrated.
- It is added to raw effluent it gets it released with bicarbonates alkalinities present in water and forms a gelatinous precipitate.

1.2.2. Preparation of alum:

Materials:

- Potassium sulfate, Aluminium sulfate, dilute H2SO4, alcohol-cold water mixture, distilled water, cold water, china dish, spatula, glass rod, beakers, measuring jar, crystallizing dish, watch glass, filter papers and hot plate.

Procedure:

1. 12.5 grams of K2SO4 crystals in clean 250ml beaker.
2. Measure 100 ml of distilled water in measuring jar.
3. Pour into the beaker containing potassium sulfate crystals. Stir the solution using glass rod to dissolve the crystals.
4. If the crystals do not dissolve, warm the solution to dissolve the crystals.
5. Take 50 grams of Al2SO4 crystals in another 25 ml beaker.
6. Pour 100 ml distilled water into this beaker.
7. To this, add about 1ml of dilute H2SO4 to prevent hydrolysis of Aluminium sulfate. Warm the beaker for about 5 minutes to obtain a clear solution now transfer K2SO4 solution into the china dish. Then, transfer Al2SO4 into the same china dish. Mix the two solutions in the china dish using a glass rod. Heat the solution in china dish over the hot

plate. To avoid the crust formation on the side of the dish, stir the solution continuously with a glass rod.

8. When the volume of solution is reduced, to about one-half its original volume, take a drop of the concentrated solution at the end of the glass rod and cool it by blowing.
9. Formation of a thin crust indicates that the crystallization point has reached. Now transferred the hot saturated solution into crystallizing dish. Place the crystallizing dish in through containing cold water.
10. Cover the dish with the watch glass and allow it to cool slowly for some time. On cooling, colourless potash alum separate out.
11. Wash the crystals 2 or 3 times with a little alcohol containing a small amount of distilled water using spatula, remove the crystals to a filter paper which soaks up the solution.
12. Transfer the crystals to another filter paper and dry by pressing them gently between the folds of the filter paper.
13. Now, transfer the crystals into a watch glass. The crystals of pure potash are colourless.
14. 100 ml of water is purified by 14 grams of potash alum.

Figure 1.1: alum crystals

1.3 Industrial effluents treated with alum:

- In this project, the raw effluent from different industries were collected and treated with alum. To reduce toxic contaminants.

1.3.1 Alum:

- Alum is a type of chemical compound, usually a hydrated double sulfate salt of Aluminium.
- The name alum is also used more generally for salts with same formulae and structure.
- Alum is used in industrial flocculation in medicine alum may also refer to Aluminium hydroxyl gel used as vaccine adjuvant.
- Alum kills or lowers total bacterial content.

1.3.2. Types of alum:

- Potassium alum K (SO4)2. Al (SO4)2.12 H2O.
- Sodium alum Na Al (SO4)2 .12 H2O.
- Ammonium alum NH4 Al (SO4)2. 12 H2O.

Crystal structure:

- Alum crystallizes in three different crystal structures. They are $\alpha, \beta \; and \; \gamma$ alums.
- Potassium alum is the mostly used alum. It has used antiquity as a flocculant in industrial effluents.
- Side effects such as swelling, itching or pain.

1.4. Advantages and disadvantages of alum:

Advantages:

- Process simplicity.
- Inexpensive capital cost.
- Very efficient for suspended solids.
- Good sludge settling.
- Rapid removal of insoluble contaminants.
- Not metal selective.

Disadvantages:

- Chemical consumption.
- Ineffective in removal of metal ions at low concentration.
- Low removal of arsenic.
- Selectivity is P^H dependent.
- High sludge production.

1.5 Ozonation in water treatment:

- Ozone is an unstable gas comprising of three oxygen atoms, the gas with readily degrade back to oxygen and during this transition a free oxygen atom or radical form. The free radical is highly reactive and short lived.
- Ozone is a colourless that has an odour similar to smell of air after transform.
- Ozone has greater disinfection effectiveness against bacteria and viruses compared to chlorination. It oxidizes the iron, manganese and sulphur in water to form elemental sulphur.

- The rate of degradation of ozone depends on function of water chemistry, PH and water temperature.

1.5.1 Process of ozonation:

- The formation of oxygen into ozone occurs with the use of energy. This process is carried out by an electric discharge field as in the CD (Corona Discharge) type ozone generators.
- In general, an ozonation system includes passing dry, clean air through a high voltage electric discharge, which creates ozone concentration of approximately 10,000 mg/L.
- The raw effluent is passed through a venturithroat which creates a vaccum and air is then bubbled up through the effluent being treated.

1.5.2 Advantages and Disadvantages

Advantages

- Ozone is effect over a wide PH range and rapidly reacts with bacteria, viruses, etc.,
- This process does not add chemicals to the effluent.
- It eliminates a wide variety of microbial problems.

Disadvantages

- There are higher and operational costs.
- It provides no germicidal or prevent regrowth.
- Ozone is less soluble in water compared to chlorine.
- Potential fire hazards and toxicity issues associated with ozone generation.

CHAPTER 2

LITERATURE REVIEW

L. Mazari et al,. This study investigates the potential reuse of alum sludge collected from a water treatment plant as primary coagulant. The recovered alum were used again as a coagulant and it results was found that pretreatment by alum sludge not only improved the removal of organic matter during wastewater treatment but also improved the permeate flux in the UF process by limiting membrane fouling. The fouling resistance and cake resistance could be efficiently reduced by alum sludge pretreatment. High efficiencies of turbidity. COD and UV_{254} removal were achieved by combining alum sludge with UF.

Sheng.H, Lin and Wen Y.LiuIn this study a continuous process of combined ozonation and chemical coagulation was employed for treating textile waste water from several dyeing and finishing plants in a multi chamber reactor system. This combined treatment was found to be very effective in decolorizing textile wastewater and in reducing its COD content up to 66% the ozonation for decolorization is able to save at least 30% of the cost of chemical decolorizing agent.

Mlik et al,. The research work aims to suggest some techniques to reduce pollution concentration in the wastewater of tannery industry. The main findings of this work are pH of the wastewater before the treatment was 10.29. After treatment it was reduced to 7.72. COD before the treatment was 2594 and it was reduced to 148 after the treatment. Initial value of TSS was 1026 before the treatment. After treatment it was 43.5. TDS valued prior to the treatment was 5512 .After the treatment it was reduced to 4705. The higher TDS can be reduced by using some tertiary treatment methods.

S.Kalavathy and M.V.S.S.Giridhar In this study the coagulation process effectively removed turbidity from synthetic high turbid water using 10-20 mg/l dosage. The highest turbidity removal efficiency was found to be 46.15% using 10mg/l alum dose at pH 7.4 for 140NTU high turbid water maintained at room temperature conditions with a settling time of 10 minutes. Coagulant aids could enhance the removal efficiency investigating the influence of agitation time and settling time for varying does and pH conditions on turbidity removal.

D Abdessemed et,al,. In this study they has determined the optimal conditions of tertiary treatment by coagulation settling, adsorption and ultrafiltration of a secondary effluent. Their goal has been to specify the efficiency of the alternative treatment plant for a reclamation wastewater and reuse. They observe that the best result of the residual COD is obtained for the coupling of coagulation-adsorption. Either value of 10.4 mg/l for a pH 5.5 and for concentrations while coagulating $Fecl_3$ equal to 40mg/l and in powered activated carbon equal to 20mg/l.

Kwon jeonget,al,.The results suggest that coagulation and ozonation can be promising pre-treatments for of membrane process. That results of EFOM characterization showed different mechanisms of flux improvement by coagulation or ozonation. The average MW, florescence intensity and aromaticity decreased slightly, but DOC decreased notably after coagulation. This indicates that the important in of membrane flux is mainly due to EFOM removal. The UF membrane flux decline decreased more greatly after ozonation along with coagulation. This was attributed to the significant decrease of high MW fraction (>5k Da) aromatic moieties of EFOM and SMP.

Taner Yonar Advanced Oxidation Process (AOPs) based on the need to dispose of residual sludge. AOPs based on the generation of very reactive and oxidizing free

radicals, especially hydroxyl radicals have been used with an increasing interest due to their high oxidant power. Advanced Oxidation Process are promising alternative of traditional treatment process for the treatment of textile effluent. Removal of color and recalcitrant organic content of textile effluent can be achieved with high efficiencies costs of AOPs are another point of view. In most cases, capital and operation and maintenance cost of AOPs are generally higher than traditional process.

Anthony F, Stricklant et al,. Waste streams representative of the effluent from azoic, disperse/sulfur, and reactive dyes were treated successfully. Almost all of the color was removed within a 30 minute time period. Therefore wastes from any of these dye range are amenable to treatment for color removal using ozone. The treatment of the vat dyes was not as successful. Only about 50% color was removed from the vat dyes could be removed by ozonation of the dye range wastewater, long treatment times and large quantities of ozone would be required.

J. Masides,J. soley et al,. In this study showed that decrease in the pH of redissolution along with an increase in pH of coagulation leads to an improvement in alum recovery yield. Temperature does not exert any significant effect on the process. In accordance with the Box-Wilson optimization method a maximum percentage of recovered coagulant was obtained at the following conditions pH_c=8.3,pH_r=1.3,T=7.5℃. This study of settling rates showed that either using fresh or recovered alum they were similar, although the $V_s$is slightly greater when the sludge is treated with fresh alum. The economic feasibility study that followed, showed the high profit level of the recovery process, with payout times ranging from 0.7 to 1.7 yr, and internal rate of return over 10yr up to 275%. Operating conditions which give the maximum profitability level were the following: pH_c=6.6, pH_r=2.5, T=25℃. Taking into account all the obtained results it would be

advisable to operate the treatment plant with recovery process at a coagulation pH within the range 6.5-8.5, and at a redissolution pH ranging from 1.5 to 2.5, depending on the particular conditions of each plant. It must be stated that, although the study is based on the use of a particular raw water, the conclusions obtained can be considered general form of the qualitative point of view.

Ahmad HussainiJagaba, et al ,. This study was aimed at alum dose reduction in the treatment of (palm oil mill effluent) POME because of its numerous effects to human and aquatic life. Thus, coagulation-flocculation method was used to examine the effectiveness alum and a combination of alum with ferric chloride, chitosan, zeolite and *moringa oleifera*. Series of jar test was carried out and the comparison of coagulants under optimized conditions indicates that the best coagulant combination in terms of sludge volume reduction was alum + zeolite as the sludge volume was reduced from 12.50% to 8.75%by a combination of 2 g/L alum + 1 g/L zeolite. The performance of heavy metals reduction was also improved when alum was combined with various coagulations. Alum combined with other coagulants gave higher reductions for turbidity, oil and grease, TSS, NH_3-N, COD, Zn, Pb, Cu, Mn and Fe as 99.61%, 98.32%, 99.69%, 98.54%, 77.65%, 92.10%, 97.65%, 89.14%, 93,985%, and 96.06% respectively. However, all combinations were not successful in high colour and Cd removals as 96.44% for colour was obtained using chitosan alone while 95.75% for Cd using alum alone. From these obtained results, it can be concluded that treatment of POMEby coagulant-flocculation technique through the combination of alum with other coagulants is effective in high effluent removal.

Rameshraja,D. and Suresh,S.In this study of various oxidation and combined processes such as UV/H_2O_2 / hypochlorites, Fenton and Electro-Oxidation, photo-chemical, photo-catalytic, ozonation and catalytic treatments have been considered.

This could help to diminish that problem by reducing the energy consumption required for generating UV radiation. The maximum reduce the Total organic Compound (TOC) content by mineralization of the organic compounds using combined $H_2 O_2$ /UV and the Fenton's oxidation process for the treatment of tannery wastewater. The $H_2 O_2$ and calcium hypochlorite were the most efficient oxidant while compared to other oxidant for removal of chromium pollutant from tannery effluent. Improvements can achieved by using metal salts or ozone and UV-light can activate $H_2 O_2$ to from hydroxyl radicals which are strong oxidants. Fenton oxidation was successful in increasing both extent and rate of biodegradation in the treatment of tannery wastewater.

G. Lofrano, et al,. This study aimed to optimize pH and coagulant does for the wastewater originated from a leather tanning plant to improve COD removal as well as reduce the toxicity of the exiting treatment process. The optimum conditions were assessed as 8.5 pH and 900 mg/l of Poly-Aluminium of Ferric Chloride (PAFC) with the pH adjustment by using$Ca(OH)_2$ which resulted in high removal of COD and TSS and reduced immobilization. Once the optimum conditions for PAFC was determined those were compared on two more samples by comparing different coagulants. The overall decrease in effluent toxicity following the (Coagulation-Flocculation) CF effluent suggested an effective removal of toxic components from tannery wastewater.

Kokila A. Parmar, et al,.the present study was undertaken to, compare under the same analytical conditions, the efficiency of ferrous sulfate and alum used as coagulant in chemical treatment of raw water collected from dairy plant. Results of visual and physicochemical evaluation of chemically treated wastewater indicated significant improvement of their selected characteristics, however different response to the coagulant treatment was observed. Results obtained in their study

the discharge of coagulated wastewater to municipal sewage system would not be possible without correction of some properties. The achieved values of COD(1361 and 1224 mg//l)and BOD (635.3 and 710.4mg/l) in coagulated wastewater with alum and ferrous sulfate respectively, still exceeded discharge limits (COD-250 and BOD-100 mg/l).

G.Durai and M.Rajasimman the article examines the extent of pollution created by tanneries and the different biological processes available for the treatment and disposal of tannery wastewater. The advanced methods like membrane filtration, oxidation by ozone being field trials. This is because of the lack of information on various aspects such as desirable influent COD, optimal level of volatile fatty acids (VFA) concentration in the reactor. In the field of wastewater treatment, it is generally accepted that anaerobic treatment is less energy intensive and, hence, preferable to aerobic treatment. This review shows that the anaerobic treatment facility is superior in most respects for the treatment of tannery wastewater.

Carla Regina Costa, et al,.The Si/BDD electrode exhibited the best performance for the removal of total phenols, COD, TOC, and absorbance at 288 nm from the wastewater, followed by the Ti/SnO_2 - Sb anode. Good results were obtained with the Ti/SnO_2 –Sb electrode, mainly with respect to the removal of total phenols; however, this anode presents a short service life. Wastewater oxidation was very slow in the case of the Ti/SnO_2 -Sb-Ir electrode. Low efficiency values were obtained with the latter electrode due to its low over potential for the oxygen evolution reaction. The performance of the oxidation process using the Si/BDD electrode was not affected by pH. The increase in current density resulted in faster oxidation of organic compounds, but it also led to lower current efficiency and higher energy conception. They conclude that Si/BDD is the best anodic material for the electrochemical treatment of tannery wastewaters containing organic

compounds in chloride –free media, because it allows complete mineralization in a shorter time range and with lower energy consumption compared with other anodic materials in the same conditions.

P.K.Singh, etal,. In this study had capacity to retain colour and COD of wastewater which may otherwise contaminate the ground water presence of calcium and magnesium in the percolate from lysimeters indicated their nonretention in the soil profile. On the other hand sodium was retained in the soil profile. Wastewater irrigated soils showed increase in the water holding capacity, pH, ECe, ESP, Organic carbon and available nutrient content of soils but decrease in the bulk density. Monsoon rains leached the accumulated salts beyond the rhizosphere there by reducing the soil ECe and indicating effective leaching of soluble salts. Wastewater irrigation did not affect the germination and nutritional quality of food grain. The application of wastewater infact increased the yield of the crop.

S.Sadri Moghaddam, etal,. In this study a coagulation/flocculation process was studied to remove AR199 dye from solutions by reusing the ferric chloride sludge. The results clearly showed that the dye removal efficiency of FCS was severely influenced by initial pH variations and with the increase of FCS dosage, no removal reduction was observed. It was found that apart from the charge neutralization mechanism, the FCS apparently served as condensation nuclei and the dye particles were enmeshed as the precipitate was settled. Therefore, RSM has been proved to be a powerful tool for optimizing the coagulation/flocculation process for the AR119 dye removal from synthetic wastewater and the FCS can be considered as an appropriate alternative for conventional costly coagulations that are widely used in WWTPs.

Azam Pirkarami, Mohammad Ebrahim OlyaThis study was an investigation into the impact of current density, anode type, temperature, pH, and salinity on the removal of Reactive Red 120 from synthesized wastewater. Regarding current density, 45Am^{-2} turned out to be optimum level. The levels of 25 and 35Am^{-2} were also effective, but they resulted in a longer electro coagulation time. The other optimum alternatives were iron anode, a temperature 25℃, a pH of 7, and an electrolyte concentration of 15 mg L^{-1}. Cost analysis was also done for the treatment process. The post-treatment product was characterized using GS-MS studies. This indicates that dye removal is more complicated in the case of real effluent than with synthesized wastewater.

M Joshi, R Bansal and R PurwarCoagulation/flocculation is the most widely used method for colour removal because of economic feasibility, rapid removal of colour and significant reduction of COD. Adsorption processes have also got a lot of attention for colour removal. Activated carbon is used mostly as the final polishing or tertiary treatment because regeneration costs are very high and high volume of textile effluent involved with dying. The best established destruction technologies are based on the chemical, bio and electrochemical oxidation techniques. These lead to either partial oxidation of the dye, destroying the conjugated bonding system in the chromophore thus, removing colour or total oxidation to form carbon dioxide and inorganic ions which is most ideal. Enzymatic microbial decolorization of textile dying effluents is also a very promising and innovative area of investigation. It eliminates the need for inorganic oxidizing agents or precipitating agents, which lead to higher toxicity in wastewater and generate additional solid waste. Microbial decolorization using enzyme degrades the aromatic ring structure to carbon dioxide, molecular nitrogen and water, thereby casing less toxicity.

Upendra D.Patel,Sumathi Suresh This study presents an electrochemical treatment method for the removal of pentachlorophenol (PCP) in water as well as in potash alum pretreated pulp bleach effluent. Mojor findings of investigation are removal of PCP in water containing NaCl was very rapid. The extent and rate of PCP removal in raw pulp bleach effluent were very poor. Removal of suspended and colloidal solids by pretreatment of raw bleach effluent was necessary in order to make the effluent amicable to electrochemical treatment. >99% of PCP was removed in potash alum pretreated pulp bleaching effluent with 30 min of electrochemical treatment. In the addition >99% of colour and COD were removed after 1 hour of treatment. Presence of active chlorine species during the electrochemical reaction suggested that indirect oxidation of the target compound; PCP was a predominant mechanism of removal. Electrochemical treatment may be promising option for efficient treatment of pulp bleaching effluent considering the simplicity and economy of the method.

CHAPTER 3

METHODOLOGY

3.1 Raw materials required

- ✓ Tannery Effluents
- ✓ Dyeing effluents
- ✓ Domestic effluents

3.2 Chemicals used

- ✓ Potassium sulfate
- ✓ Aluminum sulfate
- ✓ Sulfuric acid
- ✓ Alcohol (ethanol)
- ✓ Distilled water

3.3 Collection of Effluent

- The Tannery Effluents are collected from Common Effluent Treatment Plant located at Erode.
- The Dyeing Effluents are collected from Small Scale Mat Industry located at Omalur, Salem.
- The Domestic Effluents are collected from our campus STP Plant located at Pachal, Namakkal.

3.4 Properties of Effluents

3.4.1 Tannery Effluent

Tannery industries are one of the major sources of environmental pollution as the wastewater discharged from industries contain,

1. High concentration pollutants,
2. Organic matter,
3. Phenolics,
4. Tannins and heavy metals,
5. Chromium

It is very essential to treat the tannery wastewater adequately for the complete removal of organic pollutants and pathogenic microbes, for the safety of aquatic resource and human as well as animal health.

3.4.2 Dying Effluents

The effluents discharged from textile factories are a mixture of dyes, metals and other pollutants. Dye is the most difficult constituent of the textile waste water to treat.

1. Colors
2. Toxicants and inhibitory compound
3. Surfactants, soaps, detergents, chlorinated compound

3.4.3 Domestic Effluents

The effluents are collected by rural area sewage treatment plant located at Paavai Engineering College, Pachal, Namakkal. Treatments of these effluents are very complex.

3.4.4 Properties of Solvents

Table 3.1 properties of solvents

Properties	**Potassium Sulfate**	**Aluminum Sulfate**
Chemical formula	K_2SO_4	$Al_2(SO4)_3$
Molar mass	174.259 g/mol	342.15 g/mol
Appearance	White solid	White crystalline solid hygroscopic
Density	2.66 g/cm3	2.672 g/cm^3
Melting point	1069℃ (1956°F , 1342k)	770 ^{0}c (1420^{O}F, 1040 K)
Solubility in water	111 g/L (20^{O}C) 120 g/L (25^{O}C) 240 g/L (100^{O}C)	31.2 G/100 ml(0^{o}c) 36.4 g/100ml(20^{o}c) 89,0 g/100mi(100^{o}c)
Odor	Odorless	-

3.5 Preparation of Potash Alum

$$K_2SO_4 + Al_2(SO_4)_3.18H_2O + 6H_2O \rightarrow K_2SO_4.Al_2(SO_4)_3.24H_2O$$

- 12.5 grams of potassium sulfate crystal in clean 250 ml of beaker. Measure 100 ml of distilled water in measuring jar.

- Pour into the beaker containing potassium sulfate crystal. Stir the solution using glass rod to dissolve the crystals.
- If the crystal does not dissolve, warm the solution to dissolve the crystal. Take 50 grams of aluminum sulfate crystal in another 25 ml of beaker.
- Pour another 100 ml of distilled water into this beaker .to this add about 1.45 ml of dilute sulfuric acid to prevent hydrolysis of Aluminum sulfate warm the beaker for about 5 mines to obtain a clear solution.
- Transfer potassium sulfate solution into the china dish then, transfer Aluminum sulfate into same china dish. Mix the two solutions in the china dish using a glass rod.
- Heat the solution in china dish on the hot plate to avoid crust formation on the side of the dish, stir the solution continuously with a glass rod.
- When the volume solution is reduced, to almost one half its original volume. Take a drop of the concentrated and the end of the glass rod and cool.
- Formation of thin layer indicates that the crystallization point has reached now transferred the hot saturated solution into crystallizing dish in a through containing cold water.
- Cover the dish with the water glass and allow it to cool slowly for some. On cooling, colorless potash alum separated out.
- Wash the crystal 2 or 3 times with a little amount of alcohol containing a small amount of distilled water using the spatula remove the crystal to a filter paper.
- Transfer the crystal to another filter paper and dry by pressing them gently between the folds of the filter paper, now transfer the crystal into a

water glass the crystal of pure potash alum and its colorless. 100ml of water is purified by 14gm of potash alum.

3.6 Chemicals used

3.6.1 BOD Test

BOD measures the biodegradable organic carbon and it determines the organic content of wastewater, BOD measure the dissolved oxygen used microorganism.

The microorganisms they break down the organic matter at 20℃ over a 5 days period. Clean water has a bod value of less than 1mg/lit and wastewater has between 150-1000 mg/lit.

1. Firstly, a high concentration of active bacteria is required.
2. Secondly only the biodegradable organism is measured.
3. Thirdly a particularly long period of time is necessary to obtain the results.
4. Fourthly bod doesn't have stoichiometric validity after the soluble organic present in the solution have used.

Figure 3.1: BOD Incubator

Chemicals

- Calcium chloride

- Potassium buffer solution
- Magnesium sulfate
- Ferric chloride
- Manganese sulfate
- Alkali iodide aside (Noah + KI)
- Sulfuric acid
- Starch solution
- Sodium thiosulfate (burette solution)

3.6.2 COD Test

COD is the measure of oxygen needed to chemically oxidize in the organism in the water. Strong oxidizing agent used is potassium-di-chromate solution. The COD taking three hours to produce the results the temperature need to some inorganic compound will interface with the test. Different type of water has different translation between BOD and COD.

Figure 3.2: COD Digestion

Chemicals

- Sulfuric acid

- Potassium dichromate
- Ferrous ammonium sulfate
- Distilled water

3.6.3 pH Meter

PH meter consists of measuring glass electrode and represented colonel electrode and they are placed in a solution, circuit is completed. Glass electrode is with buffer solution at the dip and surrounded by sample solution. Potential developed between two solutions of differing hydrogen ion concentration.

.

Figure 3.3: PH meter

3.6.4 Turbidity

Turbidity is based on the law of Tyndall effect a beam of light passing through a turbid solution being tested scatters light, which in turns is collected at right angles by a photocell and indicated on a digital display. The amount of scattered light has proportional to the turbidity of the solution under test.

Figure 3.4: Turbidity

3.7 Methods

3.7.1 Coagulation

In water treatment coagulation flocculation involves the addition of compound that promotes the clumping of fines into larger folk so that they can more easily separate from the water. coagulation is a chemical process that involves neutralization of charge whereas flocculation is a physical process and does not involve neutralization of charge .The coagulation flocculation process can be used as a preliminary or intermediary step between other water or wastewater treatment process like filtration and sedimentation .Iron and aluminum salts are the most widely used coagulants but salts of other metals such titanium and zirconium have been found to be highly effective as well.

Coagulation is also important in several wastewater treatment operations. A common example is chemical phosphorus removal and other in overloaded wastewater treatment plant is the practice of chemically enhancing primary treatment to reduce suspended solids and organic loads from primary clarifiers.

Coagulation treatment neutralizes the negative electrical charge on particles, which destabilizes the force keeping colloids apart. Water treatment coagulants

are comprised of positively charged molecule that, when added to the water and mixed, accomplish this charge neutralization.

We are used primary coagulant for potassium alum. which is used for wastewater treatment process in purification method. The potash alum also used for secondary coagulating agent for the purification of water.

When metal coagulants are added to water the metal ion hydrolyze rapidly but in a somewhat uncontrolled manner, forming a series of metal hydrolysis species. The efficiency of rapid mixing the pH, and the coagulant dosage determine which hydrolysis species is effective for treatment.

There has been considerable development of pre-hydrolyzed inorganic coagulant, based on both aluminum and iron to produce the correct hydrolysis species regardless of the process conditions during treatment. The aluminum coagulants include aluminum sulfate, aluminum chloride and sodium aluminate. The iron coagulants include ferric sulfate, ferrous sulfate, ferric chloride and ferric chloride sulfate. Other chemical is used as coagulants include hydrated lime and magnesium carbonate.

These include aluminum chloral hydrate, poly aluminum chloride, poly aluminum sulfate chloride, poly aluminum silicate chloride with organic polymers. Iron forms include poly ferric sulfate and ferric salts with polymers. There are also polymerized aluminum-iron blends.

All water, especially surface water, contain both dissolved and suspended particles. Coagulation and flocculation processes are used to separate the suspended solids portion from the water. the suspended particles vary considerably in source, composition charge, particles size, shape, and density. Correct application of coagulation and flocculation process and selection of the coagulant

depend upon understanding the interaction between the factors. The present study aims to treat a sample of sea water for the removal of impurities by various coagulants such as alum, ferric chlorides and ferrous sulfate. The treatment efficiencies of coagulants have been compared for maximum removal impurities under optimum PH and optimum dosage of coagulants. the optimum dosage and PH were observed to be 7.0 and 120 mg/L respectively.

Coagulation and flocculation have been used to clarify water since ancient times-as early as 2000BC, when the Egyptians used almonds to clarify river water. There is also evidence to suggest that the romans were using alum as a coagulant at around 77AD. Coagulation and flocculation are essential components of treatment process for reducing water turbidity. Wastewater treatment operations also require coagulation for chemical removal and for reducing suspended solids. Organic coagulants are generally used for solid and liquid separation and sludge generation. Organic formulation. Polyamines and polydadmacs the most widely used organic coagulants, which are cationic in nature and function by charge neutralization alone. Cationic coagulants neutralize the negative charge of colloids and form a spongy mass called microflocs.

Melamine Formaldehydes and Tannins coagulate the colloidal material in the water, and absorb organic materials such as oil and grease. The main advantage of organic coagulants includes lower dosage, lower volume of sludge produced and no effects on the Ph. Inorganic coagulants are both cost – effective and applicable for a broad variety of water and wastewater. Inorganic coagulants are particularly effective on raw water with low turbidity and will often treat this type of water when organic coagulant cannot. Once added to water the inorganic coagulants from aluminum or iron precipitate. These absorb impurities in the water as they fall, serving to clean the water. This process is known as the "sweep-floc

mechanism. However, a downside of metal hydroxide precipitate sweep-floc is that they add to the overall sludge volume that must be treated and removed.

Aluminum sulfate is one of the most commonly used water treatment chemicals in the world. Alum is manufactured as a liquid from, which the crystalline form is dehydrated. Aluminum chloride a second choice to alum as it is more expensive, hazardous and corrosive. Ferric sulfate and ferrous sulfate are the most commonly used in, but ferrous sulfate is typically used in applications where a reducing agent or excess soluble iron ions are required. Iron coagulants work similarly to aluminum coagulants but the cost may vary based on the local source of supply. Ferric chloride is least expensive inorganic coagulants, as it is generated as a waste material from steelmaking operations.

Figure 3.5: After treatment tannery waste

Chemical coagulation is a complex phenomenon involving various inter-related parameters, hence it is very critical to define that how well coagulant will function under given conditions. On the basis of effectiveness to decolorizes the textile wastewater, chemical coagulants. It has been reported that pre-hydrolyzed metallic salts are often found to be more effective than the hydrolyzing metallic salts such as aluminum sulfate (alum), ferric chloride and ferric sulfate those are readily

soluble in water. Prehydrolysed coagulants such as Polyaluminium chloride (PACl), Polyaluminium ferric chloride (PAFCl), Polyferrous sulfate (PFS) and Polyferric chloride (PFCl) seem to give better color removal even at low temperature and may also produce lower volume of sludge. In this connection, have studied the effectiveness of various pre-hydrolyzing coagulants for the treatment of wastewater, and reported that PACl products give more rapid flocculation and strong flocs than that of alum at equivalent dosage.

This can be attributed by the fact that these coagulants are pre-neutralized, have smaller effect on the pH of water and so reduce the need of pH correction. Most of the dyes used in textile industries are of negatively charged and hence cationic polymer is preferred over anionic and nonionic polymers due to the better dye removal performance. However, the mechanisms of these products are not well established yet. Further, to conduct and evaluate the work, it is necessary to consider only the most critical controlling parameters. Various authors have suggested the most important parameters to be consider in coagulation are pH and concentration of applied metal ions (coagulant) such as alum, FeCl3, MgCl2, Polyaluminium chloride (PACl) and ferrous sulfate and organic polymeric coagulants.

Apart from these, mixing speed and time, temperature and retention time also influence the color removal efficiency. Hence, the optimization of these factors may significantly increase the process efficiency. Different coagulants affect different degrees of destabilization. The higher the valence of the counter ion, the more is its destabilizing effect and the less is the dose needed for coagulation. If pH is below the isoelectric point of metal hydroxide while precipitation of colloids by different coagulants supported by suitable polymer, then the positively charged polymers will prevail and adsorption of these positively polymers can destabilize negatively.

Charged colloids charge neutralization. Above the isoelectric point, anionic polymers will predominate where particle destabilization may take place through adsorption and bridge formation. At high dose of metal ions (coagulant), a sufficient degree of oversaturation occurs to produce a rapid precipitation of a large quantity of metal hydroxide, enmeshing the colloidal particles which are termed as sweep floc. For example, when Fe (III) salts are used as coagulants, they are monomeric and polymeric ferric.

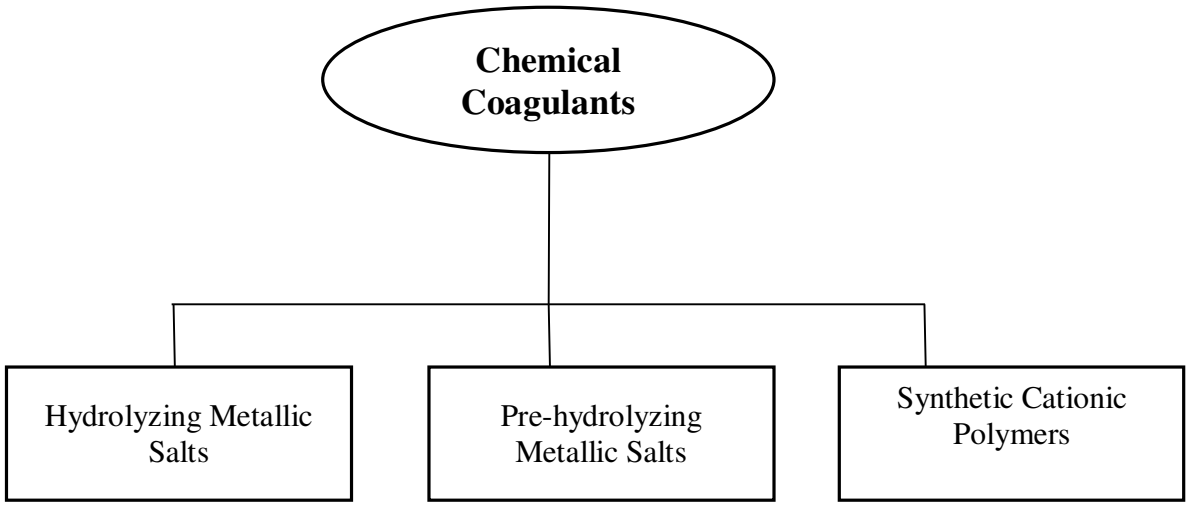


Figure 3.6: types of chemical coagulants

Hydrolyzing Metallic Salts

- Ferric Chloride
- Ferric Sulfate
- Magnesium Chloride
- Alum

Pre-hydrolyzing Metallic Salts

- Polyaluminium Chloride
- Poly Ferric Chloride
- Poly Ferrous Sulfate
- Poly Aluminum Ferric chloride
- Poly Aluminum Sulfate

Synthetic Cationic Polymers

- Amino methyl Polyacrylamide
- Poly alkaline
- Polyamine
- Poly ethylenimine

Hydrolyzing metallic salts Pre- hydrolyzing metallic salts Synthetic cationic polymers Chemical coagulants

Polyaluminiumferric chloride(PACl)chloride (PFCl) Polyaluminiumsulfate (PAS)Fig 3.4. pH is maintained near to neutral, but it again depends upon the type of dyes to be removed. Hence, the addition of base to maintain the pH becomes prime requirement. Lime or NaOH can be used for this purpose. However, addition of lime may produce extra sludge. Whereas, addition of polyelectrolyte as a coagulant aid generally improves the performance of coagulant. It can be seen from the optimum pH for alum is near to neutral and hence higher color removal efficiency can be obtained at this pH. Moreover, addition of polyelectrolyte generally improves the color removal performance. However, generation of large amount of sludge associated with this process makes it unattractive.

PACl products are aluminum-based coagulants. They are similar to alum, with several important differences: - Partially pre-neutralized (Higher basicity than

alum) - Contains Cl instead of SO4 2_ - Contains up to three times the aluminum content - Rapid aggregation velocity, bigger and heavier flocs Moreover, PACl shows better color removal efficiency in a wider pH range of 7e10. The optimum pH for FeSO4 is alkaline in the range 79 and gives higher color removal at this pH range. Various researchers have also revealed that the addition of polyelectrolyte generally increases turbidity and volume of settled sludge. This undesired effect may be eliminated if the used concentration of polyelectrolyte is less than 2 mg/L.

The optimum pH for magnesium chloride varies between 9 and 12. It gives very good color removal performance if used with lime. However, it generates large amount of sludge which may cause sludge disposal problem and also involves extra cost. Alum and magnesium chloride, because of large amount of sludge generation and production of basic effluent after treatment, may not be considered as the good coagulants. Though, both the ferric chloride and alum give roughly high efficiency, at low concentration, color removal efficiency ported less for ferric chloride. However, significant improvement in the color removal has been reported if ferric chloride used with small amount of cationic polymer is Very limited information is available based on the coagulant studies using PFS. PFS makes it attractive coagulant because it is practically soluble in water, and forms large amount of Polynuclear complex ions like $(Fe_2(OH)_3)_3$þ, $(Fe_2(OH)_2)_2$þ, (Fe8(OH)20)4þ, which are prone to render flocculation. It is advantageous as regards the following points:

- Fast settling of flocs
- Broad pH compatibility
- Low iron contamination
- High heavy metal removal rate
- Easy dehydration of sludge etc.

The principle mechanism for coagulation is similar to the PACl i.e. adsorption and charge neutralization. At high turbidity, the coagulation may follow Sweep coagulationhave investigated the application of PAFCl for the decolorization of petrochemical wastewater and reported that PAFCl gives better turbidity removal in 7.0e8.4 pH range and good color removal for suspension dyes over the other selected coagulant such as PFS and PACl. In addition to the performance of better coagulation efficiency for color removal, it also reflects the ability to quick formation of the flocs. The ability of quick formation of the flocs and superior color removal efficiency may be due to the reason that PAFCl combines the coagulator advantages of both aluminum and iron salts and hence able to form flocs rapidly with more bulky and rapid sedimentation.

This novel coagulant is not widely studied for textile wastewater treatment hence very limited information is available. The principle mechanism of PAFCl is charge neutralization and bridginghave studied the use of potassium ferrate in combination of polyamine-based polymer for treatment of dyeing effluents and found excellent color removal as well as COD reduction. Since ferrate (VI) ion is a strong oxidant in entire the pH range, hence after reduction to Fe (III) ion or ferric hydroxide during oxidation process, it possesses the ability to act as coagulant. Hence potassium ferrate represents a unique dual function (Oxidant and coagulant) chemical reagent that can be an effective alternative to current approaches for water and wastewater treatment.

3.7.2 Ozonation

Ozone is a form of oxygen (o2) with the molecular formula o3. It forms when oxygen in the air is exposed to the discharge of a powerful electric current through an air. In a nature it forms of the upper atmosphere when lightening passes through the air. Ozone is unstable and changes to o2 shortly after its formation. It is a powerful oxidant and one of the most powerful disinfectant available in water treatment.

The formation of oxygen into ozone occurs with the use of energy. This process is carried out by an electric discharge field as in the CD-type ozone generators (corona discharge simulation of the lightning), or by ultraviolet radiation as in UV-type ozone generators (simulation of the ultraviolet rays from the sun). In addition to these commercial methods, ozone may also be made thorough electrolytic and chemical reaction. In general, an ozonation systems includes passing dry, clean air through a high voltage electric charge, corona discharge which creates and ozone concentration of approximately 1% or 10,000 mg/l. In these treating small quantities of waste, the UV ozonation is the most common while large –scale systems use either corona discharge or bulk ozone-producing methods.

Today it is applied for the disinfection of drinking water, for the removal of effluents from wastewater treatment plants in a process called ozonation as well as for the degradation of organic and inorganic pollutants in wastewater.

Since ozone quickly converts to oxygen and leaves no toxic residual, it may be more advantageous than chlorine to treat wastewater prior to discharge. Since dissolved ozone reverts to oxygen, the effluents will exert less biological oxygen demand (BOD) on the receiving stream. Ozone effectiveness as an oxidant often makes it the method of choice for removing color, organic chemicals and odor

causing contaminants in wastewater. In many causes, depending on the ozone contact time and concentration, it can oxidize these contaminations to water and carbon dioxide.

Figure 3.7: After treatment dye waste

Figure 4: Treated Dyeing Effluent

Ozone is effect over a wide pH range and rapidly reacts with bacteria, viruses, and protozoans and has stronger germicidal properties then chlorination. Has a very strong oxidizing power with a short reaction time the treatment process does not add chemicals to the water.

Ozone is a strong oxidizing compound which rapidly oxides organic materials, iron, manganese and other substances when it is added to drinking water. In addition, it is an extremely effective disinfectant against bacteria and viruses. Ozone kills bacteria about 3200 times faster than chlorine.

The half-life of ozone in water is about 30 minutes, which means that every half hour the ozone concentration will be reduced to half its initial concentration. ozone produced commercially for oxidation reaction always is produced as a gas from air it at concentration between 1.0 and 2.0% by weight, or from oxygen at concentrations greater than 2% and up to 8% by weight. Since ozone is highly reactive, and has a short half-life, it cannot be stored as a gas and transported.

Consequently, ozone always is generated on site for immediate use. when ozone is applied as a gas drinking water treatment, it is done primarily because of its oxidative strength. The powerful oxidation potential allows ozone to be an effective in the reduction or elimination of color, aftertaste and odor. More importantly, ozone will effectively be destroyed bacteria and inactive viruses more active disinfection organic compound.

Figure 3.8: ozonation process

When properly applied at the start of a water treatment process, ozone will not lead to the formation of halogenated compound such as Trihalomethanes (THMs) which are formed when chlorine is added to the raw water containing humic material. Once a THM is formed it is quite difficult, if not impossible, to oxidize-even with ozone thus ozone can be used as an oxidant, where it is applied at the latter stages of water treatment. Ozonation is usually adopted for water disinfection, but it also has a high potential as a pretreatment method. Ozone as the most powerful oxidizing reagent, is capable of degrading several phenolic compounds effectively, with the advantage that oxidized products are usually less toxic than the parental compound.

- To convert inorganic components into higher oxidation stages.

- To cleave hardly biodegradable organic compounds.
- To kill bacteria.
- To destroy especially odorous, taste-causing and coloring substances.

The ozonation process consists of steps, the first of which involves compressing air from the atmosphere and feeding this air through valves into a chamber containing pellets. The valves switch back and forth to vary the pressure in the chamber from alternating vacuum and pressure cycle.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 parameters analysis on tannery effluent water before and after treatment:

Figure (4.1) shows the percentage of water purified by the given parameter analysis in tannery wastewater. The sample water is collected at Erode Common Effluent Treatment plant (CETP).

Table 4.1 Tannery industry wastewater analysis report

S.No	Test parameters	Before treatment	After treatment
1.	pH @ 25℃	8.67	8.16
2.	Specific conductance @ 25℃	41960	12350
3.	Total dissolved solids (TDS)	25130	7390
4.	Total alkalinity as $CaCO_3$	11480	3980
5.	Total hardness as $CaCO_3$	13650	4130
6.	Residual free chlorine as Cl_2	7.95	3.84
7.	Total sulfide as SO_2	8.32	5.12
8.	Chloride as Cl^-	9870	2675
9.	Sulfate as SO_4^-	1354	384
10.	Nitrate as NO_3	153	82
11.	Ammonia as NH_4	5.64	2.36
12.	Dissolved oxygen (DO)	0.87	1.13
13.	Total chromium as Cr^{6+}	4.75	2.28
14.	Fluoride as F	3.63	2.17

The tannery wastewaters are highly complex and are characterized by high contents of organic, inorganic and nitrogenous compounds, chromium, sulfides, suspended solids and dissolved solids. Treatment of tannery wastewater is carried out by physical or chemical or biological combination of these methods.

Our treatment method is chemical method by using chemical coagulation and ozonation method.

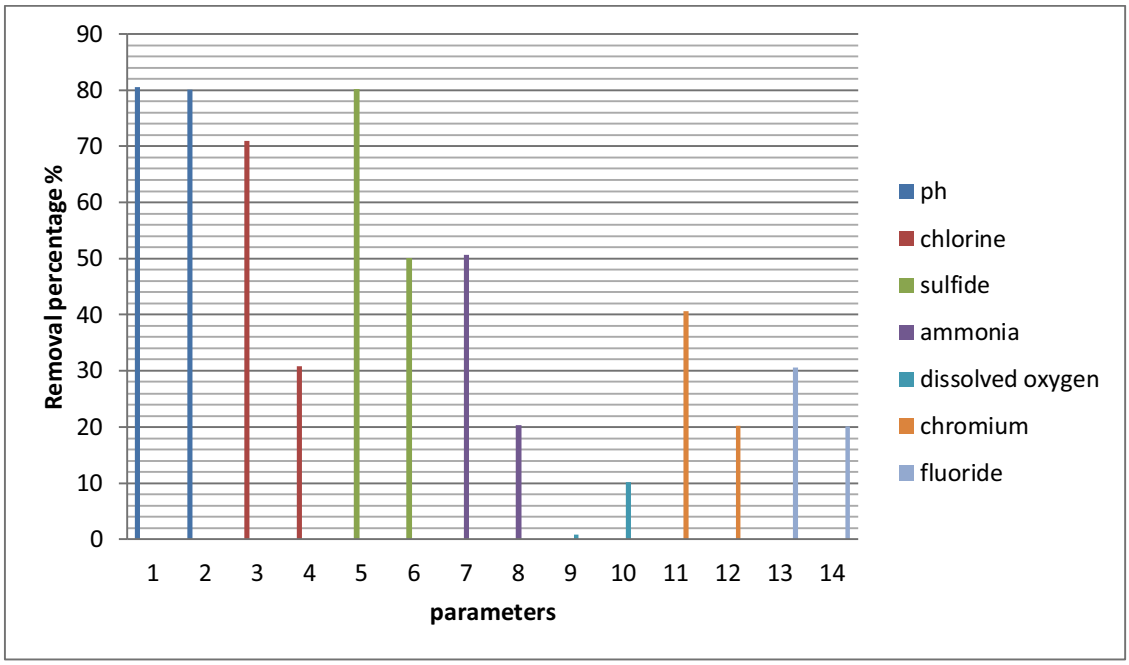


Figure 4.1 parameters removal percentage

4.2 Parameters analysis on dye effluent water before and after treatment:

Textile effluent is heavily contaminated with pollutants such as dyes, dissolved solids, suspended solids and toxic metals. The main factor to be considered in textile effluent is total dissolved solids (TDS). Because of the use of common salt and Glauber salt, the level of TDS increases in textile wastewater. The mail metals, which cause environmental challenges, are chromium, zinc, iron, mercury and lead

(Hussein 2013). However, Adinew (2012) reported that the main metals found within the dye Chromophores in textile effluents are cobalt, copper and chromium.

Table 4.2 Dye industry wastewater analysis report

S.No	Test parameters	Before treatment	After treatment
1.	pH @ 25℃	7.81	7.75
2.	Specific conductance @ 25℃	19120	11820
3.	Total dissolved solids (TDS)	11450	6960
4.	Total alkalinity as $CaCO_3$	5974	3270
5.	Total hardness as $CaCO_3$	6082	3590
6.	Residual free chlorine as Cl_2	12.9	6.42
7.	Total sulfide as SO_2	4.75	3.05
8.	Chloride as Cl^-	4580	2336
9.	Sulfate as SO_4^-	684	485
10.	Nitrate as NO_3	72.4	47.6
11.	Ammonia as NH_4	1.65	0.83
12.	Dissolved oxygen (DO)	2.5	3.0
13.	Total chromium as Cr^{6+}	0.56	0.31
14.	Fluoride as F	1.42	1.28

Figure (4.2) shows the percentage of water purified by the given parameter analysis in Dye wastewater. The sample water is collected at Salem small scale Mat industry.

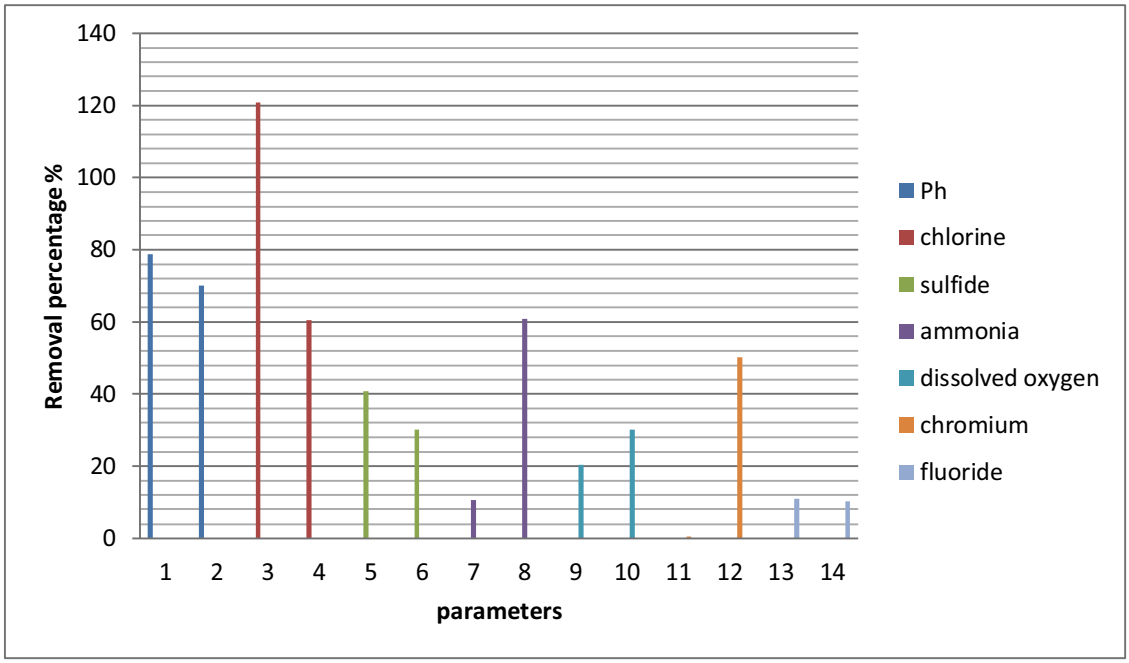


Figure 4.2 parameters removal percentage

4.3 Parameters analysis on Domestic effluent water before and after treatment:

Wastewater is any water that has been contaminated human use. Wastewater is used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff or stormwater, and any sewer inflow or sewer infiltration. Physically, domestic wastewater is usually characterized by a grey colour, musty odour and has a solids content of about o.1%. The solid material is a mixture of feaces, food particles, toilet paper, grease, oil, soap, salts, metals, detergents, sand and grit.

Table 4.3 Domestic wastewater analysis report

S.No	Test parameters	Before treatment	After treatment
1.	pH @ 25℃	7.96	7.45
2.	Specific conductance @ 25℃	38510	11250
3.	Total dissolved solids (TDS)	15340	8200
4.	Total alkalinity as CaCO3	12870	2890
5.	Total hardness as CaCO3	16450	4100
6.	Residual free chlorine as Cl2	6.84	3.23
7.	Total sulfide as SO2	8.4	4.51
8.	Chloride as Cl-	10900	2535
9.	Sulfate as SO4-	1410	146
10.	Nitrate as NO3	158	78
11.	Ammonia as NH4	6.82	2.31
12.	Dissolved oxygen (DO)	0.94	1.23
13.	Total chromium as Cr6+	5.85	2.14
14.	Fluoride as F	3.94	2.59

Figure (4.3) shows the percentage of water purified by the given parameter analysis in Domestic wastewater. The sample water is collected at our college campus.

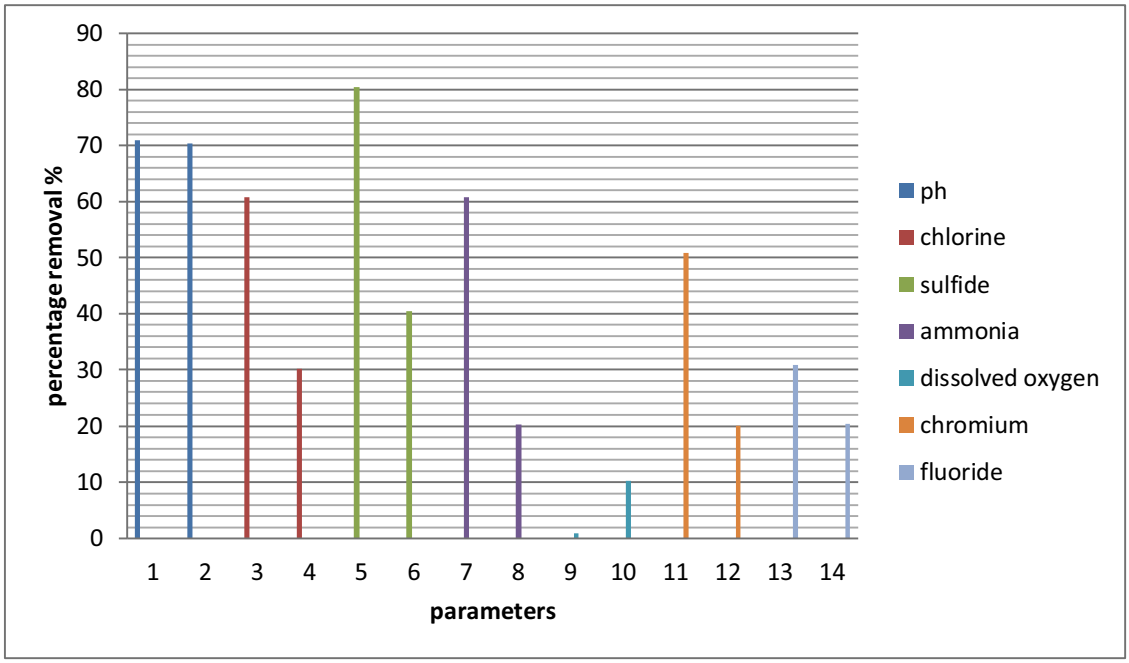


Figure 4.3 parameters removal percentage

4.4 chromium removal

Chromium in tannery and dye sludge causes serious environmental problems and is toxic to organisms and it was efficiently treated by the chemical process. The naturally occurring microbes have enough potential to mitigate the excessive contamination of their surroundings and can be used to reduce the metal concentrations in aqueous solutions in a specific time frame.

This project examines the extent of pollution created by tanneries, dye effluents and the different biological process, physical process and chemical processes available for the treatment and disposal of wastewater. The advanced methods like chemical coagulation and ozonation these methods appear to be a better choice for the removal of colour and organic content; however, some of the questions are yet to be answered on its process efficiency. This is because of the lack of information on various aspects such as desirable influent COD, optimal level of volatile fatty

acids concentrations in the reactor, the reliable estimates of the bio kinetic constants and their dependence on the substrate levels. In the field of wastewater treatment, it is generally accepted that ozonation treatment. The application of process of chemical with biological process to treat wastewater would give satisfactory results compared to individual treatment processes.

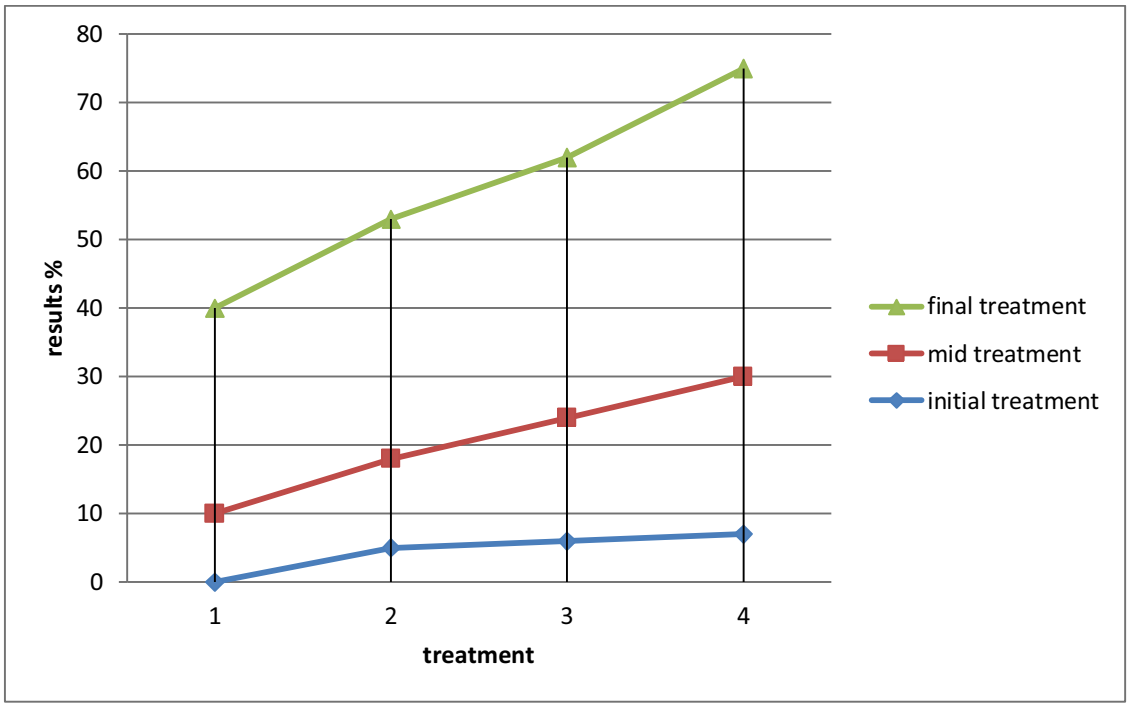


Figure 4.4 Results percentage after treatment

CHAPTER 5

DESIGN CALCULATION

5.1 Design of coagulation tank:

The coagulation tank are designed to remove sand of 0.1 mm and larger for an average flow of 1.0 m3/s. the maximum flow rate is to be 1.5 times the average flow and the water temperature is 10℃. assuming a typical water depth of 3.0 m and a factor of safety of 1.75, determine the length and width of tank and check that the surface loading (overflow) rate and the detention time are within the recommended design criteria ranges.

Solution:

- For water temperature is 10℃, (v = 1.306 × 10-6 m^2/sec), then settling velocity of particles can be calculated as:

$$\vartheta_p = \vartheta_s = \frac{g\,(s\,gp-1)\,d2\,p}{18v} = \frac{9.81\frac{m}{s2}(2.65-1)(0.0001)2}{18x\,1.306x\,10-6\,m2/s}$$

$$= 0.0069\ m/s$$

The cross sectional area of tank = A

$$= \frac{\text{maximum flow}}{\text{flow velocity}} = \frac{Qmax}{\vartheta f}$$

- The horizontal mean flow velocity at maximum flow is 0.05 m/s

$$A = \frac{1.5x\,1.0\,m3/s}{\text{tank}}\ x\ \frac{1}{0.05m/s} = 15m^2 = \text{width x depth}$$

- For a water depth of ho = 3.0 m, the width is:

$$\text{Width, } W = \frac{15\,m2}{3m} = 5m$$

- Length of tank is:

$$L = K\frac{ho}{\vartheta s}\vartheta f = 1.75\ (\frac{3\,m}{0.0069\ m/s})\ x\ 0.05\ m/s = 38\ m$$

- Verify the length to depth (L/d) and length-to-width (L/w) ratios.

$$\frac{L}{d} = \frac{38}{3} = \frac{12.7}{1} > \frac{6}{1} \quad \text{OK}$$

$$\frac{L}{w} = \frac{38}{5} = \frac{7.6}{1} > \frac{4}{1} \text{OK}$$

- Verify the detention time and surface loading rates:

$$\textbf{Detention time for } Q_{avr}, \ t = \frac{volume}{Q}$$

$$= \frac{38\ m\ x\ 5m\ x\ 3m}{\frac{1m3/s}{\text{tank}}\ x\ 60\ s/min} = 19 \text{ min}.$$

The calculated value is higher than the typical range of detention time (6 to 15 min) for average flow conditions.

$$\textbf{Detention time for } Q_{max}, \ t = \frac{19\ min}{1.5} = 12.7 \text{ min}$$

The detention time is within the acceptable range of (6 to 15 min).

- Determine the surface loading rate, OR:

$$\text{OR} = \vartheta c = \frac{Q}{A} = \frac{1\frac{m3}{s} x\ 3600\frac{s}{h} x\ 24\frac{h}{d}}{38\text{m x } 5\text{m x tank}} = 227 \text{ m3/m2.d}$$

The surface loading rate range is 200 to 400 m3/m2d thus, the computed value is within the acceptable range.

5.2 Design calculation for ozone generator:

Ozone capacity = flow rate [m3/hr] × ozone dose [gm/m3]

$$\text{Flow rate} = \frac{\text{peak STP capacity per day (m3)}}{\text{average operating hours (hr)}}$$

Example: flow rate $= \frac{200 \text{ (m3/day)}}{20 \text{ (hours of operation)}}$

= 10m3/hr.

Ozone dose: Ozone dose is decided on the basis of two major factors.

A. Characteristics of treated waste water
   - Microbiological load
   - COD
   - BOD
   - Total organic carbons
   - Odor
   - Color
   - pH
   - Temperature

B. Ozone implementation technique
   - Required dissolved ozone
   - Ozone concentration
   - Ozone injection pressure
   - Ozone diffusion technique
   - Ozone dissolution efficiency [in %]
   - Oxygen purity [in %]
   - Retention time

Note: As per chemtronics design standard applied ozone dose is 3.0 to 6.0 ppm (gm/m3)

Example: **Ozonator capacity =** flow rate × ozone dose (gm/m3) ppm

= 10 m3/hr× 4.0 gm/m3

= 40 gm/hr

1. Applied ozone dose : 4.0 ppm
2. Ozonator capacity : 40gm/hr
3. Ozonator model no : OG/HC-50
4. System model no : IOS/WW-50S

5.3 Ozone bubble size calculation:

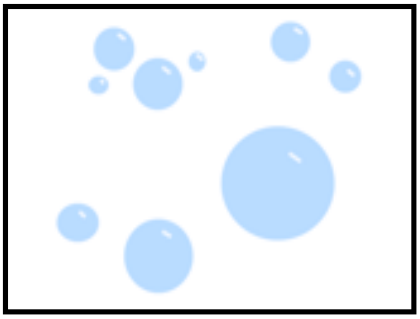
Cube : 1.0 mm3

Bubble Dia : 1.0

Nos. of bubbles: 1.0 no.

Surface area : 3.14 mm2

Total S. Area : 3.14 mm2



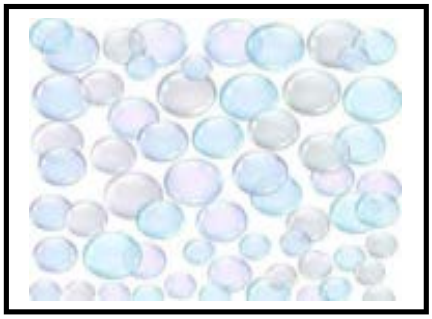
Cube : 1.0mm3

Bubble Dia : 0.5 mm

Nos. of bubbles: 8.0 no.

Surface area : 0.786 mm2

Total S. Area : 6.29 mm2



Cube : 1.0mm3

Bubble Dia : 0.1 mm

Nos. of bubbles: 1,000.0 no.

Surface area : 0.0314 mm2

Total S. Area : 31.43 mm2

5.1 Different bubble size calculations

5.4 Material balance:

Material balance for 1 hr production at 5000 litters feed of water.

Step 1 - Inlet wastewater into coagulation tank.

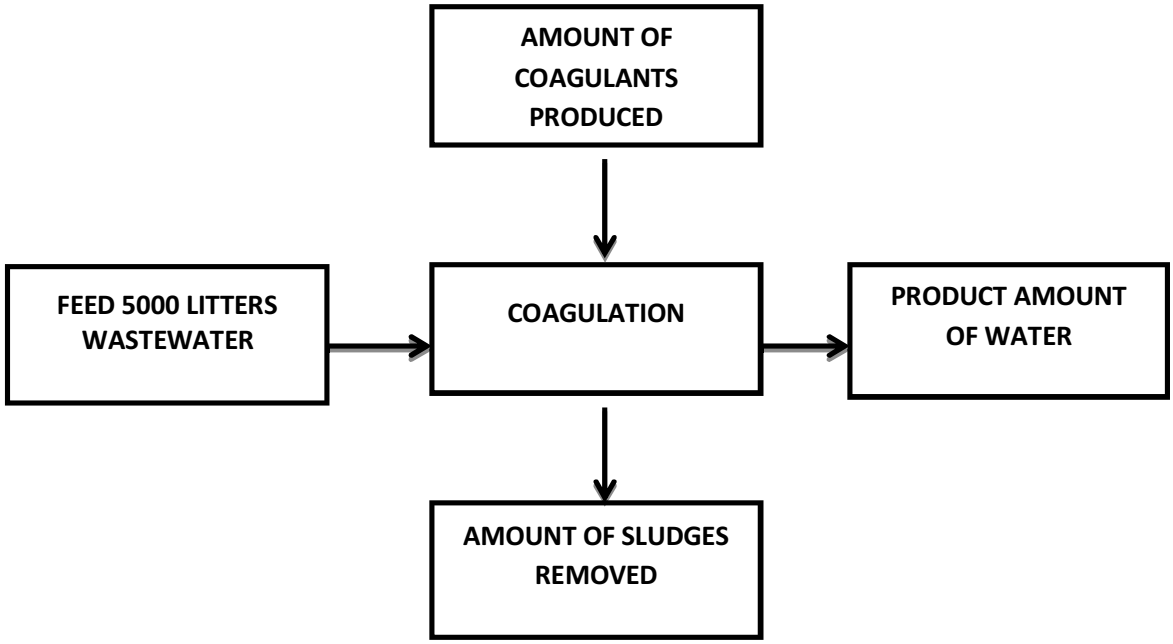


Figure 5.2 mass balance over the coagulation

Weight of water in feed = 5000×0.2

= 1000 lit

Weight of solid in feed = 5000×0.8

= 4000 lit

While in filtering the amount of sludge removed is more than that of the solids,

Therefore,

Amount of solid in feed = Amount of solid out

From the design of coagulation tank, it is said that about 2% of sludges will be removed from a solution containing 20% sludges.

Therefore if the product contains 2% sludges apart from that 98% will be water.

Weight of water in product,

$$0.98X = 4000$$

$$X = 4000 \div 0.98$$

$$X = 4081.63 \text{ lit}$$

Difference in the weight of water in product and feed will give the water content in product.

Weight of solid in product = (weight solid in product – weight of solid in feed)

$$= 4081.63 - 4000$$

$$= 81.63 \text{ lit}$$

Weight of water removed (y) = (weight of water in feed – weight of water)

$$= 1000 - 81.63$$

$$= 918.37 \text{ lit}$$

Percent of coagulants removed = $(918.37 \div 1000) \times 100$

$$= 91.8\%$$

Input (5000 lit) = waters (4081.63 lit) + coagulants removal (918.37 lit)

Step 2 – Ozonation

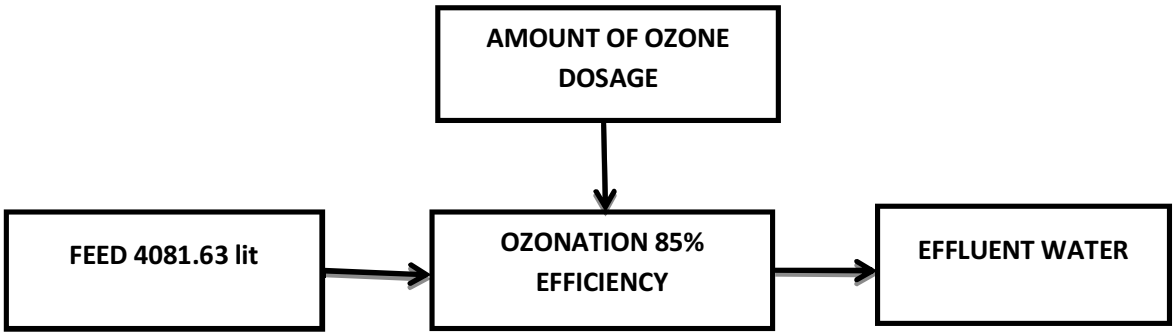


Figure 5.3 mass balance over ozonation

Overall material balance for Ozonation process,

Feed water = amount of ozone dosage supplied + effluent water

4081.63 lit = X + Y

Material balance for ozone supplied,

Ozone in water = amount of ozone dosage supplied + effluent water

Ozonation working under 85% Efficiency,

Effluent water (Y) = 4081.63 × 0.85

Y = 3469.38 lit

Amount of ozone dosage supplied (X) = 4081.63 × 0.15

X = 612.24 lit

Input(4081.63 lit) = effluent water (3469.38 lit) + amount of ozone dosage supplied (612.24 lit)

Product efficiency,

For 5000 lit feed of effluent water,

Process yield of effluent = $4081.63/5000 \times 100$

= 81.63%

Efficiency of effluent = 81.63%

CHAPTER 6

ECONOMIC ANALYSIS

The Economic analysis was estimated by calculating the following data:

1. Purchase equipment cost (PEC)
2. Total direct cost (TDC) and total indirect cost (TIC)
3. Fixed capital investment (FCI)
4. Total capital investment (TCI)
5. Total product cost (TPC)
6. Profit or loss
7. Pay Back period

6.1 Purchase Equipment Cost (PEC)

The cost was converted to Indian Rupees (Rs) from Dollars (USD) using the following assumptions:

The Currency Conversion Factor of 75.62 Rupees (Rs) for one Dollar (USD) was used. (Currency convertor, 21st march 2020)

$$\text{Conversion} = \text{Price in Dollar (USD)} \times \text{Currency Conversion Factor}$$

$$= \text{USD} \times \text{Rs } 75.62$$

Table 6.1: Equipment and their cost

S.No	Equipment	Amount	Price (USD)
1.	Settling chamber	1	$15,000
2.	Ozonation motor	2	$20,000
3.	Recirculation pump	2	$25,500
4.	Valves	6	$2,000
5.	Ozonation chamber	1	$18,000
6.	Storage chamber	1	$22,000
7.	Chemicals (Al2SO4, K2SO4, H2SO4)	3	$40,000

8.	Ethanol alcohol (10 lit)	1	$30,000

Table 6.2: Conversion table for purchased equipment

S.No	Equipment	Conversion of USD to Rs	Total price of equipment (Rs)
1.	Settling chamber	15,000 × 75.62	1,134,300
2.	Ozonation motor	20,000 × 75.62	1,512,400
3.	Recirculation pump	25,500 × 75.62	1,928,310
4.	Valves	2,000 × 75.62	151,240
5.	Ozonation chamber	18,000 × 75.62	1,361,160
6.	Storage chamber	22,000 × 75.62	1,663,640
7.	Chemicals (Al2SO4, K2SO4, H2SO4)	40,000 × 75.62	3,024,800
8.	Ethanol alcohol (10 lit)	30,000 × 75.62	2,268,600
Total			**13,044,450**

6.2 Total Direct Cost (TDC) and Total Indirect Cost (TIC)

The TDC and the TIC were calculated by using the following formula

a) Direct costs

Direct cost = percentage used × purchased equipment cost

b) Indirect costs

Indirect cost = percentage used × total direct cost

Table 6.3: Total direct cost calculations

Direct cost	% taken	PEC (Rs)	calculations	Costs (Rs)
Purchased equipment	0.30%	13,044,450	0.30 × 13,044,450	3,913,335

installation				
Instrumentation & control	0.20%	13,044,450	0.20 ×13,044,450	2,608,890
Piping	0.10%	13,044,450	0.10 × 13,044,450	1,304,445
Electrical equipment & materials	0.05%	13,044,450	0.05 × 13,044,450	652,223
Service facilities	0.25%	13,044,450	0.25 × 13,044,450	3,261,112
Land	0.06%	13,044,450	0.06 × 13,044,450	782,667
Total direct cost (TDC)				**11,935,672**

The TDC was obtained by adding all the direct cost and the value is **Rs 11,935,672**

Table 6.4: total indirect cost calculations

Indirect costs	**% taken**	**PEC (Rs)**	**Calculations**	**Costs (Rs)**
Engineering & supervision	0.10%	13,044,450	0.10 × 13,044,450	1,304,445
Construction expenses	0.25%	13,044,450	0.25 × 13,044,450	3,261,113
Contractors fee	0.12%	13,044,450	0.12 × 13,044,450	1,565,450
Contingency	0.20%	13,044,450	0.20 × 13,044,450	2,608,890
Total indirect costs (TIC)				**8,739,898**

The TIC was obtained by adding all the indirect cost and the value is **Rs 8,739,898**

6.3 fixed capital investment (FCI)

The FCI was obtained by using the equation:

Fixed capital investment = total direct cost + total indirect cost

FCI = TDC + TIC

= 11,935,672 + 8,739,898

= 20,675,570 Rs

The FCI of the process plant is **Rs 20,675,570**

6.4 Total Capital Investment (TCI)

The TCI has the following equation:

Total capital investment = Fixed capital investment + Working capital

TCI = FCI + WC

Assumption: the percentage of the WC assumed was 10% of the TCI.

When the WC represents a percentage of 10%,

TCI = FCI + 0.01 TCI

TCI = (FCI/0.9)

TCI = Rs (20,675,570 /0.9) = **22,972,856**

WC = Rs (0.1 × 20,675,570) = 2,067,557

6.5 total product cost (TPC)

Table 6.5: total product cost (TPC) calculations

Total product cost	**Calculations**	**(Rs)**
Raw material (chemicals)	Rs 75,000 × 1 day	75,000/days
Fixed charges	10% TPC	0.1 TPC
Plant overhead cost	10% TPC	0.1 TPC
Administrative cost	4% TPC	0.04 TPC
Distribution and selling	6% TPC	0.06 TPC

General expenses	8% TPC	0.08 TPC
Total product cost (TPC)		**75,000 + 0.38 TPC**

TPC = Rs (75,000 + 0.38 TPC)

TPC = Rs 120,968/day

The value obtained by TPC value is **Rs 120,968/day**

6.6 Profit/ Loss

Profit/Loss = Revenue – TPC

The revenue of the process plant will be considered Rs 300,000

The profit encountered by the process plant is = Rs (300,000-120,968)

= Rs 179,032

6.7 Pay Back period

The Pay Back Period of the process plant was determined by using the equation:

$$\text{Pay Back period} = \frac{\text{Total capital investiment}}{\text{Profit/loss per year}}$$

When:

I. TCI of the plant is Rs 22,972,856
II. And the profit obtained per year is Rs 64,451,520

The payback of the process plant = (22,972,856/64,451,520)

= 0.356 years

Table 6.6: Economic analysis calculations

Purchase Equipment Cost	**Rs 13,044,450**
Fixed Capital Investment	**Rs 20,675,570**
Total Capital Investment	**Rs 22,972,856**
Total Product Cost	**Rs 120,968/day**
Profit	**Rs 179,032**
Pay Back Period	**0.356 years**

CHAPTER 7

CONCLUSION

This study was aimed at contaminants removal in the treatment of wastewater because of its numerous effects to human and aquatic life. the performance of heavy metals reduction was also improved. Alum coagulation gave higher reductions for turbidity, oil & grease, TSS, NH3-N, COD, Zn, Pb, Cu, Mn and Fe as 81.63% respectively.

When comparing the resultant PH of coagulation treated water, it was observed that alum exhibits a different behavior compared to other coagulants PH of treated water tends to stay stable when alum used as coagulant, whereas when treated with other coagulants, the PH of treated water increase tremendously.

From this obtained results, it can be concluded that treatment of wastewater by coagulation-ozonation technique through the combination of alum and ozone is effective in high effluent removal.

CHAPTER 8

REFERENCE

1. J. Peter, S. Emma, P. Marc, M. Roger, A. P. Simon and J. Bruce (2012). Comparison of coagulation performance and floc properties using a novel zirconium coagulant against traditional ferric and alum coagulants.

2. G. K. Folkard, J. Sutherland, R. Shaw, (2000). Water clarification using Moringa oleifera seed coagulant. On electronic products: http:www.Iboro.ac.uk/well/resources/technical-briefs/60.

3. F. Renault, B. Sancey, P., M. Badot, G. Crini (2009). Chitosan for coagulation/flocculation processes – An eco-friendly approach. Polymer Journal 45: 1337–1348.

4. B. Marcela and D. Petr (2006). Chitosan- A new type of polymer coagulant.

5. P. Harish, K. V. Prashanth, R. N. Tharanathan(2007). Chitin/chitosan: modifications and their unlimited application—an overview. Trends Food Sci Technol; 18: 117–31.

6. J. K. Fatombi, B. Lartiges, T. Aminou, O. Barres, C.Caillet (2013). A natural coagulant protein from copra (Cocos nucifera): isolation, characterization, and potential for water purification. Sep. Purif. Technol. 116: 35–40.

7. C. M. Teixeira, F. V. Kirste, P. C. N. Teixeira (2012). Evaluation of Moringa oleifera seed flour as a flocculating agent for potential biodiesel producer microalgae. J. Appl. Phycol. 24: 557–563.

8. T. Jingxi, M. Jiang, H. Li, S. Zhang, X. Zhang (2015), A comparison between moringa oleifera seed presscake extract and polyaluminum chloride in the removal of direct black 19 from synthetic wastewater. Industrial Crops and Products (74) 530–534.

9. S. Bhatia, Z. Othman and A. L. Ahmad (2007b). Coagulation–flocculation

process for POME treatment using Moringa oleifera seeds extract: Optimization studies. Chemical Engineering Journal. 133(1): 205-212.

10. A. M. Abdelaal, (2004). Using a natural coagulant for treating wastewater. Eighth International Water Technology Conference, IWTC8, Alexandria, Egypt.

11. M. Syafalni, A.Rohana, A. Ismail & N. I. Aimi (2013). Wastewater treatment using bentonite, the combinations of bentonite-zeolite, bentonite-alum, and bentonite-limestone as adsorbent and coagulant. International Journal of Environmental Sciences, 4(3): 379-391.

12. P. Chantaraporn, M. Juntipa, I. Kanita and N. Boonyarit (2010). Pretreatment of palm oil mill effluent by electrocoagulation and coagulation. ScienceAsia (36) 142–149.

13. APHA (2005). Standard Method for the Examination of Water and Wastewater. American Public Health Association, Washington. 21st Edition.
A. H. Mohd. & H. P. Mohd (2007). Pre-treatment of Palm Oil Mill Effluent (POME): A Comparative Study Using Chitosan and Alum. Malaysian Journal of Civil Engineering 19(2): 38-5.

14. APHA (1998)America Public Health Association Standard Method for the Analysis of Water and Waste Water Method 4500-SO42- 20th edition. Washington DC pages 4-178 to 4-179

15. APHA (2012) America Public Health Association Standard Method 2130 Turbidity Standard Method for Examination of Water and Wastewater 22nd edition. Washington DC.

16. Babayemi, J.O., Adewuyi, G.O., Dauda, K.T., and Kayode A.A., (2011. The ancient Alkali Production Technology and Modern Improvement. Asian Journal of Applied Science 4: 22-29

17. Bahman, R., (2014) Treatment of Water Turbidity and Bacterial by Using a Coagulant Extracted From Plantago ovate. J. Water Res. and Ind. 6:36- 50

18. BirninYauri, A.U., and Musa, A. (2014) Synthesisand Analysis of

Potassium Aluminium Sulphate(Alum) from Waste Aluminium Can International Journal of Advance Research in Chemical Science.

19. Bustanafruza, F., Jafar-Tafreshi. M., and Fazlib, M.,(2013) Studies on Thermal Decomposition of Aluminium Sulfate to Produce Alumina Nano Structure Journal of Nano Structure 2 (2013) 463- 468

20. Casey, T.J (1997) Unit Treatment in Water and Wastewater AUAVARRA Research Ltd. Blackrock Dublin online htpp://www.aquavarra. i.e./publications

21. Chingodo ,F., Nyamundo, B.C., and Bhebhe V., (2015) Extraction of Water Treatment Coagulant from Locally Abundant Kaolin Clays. J. Chem. 2015: 7

22. Ekere, N.R., Ihedioha J. N., and Agwogie, A.B. (2014), Synthesis of Potash Alum from Waste Aluminum Foil and Aluminum Scrap. International Journal of Chemical Science 12(4): 1145-1152

23. Folkard, G.J., (1995) Natural Coagulants: A Sustainable Approach 21st WEDC Conference Kaihmandu Nepal 30, Loughborough University Press pp 45-49

24. Gregory, J., and Duan. J., (2001), Hydrolyzing Metal Salt as Coagulants. Pure and Applied Chemistry. 73(12):2017-2026

25. Gregoire, S and Wenqian S., (2007) Coagulation and Flocculation: Colour Removal College of Engineering Michigan State University Spring 2007

26. Hubbard, A. T (2004) Encyclopaedia of Surface and Colloid Science. CRC Press pp 4230 retrieved 2007

27. Kishmura, H., Imasu, Y. and Matsumoto. H., (2014) Dehydration of Potash Inducedby Shock Load. Journal of Physics Conference.

28. Babu R, Chaudhuri M. Home water treatment by direct filtration with natural coagulant. J Water Health 2005; 3:27–30.

29. G.Vijayaragavan, T.Sivakumar, A.Vimal Kumar, "Application of plant based coagulants for wastewater treatment", International Journal of Advanced Engineering Research and Studies, Vol I, Issue I, 2011 December.

30. Tasneembanokazi, Arjun Virupakshi, " Treatment of tannery wastewater using natural coagulants", International journal of Innovative research in Science, Engineering and Technology, Vol II, Issue VIII, August 2013.

31. Baisali Sarkar, P.P. Chakrabarti, A. Vijaykumar, Vijay Kale,(2006), —Wastewater treatment in dairy industries — possibility of reuse‖ pp. 1 41–152, 2006.] G. Durai, M. Rajasimman and N. Rajamohan,(2011), —Kinetic studies on biodegradation of tannery wastewater in a sequential batch bioreactor , Journal of Biotech Research [ISSN: 1944-3285], 3:19-26,2011.

32. M. A. Aboulhassan, S.Souabi, A. Yaacoubi, (2008), —Pollution reduction and biodegradability index improvement of tannery effluents, Int. J. Environ. Sci. Tech., 5 (1), pp 11-16, 2008.

33. Md. Asrafuzzaman, A.N. M. Fakhruddin, and Md. Alamgir Hossain,(2011),—Reduction of Turbidity of Wat er Using Locally Available Natural Coagulants ISRN Microbiology Volume , Article ID 632189,2011.

34. Harush D. P, Hampannavar U. and Mallikarjunaswami M. E ,(2011) , — Treatment of dairy wastewater using aerobic biodegradation and coagulation , International Journal of Environmental Sciences and Research Vol. 1, No. 1, 2011, pp. 23 26.

35. B. S. Shilpa, Akanksha, Kavita, P . Girish, (2012), —Evaluation of Cactus and Hyacinth Bean Peels as Natural Coagulants, International Journal of Chemical and Environmental Engineeri ng , Volume 3, June 2012.

36. Veeramalini ,Sravanakumar. K and JoshuaAmarnat h. D, (2012), —Removal of reactive yellow dye from aqueous solutions by using natural coagulant (moringa oleifera).International Journal of Science, Environment and Technology, Vol. 1, No 2, 56 - 62, 2012.

37. Yin Chun Yang, Suhaimi Abdul-Talib, Lim Ying Pei, MohdSafirunNizan Ismail, Siti Nor Aisah Abd-Razak and Ahmad MahyuddinMohd- Mohtar, —A study on cactus opuntia as natural coagulant in turbid Water treatment CSSR 06 ' 07,1 7.

38. APHA (1995) standards methods for the examination of water and waste water, American public Health Association, American water works Association and water pollution control Federation, 19th end, Washington, D.C

39. C.P.Pise, Dr.S.A.Halkude,"A new Tec hnique for Purification of water using Natural Coagulant", International Journal of Engineering and Technology Vol 6 No 6 Decemebr2016.

40. K. A. Ghebremichael, Moringa seed and pumice as natural alternative materials for drinking water treatment, Ph.D. thesis, KTH Land and Water Resources Engineering, 2004.

41. D. J. Gomes, "Waterborne illness: a real disaster in Bangladesh," in Proceedings of the Japan-Bangladesh Joint International Conference on Microbiology Education & the Prospect of Japanese Collaboration in Education and Research, December 2005.

42. A. R. Khan, "Increasing environmental pollution in Dhaka city and plans for control," in Souvenir on the Occasion of the World Environment Day, pp. 84–90, Department of Environment, Ministry of Environment and Forest, Government of Bangladesh, June 2000

43. M. A. Hossain, Impact of ammonia contamination on surface water treatment processes and its removal from polluted river water by aquatic macrophytes and nitrifying bacteria, Ph.D. thesis, Department of Microbiology, Faculty of Biological Sciences, University of Dhaka, Bangladesh, 2009.

44. G. L. McConnachie, G. K. Folkard, M. A. Mtawali, and J. P. Sutherland, "Field trials of appropriate hydraulic flocculation processes," Water Research, vol. 33, no. 6, pp. 1425–1434, 1999.

A STUDY ON CASH FLOW STATEMENT TOWARDS C.R POULTRY FARM, NAMAKKAL

A PROJECT REPORT

Submitted by

M.SARANYA (18501034)

In the partial fulfillment for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION

PAAVAI ENGINEERING COLLEGE, NAMAKKAL

(AUTONOMOUS)

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op.

Rajendran

TO WHOMEVER IT MAY CONCERN

This is to certify that **M.Saranya** (18501034) **I MBA** From **PAAVAI ENGINEERING COLLEGE, NAMAKKAL** have successfully completed her project in **CR POULTRY FARM, NAMAKKAL.** In the field of **Cash Flow Statement** from the period of **10th June 2019 to 10th July 2019 .**

We wish her all the very best in her future endeavors.

For CR. POULTRY FARM,

Managing Partner.

DECLARATION

I **M.SARANYA** hereby declare that the project report titled **"A STUDY ON CASH FLOW ANALYSIS TOWARDS CR. POULTRY FARM, NAMALLAL"** done by me under the guidance of **J.ISWARYA, B.COM.,MBA.,** is submitted in partial fulfillment of the requirements for the award of **Master of Business Administration**. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 23.10.19

PLACE: NAMAKKAL

M. S

SIGNATURE OFTHECANDIDATE

PAAVAI ENGINEERING COLLEGE (AUTONOMOUS), PACHAL, NAMAKKAL.

MBA Main Project Work

(Batch 2018– 2020)

Title of the project	A STUDY ON CASHFLOW ANALYSIS TOWARDS CR. POULTRY FARM, NAMAKKAL.
Name of the student	M. SARANYA
Name of the supervisor	ISWARYA.J

ABSTRACT

Cash flow statement is an important tool to analyze the cash position of business firm. It can denote changes in cash position during three financial years. Concern is the world's second largest manufacturer of micro irrigation system and the business model of concern is loaded with heavy working capital as huge fund is blocked in trade receivables. Recently, the concern has reported fluctuating turnover for last three years in its annual reports. Hence it is necessary to judge the sufficiency of the cash position to support the success story of company. This study is based on financial figures disclosed by company in three consecutive years. Study involves comparative analysis of cash flow from three business activities i.e. operating, financing and investing. Accordingly the sufficiency of cash position is concluded and some recommendation is made to overcome the scenario.

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CHAPTER-I

INTRODUCTION

1.1 INTRODUCTION TO THE STUDY

Over the last twenty Nine years income from the sale of egg has accounted for approximate six percent of the total cash income of Indian farmers. During this same period, production techniques and methods have changed drastically from a situation with a few eggs being produced on virtually every farm in t1.1he state of the present situation in which the majority of eggs are produced by large commercial laying operations with Up to more than four lakes of birds. This is not to say that small flocks do not exist today, but their importance is becoming less in terms of total egg production.

The change in egg production practices have been accompanied by changes in the structure of egg marketing in India. These changes have occurred because of attempts by egg producers to obtain better prices for their product, advancing technology in the handling of eggs, competition from surplus egg areas, and other reason. There is concern among farmers, poultry specialists, and other people about the future of the Indian egg industry, whose chief competitors are large-scale laying operations surplus production areas outside of India.

The study, on which this project is based, was intended to supply knowledge of the situation of the egg industry at Tamilnadu Namakkal. Also, information about the egg industry was needed by extensions personnel, researchers, the general public and other to appraise current research, guide further research, and decide upon alternative courses of action.

Financial performance analysis is the process of identifying the financial strengths and weakness of the firm by properly establishing the relationship between the items of balance sheet and profit and loss account. It also help in short-term and long term forecasting and growth can be identified with the help of financial performance analysis. Financial analysis (also referred to as financial statement analysis or accounting analysis or analysis of finance) refers to an assessment of the viability, stability and profitability of a business, sub-business or project.

The information contained in these statement is used by management, creditors, investors and other to form judgment about the operating performance and financial position of firm. Uses of financial statement can get further insight about financial strength and weakness of the firm if they properly analyze information reported I these statements. Management should be particularly interested in knowing financial strength of the firm to make their best use and to be able to spot out financial weakness of the firm to take suitable corrective actions. The further plans firm should be laid down in new of the firm's financial strength and weakness. Thus financial analysis is the starting point for making plans before using any sophisticated and planning procedures. Understanding the past is a prerequisite the further.

Standards of comparison:

The ratio analysis involves comparison for a useful interpretation of the financial statements. A single ratio in itself does not indicate favorable or unfavorable condition. It should be compared with some standard. Standards of comparison may consist of:

- **Past ratio**- ratio calculated form the past financial statements of the same firm;
- **Competitor ratio**- some selected firms, especially the most progressive and successful competitor, at the same pint in time;
- **Industry ratio**- ratios of the industry to which the firm belongs; and
- **Protected ratio**- developed using the protected or Performa, financial statements of the same firm.

1.2 STATEMENT OF THE PROBLEM:

The problem of investing this excess amount of cash arises simply because it contributes noting towards profitability of the firm as idle cash precisely earns no returns. Further permanent disposal of such cash is not possible, as the concern may again need this cash after a short while. But, if such is deposited with the bank, it definitely would earn a nominal rate of interest paid by the firm. A much better returns than the bank interest can be expected if a company deploys idle cash in marketable securities.

1.3 OBJECTIVES OF THE STUDY

PRIMARY OBJECTIVE

- To study the cash management in CR Poultry farm at Namakkal.

SECONDARY OBJECTIVES

- To know the sources of cash inflow and uses of cash outflow in the company.
- To determine how short term/current obligation of the company are met by the liquidity ratio.
- To know the short term solvency position and the trend.
- To offer suggestion and recommendation to improve the cash position of the company
- To meet the cash disbursement needs.
- To know the effective utilization of assets in day-today activities.

1.4 SCOPE OF THE STUDY

- The study only analysis the cash flow statement.
- It helps to take short term financial decision.
- It analysis the concern INDIA bank only. It would not be applicable to the industry.
- It indicates the cash requirement needed for plant or equipment expansion programmers.
- It helps to meet routine cash requirement to finance the transaction.
- It reveals the liquidity position of the firm by highlighting the various sources of cash and its uses.

1.5 LIMITATIONS OF THE STUDY

- Analysis and interpretation are made based on the figures given the annual reports.
- Difficult of getting access to some important data due to its confidential nature.
- Cash flow statement is a wide term and the study is limited to the time available
- External factors that affect the financial performance of the company have not given much importance.

1.6 CHAPTERIZATION:

This study has been presented in five chapters.

CHAPTER - I

This chapter deals with Introduction of the study, about the study, Importance of the study and Chapterization.

CHAPTER - II

This chapter deals with the Concept and review.

CHAPTER – III

This chapter deals with the Research Methodology.

CHAPTER – IV

This chapter provides the Data Analysis and Interpretation.

CHAPTER - V

This chapter gives a summary of Findings, Suggestions and Conclusion

CHAPTER-II

CONCEPTS AND REVIEW

2.1 REVIEW OF LITERATURE:

Hellin.(2005) in his study reported that understanding that understanding of village chicken functioning and marketing structure prerequisites for developing market opportunities for rural households and could be used to inform policy make and development in considering the commercial and institutional environmental in which village chicken keepers have to operate. Efforts to improve management of village chicken should therefore be complemented by supportive system.

Alemu(2006) in the study suggested that marketing problem is one of the constraints for the adoption of poultry technology poultry products. Another study has indicated that the six major wholesale egg market in India are co-indicated apparently due to performance of market intelligence functions by the national egg

Aklilu(2007) Studies on marketing of free range chicken can also provide clues for management strategies of these chickens especially in reducing chicken losses that smallholder farmers experience annually due to the threat of diseases, especially, Newcastle Disease Access to markets affects the price and transaction costs and is influenced by access to infrastructure and information.

DeJanvry and Sadoulet (2008) highlighted that the majority of rural households in India are net buyers of food: based on data from the 59thNSS Survey, estimate that about 74 and 53.7 percent of the marginal and small farmers, and most probably a higher proportion of rural landless, are net buyers of food. But the average food intake is largely insufficient to provide adequate nourishment to all family members: according to a World Bank Report, in India the largest majority of pre-school children experience protein-energy malnutrition and micronutrient deficiency (World Bank, 2005).

Senthilkumar (2008) conducted a study to know the knowledge level of commercial poultry (layer) farmers on scientific poultry farming among the farmers of Namakkal district in Tamil

Nadu. It was revealed that the farmers with large flock size were having more knowledge than the small flock size holders. This could be due to their higher socio-economic status, more mass media exposure, cosmopolitans, etc According to Abbot and Makeham, 1981; Kishindo 201042, markets are efficient when the ratio of the value of output to the value of input throughout the marketing system is maximized. The output of marketing is the consumer satisfaction with the goods and service and the inputs are the various resources of labor, capital and management that marketing firms use in the process accomplishing particular job without reducing consumer's satisfaction and with the output of improvement is efficiency.

Sreek and Babu (2009) in their study entitled The study on management of broiler industry in Andhra Pradesh concluded that the total investment and total cost per bird increased with the increase in the farm size at total costs per kg live weight decreased with the increase in the farm size, while the net returns increased with the increase in farm size.

Singh (2009) in his study entitled "Broiler marketing Ambala and Gurgaon districts of Haryana state" found that the most important channel in producer - wholesaler - retailer - consumer and price spread was found to decrease with the elimination of intermediaries. Two indices (concentration ratio and Hirschman index) were used to analyses market structure. The indicator revealed an absence of monopoly in broiler marketing.

Bhullar (2010) in his study entitled Comparative study of poultryfarming in Punjab and Andre Pradeshfound that the total cost of maintenance, cost offered, the interest on working capital, the value of bird and labour expenses were the major items of maintenance cost per bird.

Natalia Moreirade (2015) textiles can be applied in a wide variety of aircrafts' components and it is known for its highly polluting dyes, short life-cycle and small concern with end of life. Combined with the aeronment, but it also represents opportunities. In order to promote sustainability in the completion industry, the product development process is of central importance. A large approaches and methods for the development of integrated to improve the design process in the Green Aircraft completion (GAC) sector is an open research question.

Patricacrifoed(2016) this paper analyzes how different combinations of corporate social responsibility (CSR) dimensions affect corporate economic performance. We use various dimensions of CRS to examine whether firms rely on different combinations of CSR, in term of

quality versus quantity of CSR practices. Our empirical analysis based on an original database including 10,293 freshfirms shows that different CSR dimension in isolation impact positively firms' profits but their effect in term on intensity varies among CSR dimensions. Moreover, the finding on the qualitative CSR measure, based on interaction between is dimensions, show that the substitutability of these dimensions is highly significant for firm performance. However, in terms of the intensity, those interactions produce differential effects.

G.Y.Qied(2017) the debate on the relationship between corporate or industrial environment performance (EP) and performance (FP) has yet to be resolved, and studies need to examine the possible moderating effects on the EP-FP link. We argue that industrial EP-FP link. Using a dataset from Chinese industrial firms, we examine the direct effect of industrial EP on FP and the indirect effects of industrial munificence and resource slack on the EP-FP link. Our result show that improving corporate or industrial level EP significantly influences FP and that slack resources play a significant role on the EP-FP link. However, we found no significant moderating effect munificence on the link.

JohnZ.Nied(2018) the increase in the number of high-profit product recalls in recent years highlights the issue of ensuring product safety in global supply chains. Although the perspective of manufacture it has not been investigated for retailers .Because retailers are as the first link in the reverse supply chain. Building upon attribution theory, signaling theory attributes of a retailer recall announpoultry and test them using event study methodology hypotheses that a product recall announ poultry has a financial impact on retailers that is are potentially more hazardous.

A.LUI (2019) the value of radio frequency Identification(RFID) technology is critical for the clothing and textile supply chain, because the fashion business is characterized by a wide assortment of seasonal items with short life-cycles, high levels of impulse-purchasing and complicated distribution and logistics operations. This study aims to test whether the adoption of the RFID system can improve supply chain performance (measured as inventory companies that publicly announced their RFID adoption, 18 of them were matched with comparable control firm for the testing of abnormal supply chain performance. The results shown the clothing and textile RFID adopters' inventory days' drop by about 12.89 days over the 5years period, whole other RFID adopters (other manufacturing sectors) only drop by about 2.47 days.

2.2INDUSTRY PROFILE

HISTORY

The egg has been a protein source for centuries. Sometime in the second millennium B.C Indian wild red jungle fowl, the ancestor of the modern chicken (Gallus) was dispersed through Group, China, and the Middle East. Chickens were brought to the new world on Columbus's second voyage in the late fifteen century. These imported chickens laid eggs year-round and were considered most valuable for egg production rather than for meat. Soon family farms raised chickens for the family's consumption of egg and meat within the household-few families had laying flocks of any size. However, by 1800 chickens began being raised for meat and egg production in increasing numbers in the United States. Until World War II, egg production came from rather small flocks of less than 400 laying hens. After the war, automation and advances in breeding, feeding, and developing efficient henhouses gave rise to modern high-volume chicken farms. Today, a single egg producer may well have a flock of over, 100,000 laying hens—and some have flocks of over one million.

RAW MATERIALS

The egg itself is the ingredient in egg production. Soaps are used in egg production facilities to clean the shell. Some processors coat the shell in a light film of oil.

However, the hen from which the egg drops can consider an important part of the raw materials. Certain breeds lay the majority of eggs in the United States. A particularly prolific laying hen is the single comb white leghorn. This breed reaches maturity early and can begin laying at 19 weeks of age and continue to ay egg for about a year. In addition, the leghorn utilizes feed efficiently, is fairly small, can adapt to a variety of climates and is able to lay a relatively large amount of white egg, the type most in demand. Play mouth rock hens, Rhode Island reds and New Hampshire hens produce brown Eggs much favored in New England.

Feed for chickens is generally all-mash, consisting of sorghum grains, corn, and either cottonseed meal or soybean oil depending on availability. Farmers carefully mix the mash so that the chicken gets just the right amounts of protein fat, carbohydrates, vitamins, and minerals. This is essential in that the nutritional quality of the laid egg depends on the feed the chicken was

given. All additives to chicken feed must be approved by the federal government (after research on toxicity to animals and human is determined). Hormones are not given to chicken requires about 4lb (1.8kg) of feed to produce a dozen eggs; a leghorn hen east about 0.25lb (0.1134kg) of chicken mash a day.

PROCESSING EGGS

Some egg farmers have their own egg processing facilty on premises. Other contract with egg processing firms in the locale who purchases egg and processes them. Generally, an egg moves from the egg farm to being ready for public consumption in just a few days.

EGG PROCESSING SYSTEM

1. **In line processing**

This processing method is the most efficient egg collection and processing of eggs available. Eggs are delivered from the egg production facility to the egg processing facility by an enclosed and refrigerated conveyor system.

2. **Off line processing**

This processing method utilizes satellite farms. Satellite farms are egg production facilities that are located at a different location from the egg processing facility. Eggs produced at satellite farms must be gathered and delivered to the egg processing facility. Egg handling and gathering is performed with automated equipment.

LAYING THE EGG

Hens are kept in cages, usually in group of three to five. After the egg is laid, the cage is devised so the egg rolls out for easy collection. Egg are gathered twice a day, generally by automated machinery but are occasionally still gathered by hand. Eggs are gathered as soon as hens lay them because warmer temperatures encourage farmers refrigerate the egg immediately after gathering before they are packed are packed for transport to the processor.

PACKING THE EGGS ON THE FARM

The eggs are than packed on skids that are formed of layers of flats—eggs are packed on flats that include 2.5 dozen eggs, with as many as six per layer (layers of six flats are separated by aboard). A single skid holds about 30 cases or 900 dozen eggs these eggs are then sent to the processing plant via truck.

WASHING THE EGGS

3the skids are brought into the productions room ans the individual flats are put on the conveyor, one at a time. Individual eggs are grasped by small suctions cups and placed onto another conveyor belt. Now , the eggs are moved into the grader where they are cleaned with a USDA approved cleanser. They are rotated as brushes and water jets move carefully across the eggs.

CANDLING AND GRADING

The cleaned eggs are graded in a candling booth which is a dark cubical or room. A penetrating light is shined on the eggs in order to grade them. The egg processor is able to grade the egg during candling. The trained Candler can see that an older egg has thinner albumen; thus, the yolk casts a sharp shadow and immediately indicates an older egg. Egg are graded as "A" (sold for household use or at retail markets), or grade"C"(sent to egg breakers who break the shell in order to convert in to other egg products);

Commercial egg processing is a quick business the relies on speed to market in order to provide fresh, quality hens are kept in cages that are devised so that when an egg is laid it rolls in to a collection bin. The egg arethen packed on skids which are formed of layers of last. Skids are individually placed on a conveyor belt. Each egg in the skid is grasped by a small suction cup and placed onto another conveyor belt. The egg move into the grader where they are rotated as brushed and water jets move carefully across the egg. A fan then dries the eggs. Once graded, the eggs are place in cartons, packaged, and shipped to stores.

Higher grade eggs have a thick, upstanding albumen, an oval yolk, and a clean, smooth, unbroken shell. Egg with cracks that are not leaking are removed from the process at this point and are not packaged for household use or retail sale.

PROBLEM FACED IN POULTRY

Family poultry makes up nearly 80%of all the poultry products in the developing countries, especially the ones located in Africa. This mod of poultry is indeed of grate importance for the people who are in some ways linked t this discipline for their survival.

LABOUR AND DISEASE CONTROL PROBLEMS

The sector now faces a number of issues and difficulties including, labour disease and other major problems. In addition to the challenges posed by the various pathogenic diseases, the farmers also face the problem for low capital. Help from the side of the government and other investment institution, is all that is needed by them for ensuring health growth and development conditions for the domesticated animals.

HIGH PRODUCTION COST AND LOW RETURN

Most of the farmers of the third world countries are forced to sale their products at low costs to the suppliers, which in turn earn some large profits from them.

LIMITED ACCESS TO THE CORE MARKETS

It is all because of the limited access to the worldwide markets which is barriers in the ways of the farmers. As they get little return on what they sale, so they never try to improve the quality pf the poultry products and farms. Various significant improvements can be made in these production system through the use and implementation of the most advanced and scientific practices.

In order to provide a solution to the poultry problems, some investment is now being made in those countries and proper steps are being taken to ensure the the Introduction of scientific research in these countries. But here an important thing to note is the specific economic and social environment of the area which is quite different from the rest of the developed countries.

TECHNICAL TRAINING AND ASSISTANCE FOR THE FARMERS

In order to solve the issues, specialized poultry network and training programs should be introduced in order to provide awareness to the famers about the various diseases, health conditions, strategies and techniques which are necessary to ensure the quality of poultry products and for the better health of the chickens, ducks and other domesticated animals. The poultry producers in Asia and Africa are the ones which face the most number of challenges in comparison to the once in EU and America.

2.3 COMPANY PROFILE

ABOUT ENTERPRISE CR POULTRY FARM, COMPANY

Our company CR farms is a renowned producer of eggs in India. It was establish in the year 1996 on a small scales. Major expansion of the business happened in 2005. Currently the poultry farm has the capacity for producing 1.5lakh eggs per day. Level of production of eggs to 3lakh eggs per day.

POULTRY LOCATION RPF

The firm is located in a serine well aerated and clean environment in Namakkal, Tamil Nadu CPF is far away from any other poultry farms which prevent spreading of diseases from other poultry farm which prevent spreading of diseases from other poultry farms.

OUR MISSION

Our mission is to produce healthy, tasty and incredible eggs to the customellrs globally and to provide daily eggs which are fresh, nutritive low in fat content and rich in protein to people around the world.

OUR SUPPORT

We have a strong and dependable infrastructure. The entire work force has been separated into teams for better performance and efficiency. Our team comprises of skilled professionals, experts and and dedicated workforce, who work to produce high quality products. We offer the best quality white shell eggs to out customers procured from our local production

farm. The eggs are processed under healthy and hygienic conditions and packaging of the eggs is also given a lot of care and attention. We use the most sophisticated and modern egg grading techniques in our entire process right from procurement of eggs till packaging and delivering.

OUR QUALITY

We have devised several strategies revolving around the quality of products. They primarily pertain to the inspections we run on our products before releasing them to market. For the purpose, we have a slew of experts with intensive knowledge of our products. Each egg provided by us is stringently tested. The poultry eggs are tested for bird flu, salmonella infection and other contamination and hence certified fit for human consumption. The eggs are subjected to bacteriological tests and are seen whether they are free from salmonella infection.

OUR CLIENTS

Thanks to the satisfactory quality of our services we have prestigious clients and managed to earn the their trust. Out prestigious clients distributors of eggs across Tamil-Nadu and Kerala.

ADDRESS

CR.POULTRY FARM,

Mongilpatty,

Tholur(Po),

NAMAKKAL(Tk&Dt) – 637 017

IMPLEMENTATION OF NEW POLICIES:

Furthermore the poultry sectors in Africa and Asia should be given due attention by the agricultural policy makers and scientists. Unfortunately, small scale poultry farm are not given due regards by the researches. It is all because of the fact that there researchers find no sort of political significance in working in some of the underdeveloped and backward areas of Asia and Africa. In order to ensure the betterment for all, policy makers and poultry tycoons should take some measure for changing the lives of the poultry farmers in the developing countries. The

poultry producers should also change their attitudes and efforts in managing the quality of the products and the welfare of all the animals on their farms.

POULTRY FARMING IN INDIA

Before discussing commercial poultry farming in India, let me first explain what does poultry farming means. Generally, poultry farming means, raising various types of domestic birds for the purpose of producing foods like eggs and meat. Nowadays, most of the people are using poultry as the synonym of chickens. Because chickens are the widely raised poultry birds.Along with chicken ducks, geese, turkeys, guinea fowl, quails, peacock etc. are also popular domestic poultry birds. In India, various types of poultry birds are being raised from a long time ago. The largest number of poultry population in India is found in Andhra Pradesh followed by Tamil Nadu Maharashtra, west Bengal, Karnataka, Bihar, Orissa, Kerala, Assam, Uttar Pradesh and Punjab. Some important urban areas like Mumbai, Prune, Nagpur, Kolkata, Delhi, Chandigarh, Bangalore, Chennai, Hyderabad, Shimla, Bhubaneswar, Ajmer etc. are raising poultry through a developed poultry farming systems. We Bengal and some other regions like Assam.

SELECTING BREEDS

Selecting high quality productive breeds is very important for successful poultry farming in India. There are numerous local and foreign high quality poultry breeds available in India. Choose proper breeds according to your desired production. If you want to start producing eggs commercially, select high productive layer poultry breeds. For commercial meat production business, go with highly meat productive broiler poultry breeds. Contact with your nearest expect poultry producer to learn more about highly productive breeds. Contract with your nearestexpect poultry producer to learn more about highly productive breeds. Common and mostly raised poultry breeds in India are of three types.

Broilers: the poultry breeds that are suitable for commercial meat production is known as broiler poultry. That is like meat producing machines. They consume foods and covert them to meat quickly. They grow fast and become suitable for slaughter purpose within very short time.

Cockerels: cockerels are other types of meat producing poultry breeds. They also used for commercial meat production like broilers. But their growing rate is slower than toilers.

They become hardy and can adopt themselves with the environment easily than the broilers. Cockerel meat is also very popular and has a grate demand in India.

Layers: various types of layer poultry are very popular for commercial eggs production throughout world. Some of them are very suitable for farming in India. Layers can be used for both commercial meat and egg production. There are some layer poultry breeds available which can upto 300 eggs per years.

Choose any of those breeds according to your desired production. While choosing breeds for commercial production, consider the available of all types of necessary facilities. Visit your nearest local market and try to understand which product has a huge demand and price.

HOUSING/CAGE

Making a suitable poultry housing is another important factor for commercial production. But it is not too expensive like buying land. There numerous ways for making a good house for the poultry birds. Always be sure that, the house or cage is sufficient and spacious enough to accommodate the birds with necessary space and facilities. In free range farming system, ensure sufficient amount of space for moving. The design of the house depends on the breeds and production Make a proper ventilation system in the house. Because good ventilation system ensures good health and proper growth of the birdsSo, the must have to be well ventilated.

Ensure flow of sufficient amount of fresh air and light inside the house.

Try to make south faced house. This will help to entrance amount of clean and fresh air.

If you go for larger scale commercial production and make numerous houses, then the distance from one house to another house will be at least 40feet.

Always keep the house clean and fresh. And clean it perfectly before bring the chicks into the farm.

Prevent all type of harmful animals and predators.

Make good facilities so that rain water and cold wind can't enter inside the house.

Try to build the house in a calm and quiet place.

Make a suitable drainage system inside the house. It will help you to clean the house easily. keep all equipment in proper distance inside the house. And always clean the house and equipment in a regular basis.

Type. However, while making a poultry house, consider the following.

FEEDING

Feeding good quality and nutritious food keeps is a must for commercial poultry birds healthy and productive. So, good and high quality nutritious food is a must for commercial poultry production. There are numerous poultry feed producing companies available in india. They produce feds for all types of poultry feed producing companies available in india. They produce for all types of poultry birds. You can easily use those foods for your bids. If you want to prepare the feed at your home, then you must have to know the necessary nutrient in their food. And you also have to buy all those elements separately from the market and mix it in proper ratio. Along with proving fresh and nutritious food, always try to serve them sufficient amount of fresh and clean water according to their demands.

- Poultry feed
- Broiler poultry feed
- Layer poultry feed
- Care & management

Always try to take good care of your birds. And good management ensures proper growth and production. The main threat of poultry farming in India is diseases. So, always take good care of your birds and provide them nutritious food and clean water. Never try to mix contaminated or polluted food with their regular food. Vaccinate them timely and make storage of some common and necessary medicines.

MARKETING

The main benefits of poultry farming in India are easy marketing. You can easily sell your products in your nearest local market. So, you don't have to worry about marketing your products. If the local market located so far from your farms then transport the products very carefully. If you are new in this business and want start poultry farming in India, then first of all try to visit some farms practically and start rising in small scale.

After gaining sufficient knowledge about poultry rising go for large scale commercial production. Wish your success!

BACKGROUND

The unfertilized egg is considered an important and inexpensive food source, particularly high in protein, including 0.21oz(6g) of complete protein per two-ounce egg. However, it also includes 0.4oz (12g) fat, both saturated and unsaturated, which is nearly all located in the yolk. Therefore, if the yolk is separated from the albumen (white) of the egg and the white only used, the egg contains no fat amount of protein. The egg also contains significant amounts of iron, vitamins A and D riboflavin, and thiamine. However that nutritional value does vary depending on the diet of the laying hen. Annual consumption during the late 1900s averaged 245 eggs for

While gees, squab ducks, and turkeys supply edible eggs, the females (mature hens and younger pullets) are raised for meat and egg production and breeds have been developed to fulfill commercial needs. Each of the 235 million laying hens in the united states produces about 300 eggs a year. Farmers are careful to house and feed the chicken to maximize laying hens at different ages, ensuring they have a steady supply of eggs ready for market to provide year-round income.

Eggs are an important ingredient in many recipes. Because the protein in the egg white coagulates as it is heated, eggs are utilized in many recipes as a structural component. Stiffly beaten egg whites expand as they are heated and are used as leaving in angel-food cakes, souffles, and meringues. In cake batters that utilize the entire egg, the egg acts as leaving as well as providing moisture and firm texture. soups and sauces use eggs as a thickening agent. Ice

creams often include eggs to prevent the formation of ice crystals which can ruin the product. But the plain egg is eaten by million each day for its own unique flavor and nutritive value- they may b boiled, poached, fried, scrambled, or baked.

Fresh egg production is primary to the egg industry, however, a significant amount of egg production includes eggs purposely broken and use for powdered eggs, frozen or purchased by food producers for inclusion in food products. (in some fresh egg production plants, accidentally broken eggs are sold to bakeries or other food production plants.)

CHAPTER-III

RESEARCH METHODOLOGY

RESEARCH

Research in common parlance refers to a search for knowledge. One can also define research as scientific and systematic search for patient information on a specific topic. In fact research is an art of scientific investigation.

3.1 RESEARCH DESIGN

The design of this project is analytical in nature. The research design of the present is descriptive. The facts and information is already available were used and analyzed to critical of the material

3.2 SOURCE OF DATA

Only secondary data has been used for the study. The secondary data is derived from the annual report, website on Poultry farm at Namakkal

PERIOD OF THE STUDY

The data has been collection or the period 2014-2015, 2015-2016, 2016-2017, 2017-2018, and 2018-2019.

FINANCIAL TOOLS USED

Ratio analysis

3.2 DATA COLLECTION

Sources of data:

The study is based on Secondary data.

Secondary Data:

Secondary data is the data that have been already collected by and readily available from other sources. Such data are cheaper and more quickly obtainable than the primary data and also may be available when primary data cannot be obtained at all.

An incorrect capital structure can mean ruin of an otherwise healthy firm. This is because, if the firm is funded by too much debt, it has a lot of interest bills to pay. The worst part is that if the firm defaults a few times, debt holders have the right to seek legal counsel and start liquidating the firm. In such a scenario, an otherwise healthy firm may have to sell its assets at throw away prices. Thus an ideal capital structure is one that provides enough cushions to shareholders so that they can leverage the debt – holder's funds but it should also provide surety to debt holders of the return of their principal and interest. Since capital structure ratio reveal these facts, analyst pay careful attention to them.

Since the study is aimed at the financial aspects of the whole data has been gathered from,

- Annual report of the company
- Broachers of the company
- Library books
- Tally reports

The Secondary data, on the other hand, are those which have already been collected by someone else and which have already been passed through the statistical process. Usually published data are available in:

- Various publications of the central, state or local government;
- Various publications of foreign governments or of international bodies and their subsidiery organizations;
- Technical and trade journals;
- Books, Magazines and Newspapers:
- Reports and publications of various associations connected with business and industry, banks, stock exchange etc.,

3.4 TOOLS OF STUDY

Ratio Analysis:

Ratio is a relationship between two figures expressed mathematically. Financial ratio provides numerical relation between two relevant financial data. Financial ratios are calculated from the Balance sheet and Profit & loss A/c. The relationship can be either expressed as a ratio on as a quotient. Ratios summarize the data for easy understanding, comparison and interpretation.

The ratio analysis is the financial statement. It provides a yardstick to measure the relationships between the variable of figures.

The term ratio analysis simply means one number expressed in terms of another. It describes in mathematical term as the qualitative relationship that exists between two numbers. Nowadays it is used by all business and industrial concern in their financial analysis.

NATURE OF DATA

The study uses both the primary and secondary data

(1) **primary data:** unstructured interview discussion observation.

(2) **secondary data**: annual reports, reports, maintained by departments, books, journals, periodicals etc.,

CHAPTER-IV

DATA ANALYSIS THE CASHFLOW STATEMENT

4.1INTRODUCTION:

Ratio Analysis is a powerful tool of financial analysis. Alexander Hall first presented it in 1991 in Federal Reserve Bulletin. Ratio Analysis is a process of comparison of one figure against other, which makes a ratio and the appraisal of the ratios of the ratios to make proper analysis about the strengths and weakness of the firm's operations. The term ratio refers to the numerical or quantitative relationship between two accounting figures. Ratio analysis of financial statements stands for the process of determining and presenting the relationship of items and group of items in the statements.

1. LIQUIDITY RATIOS:

Liquidity Ratios help in establishing a relationship between cast and other current assets to current obligations to provide a quick measure of liquidity. A firm should ensure that it does not suffer from lack of liquidity and also that it does not have excess liquidity. A very high degree of liquidity is also bad, idle assets earn nothing. The firm's funds will be unnecessarily tied up in current assets. Therefore it is necessary to strike a proper balance between high liquidity. Liquidity ratios can be divided into three types:

- Current ratio
- Acid Test Ratio / Quick Ratio / Liquidity Ratio
- Absolute liquid ratio

2. TURNOVER/ACTIVITY RATIOS:

These are the ratios which indicate the speed with which assets are converted or turned over into sales.

- Inventory Turnover Ratio
- Debtors/ Accounts receivables Turnover Ratio
- Creditors/Accounts Payables Turnover Ratio.

CURRENT RATIO:

Liquidity ratio that measure a company ability to pay short them obligation. The ratio in mainly used an idea of the company ability to pay back its short term liability (debt& payable) with its short term assets (cash, inventory, receivables). If the current assets of a company are more than current liability.

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current liability}}$$

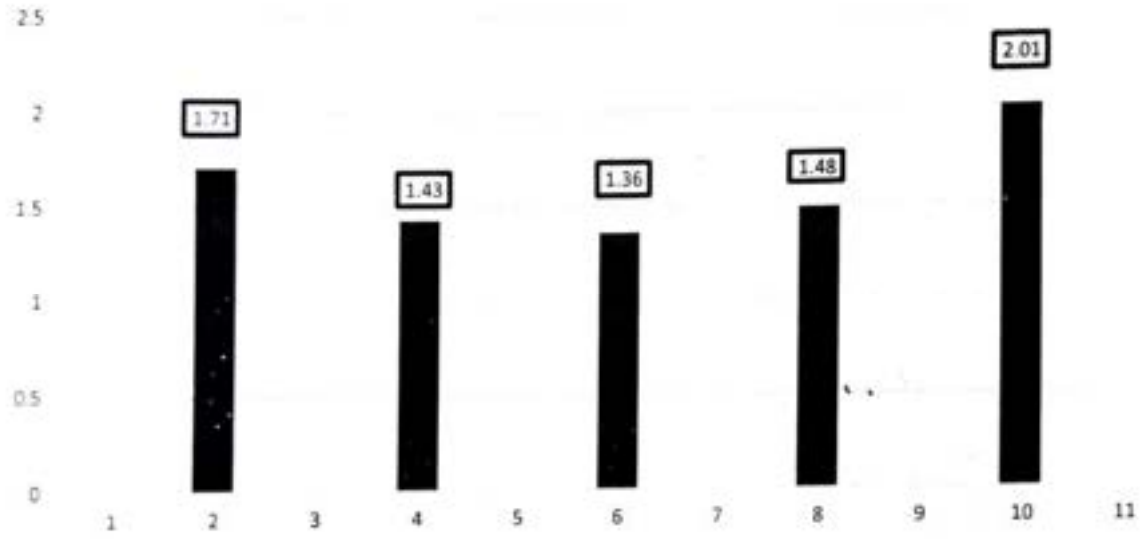
TABLE NO: 4.1

CURRENT RATIO

YEAR	CURRENT ASSETS	CURRENT LIABILITIES	CURRENT RATIO
2014-2015	895.95	523.90	1.71
2015-2016	806.36	563.11	1.43
2016-2017	645.03	472.60	1.36
2017-2018	539.36	362.39	1.48
2018-2019	752.84	374.09	2.01

CHART NO: 4A

CURRENT RATIO



INTERPRETATION:

From the above it was clear that, the current ratio for the year 2014-2015 is 1.71, the ratio is 1.43 during the year 2015-2016, the current ratio is 1.36 during the year 2016-2017, the current ratio is1.48 during the year 2017-2018 and the current ratio is 2.01 during the year 2018-2019. 2.01 is the current ratio of Ravi Poultry Farm in 2018-2019. It gives the overall picture about the company.

QUICK RATIO:

Quick ratio is also known as acid test ratio or liquid ratio. This is relationship between liquid assets and current liabilities. Liquid include the assets, which are immediately convertible into cash without much loss. The ratio is a better test of financial strength then the current ratio, as it gives on consideration to inventory, which may be slow moving. Liquid assets of the CR Poultry Farm Corporation Ltd., sundry debtors and cash and bank balance.

$$\text{Quick Ratio} = \frac{\text{Quick Assets}}{\text{Quick Liability}}$$

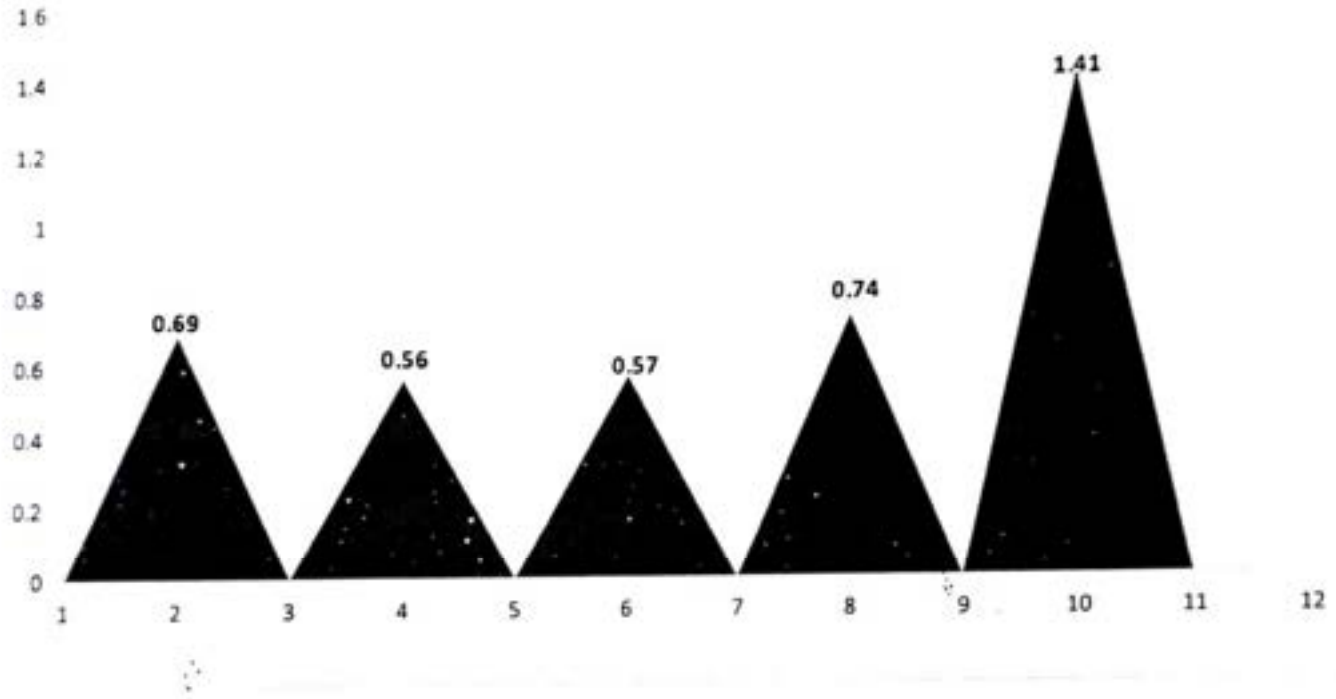
TABLE NO 4.2

QUICK RATIO

YEAR	QUICK ASSETS	QUICK LIABILITIES	QUICK RATIO
2014-2015	364.87	523.90	0.69
2015-2016	317.6	563.11	0.56
2016-2017	270.18	472.60	0.57
2017-2018	270.18	362.39	0.74
2018-2019	528.75	374.09	1.41

CHART NO: 4.B

QUICK RATIO



INTERPRETATION:

From the above tablet is was clear that, the quick ratio for the year 2014-2015 is 0.69, the quick ratio is 0.56 during the year 2015-2016, the quick ratio is 0.57 during the year 2016-2017, the quick ratio is 0.74 during the year 2016-2017 and the quick ratio is 1.41 during the year 2018-2019. 1.41 is the quick ratio of Poultry Farm in 2018-2019. It gives the overall picture about the company.

ABSOULTE LIQUID RATIO:

This ratio is calculated when liquidity is highly restricted in term of cash and cash equivalents. This ratio measures liquidity in terms of cash and near item and short current labilities.

$$\text{Absolute Liquid Ratio} = \frac{\text{Absolute Liquid Assets}}{\text{Liquid Liability}}$$

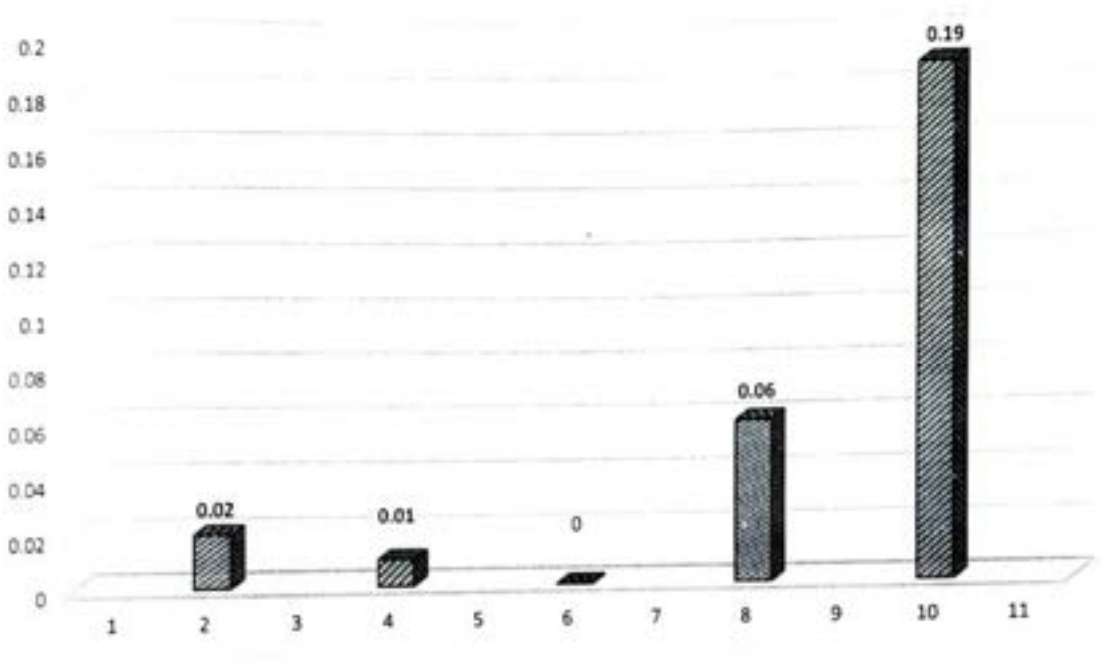
TABLE 4.3

ABSOLUTE LIQUID RATIO

YEAR	ABSOLUTE LIQUID RATIO	LIQUID LIABILITY	ABSOLUTE LIQUID RATIO
2014-2015	9.13	523.90	0.02
2015-2016	4.58	563.11	0.01
2016-2017	1.94	472.60	0.00
2017-2018	20.73	362.39	0.06
2018-2019	73.07	374.09	0.19

CHART NO: 4.C

ABSOLUTE LIQUID RATIO



INTERPRETATION:

From the Above table it was clear that, the absolute liquid ratio for the year 2014-2015 is 0.02, the absolute liquid ratio is 0.01 during the year 2015-2016, the absolute liquid ratio is 0.00 during the year 2016-2017, the absolute liquid ratio is 0.06 during the year 2017-2018 and the absolute liquid ratio is 0.19 during the year 2018-2019. The absolute liquid ratio is increased in the firm.

WORKING CAPITAL TURNOVER RATIO:

Working capital turnover ratio indicates the velocity of the utilization of net working capital. This ratio indicates the number of times the working capital is turned over in the cause of a year. This ratio can be used by manning of comparative and trend analysis for different firms in the same industry and for various period. This ratio can be calculated working capital turnover ratio.

$$\text{Working Capital Turnover Ratio} = \frac{\text{Sale}}{\text{Working Capital}}$$

Working Capital= Current Assets-Current Liabilities

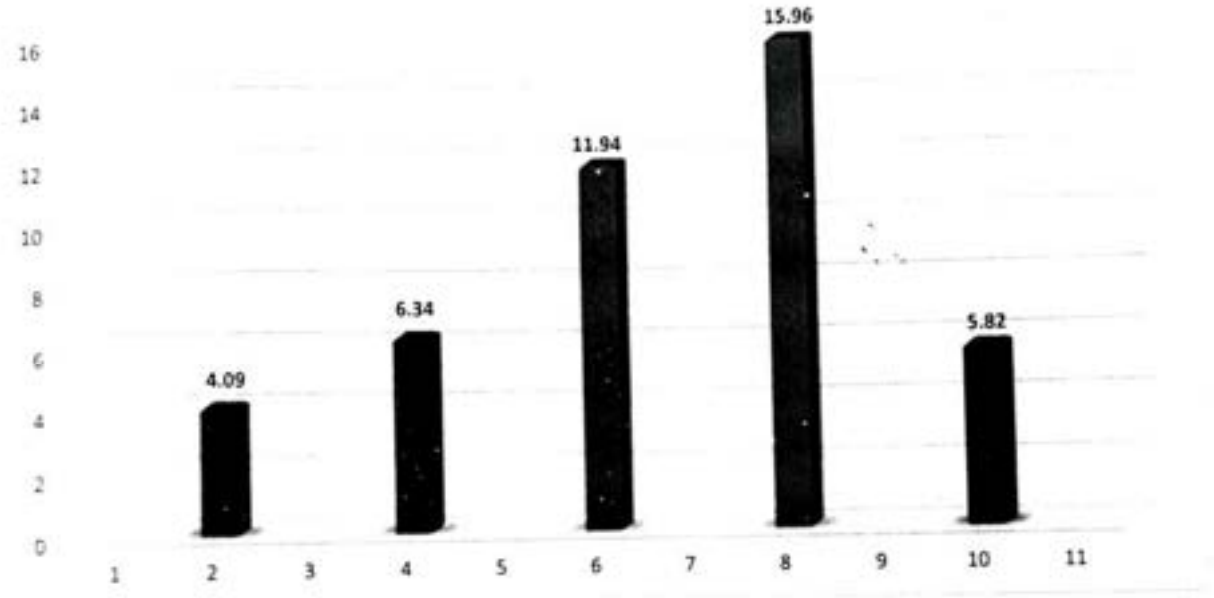
TABLE 4.4

WORKING CAPITAL TURNOVER RATIO

YEAR	SALES	WORKING CAPITAL	WCTR
2014-2015	1535.12	372.05	4.09
2015-2016	15544.17	243.25	6.34
2016-2017	2059.90	172.43	11.94
2017-2018	2825.41	176.97	15.96
2018-2019	2206.18	378.75	5.82

CHART 4.D

WORKING CAPITAL TURNOVER RATIO



INTERPRETATION:

From the above it was clear that, the working capital turnover ratio for year 2014-2015 is 4.09, it was increased to 6.34 during the year 2015-2016, and the working capital turnover ratio is 11.94 during the year 2016-2017, working capital turnover ratio is 15.96 during the year 2017-2018 and the working capital turnover ratio is 5.82 during the year 2018-2019.

SROCK TO WORKING CAPITAL RATIO:

The stock to working capital ratio measures how well the company is able to generate cash using working capital at its current inventory level.

$$\text{Stock To Working Capital Ratio} = \frac{\text{Stock}}{\text{Working Capital}}$$

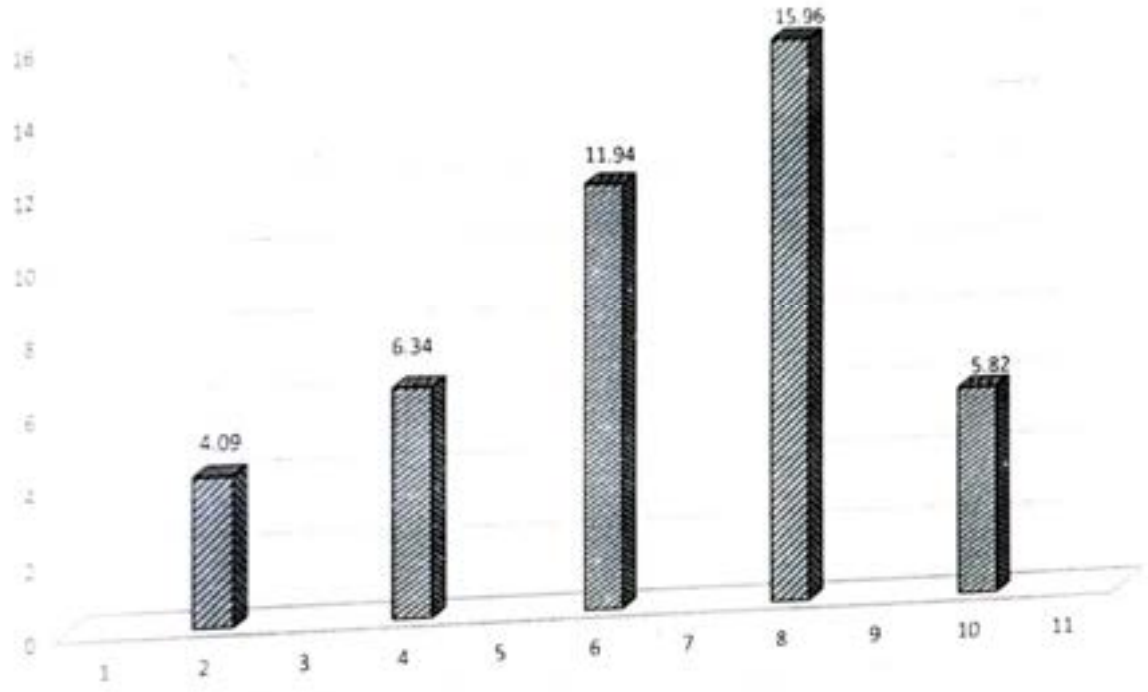
TABLE 4.5

STOCK TO WORKING CAPITAL RATIO

YEAR	SALES	WORKING CAPITAL	SWCR
2014-2015	531.08	372.05	1.43
2015-2016	488.76	243.25	2.01
2016-2017	374.85	172.43	2.17
2017-2018	231.62	176.97	1.31
2018-2019	224.09	378.75	0.59

CHART NO: 4.E

STOCK TO WORKING CAPITAL RATIO



INTERPRETATION:

Form the above table it was clear that, the stock to working capital ratio for the year 2014-2015 is 1.43, the stock to working capital ratio is 2.01 during the year 2014-2015-2016,the Stock to working capital ratio is 2.17 during the year 2016-2017,the stock to working capital ratio is 1.31 during the year 2017-2018 and the stock capital ratio is 0.59 during the year 2018-2019.

CURRENT ASSET TO WORKING CAPITAL RATIO:

Radio show the difference between the current assets and working capital thus shows the position Of the firm. The purpose of the ratio is to working capital influenced in current assets.

$$\text{Current Assets to Working Capital Ratio} = \frac{\text{Current Assets}}{\text{Working capital}}$$

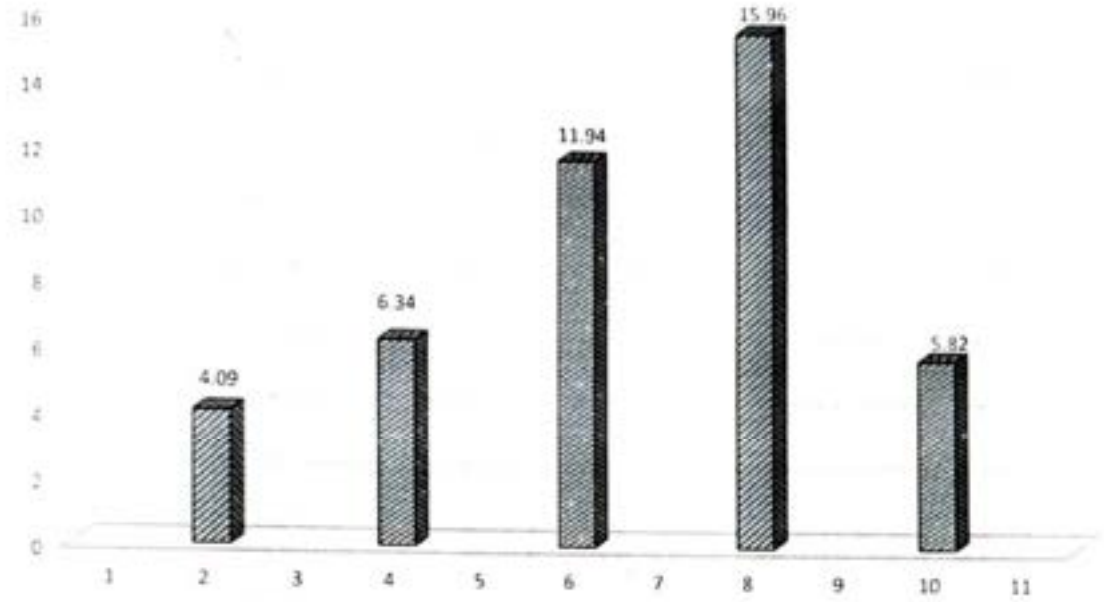
TABLE NO: 4.6

CURRENT ASSETS TO WORKING CAPITAL RATIO

YEAR	CURRENT ASSETS	WORKING CAPITAL	CAWCR
2014-2015	895.95	372.05	2.41
2015-2016	806.36	243.25	3.31
2016-2017	645.03	172.43	3.74
2017-2018	539.36	176.97	3.05
2018-2019	752.84	378.75	1.98

CHART NO: 4.E

STOCK TO WORKING CAPITAL RATIO



INTERPRETATION:

Form the above table it was clear that, the stock to working capital ratio for the year 2014-2015 is 1.43, the stock to working capital ratio is 2.01 during the year 2014-2015-2016.the Stock to working capital ratio is 2.17 during the year 2016-2017,the stock to working capital ratio is 1.31 during the year 2017-2018 and the stock capital ratio is 0.59 during the year 2018-2019.

CURRENT ASSET TO WORKING CAPITAL RATIO:

Radio show the difference between the current assets and working capital thus shows the position Of the firm. The purpose of the ratio is to working capital influenced in current assets.

$$\text{Current Assets to Working Capital Ratio} = \frac{\text{Current Assets}}{\text{Working capital}}$$

TABLE NO: 4.6

CURRENT ASSETS TO WORKING CAPITAL RATIO

YEAR	CURRENT ASSETS	WORKING CAPITAL	CAWCR
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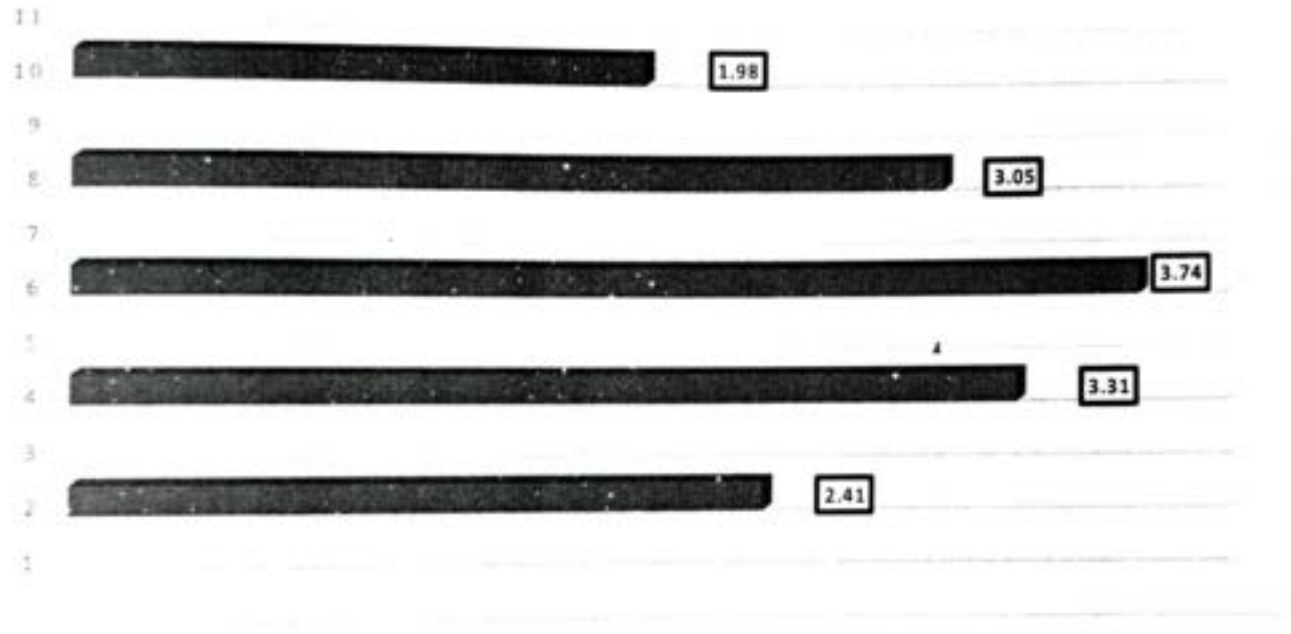
2015-2016	806.36	243.25	3.31
2016-2017	645.03	172.43	3.74
2017-2018	539.36	176.97	3.05
2018-2019	752.84	378.75	1.98

CHART NO: 4.F

CURRENT ASSETS TO WORKING CAPITAL RATIO



INTERPRETATION:

Form the above table it was clear that, the stock to working capital ratio for the year 2014-2015 is 2.41, the next year ratio is 3.31 during the year 2014-2015-2016,and the nest year ratio is 3.74 in2016-2017,the current assets to working capital ratio is 30.5 during the year 2017-2018 and the last year ratio is decreased to 1.98.to 2018-2019. The current asset to working capital ratio decreased in 2018-2019.

LIQUID ASSETS TO WORKING CAPITAL RATIO

Ratio shows difference between the liquid assets and the working capital thus shows the position of the firm.

$$\text{Liquid Assets To Working Capital Ratio} = \frac{\text{Liquid Assets}}{\text{Working Capital}}$$

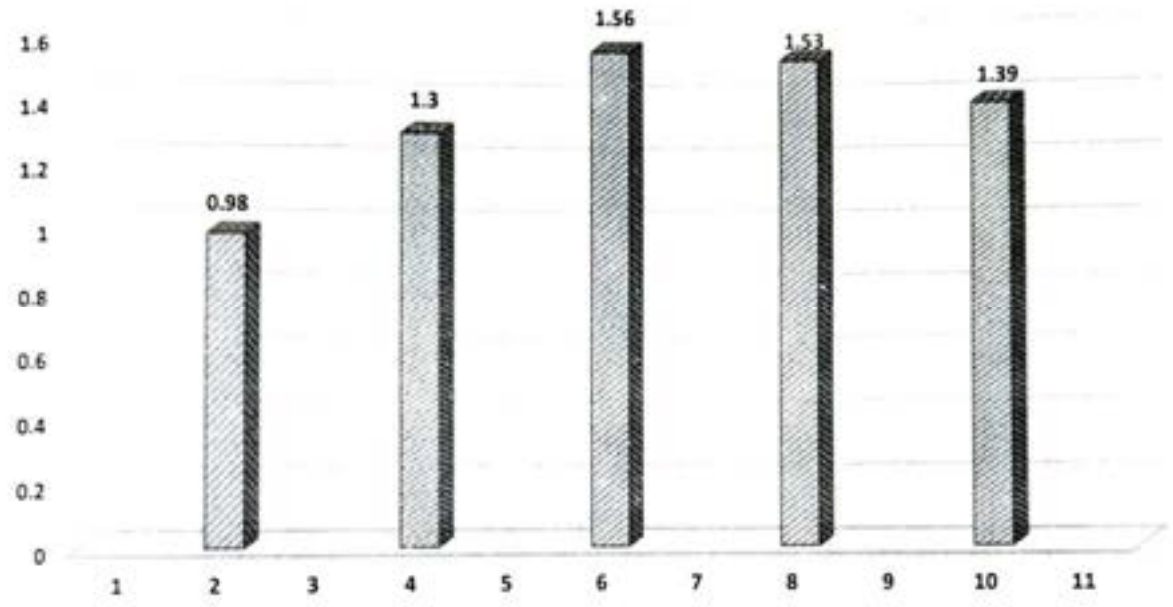
TABLE NO: 4.7

LIQUIDTY ASSETS TO WORKING CAPITAL RATIO

YEAR	LIQUID ASSETS	WORKING CAPITAL	LAWCR
2014-2015	364.87	372.05	0.98
2015-2016	317.6	243.25	1.30
2016-2017	270.18	172.43	1.56
2017-2018	270.18	176.97	1.53
2018-2019	528.75	378.75	1.39

CHART NO: 4.F

LIQUIDITY ASSETS TO WORKING CAPITAL RATIO



INTERPRETATION:

Form the above table it was clear that, the liquid assets to working capital ratio for the year 2014-2015 is 0.98, the next year is increased to 1.30 in 2014-2015-2016 the liquid assets to year working capital ratio is increased to next year is 1.56 in 2016-2017, in the year of 2017-2018 is 1.53 and the final year ratio is 208-2019.

DEBT EQUITY RATIO;

This ratio is ascertained to determine long term solvency position of a company debt equity ratio is also called external, internal equity ratio.

$$\text{Debt equity ratio} = \frac{\text{Total Long Term Debt}}{\text{Shareholder funds}}$$

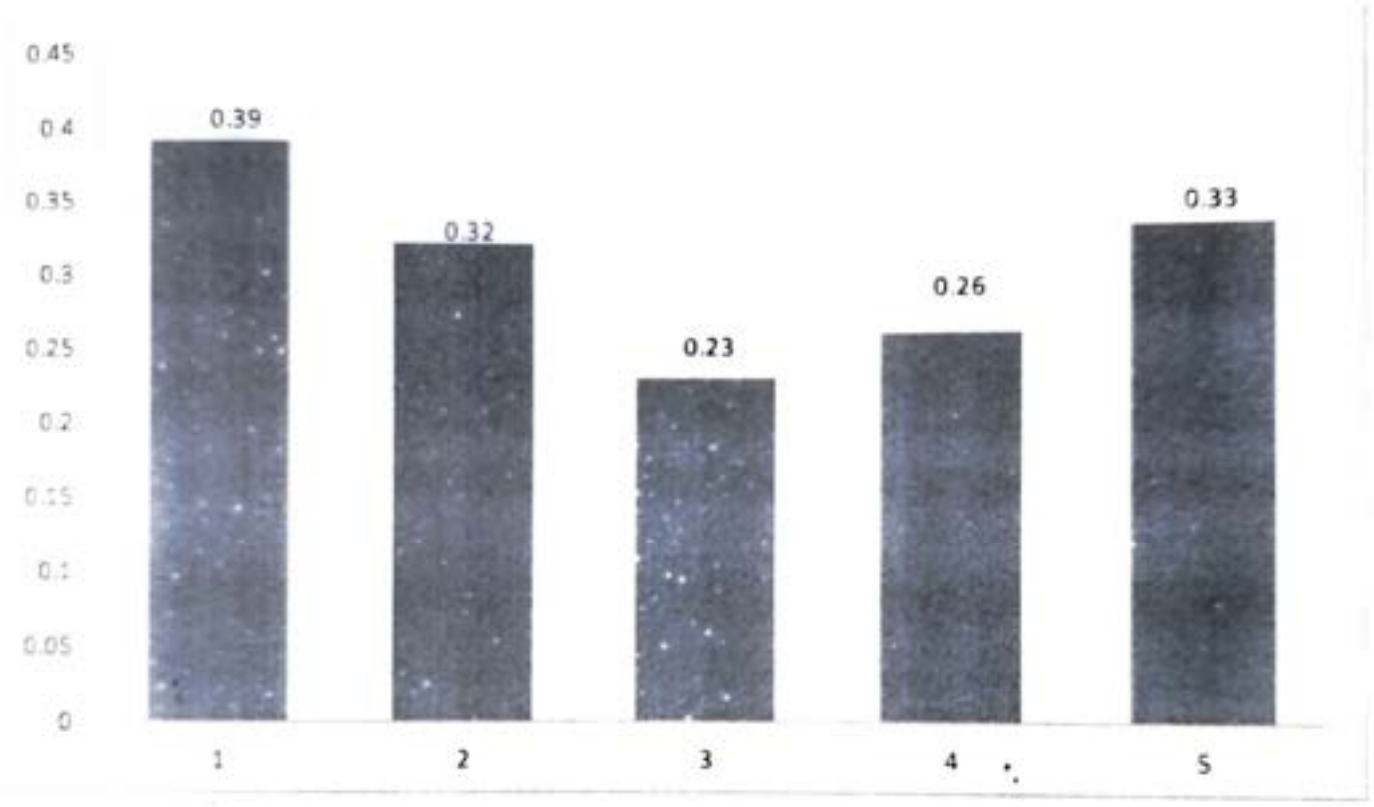
TABLE NO: 4.8

DEBT EQUITY RATIO

YEAR	TOTAL LONG TERM DEBT	SHAREHOLDER'S' FUNDS	DEBT EQUITY RATIO
2014-2015	343.89	863.72	0.39
2015-2016	297.92	925.71	0.32
2016-2017	249.50	1080.41	0.23
2017-2018	315.28	1195.60	0.26
2018-2019	418.51	1278.50	0.33

CHART NO: 4.G

DEBT EQUITY RATIO



INTERPRETATION:

Form the above table it was clear that, the debt equityratio for the year 2014-2015 is 0.39, the next year is ratio is 0.32 in -2015-2016 the debt equity ratio is 0.23 during the year 2016-2017, the year is 0.33 in 2017-2018 in the debt equity ratio is flexible in the company.

4.9 DEBTORS TURNOVER RATIO:

Debtor's turnover ratio measures the number at tomes the receivables are rotated in a year in terms of sales. This ratio also indicates the efficiency of credit collection and efficiency of credit policy.

$$\text{Debtor Turnover Ratio} = \frac{\text{Credit Sales}}{\text{Average Debtors}}$$

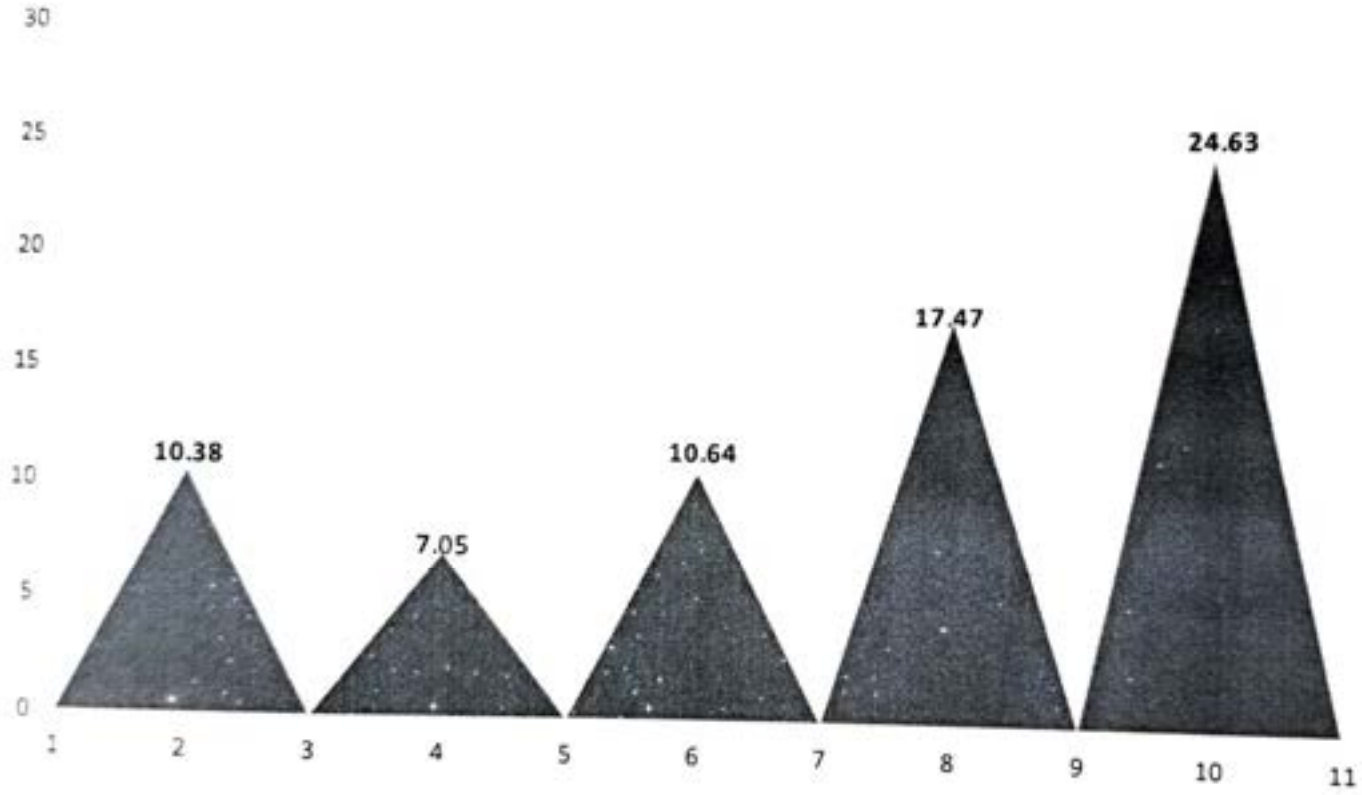
TABLE 4.9

DEBTOR TURNOVER RATIO

YEAR	CREDIT SALES	AVERAGE DEBTORS	DEBTOR TURNOVER RATIO
2014-2015	1368.74	131.78	10.38
2015-2016	1544.17	219.03	7.05
2016-2017	2059.90	193.55	10.64
2017-2018	2450.78	140.24	17.47
2018-2019	2206.18	89.54	24.63

CHART NO: 4.H

DEBTOR TURNOVER RATIO



INTERPRETATION:

Form the above table it was clear that, the debtors turnover ratio for the year 2014-2015 is 10.38,inthat year of 2015-2016 ratio is 7.05,and the next year debtors turnover ratio is 10.64 in 2016-2017, in the year of 2017-2018 ratio is 24.63.It was good performance.

APPENDICES

BALANCE SHEET OF CR. POULTRY FARM ON THE YEAR OF 2014-2018

Particular	2014	2015	2016	2017	2018
Income					
Sales turnover	1,535.12	1,544.17	2,059.90	2,825.41	2,206.18
Excise duty	166.38	0.00	0.00	374.63	0.00
Net sales	1,368.74	1,544.17	2,059.09	2,450.78	2,206.18
Other income	1.50	-60.37	8.75	6.47	8.08
Stock adjustment	-9.94	-6.00	40.70	23.69	-12.51
Total income	1,360.30	1,598.54	2,109.35	2,480.94	2,201.75
Expenditure					
Raw materials	270.97	268.85	357.18	609.34	507.02
Power& fuel cost	310.57	426.82	564.68	666.53	611.33
Employee cost	64.54	80.00	103.06	121.95	116.76
Other manufacturing experiences	20.050	0.00	0.00	0.00	52.55
Selling and Admin experience	172.86	0.00	0.00	0.00	0.00
Miscellaneous expenses	8.10	301.94	393.93	448.36	430.18
Preoperative capitalized	0.00	0.00	0.00	0.00	0.00
Total expenses	847.09	1,007.61	1,418.85	1,846.18	1,171.84
Operating profit	511.71	406.56	681.75	628.29	475.83
PBDIT	513.21	520.93	690.50	634.76	483.91
Interest	77.91	62.99	92.49	106.05	79.68
PBDIT	435.30	457.94	598.01	528.71	404.23
Depreciation	308.08	326.87	346.81	371.49	298.24
Other written off	0.00	0.00	0.00	0.00	0.00
Profit before tax	127.22	95.07	251.20	157.22	105.99
Extra-ordinary items	11.20	0.00	0.00	0.00	0.00
PBT(post Extra-ord items)	138.42	95.07	251.20	157.22	105.99
Tax	30.59	19.90	63.20	19.68	-0.05
Reported Net profit	96.63	75.17	188.00	137.54	106.04
Total value addition	576.12	808.76	1,061.67	1,236.84	1,210.82
Preference dividend	0.00	0.00	0.00	0.00	0.00
Equity dividend	0.00	19.10	28.65	19.90	19.10
Corporate dividend tax	0.00	3.17	4.65	3.26	3.25
Per share data (annualized)					
Share in issues (lakhs)	295.03	381.99	381.99	381.99	381.99
Earning per share(Rs)	32.75	19.68	49.22	36.01	27.76
Equity dividend(%)	0.00	50.00	75.00	50.00	50.00
Book value (Rs)	289.80	242.34	282.84	312.99	334.69

BALANCE SHEET OF CR. POULTRY FARM ON THE YEAR OF 2015-2019

Particular	2014	2015	2016	2017	2018
Sources of funds					
Total share capital	29.50	38.20	38.20	38.20	38.20
Equity share capital	29.50	38.20	38.20	38.20	38.20
Share application money	8.70	0.00	0.00	0.00	0.00
Preference share capital	0.00	0.00	0.00	0.00	0.00
Reserves	825.52	887.51	1,042.21	1,157.40	1,240.30
Net worth	863.72	925.71	1,080.41	1,195.60	1,278.50
Secured loans	343.89	297.92	249.50	315.28	418.51
Unsecured loans	414.98	489.78	739.78	568.78	349.37
Total debt	758.87	787.70	989.28	884.06	767.88
Total liabilities	1,622.59	1,713.41	2,069,69	2,079,66	2,046.38
Application of funds					
Gross block	2,315.69	2,832.90	3,549.30	3,904.13	4,144.24
Less: Revaluation Reserves	0.00	0.00	0.00	0.00	0.00
Less: Accum. depreciation	1,167.89	1,459.12	1,805.68	2,176.96	2,475.03
Net block	1,147.80	1,373.78	1,743.62	1,727.17	1,669.21
Capital work in progress	95.46	162.08	153.06	109.24	5.12
Investment	0.58	0.58	0.58	0.00	0.00
Inventories	224.09	231.62	374.85	488.76	531.08
Sundry debtors	72.51	106.57	173.91	213.20	224.86
Cash and bank balance	73.07	20.73	1.94	4.58	9.13
Total current assets	369.67	358.92	550.70	706.54	765.07
Loans and advances	383.17	108.44	94.33	99.82	103.88
Fixed deposits	0.00	0.00	0.00	0.00	0.00
Total CA, loans & advances	752.84	539.36	645.03	806.36	895.95
Differed credit	0.00	0.00	0.00	0.00	0.00
Current liabilities	752.84	539.36	645.03	806.36	895.95
Provisions	0.00	0.00	0.00	0.00	0.00
Total CL & provisions	151.96	327.73	416.23	531.94	494.74
Net current assets	222.13	34.66	56.37	31.17	29.16
Miscellaneous expenses	374.09	362.39	472.60	563.11	523.90
Total	78.75	176.97	172.43	243.25	372.05
Provision	0.00	0.00	0.00	0.00	0.00
Net current liabilities	1,622.59	1,713.41	2,069.69	2,079.66	2,046.38
Contingent liabilities	318.74	276.92	204.65	102.44	245.01
Book value(Rs)	289.80	242.34	282.84	312.99	334.69

CHAPTER-V

RESULT AND DISCUSSIONS

5.1 FINDNGS

1. The current ratio for the year 2014-2015 is 1.71 the next ratio is 1.43 in 2015-2016,the current ratio is 1.36 in 2016-2017.the current ratio is 1.48 in 2017-2018 and the current ratio is 2.01 in 2018-2019.
2. The quick ratio for the year 2014-2015 in 0.69,the quick ratio is 0.56 in 2015-2016,the quick ratio in 0.57 in 2016-2017,the quick ratio is 0.74 in 2017-2018 and quick ratio is 1.41 in 2018-2019
3. The working capital turnover ratio for the year 2014-2015 is 4.09,it was increased to 6.34 in 2015-2016, and the next year is 11.94 in 2016-2017, the working capital turnover ratio is 15.96 in 2017-2018 an the working capital turnover ratio is 5.82 in 2018-2019.
4. The stock to working capital ratio is 2.01 in 2015-2016, the stock to working capital ratio is2.17 in 2016-2017, and the stock to working capital ratio is 0.59 in 2017-2018.
5. The current assets to working capital ratio for the year 2014- 2015 the ratio was 2.41, the next year ratio is 3.31 in 2015-2016, and the last year ratio is decreased to 1.98 in 2016-2017.
6. The liquid assets to working capital ratio for the year 2014-2015 is 0.98, the next year is increased to 1.30 in 2015-2016,the liquid assets to working capital ratio is increased to next year is 1.56 in 2016-2017, in the year of 2016-2017 is 1.53 and the final year ratio is 1.39 in 2017-2018.
7. The debt equity ratio for the year 2014-2015 is 0.39 the next year is 0.32 in 2015-2016, the debt equity ratio is 0.23 in 2016-2017, the last year ratio was 0.33 in 2017-2018 .in the debt equity ratio is flexible in the company.
8. The debtors turnover ratio for the year 2014-2015 is 10.38, in the year of 2015-2016 ratio is 7.05, and the next year debtors turnover ratio is 10.64. 2016-2017. In the final year of 2017-2018 ratio is 24.63. it was good performance.

5.2 SUGGESTIONS

- The company needs to adopt the following measures to curb the hindrances of its development:
- The company working capital is good.
- The company should manage the current assets and current liabilities in such a way that a satisfactory level of working capital is maintained.
- The company needs to improve its short-term financial position. They should maintain the receivables at the optimum level and review the credit policy and procedures.
- The company should ensure proper and efficient utilization of inventory in future also.

5.3 CONCLUSION

The firm has a very good market, which is shown by the raise in the sales figures. It the company takes of the above suggestion them its working capital position will hold good even after. The environment conditions in are very conducive for the workers to work they have been given all the basic and necessary require.

A major study of working capital management explain the need and scope of the same in the manufacturing industry. Its effective provision can do much to ensure the success of a business while its sufficient management can led to loss or profit .a study of cash flow statement is of major importance to internal and external analysis of its close relationship with the current day to day operations of a business.

REFERENCES:

1. G.Y.Qied "FinancialManagement", Eleventh Edition, Prentice- hall of India Private Limited, New Delhi
2. A.LUIFinancialManagement, TATA Mc Grew- Hill publishing Company limited ., New Delhi
3. JOHNZ.NEIDFundamental of financial Management,Sultan chand& sons., newDelhi
4. Patricacrifoed Financial management,vikas publishing house private limited., Noida.
5. NatailaMoreiradeFundamental of financial management(Fourth education) Tata McGraw- hills Publishing Company limited., New Delhi.

WEBSITE:

www.cashflowstatement.com

www.free-management–ebooks.com

http://www.investopedia.com/university/fundamentalvsis/cashflow.asp

CARDIOVASCULAR DISEASE PREDICTION ANALYSIS

A PROJECT REPORT

Submitted by

JAYAPRAKASH G (17601303)

In partial fulfillment for the award of the degree of

FACULTY OF INFROMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTER APPLICATIONS

PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

MAY & 2020

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06-04-2020
Coimbatore

TO WHOM SO EVER IT MAY CONCERN

This is to inform you that **Mr. JAYAPRAKASH.G [Reg. No:17601303]** Final Year MCA Student of **PAAVAI ENGINEERING COLLEGE, NAMAKKAL** has completed Internship project entitled **CARDIOVASCULAR DISEASE PREDICTION ANALYSIS** in our Organization in **PYTHON TECHNOLOGY** during the period from JANUARY 2020 to MARCH 2020.

During this period, his performance and character have been good. We wish all the success in his future endeavors.

For i2softwaretechsolutions Pvt Ltd

Authorised Signatory

i2 Software Tech Solutions Private Limited

DECLARATION

I, **JAYAPRAKASH G** hereby declare that the project report titled "**CARDIOVASCULAR DISEASE PREDICTION ANALYSIS**" done by me under the guidance of and **Mr.S.SENTHIVELAN,M.C.A.,M.E.,** and **Mr.S.SABHARI** at **i2 SOFTWARE TECH SOLUTIONS PRIVATE LIMITED, Coimbatore** is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Pachal

SIGNATURE OF THE CANDIDATE

JAYAPRAKASH.G

ABSTRACT

In this project, the user could predict the diseases of cardiovascular. It is the process in which the different types of retinal images with certain values are downloaded from the databases. The retina can be photographed relatively straightforwardly with a fundus camera and now with direct digital imaging there is much interest in computer analysis of retinal images for identifying and quantifying the effects of diseases. A retinal image provides a snapshot of what is happening inside the human body. In particular, the state of the retinal vessels has been shown to reflect the cardiovascular condition of the body. Retinal images provide considerable information on pathological changes caused by local ocular disease which reveals diabetes, hypertension, arteriosclerosis, cardiovascular disease and stroke. So in this project, the implementation of automate segmentation approach is carried out based on active contour method to provide regional information. The project is developed in the web mode to access dynamically by using HTML as front-end tool, server side as Python script and client side as JavaScript.

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LIST OF ABBREVIATIONS

SERIAL.NO	ABBREVIATION	EXPANSION
1	HTML	Hyper Text Markup Language
2	CSS	Cascading Style Sheet
3	JS	Java Script
4	WWW	World Wide Web
5	API	Application Program Interface
6	DOM	Document Object Model
7	AVR	Arteria Venous Ratios
8	CRAE	Central Retinal Artery Equivalent
9	CRVE	Central Retinal Vein Equivalent

CHAPTER 1

INTRODUCTION

1.1 ORGANIZATION PROFILE

i2 Software Tech Solutions Private Limited company founded by Mr.Ashwin Krishnamoorthy and Mr.Pranav Krishna in the year 2014, i2STS helps organizations assess how to maximize their performance and works with them to achieve their vision. We develop and implement technology to improve our clients productivity and efficiency and may run parts of their business.

Ultimately, we enable our clients to become high performance business and governments. 1) Global delivery network that provides clients with high quality solutions, lower costs and quicker results. 2) The best people in our industry, functionality specialized in particular industries and/or technological skills. 3) Powerful culture of innovation, collaboration and teaming.

i2STS is a leading software development company, which is into customized software applications, website development services based on a range of platforms and technologies.

i2STS provides Web designing, Application Development and Maintenance Outsourcing services that lead to business process improvement. This allows for reduction of costs and enables business growth. i2STS is Application Development and Maintenance Services is a part of its IT Services Group.

Our Vision

Integrity - Honesty in how the deal with their clients, each other and with the world

Condor - Be open and upfront in all conversations. Keep clients updated on the real situation. Deal with situations early; avoid last minute surprises

Service - Seek to empower and enable the clients. Consider ourselves successful not when we deliver our client's final product but when the product is launched and meets success

Kindness - Go the extra mile. Speak the truth with grace. Deliver more than is expected or promised

Competence - Benchmark with the best in the business. Try new and better things. Never rest on laurels. Move out of comfort zones. Keep suggesting new things. Seek to know more.

Our Mission

i2 SOFTWARE TECH SOLUTION Pvt Ltd mission is "To assist company's progression and mechanize there in sequence stream" and to reach out the global markets and create innovative, world-class software solutions that match to the International quality standards.

Our Team

i2STS is proud of its company team. i2STS believes that people are the key for successfully provided high level offshore software development services and more importantly, an ongoing relationship with our clients. i2STS has a clear policy of employing only the very best in their field. The team is composed of developers who have significant experience in the Education, Healthcare, Transportation, Hospitality, and Manufacturing, Real estate, Retailing and Technology sector.

Visionary & Dynamic Management

i2STS Management is passionate about its operations & team. Short years have led to a long track record and ever green relationships with its clients. The company's management has experience in delivering projects to several companies. They have managed team's people effectively delivering projects in time and to stipulated norms.

1.2 OBJECTIVE

The aim of this project is retinal image processing is greatly required in diagnosing and treatment of many diseases affecting the retina. Retinal imaging is a recent technological advancement in eye care. It enables optometrist to capture a digital image of the retina, blood vessels and optic nerve located at the back of eyes. This aids in the early detection and management of diseases that can affect both eyes and overall health. This includes glaucoma, macular degeneration, diabetes and hypertension. With retinal imaging technology, the most subtle changes to the structures at the back of eyes can be detected.

The result of retinal image analysis relies on a preliminary phase of identifying good quality images, which have high contrast and proved the automatic assessment of quality of retinal images taken by funds camera with a reference image. The retinal based disease prediction includes Retinal image acquisition, Pre-processing, Vessel Segmentation, Vessel classification, Disease diagnosis.

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

In the existing system, the vascular network is mapped by hand in a time-consuming process that requires both training and skills. Thus, the retinal images have become an excellent tool for the study and diagnosis of several pathologies related with alterations in the vessel tree. In this sense, numerous studies have reported that retinal micro vascular abnormalities, such as arterio-venous nicking, focal or generalized arteriolar narrowing and venular dilation, are related to different pathologies, such as hypertension and diabetes.

The work closest to this one is an automated classification method in which the vasculature is segmented using a vessel tracking procedure and the vessel centre lines are detected. After defining an area of interest around the optic disc and dividing this area into four quadrants, colour based features are extracted from the vessel segments that are then classified into arteries and veins using an unsupervised clustering method.

2.1.1 Disadvantages

- It presents an unsupervised algorithm of vessel tracking that is applied to detection of ocular vessels and usage of manual screening.
- The retinal microvasculature shares anatomical and physiological characteristics with the vessel structure in other parts of the human body.
- Some imaging techniques, such as retinographies, provide non invasive views of the blood vessels in the retina.
- All vessels as either artery or vein using existing vessel segmentation and some manually labelled starting vessel segments.
- Color based features are extracted from the vessel segments that are then classified into arteries and veins using an unsupervised clustering method.

2.2 PROPOSED SYSTEM

Examination of blood vessels in the eye allows detection of eye diseases such as glaucoma and diabetic retinopathy. Traditionally, the vascular network is mapped by hand in a time-consuming process that requires both training and skill. So the developer implements automatic process to examine the blood vessels to identify the cardio vascular diseases in retinal images.

Finally, This will be a powerful tool for analyzing vasculature for better management of a wide spectrum of vascular-related diseases. Retinal vascular calibre (CRAE and CRVE) was analyzed as continuous variables. We used analysis of covariance to estimate mean retinal vascular calibre associated with the presence versus absence of categorical variables or increasing quartiles of continuous variables to predict the cardio vascular diseases

2.2.1 Advantages

- Automating the process allows consistency, and most importantly, frees up the time that a skilled technician or doctor would normally use for manual screening.
- This system overcomes the problems of initialization and vessel profile modelling that are encountered and automatically tracks vessels.
- The proposed method utilizes the concept of active contours to remove noise, enhance the image, track the edges of the vessels.
- Calculate the perimeter of vessels and identify the cardio diseases.
- Implement infinite perimeter active contour with hybrid region information (IPACHI) model to segment blood vessels and calculate perimeter of the blood vessels.
- Proposed an efficient and effective infinite perimeter active contour model with hybrid region terms for vessel segmentation with good performance.

2.3 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system

analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. Three key considerations involved in the feasibility analysis are

- Economical feasibility
- Technical feasibility
- Operational feasibility

2.3.1 Economical Feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

2.3.2 Technical feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

2.3.3 Operational feasibility

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 HARDWARE REQUIREMENTS

- Processor : Intel Pentium Family
- Processor Speed : 250MHz to 667 MHz
- RAM : 4 GB or higher
- Hard Disk : 200 GB or higher
- Keyboard : Standard 104 enhanced keyboard
- Mouse : Local PS/2
- Network Card : Ethernet Card

3.2 SOFTWARE REQUIREMENTS

- Operating System : Windows 7 or above
- Web Server : Apache
- Web Browser : Mozilla Fire fox
- Front-End Tool : HTML
- Client side Script : JavaScript
- Server side Script : PYTHON 3.5.4

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 FRONT END

4.1.1 Python

Python is widely used high-level programming language for general-purpose programming, created by Guido Van Rossum and first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax which allows programmers to express concepts in fewer lines of code.

The language provides constructs intended to enable writing clear programs on both a small and large scale. Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including functional programming and procedural styles. It has large standard library.

Python is an interpreter, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together.

Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy that a bug or bad input will never cause

a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace.

A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective.

4.1.2 HTML

Html stands for Hyper Text Markup Language. It is used to design web pages using markup language. HTML is the combination of Hypertext and Markup language. Hypertext defines the link between the web pages. Markup language is used to define the text document within tag which defines the structure of web pages.

This language is used to annotate (make notes for the computer) text so that a machine can understand it and manipulate text accordingly. Most of markup (e.g. HTML) languages are human readable.

HTML was created by Tim Berners-Lee in 1991. The first ever version of HTML was HTML 1.0 but the first standard version was HTML 2.0 which was published in 1999. HTML is a mark-up language, heavily utilized for creating web pages and web applications. HTML, when combined with JavaScript and CSS, has become a milestone for web development. One of a useful aspect of HTML is, it can embed programs written in a scripting language like JavaScript, which is responsible for affecting the behavior and content of web pages.

CSS inclusion would affect the layout and appearance of the content. Basic building blocks of any HTML pages are HTML elements. A structured document can be created with help of structural semantic for text like heading, paragraph, list, link, and other items. Browser indeed does not display the HTML tags but utilize them to interpret the content of the page.

4.1.3 Java script

Brendan Eich is an American technologist and creator of the JavaScript programming language. This language was released in September 1995. He co-founded the Mozilla project, the Mozilla Foundation and the Mozilla Corporation, and served as the Mozilla Corporation's chief technical officer and briefly its chief executive officer.

JavaScript often abbreviated as JS, is a high-level, interpreted programming language. It is a language that is also characterized as dynamic, weakly typed, prototype-based and multi-paradigm.

Alongside HTML and CSS, JavaScript is one of the three core technologies of the World Wide Web (WWW). JavaScript enables interactive web pages and thus is an essential part of web applications. The vast majority of websites use it, and all major web browsers have a dedicated JavaScript engine to execute it.

As a multi-paradigm language, JavaScript supports event-driven, functional, and imperative (including object-oriented and prototype-based) programming styles. It has APIs for working with text, arrays, dates, regular expressions, and the DOM, but the language itself does not include any I/O, such as networking, storage, or graphics facilities, relying for these upon the host environment in which it is embedded.

Initially only implemented client-side in web browsers, JavaScript engines are now embedded in many other types of host software, including server-side in web servers and databases, and in non-web programs such as word processors and PDF software, and in runtime environments that make JavaScript available for writing mobile and desktop applications, including desktop widgets.

CHAPTER 5

PROJECT DESCRIPTION

5.1 PROBLEM DEFINITION

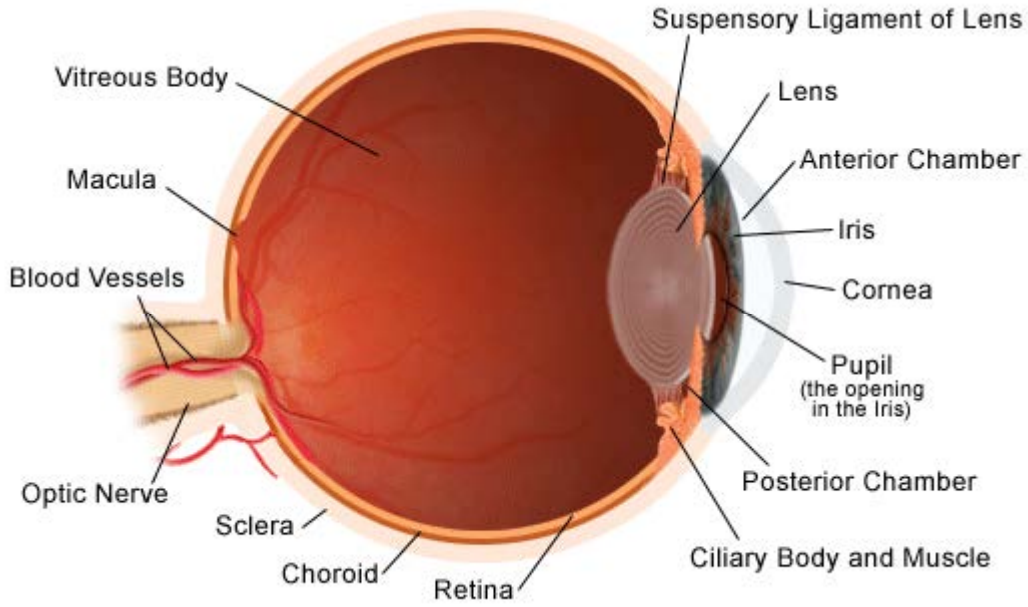
The user could predict the diseases of cardiovascular. It is the process in which the different types of retinal images with certain values are downloaded from the databases. The retina can be photographed relatively straightforwardly with a fundus camera and now with direct digital imaging there is much interest in computer analysis of retinal images for identifying and quantifying the effects of diseases. A retinal image provides a snapshot of what is happening inside the human body.

Retinal imaging is a recent technological advancement in eye care. It enables optometrist to capture a digital image of the retina, blood vessels and optic nerve located at the back of eyes. This aids in the early detection and management of diseases that can affect both eyes and overall health. This includes glaucoma, macular degeneration, diabetes and hypertension. With retinal imaging technology, the most subtle changes to the structures at the back of eyes can be detected.

In particular, the state of the retinal vessels has been shown to reflect the cardiovascular condition of the body. Retinal images provide considerable information on pathological changes caused by local ocular disease which reveals diabetes, hypertension, arteriosclerosis, cardiovascular disease and stroke.

5.2 OVERVIEW OF THE PROJECT

Retinal image processing is greatly required in diagnosing and treatment of many diseases affecting the retina and the choroid behind it.



The result of retinal image analysis relies on a preliminary phase of identifying good quality images, which have high contrast and proved the automatic assessment of quality of retinal images taken by funds camera with a reference image. The retinal based disease prediction includes Retinal image acquisition, Pre-processing, Vessel Segmentation, Vessel classification, Disease diagnosis.

5.3 MODULE DESCRIPTION

A module is a small part of our project. This plays a very important role in the project and in coding concepts. In software engineering concept we treat it has a small part of a system but whereas in our programming language it is a small part of the program.

5.3.1 Retinal image acquisition

Retinal images of human plays an important role in the detection and diagnosis of cardio vascular diseases that including stroke, diabetes, arteriosclerosis, cardiovascular diseases and hypertension, to name only the most obvious. Vascular diseases are often life critical for individuals, and present a challenging public health problem for society. Therefore, the detection for retinal images is necessary, and among them the detection of blood vessels is most important.

The alterations about blood vessels, such as length, width and branching pattern, can not only provide information on pathological changes but can also help to grade diseases severity or automatically diagnose the diseases. In this module, the retinal images are uploaded.

5.3.2 Pre-processing

In this module, the gray scale conversion operation is carried out to identify black and white illumination. Noise in coloured retinal image is normally due to noise pixels and pixels whose colour is distorted. The Gabor filtering can be used to enhance and sharpen the vascular pattern for pre-processing and blood vessel segmentation of retinal images performing well in pre-processing, enhancing and segmenting the retinal image and vascular pattern. Human perception is highly sensitive to edges and fine details of an image, and since they are composed enhancing the high-frequency components of an image leads to an improvement in the visual quality.

5.3.3 Vessel Segmentation

In this module, the noise removed image is taken as input for vessel segmentation to extract features and segmented into arteries and veins. The feature of extraction and vessel segmentation is performed. It can create vascular network using active contour with measure to neighbourhood function. It can extract the distribution model to restrict the shape, range to an explicit domain learned from a training set. Finally it provides the segmentation mask for pre-processed retinal images.

5.3.4 Vessel classification

In this module, the test sample images are compared with vessel segmented image with certain accuracy and loss of the retinal image to predict the diseases. The segmented vessels are classified into arteries and veins. Correct classification of vessels is vital, because diseases affect arteries and veins differently. The alterations in veins and arteries cannot be analyzed without distinguishing them. After extraction of blood vessels, feature vector is formed based on properties of artery and veins. The features get extracted on

the basis of centerline extracted image and a label is assigned to each centerline, indicating the artery and vein.

5.3.5 Disease diagnosis

In this module, the diagnosis of diseases is carried out using AVR (Arterio-venous ratios) ratio based on CRAE (central retinal artery equivalent) and CRVE (central retinal vein equivalent) measurements. The cardiovascular diseases are predicted and categorized into different types. The vessel measurements of CRAE, CRVE have been found to be correlated with risks factors of cardiovascular diseases and are positive real numbers. The formula to calculate is:

$$CRAE = 0.88*(W_1^2 + W_2^2)^{1/2}$$

$$CRVE = 0.95*(W_1^2 + W_2^2)^{1/2}$$

Where W_1,W_2, is a pair of width values. Then Artery- vein ratio can be calculated as

$$AVR = CRAE / CRVE$$

5.4 USE CASE DIAGRAM

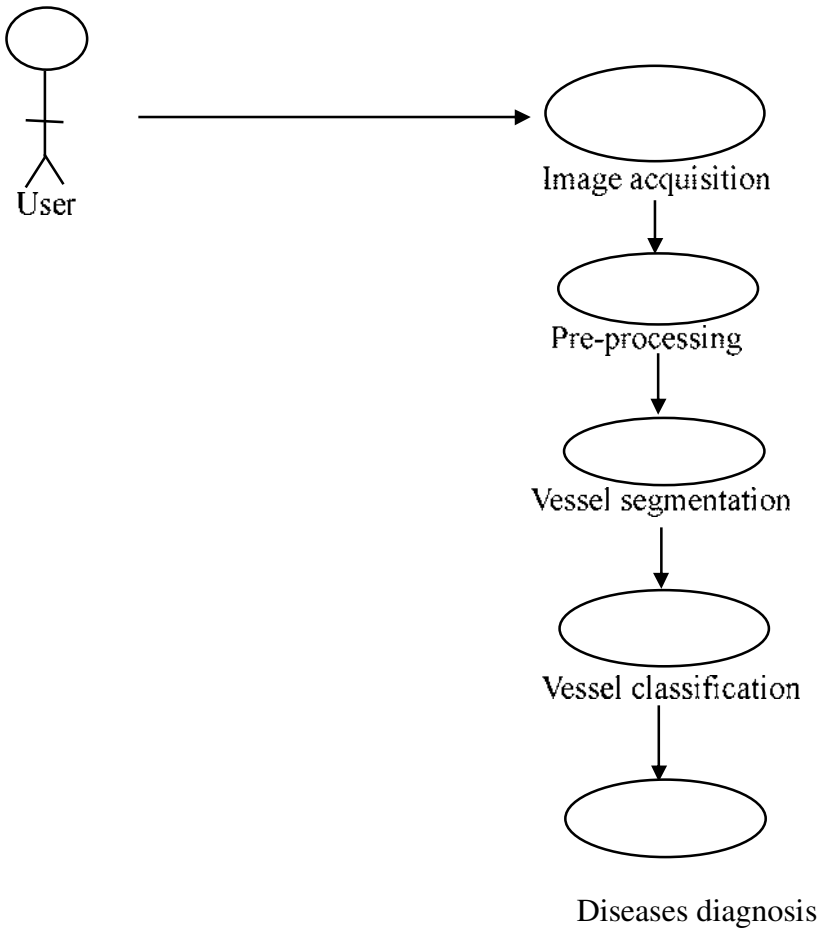


Figure 5.4 Use Case Diagram

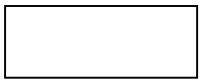
5.5 DATA FLOW DIAGRAM

The first step in system analyses is to draw a Data Flow Diagram (DFD). A DFD shows the logical flow of a system and defines the boundaries for the system. Data flow diagram is a modeling that allows picturing a system as a network of functional process to one another by data.

It is also widely used for representation of external and internal design specification. A DFD consists of series of bubbles joined by lines. The bubbles represent data transformations and the lines represent data flows in the system.

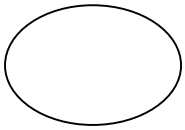
DFD Symbols

- Entity - Defines a source or destination of system data.



- Data flow- Identifies dataflow in motion. It is a pipeline through which information flows.

- Process- Represents a process that transforms incoming dataflow into outgoing dataflow



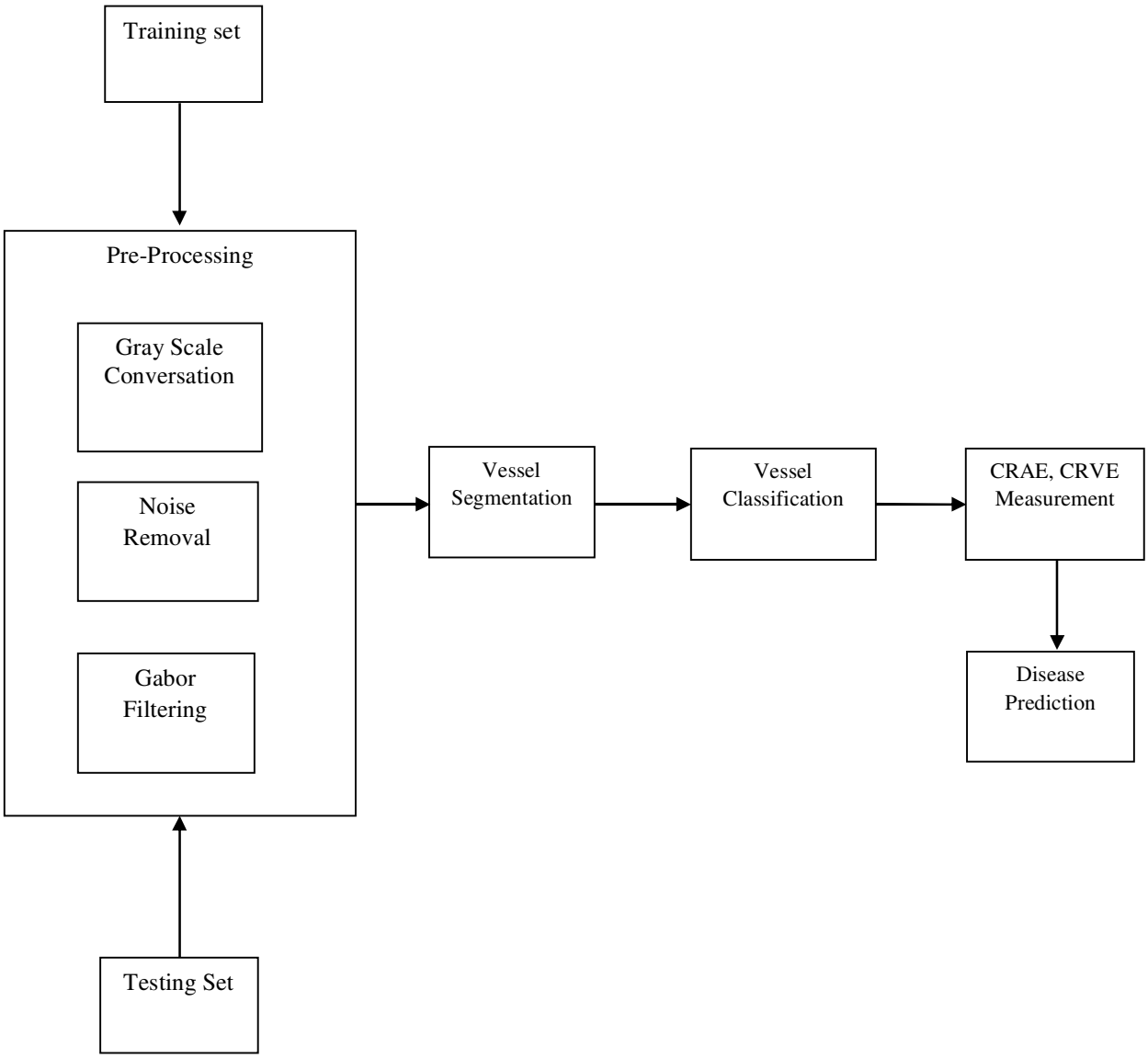


Figure 5.5 Data Flow Diagram

5.6 INPUT DESIGN

Input design is the process of converting the user-oriented input to a computer based format. The goal of the input design is to make the data entry easier, logical and free of error. Errors in the input data are controlled by the input design. The quality of the input determines the quality of the system output.

The entire data entry screen is interactive in nature, so that the user can directly enter into data according to the prompted messages. The user also can directly enter into data according to the prompted messages. The users are also provided with option of selecting an appropriate input from a list of values. This will reduce the number of error, which are otherwise likely to arise if they were to be entered by the user itself.

Input design is one of the most important phases of the system design. Input design is the process where the input received in the system are planned and designed, so as to get necessary information from the user, eliminating the information that is not required. The aim of the input design is to ensure the maximum possible levels of accuracy and also ensures that the input is accessible that understood by the user.

The input design is the part of overall system design, which requires very careful attention. If the data going into the system is incorrect then the processing and output will magnify the errors.

The objectives considered during input design are:

- **User provides the retinal eye image**

Input design features can ensure the reliability of the system and produce result from accurate data or they can result in the production of information.

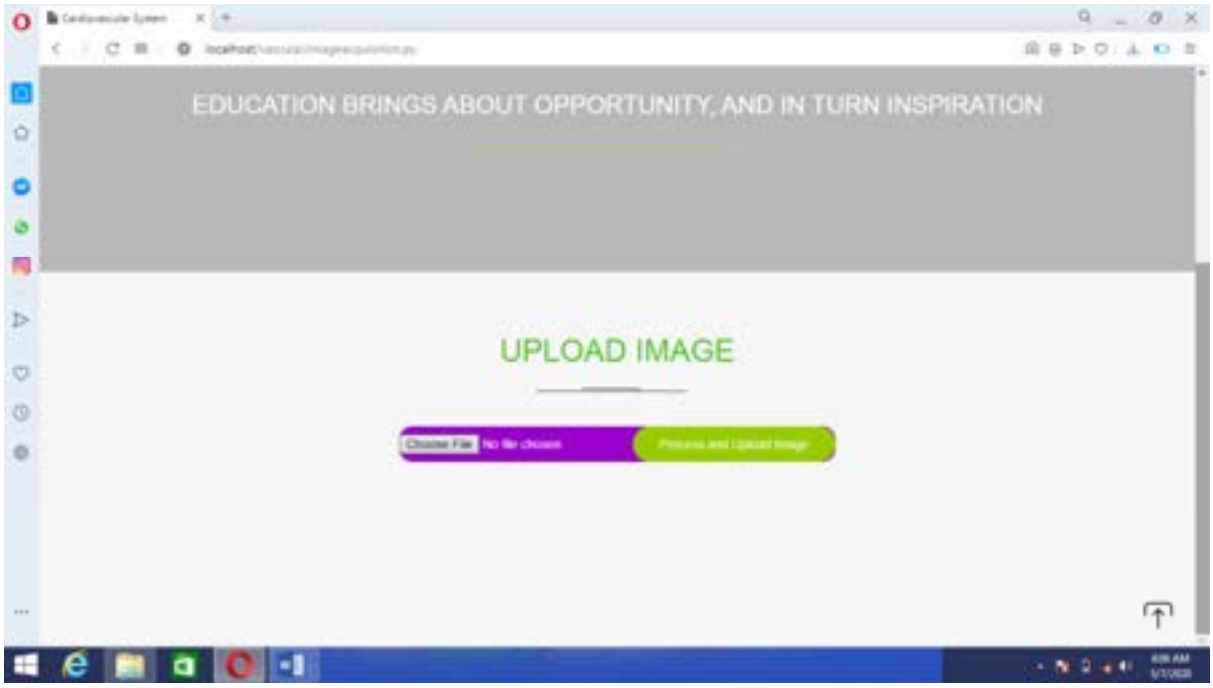


Figure 5.6.1 Image Acquisition

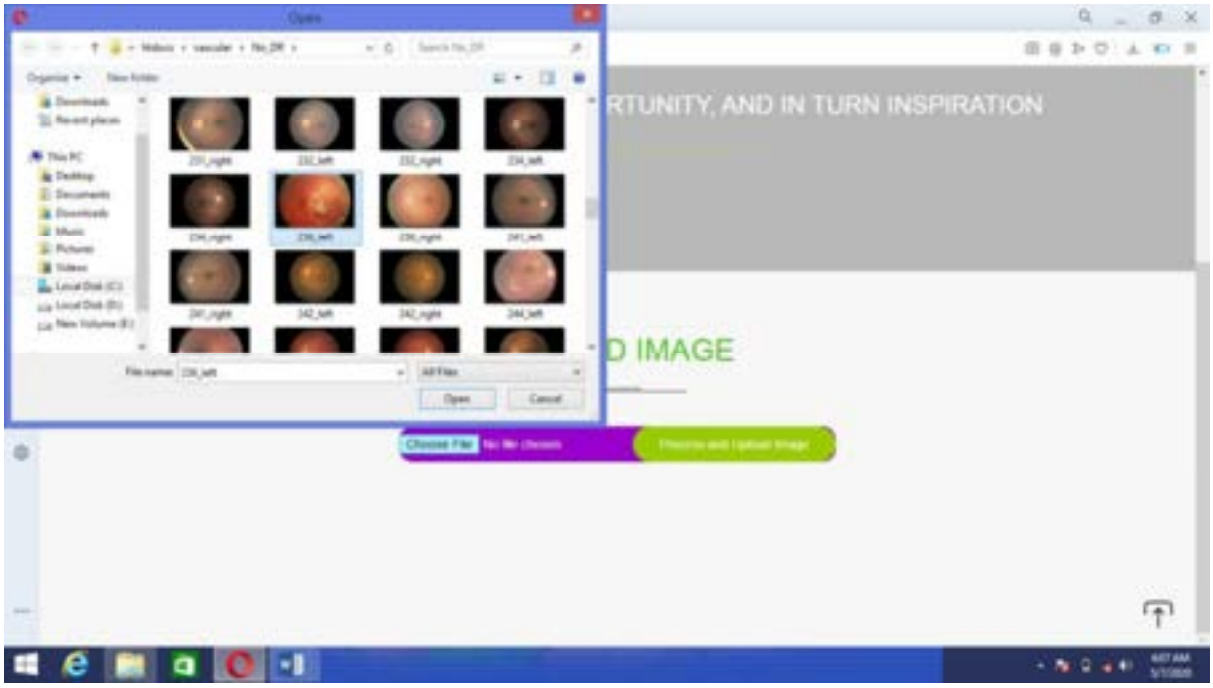


Figure 5.6.2 Upload Image

5.7 OUTPUT DESIGN

Output design is very important concept in the computerized system, without reliable output the user may feel the entire system is unnecessary and avoids using it. The proper output design is important in any system and facilitates effective decision-making. The output design of this system includes various reports. The reports are

- Pre-processing
- Vessel Segmentation
- Vessel Classification
- Disease Diagnosis

The output design was done so that results of processing could be communicated to the user. The various outputs have been designed in such a way that they represent the same format that the office and management used to.

Computer output is the most important and direct source of information to the user. Efficient, intelligible output design should improve the system relationships with the user and help in decision making. A major form of output is the hardcopy from the printer.

Output requirements are designed during system analysis. A good starting point for the output design is the Data Flow Diagram (DFD). Human factors educe issues for design involves addressing internal controls to ensure readability.

CHAPTER 6

SYSTEM TESTING

The software and hardware are integrated and a full range of system tests are conducted in an attempt to uncover error at the software and hardware interface. Before the system is released to user, testing is the sole duty of the developer to see that the system is free from all kinds of bugs. The main purpose of testing an information system is to find out errors and correct them.

6.1 WHITE BOX TESTING

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

6.2 BLACK BOX TESTING

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. it is a testing in which the software under test is treated, as a black box you cannot "see" into it. The test provides inputs and responds to output s without considering how the software works.

6.3 UNIT TESTING

Unit testing focuses the verification effort on the smallest unit of software design i.e., the module. The testers can use the same project or projects as the developers, if functional units organize the project, or separate projects have been created for functional units. The project or projects can also be exported, so unit test can take place in a variety of environments and on a variety of platforms.

Unit testing comprises the set of test performed by an individual programmer prior to integration of the unit into a larger system. There are different types of tests to be performed on a programming unit. These may be classified as follows:

- Functional Tests
- Performance Tests
- Stress Tests
- Structure Tests

Functional Test cases involves exercising the code with normal input values for which the expected results are known, as well as boundary values and special values. Performance Testing determines the amount of execution time spent in various parts of the unit, program through put, response time and device utilization by the program unit.

Stress Tests are those tests designed to intentionally break the limit. A great deal can be learnt about the strengths and limitations of a program by examining the manner in which a program unit breaks.

Structure Tests are concerned with exercising the internal logic of a program and traversing particular execution paths to exercise, criterion to be used, executing test cases.

6.3.1 Unit Test Considerations

The test that occurs is the part of unit testing. The modules are tested to ensure that information properly flows into and out of the program unit under test. The 'local data structures' are examined to ensure that data stored temporarily maintains its integrity during all steps in execution.

'Boundary Conditions' are tested to ensure that the module operates properly at boundaries established to limit or restrict processing. All 'independent paths' through the control structures are exercised to ensure that all statements in a module have been executed at least once. Finally, all 'error-handling paths' are tested.

6.3.2 Unit Test Procedures

Unit testing is considered an equivalent to the coding step. After the source level code has been developed, reviewed and verified for correct syntax, unit test case design begins since a module is not a standalone program, 'driver' and/or 'stub' software must be developed for each unit test.

In most applications, a driver is nothing more than a main program that accepts test case data, passes such data to the module to be tested, and prints the relevant results. The stubs serve to replace modules that are subordinates called by the modules to be tested. A stub or a dummy stub or a dummy subprogram uses the subordinate modules interface, may do minimal data manipulation, prints verification of entry, and returns.

In this project, Unit testing takes place at every module. First stage the user will provide the retinal image as an input. Then the image will be pre-processed. The output of pre-processed image is Gray scale filtering, Noise removal and Gabor filtering. Then the noise removed image will be the input for vessel segmentation.

The vessel segmentation will produce the output image with arteries and veins. Then this image will be an input for vessel classification. Finally the AVR(Arterio-Venous ratio) is calculated using CRAE and CRVE to find the disease. The Unit Test is carried out in this project, and is found successful. The data is flowing correctly to all parts of the project.

6.4 INTEGRATION TESTING

It addresses the issues associated with the dual problems of verification and program construction. Black box test case design techniques are the most prevalent during integration, although a limited amount of white box testing may be used to ensure converge of major control paths. Integration testing is a systematic technique for constructing the program structure while at the same time conducting tests to uncover errors associated with interfacing. The objective is to take unit-tested modules and build a program structure that has been depicted by design. Incremental Integration Strategies are

- Top-Down Integration
- Bottom-Up Integration

Test cases were designed so that all units are tested, modules were executed from the main module and the diseases are predicted.

In our project, integration testing checks if the input image is provided then application will move to next step i.e. to make execute the modules one after another. The output of previous module will be an input to the current module. It means it will maintain a bridge to move to other modules and integrate them.

This test was performed with the users of the system and made sure that it performed as they expected. It was verified that all functionality required by the user have been satisfied. So for, the system has been found defect free and is working well.

6.5 VALIDATION TESTING

Validation testing is one, which checks the given data is a valid one, or not. In our system, first stage input is check whether it is an image or other file type. . If it is a valid one, then the application will start to function. Hence validation testing takes place at the earlier part of the project.

6.6 ACCEPTANCE TESTING

This is one of the most crucial one, which takes place at the all kind of projects**.** This test was performed with the users of the system and made sure that it performed as they expected. It was verified that all functionality required by the user have been satisfied. So for, the system has been found defect free and is working well.

CHAPTER 7

SYSTEM IMPLEMENTATION

System Implementation is one of the stages of project when the theoretical design is tuned into working system. If the implementation system stage is not carefully controlled and planned, it can cause errors. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user a confidence that the system will work and be effective.

This section describes about the Implementation of the Safe application and the details of how to access this control from any application.

Implementation is the process of assuring that the information system is operational and then allowing users take over its operation for use and evaluation. Implementation includes the following activities:

- Obtaining and installing the system hardware.
- Installing the system and making it run on its intended hardware.
- Providing user access to the system.
- Documenting the system for its users and for those who will be responsible for maintaining it in the future.
- Making arrangements to support the users as the system is used.
- Transferring ongoing responsibility for the system from its developers to the operations or maintenance part.
- Evaluating the operation and use of the system.

The new system of "CARDIOVASCULAR DISEASE PREDICTION ANALYSIS" has been implemented. The present system has been integrated with the already existing hardware. Documentation is provided well in such a way that it is useful for users and maintainers.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

8.1 CONCLUSION

In this proposed system of "CARDIOVASCULAR DISEASE PREDICTION ANALYSIS", it is concluded that the implementation is successful with accurate identification of true vessels to obtain correct retinal ophthalmology measurements. In the existing system, the vascular network is mapped by hand in a time-consuming process that requires both training and skill. Automating the process allows consistency, and most importantly, frees up the time that a skilled technician or doctor would normally use for manual screening.

This system overcomes the problems of initialization and vessel profile modelling that are encountered and automatically tracks vessels. And it is implemented by the pre-processing step which includes gray scale conversion, noise removal, gabor filtering and then vessel segmentation step followed by vessel classification. It provides accuracy and loss of data in retinal images when test data are compared with trained data. In the disease diagnosis, the prediction of cardiovascular disease is categorized into 5 levels such as no disease, low, moderate, high, severe. This step is used to track all true vessels. This system can overcome wrong diagnosis of crossovers by using simultaneous identification of the significance of using structural information.

Furthermore, this will be a powerful tool for analyzing vasculature for better management of a wide spectrum of vascular-related diseases. This automated system is compared to the preface of this approach with other recently proposed methods, and concluded that it is achieving better results.

8.2 FUTURE ENHANCEMENT

This project is designed in such a way that it is flexible for changes in future user requirements. Further extensions can be made to provide more reports.

- The existing system has good scope for further development to predict all the diseases using retinal images other than cardiovascular diseases.
- In the future enhancement, all other diseases can be predicted by accuracy and loss of data using retinal images.
- It provides better facility regarding to security purpose. It can have an enhancement in
- the future according to the user's requirements on predicting all diseases using retinal images.

APPENDICES

APPENDIX 1 SAMPLE SOURCE SCODE

```
#!C:\Python35\python.exe
print ("content-type:text/html\n\r\n\r")
print ("""<!DOCTYPE html>
<html><head><title>Cardiovascular System</title>
<script type='application/x-javascript'> addEventListener('load', function() {
setTimeout(hideURLbar, 0); }, false);
function hideURLbar(){ window.scrollTo(0,1); } </script>
<link href='css/bootstrap.css' rel='stylesheet' type='text/css' />
<!-- Custom Theme files -->
<link href='css/style.css' rel='stylesheet' type='text/css' />
<link rel='stylesheet' href='css/jquery-ui.css' type='text/css' />
<link rel='stylesheet' href='css/smoothbox.css' type='text/css' >
<!-- //Custom Theme files -->
<!-- js --><script src='js/jquery.min.js'></script><!-- //js -->
<!--webfont--><link href='//fonts.googleapis.com/css?family=Gloria+Hallelujah'
rel='stylesheet' type='text/css'>
<link
href='//fonts.googleapis.com/css?family=Open+Sans:400,300,300italic,400italic,600,600ital
ic,700,700italic,800,800italic' rel='stylesheet' type='text/css'>
<!-- start-smoth-scrolling -->
<script type='text/javascript' src='js/move-top.js'></script>
<script type='text/javascript' src='js/easing.js'></script>
<script type='text/javascript'>
jQuery(document).ready(function($) {
$('.scroll').click(function(event){
event.preventDefault();
$('html,body').animate({scrollTop:$(this.hash).offset().top},1000);
});                });
</script><!-- start-smoth-scrolling -->         </head>""")
```

```
print ("""<body><script src='js/jquery.vide.min.js'></script>
<div data-vide-bg='video/srix'><div class='center-container'><div class='navigation'>
<div class='container'><div class='logo'><br><h3 style='color:#ffffff'>Cardiovascular
System</h3>            </div>
<div class='navigation-right'>
<span class='menu'><img src='images/menu.png' alt=' ' /></span>
<nav class='link-effect-3' id='link-effect-3'>                    <ul class='nav1 nav nav-wil'>
<li><a data-hover='Home' href='index.py'>Home</a></li>
<li><a data-hover='Gallery' href='#gallery' class='scroll'>Gallery</a></li>
<li><a data-hover='Image Acquisition' href='imageacquisition.py'>Image
Acquisition</a></li>                    </ul>    </nav>
<!-- script-for-menu -->
<script>        $( 'span.menu' ).click(function() {
$( 'ul.nav1' ).slideToggle( 300, function() {            // Animation complete.
});                });        </script>        </div>
<div class='clearfix'></div> </div>  </div>
<div class='w3ls_banner_info'><div class='container'><div class='w3l_banner_logo'>
<h2>S</h2>  </div> <h3>education brings about opportunity, and in turn inspiration</h3>
<!--modal-video-->
<div class='modal video-modal fade' id='myModal' tabindex='-1' role='dialog' aria-
labelledby='myModal'>
<div class='modal-dialog' role='document'><div class='modal-content'><div class='modal-
header'>Schooling
<button type='button' class='close' data-dismiss='modal' aria-label='Close'><span aria-
hidden='true'>&times;</span></button>
</div></div></div></div></div></div></div></div>        <!-- about -->
<div class='banner-bottom'><div class='container'>
<div class='col-md-4 wthree_banner_bottom_left'>
<img src='images/cardiovascular.png' alt=' ' class='img-responsive' />
</div>
<div class='col-md-8 wthree_banner_bottom_right'>
<h3>The anatomy of the eye is complex. The main structures of the eye include:</h3>
<ol>
```

```
<li>Cornea: clear tissue in the very front of the eye</li>
<li>Iris: colored part of the eye surrounding the pupil</li>
<li>Pupil: dark hole in the iris that regulates the amount of light going into the eye</li>
<li>Lens: small clear disk inside the eye that focuses light rays onto the retina</li>
<li>Retina: layer that lines the back of the eye, senses light, and creates electrical impulses that travel through the optic nerve to the brain</li>
<li>Macula: small central area in the retina that allows us to see fine details clearly</li>
<li>Optic nerve: connects the eye to the brain and carries the electrical impulses formed by the retina to the visual cortex of the brain</li>
<li>Vitreous: clear, jelly-like substance that fills the middle of the eye</li>
</ol></div><div class='clearfix'> </div></div></div>
<div class='gallery' id='gallery'><div class='clearfix'> </div></div>
<script type='text/javascript' src='js/smoothbox.jquery2.js'></script>        </div>
<script src='js/bootstrap.js'></script>
<script type='text/javascript'>
$(document).ready(function() {
/*
var defaults = {
containerID: 'toTop', // fading element id
containerHoverID: 'toTopHover', // fading element hover id
scrollSpeed: 1200,
easingType: 'linear'
};
*/
$().UItoTop({ easingType: 'easeOutQuart' });
});     </script>
</body></html>""")



#!C:\Python35\python.exe
print ("Content-type:text/html\r\n\r\n")
import os
import cgi
```

```
try:
        import msvcrt
        msvcrt.setmode (0, os.O_BINARY) # stdin  = 0
        msvcrt.setmode (1, os.O_BINARY) # stdout = 1
except ImportError:
        pass
import numpy as np
import cv2 as cv
form=cgi.FieldStorage()
photo=form['ImageToProcess']
pic=photo.filename
path="No_DR"
graypic_path ="No_DR/graypics"
if not os.path.exists(graypic_path):
        os.mkdir(graypic_path)

noisepic_path ="No_DR/noisepics"
if not os.path.exists(noisepic_path):
       os.mkdir(noisepic_path)

gaborpic_path ="No_DR/gaborpics"
if not os.path.exists(gaborpic_path):
       os.mkdir(gaborpic_path)

if photo.filename:
       #converting into grayscale\n"
       imagedir = path+"/"+pic
       image = cv.imread(imagedir)
       grayimage=cv.cvtColor(image, cv.COLOR_BGR2GRAY)
       grayout = graypic_path+"/"+pic
       cv.imwrite(grayout,grayimage)

        #remove noise\n"
```

```
        noiselessimage = cv.fastNlMeansDenoising(grayimage,None,9,13)
        noiseout =noisepic_path+"/"+pic
        cv.imwrite(noiseout,noiselessimage)

        #gobor filtering\n\n"
        g_kernel = cv.getGaborKernel((21, 21), 8.0, np.pi/4, 10.0, 0.5, 0, ktype=cv.CV_32F)
        filtered_image = cv.filter2D(noiselessimage, cv.CV_8UC3, g_kernel)
        gaborout = gaborpic_path+"/"+pic
        cv.imwrite(gaborout,filtered_image)
        path_folder="No_DR/final/"
        if os.path.exists(path_folder):
            import shutil
            os.chdir("No_DR")
            shutil.rmtree('final')
            print ("<script>alert('Filtering
successfully');location.href='stage2.py?pic="+pic+"';</script>")
        print ("<script>alert('Filtering
successfully');location.href='stage2.py?pic="+pic+"';</script>")

#!C:\Python35\python.exe
print ("Content-type:text/html\r\n\r\n")
import cv2
import numpy as np
import os
import csv
##try:
##        import msvcrt
##        msvcrt.setmode (0, os.O_BINARY) # stdin  = 0
##        msvcrt.setmode (1, os.O_BINARY) # stdout = 1
##except ImportError:
##        pass
import cgi
form=cgi.FieldStorage()
```

```
file_name=form.getvalue('pic')
path="No_DR/noisepics"

segmentation_path ="CNN/"
if not os.path.exists(segmentation_path):
        os.mkdir(segmentation_path)
segmentation_path ="CNN/CNN/"
if not os.path.exists(segmentation_path):
        os.mkdir(segmentation_path)
segmentation_path ="No_DR/final/"
if not os.path.exists(segmentation_path):
        os.mkdir(segmentation_path)
segmentation_path ="No_DR/final/final/"
if not os.path.exists(segmentation_path):
        os.mkdir(segmentation_path)

def extract_bv(image):
         b,green_fundus,r = cv2.split(image)
         clahe = cv2.createCLAHE(clipLimit=2.0, tileGridSize=(8,8))
         contrast_enhanced_green_fundus = clahe.apply(green_fundus)

         # applying alternate sequential filtering (3 times closing opening)
         r1 = cv2.morphologyEx(contrast_enhanced_green_fundus, cv2.MORPH_OPEN,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(5,5)), iterations = 1)
         R1 = cv2.morphologyEx(r1, cv2.MORPH_CLOSE,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(5,5)), iterations = 1)
         r2 = cv2.morphologyEx(R1, cv2.MORPH_OPEN,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(11,11)), iterations = 1)
         R2 = cv2.morphologyEx(r2, cv2.MORPH_CLOSE,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(11,11)), iterations = 1)
         r3 = cv2.morphologyEx(R2, cv2.MORPH_OPEN,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(23,23)), iterations = 1)
```

```
        R3 = cv2.morphologyEx(r3, cv2.MORPH_CLOSE,
cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(23,23)), iterations = 1)
        f4 = cv2.subtract(R3,contrast_enhanced_green_fundus)
        f5 = clahe.apply(f4)

        # removing very small contours through area parameter noise removal
        ret,f6 = cv2.threshold(f5,15,255,cv2.THRESH_BINARY)
        mask = np.ones(f5.shape[:2], dtype="uint8") * 255
##          _, contours, _= cv2.findContours(f6.copy(), cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
        contours, hierarchy = cv2.findContours(f6.copy(), cv2.RETR_LIST,
cv2.CHAIN_APPROX_SIMPLE)
        for cnt in contours:
                if cv2.contourArea(cnt) <= 200:
                        cv2.drawContours(mask, [cnt], -1, 0, -1)
        im = cv2.bitwise_and(f5, f5, mask=mask)
        ret,fin = cv2.threshold(im,15,255,cv2.THRESH_BINARY_INV)
        newfin = cv2.erode(fin, cv2.getStructuringElement(cv2.MORPH_ELLIPSE,(3,3)),
iterations=1)

        # removing blobs of unwanted bigger chunks taking in consideration they are not
straight lines like blood
        #vessels and also in an interval of area
        fundus_eroded = cv2.bitwise_not(newfin)
        xmask = np.ones(fundus.shape[:2], dtype="uint8") * 255
##          _, xcontours, _= cv2.findContours(fundus_eroded.copy(),
cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
        xcontours, xhierarchy =
cv2.findContours(fundus_eroded.copy(),cv2.RETR_LIST,cv2.CHAIN_APPROX_SIMPLE
)
        for cnt in xcontours:
                shape = "unidentified"
                peri = cv2.arcLength(cnt, True)
```

```
                approx = cv2.approxPolyDP(cnt, 0.04 * peri, False)
                if len(approx) > 4 and cv2.contourArea(cnt) <= 3000 and
cv2.contourArea(cnt) >= 100:
                        shape = "circle"
                else:
                        shape = "veins"
                if(shape=="circle"):
                        cv2.drawContours(xmask, [cnt], -1, 0, -1)

        finimage = cv2.bitwise_and(fundus_eroded,fundus_eroded,mask=xmask)
        blood_vessels = cv2.bitwise_not(finimage)

        #morphology transformations
        kernel = np.ones((5,5),np.uint8)
        s = cv2.erode(blood_vessels,kernel,iterations = 1)

        #edge enhancement
        ss = cv2.Sobel(s,cv2.CV_64F,1,0,ksize = 5)
        return ss

if __name__ == "__main__":
        pathFolder = "No_DR/noisepics"
##    filesArray = [x for x in os.listdir(pathFolder) if
os.path.isfile(os.path.join(pathFolder,x))]
        destinationFolder ="No_DR/Vessel_Segmentation/"
        destinationFolder1 ="CNN/CNN/"
        destinationFolder2 ="N0_DR/final/final/"
        if not os.path.exists(destinationFolder):
                os.mkdir(destinationFolder)
        file_name_no_extension =file_name.split(".")
        file_name_no_extension =file_name_no_extension[0]
        fundus = cv2.imread(pathFolder+'/'+file_name)
        bloodvessel = extract_bv(fundus)
```

```
cv2.imwrite(destinationFolder+file_name_no_extension+"_bloodvessel.png",bloodvessel)

cv2.imwrite(destinationFolder1+file_name_no_extension+"_bloodvessel.png",bloodvessel)

cv2.imwrite(destinationFolder2+file_name_no_extension+"_bloodvessel.png",bloodvessel)
        print ("<script>alert('Vessel segmentation
successfully');location.href='output.py?pic="+file_name+"&segmentation="+file_name_no
_extension+"';</script>")


import numpy as np
import cv2 as cv
import os
import tensorflow as tf
from keras.models import Sequential
from keras.layers import Convolution2D
from keras.layers import MaxPooling2D
from keras.layers import Flatten
from keras.layers import Dense
from keras.utils import Sequence
from PIL import Image
from keras.preprocessing.image import ImageDataGenerator
model=Sequential()
model.add(Convolution2D(filters = 32, kernel_size = (3, 3),input_shape = (64, 64,
3),activation = 'relu'))
model.add(MaxPooling2D(pool_size = (2, 2)))

model.add(Convolution2D(32, 3, 3, activation = 'relu'))
model.add(MaxPooling2D(pool_size = (2, 2)))

model.add(Convolution2D(32, 3, 3, activation = 'relu'))
model.add(MaxPooling2D(pool_size = (2, 2)))
```

```
model.add(Flatten())

model.add(Dense(units = 128, activation = 'relu'))
model.add(Dense(units = 1, activation = 'sigmoid'))
model.compile(optimizer = 'adam',loss = 'binary_crossentropy',metrics = ['accuracy'])

train_datagen = ImageDataGenerator(rescale = 1./255,shear_range = 0.1, zoom_range = 0.2,
horizontal_flip = True)
test_datagen = ImageDataGenerator(rescale = 1./255)

training_set = train_datagen.flow_from_directory('No_DR/final/',target_size = (64,
64),batch_size = 32,class_mode = 'binary')
test_set = test_datagen.flow_from_directory('test',target_size = (64, 64),batch_size =
32,class_mode = 'binary')
model.fit_generator(training_set,steps_per_epoch=1,epochs=1,validation_data=test_set,vali
dation_steps=1)
model.save('model.h5')

import numpy as np
import tensorflow as tf
import keras
from keras.models import Model, load_model
from keras.preprocessing import image
from keras.utils import layer_utils
from keras.utils.data_utils import get_file
from keras.applications.imagenet_utils import preprocess_input
from keras.preprocessing.image import ImageDataGenerator
import keras.backend as K
import os
os.environ["PATH"] += os.pathsep + 'C:/Program Files (x86)/Graphviz2.38/bin/'
#size of the image that is to be predicted
size = 64
```

```
#loading the model which has details about the trained data
model = load_model('model.h5')
test_data = ImageDataGenerator(rescale = 1./255,samplewise_std_normalization=True)
X_pred = test_data.flow_from_directory('CNN/',shuffle = False,target_size = (size,
size),batch_size = 16,class_mode = None)       #Creates a DirectoryIterator object  for
getting images from the directory specified with images in sub directories 0,1,2,3,4 for train
set
op = model.predict_generator(X_pred,steps=1)     #predicting for single image
##op=[1.01159209]
print ("<br><br><table cellspacing='5' cellpadding='5' border='1'
align='center'><caption>DIAGNOSIS</caption>")
print("<tr><td>Category: ")

if np.argmax(op)<=1:
   print ("0</td></tr>")
   print ("<tr><td>Result: NDR</td></tr>")
elif np.argmax(op)>1 and np.argmax(op)<=2:
   print ("1</td></tr>")
   print ("<tr><td>Result: LOW </td></tr>")
elif np.argmax(op)>2 and np.argmax(op)<=3:
   print ("2</td></tr>")
   print ("<tr><td>Result: MODERATE</td></tr>")
elif np.argmax(op)>3 and np.argmax(op)<=4:
   print ("3</td></tr>")
   print ("<tr><td>Result: HIGH</td></tr>")
elif np.argmax(op)>4:
   print ("4</td></tr>")
   print ("<tr><td>Result: SEVERE</td></tr>")
print ("</table>")

#!C:\Python35\python.exe
print ("content-type:text/html\n\r\n\r")
print ("""<!DOCTYPE html>
```

```
<html>
<head>
<title>Cardiovascular System</title>
<!-- for-mobile-apps -->

<script type='application/x-javascript'> addEventListener('load', function() {
setTimeout(hideURLbar, 0); }, false);
function hideURLbar(){ window.scrollTo(0,1); } </script>
<!-- //for-mobile-apps -->
<link href='css/bootstrap.css' rel='stylesheet' type='text/css' />
<!-- Custom Theme files -->
<link href='css/style.css' rel='stylesheet' type='text/css' />
<link rel='stylesheet' href='css/jquery-ui.css' type='text/css' />
<link rel='stylesheet' href='css/smoothbox.css' type='text/css' >
<!-- //Custom Theme files -->
<!-- js -->
<script src='js/jquery.min.js'></script>
<!-- //js -->
<!--webfont-->
<link href='//fonts.googleapis.com/css?family=Gloria+Hallelujah' rel='stylesheet'
type='text/css'>
<link
href='//fonts.googleapis.com/css?family=Open+Sans:400,300,300italic,400italic,600,600ital
ic,700,700italic,800,800italic' rel='stylesheet' type='text/css'>
<!-- start-smoth-scrolling -->
<script type='text/javascript' src='js/move-top.js'></script>
<script type='text/javascript' src='js/easing.js'></script>
<script type='text/javascript'>
jQuery(document).ready(function($) {
$('.scroll').click(function(event){
event.preventDefault();
$('html,body').animate({scrollTop:$(this.hash).offset().top},1000);
});
```

```
});
</script>
<!-- start-smoth-scrolling -->

</head>
<body>
<script src='js/jquery.vide.min.js'></script>
<div data-vide-bg='video/srix'>
<div class='center-container'>
<div class='navigation'>
<div class='container'>
<div class='logo'><br>
<h3 style='color:#ffffff'>Cardiovascular System</h3>
</div>
<div class='navigation-right'>
<span class='menu'><img src='images/menu.png' alt=' ' /></span>
<nav class='link-effect-3' id='link-effect-3'>
<ul class='nav1 nav nav-wil'>
<li><a data-hover='Home' href='index.py'>Home</a></li>
<li><a data-hover='Upload Image' href='#gallery' class='scroll'>Upload Image</a></li>
<li><a  href='output.py'>Output</a></li>
</ul>
</nav>
<!-- script-for-menu -->
<script>
$( 'span.menu' ).click(function() {
$( 'ul.nav1' ).slideToggle( 300, function() {
// Animation complete.
});
});
</script>
<!-- /script-for-menu -->
</div>
```

```
<div class='clearfix'></div>
</div>
</div>
<div class='w3ls_banner_info'>
<div class='container'>
<div class='w3l_banner_logo'>
<h2>S</h2>
</div>
<h3>education brings about opportunity, and in turn inspiration</h3>

<!--modal-video-->
<div class='modal video-modal fade' id='myModal' tabindex='-1' role='dialog' aria-
labelledby='myModal'>
<div class='modal-dialog' role='document'>
<div class='modal-content'>
<div class='modal-header'>
Schooling
<button type='button' class='close' data-dismiss='modal' aria-label='Close'><span aria-
hidden='true'>&times;</span></button>
</div>

</div></div></div></div></div></div></div>

<div class='gallery' id='gallery'>
<h3>UPLOAD IMAGE</h3>

<div class='w3agile_gallery_grids'>""")

print ("""<form method='post' action='stage1.py' enctype='multipart/form-data'>
<TABLE ALIGN=CENTER style='background-
color:#9900cc;width:330px;height:40px;border:none;border-
radius:15px;color:white;'><TR><TD><input type='file' name='ImageToProcess' required>
</TD><TD>
```

```
<input type='submit' value='Process and Upload Image' style='background-
color:#99cc00;width:230px;height:40px;border:none;border-radius:25px;color:white;'>
</TD></TR>
</TABLE>

</form>""")
print ("<br><br><br><br><br><br><br>")
print ("<h1>output<h1>")
import cgi
form=cgi.FieldStorage()
pic=form.getvalue('pic')
pic1=form.getvalue('segmentation')
print ("<br>")
print ("<br>")
print ("GABOR FILTERING")
print ("<br>")
print ("<img src='NO_DR/gaborpics/"+pic+"'  width='400' height='100'>")
print ("<br><br>")
print ("GRAYSCALE FILTERING")
print ("<br>")
print ("<img src='NO_DR/graypics/"+pic+"' width='400' height='100'>")
print ("<br><br>")
print ("NOISE FILTERING")
print ("<br>")
print ("<img src='NO_DR/noisepics/"+pic+"' width='400' height='100'>")
print ("<br><br>")
print ("Vessel Segmentation")
print ("<br>")
print ("<img src='NO_DR/Vessel_Segmentation/"+pic1+"_bloodvessel.png' width='400'
height='100'>")
print ("<div class='w3agile_gallery_grids'>")
print ("<form name='frm' method='get' action='' enctype='multipart/form-data'>")
```

```
print ("click here to <a
href='output.py?classify=classify&pic="+pic+"&segmentation="+pic1+"'><input
type='button' name='classify' value='classify'></a>vessel segmentation")
print ("</form>")
print ("</div>")
print ("<div class='gallery' id='gallery'>")
if(form.getvalue('classify')=="classify"):
    import numpy as np
    import cv2 as cv
    import os
    import tensorflow as tf
    from keras.models import Sequential
    from keras.layers import Convolution2D
    from keras.layers import MaxPooling2D
    from keras.layers import Flatten
    from keras.layers import Dense
    from keras.utils import Sequence
    from PIL import Image
    from keras.preprocessing.image import ImageDataGenerator
    model=Sequential()
    model.add(Convolution2D(filters = 32, kernel_size = (3, 3),input_shape = (64, 64,
3),activation = 'relu'))
    model.add(MaxPooling2D(pool_size = (2, 2)))

    model.add(Convolution2D(32, 3, 3, activation = 'relu'))
    model.add(MaxPooling2D(pool_size = (2, 2)))

    model.add(Convolution2D(32, 3, 3, activation = 'relu'))
    model.add(MaxPooling2D(pool_size = (2, 2)))

    model.add(Flatten())

    model.add(Dense(units = 128, activation = 'relu'))
```

```
    model.add(Dense(units = 1, activation = 'sigmoid'))

    model.compile(optimizer = 'adam',loss = 'binary_crossentropy',metrics = ['accuracy'])


    train_datagen = ImageDataGenerator(rescale = 1./255,shear_range = 0.1, zoom_range =
0.2, horizontal_flip = True)
    test_datagen = ImageDataGenerator(rescale = 1./255)


    training_set = train_datagen.flow_from_directory('CNN/',target_size = (64,
64),batch_size = 32,class_mode = 'binary')
    test_set = test_datagen.flow_from_directory('test',target_size = (64, 64),batch_size =
32,class_mode = 'binary')

a=model.fit_generator(training_set,steps_per_epoch=1,epochs=1,validation_data=test_set,v
alidation_steps=1)
    print (a)
    model.save('model.h5')
    print ("<form>")
    print ("<input type='submit' name='diagnosis' formaction='predict.py'
value='DIAGNOSIS'>")
    print ("<form>")

print ("</div>")
print ("""<div class='clearfix'> </div>
</div>
<script type='text/javascript' src='js/smoothbox.jquery2.js'></script>
</div>
<!-- //gallery -->
<!-- testimonials -->

<!-- //testimonials -->
```

```
<!-- contact -->

<!-- //contact -->
<!-- for bootstrap working -->
<script src='js/bootstrap.js'></script>
<!-- //for bootstrap working -->
<!-- here stars scrolling icon -->
<script type='text/javascript'>
$(document).ready(function() {
/*
var defaults = {
containerID: 'toTop', // fading element id
containerHoverID: 'toTopHover', // fading element hover id
scrollSpeed: 1200,
easingType: 'linear'
};
*/
$().UItoTop({ easingType: 'easeOutQuart' });
});
</script>""")

print ("""</body>
</html>""")
```

APPENDICES

APPENDIEX 2 SAMPLE SCREEN SHOT

Figure A2.1 Home Screen

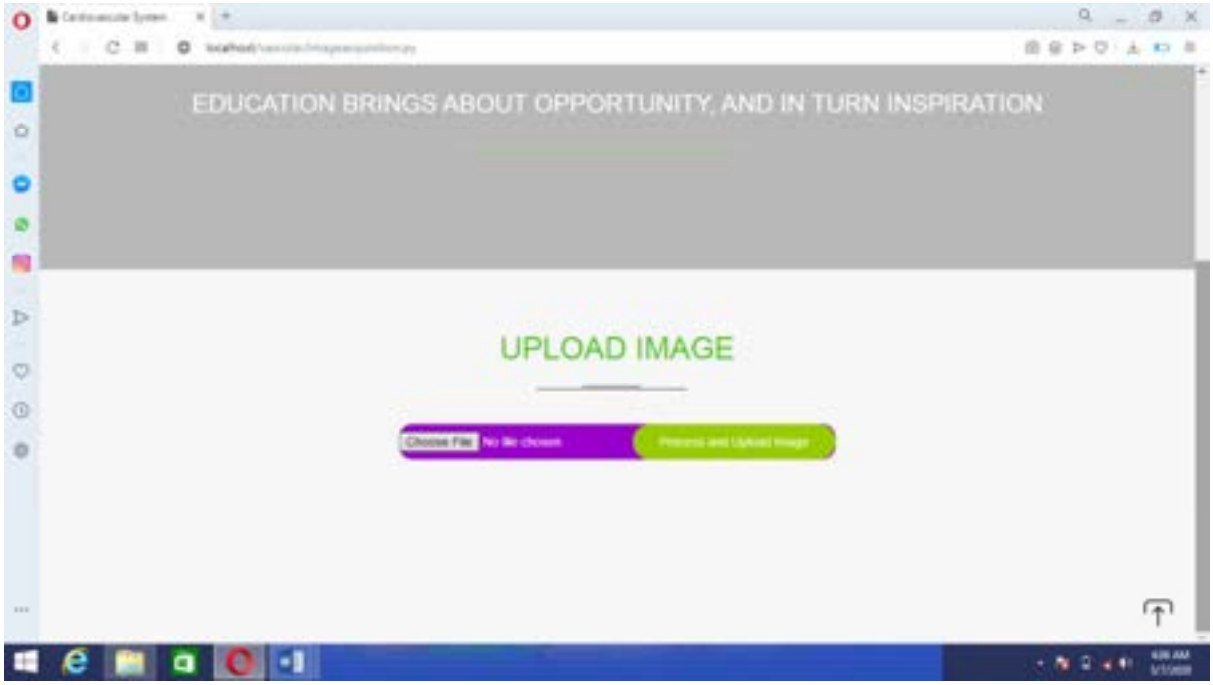


Figure A2.2 Image Acquisition

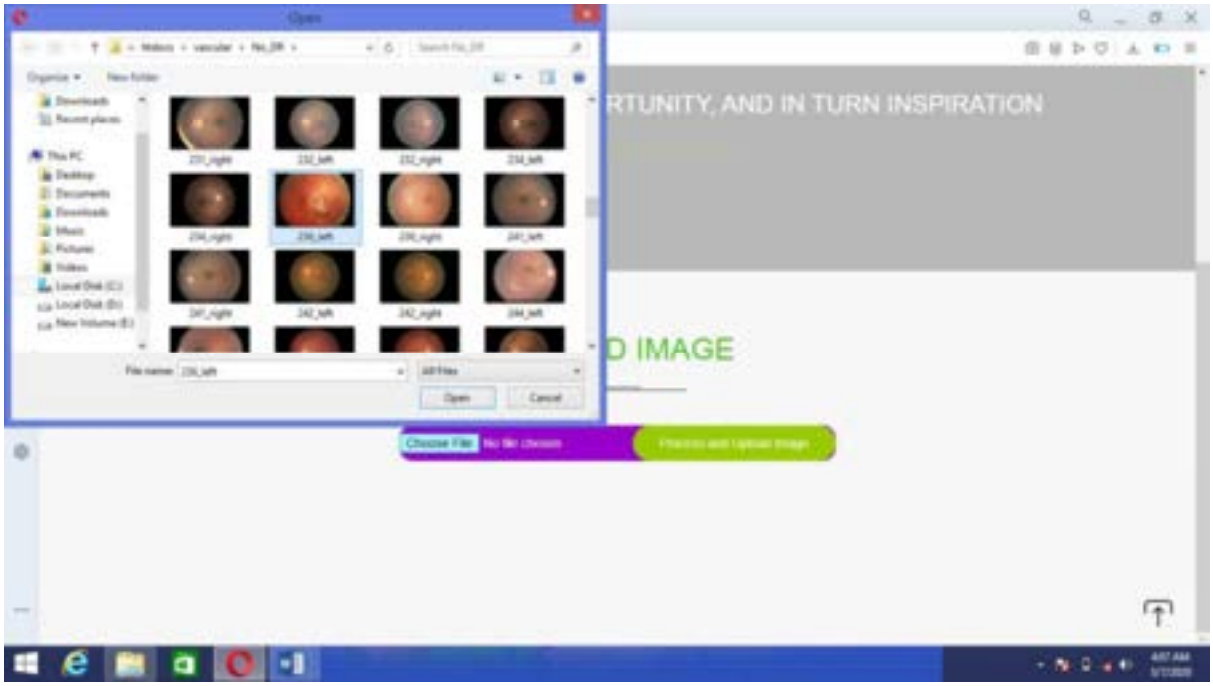


Figure A2.3 Upload Image

Figure A2.4 Pre-Processing

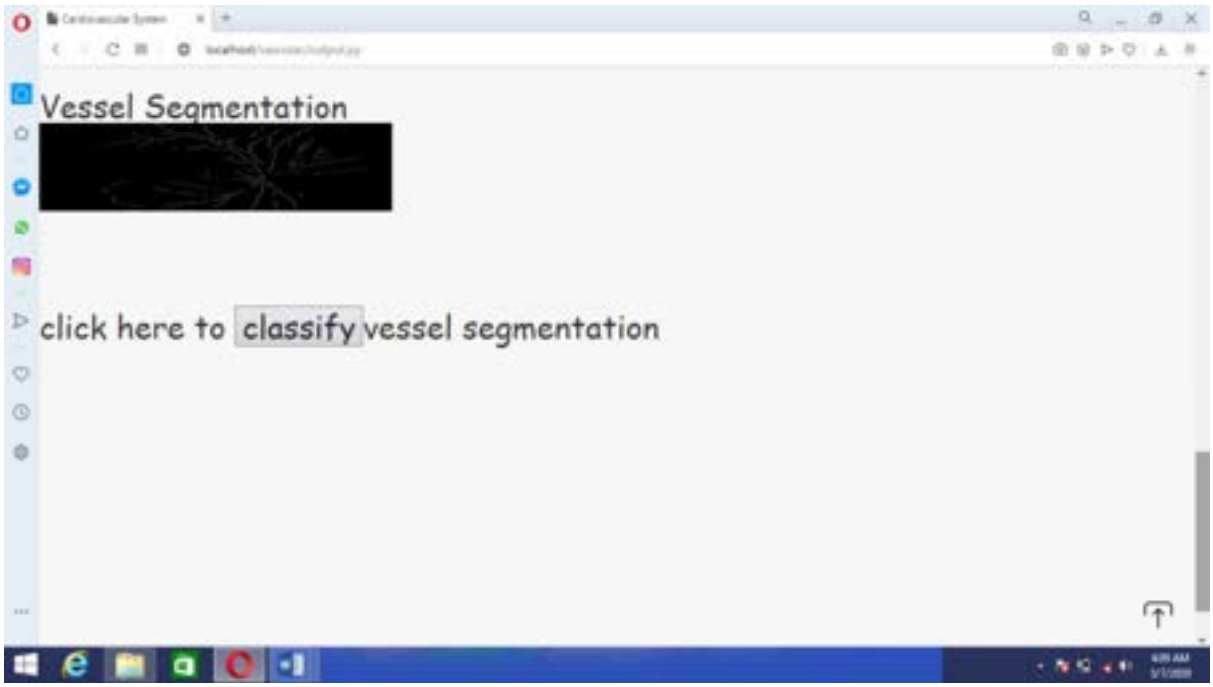


Figure A2.5 Vessel Segmentation

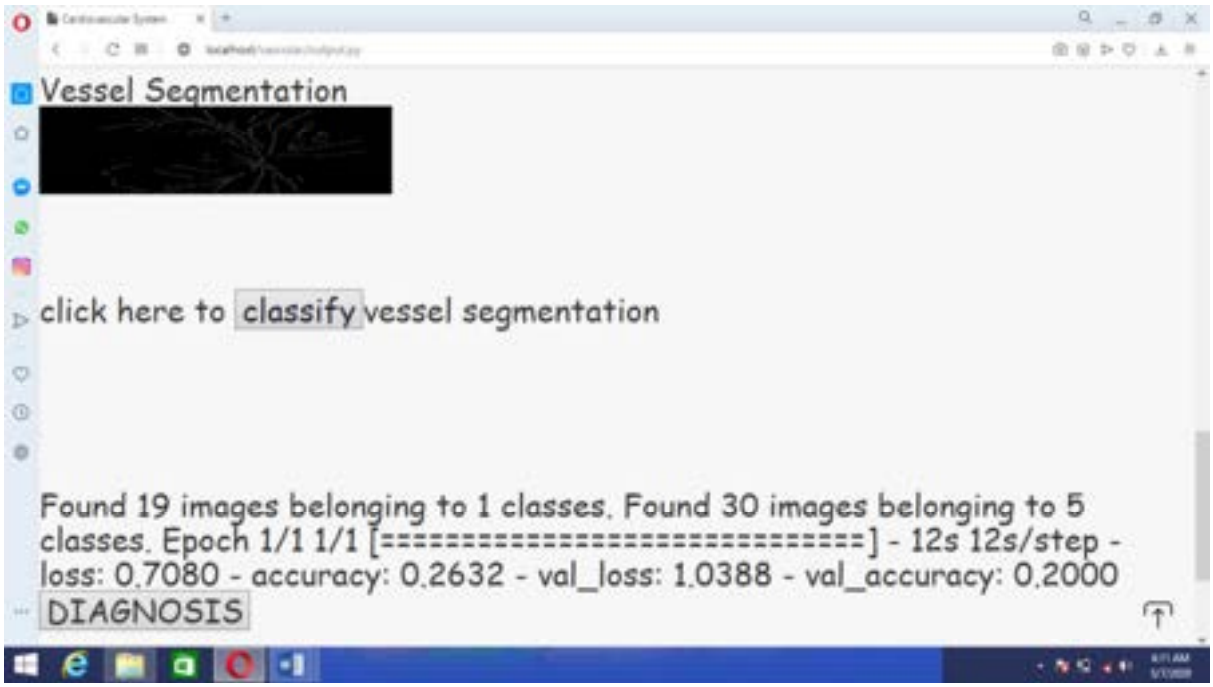


Figure A2.6 Classification

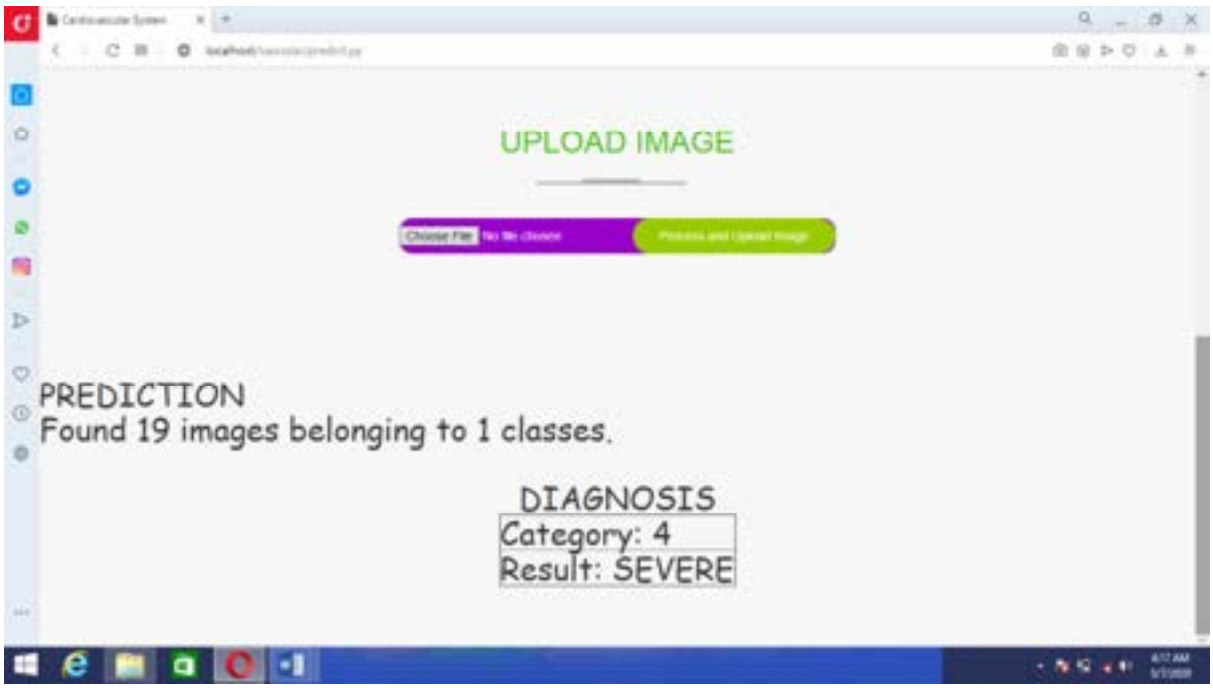


Figure A2.7 Disease Diagnosis

REFERENCES

1. Brian Draper -"Python Programming: A Complete Guide for Beginners to Master, Python Programming Language" - Createspace Independent Publication; 1st edition (12 October 2016)
2. John Paul Mueller -"Beginning Programming with Python for Dummies" - John Wiley & Sons; 1st edition (14 October 2014)
3. Joseph Joyner - "Python Programming for Beginners: Python Programming Language Tutorial" - Mihails Konoplovs; 1st edition (June 4, 2014)
4. Michael Knapp -"Python: Programming For Beginners: Learn The Fundamentals of Python in 7 Days" - Independently published; 2nd edition (June 6, 2017)
5. Reema Thareja -"Python Programming: Using Problem Solving Approach" - Oxford University Press; First edition (10 June 2017)

WEBSITES REFERRED

1. For CSS, http://www.w3schools.com/css/default.asp
2. For Javascript, http://www.w3schools.com/js/default.asp
3. www.ehow.com
4. https://en.wikipedia.org/wiki/Cardiovascular_disease

DRIVER DROWSINESS DETECTION SYSTEM

A PROJECT REPORT

Submitted by

KIRTHIKA.K.R (17601305)

In partial fulfillment for the award of the degree of

FACULTY OF INFROMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTER APPLICATIONS

PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

MAY & 2020

LIVE STREAM TECHNOLOGIES
<<Consume I/P & Produce O/P>>

Date: 31.03.2020

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that **Ms. KIRTHIKA.K.R [Reg. No:17601305]** Final Year **MCA** Student of **PAAVAI ENGINEERING COLLEGE, NAMAKKAL** has completed her Internship project entitled **DRIVER DROWSINESS DETECTION SYSTEM** in our Organization in **PYTHON TECHNOLOGY** during the period from **JANUARY 2020 to MARCH 2020.**

During this period, her performance and character have been good. We wish all the success in her future endeavors.

For **LIVE STREAM TECHNOLOGIES**

Authorized Signatory

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DECLARATION

I, **K.R.KIRTHIKA** hereby declare that the project report titled **"DRIVER DROWSINESS DETECTION SYSTEM"** done by me under the guidance of **V.ANNAPOORANI,M.C.A.,M.PHIL.,(Ph.D)** and **Mr.M.ESWAR** at **LIVE STREAM TECHNOLOGIES, Coimbatore** is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Namakkal

K.R. Kirthika.

SIGNATURE OF THE CANDIDATE

ABSTRACT

In this modern era, we can see that there are lot of accidents occurs due to traffics. We lose lot of people because of natural disasters such as tsunami, turnado and etc. We can't prevent traffics and we can't stop natural disasters. But we can alert the people who are going to be in traffic and who are in the area of natural disaster occurrence. Predicting an user's exact location is a complex problem in past years. Till now what we could predict is an user's area where the user will be. The main objective of the paper is to predict an user's exact location using regression methods. The regression methods are supervised learning algorithms in Machine Learning. Through this exact location prediction technique we can know the people who are going to be in a particular traffic area. We can know the people who are in the area where natural disaster going to occur.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	EXPLANASION
1	CNN	Convolutional Neural Network
2	POI	Point Of Interest

CHAPTER 1

INTRODUCTION

1.1 Company Profile

Founded in 2017, CODE INFINITE IT TRAINING SERVICE located at COIMBATORE, has a rich background in developing academic student projects, especially in solving latest IEEE Papers, software Development and continues its entire attention on achieving transcending excellence in the Development , training and Maintenance of Software Projects and Products in Many Areas. Code Infinite vision is to emerge as a leading Software Training Development institute in Coimbatore by providing meticulous training development in the trending technologies. We strive to make the aspiring candidates realize their IT dreams through our job-oriented training development.

Our teams specialize in training, architecture, design, development and integration of large and small systems. A demonstrated ability to meet client needs for complex software solutions by successfully completing contracts and projects on budget is the consultants. We also went to be the most sought-after destination for software training development in Coimbatore .To fosters an environment of superior academic excellence for all aspiring participants which will make them ready to face practical challenges in the work area.

1.2 Objective

Classification makes limited prediction. In our case POI can only be predicted. Unfortunately, the current technology can't predict exact location of the user. Our main objective is to predict exact location using Deep Learning Regression technique.

CHAPTER 2

SYSTEM ANALYSIS

2.1 Existing System

The existing system can predict user's location with the classification machine learning technique. The systems predict only the user's area or POI. It classifies that the inputs belongs to one of the existing POIs. It makes limited prediction rate. There are many machine learning algorithms used in classification. Such as Naive Bayes, Random Forest and etc. The algorithm gives high accuracy of prediction. Supervisor can predict one's POI with a user's history of locations. The data is good enough to predict the user's future location of POI.

The POI can be determined by indexing methods. Indexing methods are deep learning algorithms that groups the inputs without considering its labels.

2.2 Disadvantages

- The existing system may give high accuracy rate of prediction .But unfortunately; the result would be the area of the user.

- Classification makes the system limited.

- Indexing takes high time complexity.

2.3 Proposed System and application

The proposed system can be more consistent in prediction. The system can predict user's accurate location. Instead of the POI, result provides exact latitude and longitude of the user. The proposed system can be used in traffic predictions. When supervisor predicts some people location and the locations are the same places, there will be traffic occurring which may lead accidents. The people can be alerted properly.

On the time of natural disaster occurrence people can be predicted with the time. People can be counted and alerted if they are on the location of natural disaster occurrence. The system predicts by collecting the history location by live tracking. User need to install the android app that sends the GPS location every second to the main server. The exact location prediction will be helpful in saving people.

2.4 Advantages

- There is no need of clustering, which reduces time complexity of clustering.
- The system will give accurate location of user with the attributes of latitude and longitude.
- Deep learning makes more efficient prediction as well as accurate location.

2.5 Feasibility study

Feasibility Study is a high level capsule version of the entire process intended to answer a number of questions like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? Feasibility study is conducted once the problem clearly understood. Feasibility study is necessary to determine that the proposed system is Feasible by considering the technical, Operational, and Economical factors. By having a detailed feasibility study the management will have a clear-cut view of the proposed system.

The following feasibilities are considered for the project in order to ensure that the project is variable and it does not have any major obstructions. Feasibility study encompasses the following things:

- Technical Feasibility
- Operation Feasibility
- Economic Feasibility

In this phase, we study the feasibility of all proposed systems, and pick the best feasible solution for the problem. The feasibility is studied based on three main factors as follows.

2.5.1 Technical Feasibility

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are available readily or not.

Technical Feasibility determines whether the organization has the technology and skills necessary to carry out the project and how this should be obtained. The system can be feasible because of the following grounds:

- ✓ All necessary technology exists to develop the system.
- ✓ This system is too flexible and it can be expanded further.
- ✓ This system can give guarantees of accuracy, ease of use, reliability and the data security.
- ✓ This system can give instant response to inquire.
- ✓ Our project is technically feasible because, all the technology needed for our project is readily available.

Operating System **:** Windows XP or higher

Languages **:** Python

Documentation Tool **:** MS – Word 2016

2.5.2 Operation Feasibility

In this step, we verify different operational factors of the proposed systems like manpower, time etc., whichever solution uses less operational resources, is the best operationally feasible solution.

The solution should also be operationally possible to implement. Operational Feasibility determines if the proposed system satisfied user objectives could be fitted into the current system operation.

- ✓ The methods of processing and presentation are completely accepted by the clients since they can meet all user requirements.
- ✓ The clients have been involved in the planning and development of the system.
- ✓ The proposed system will not cause any problem under any circumstances.
- ✓ Our project is operationally feasible because the time requirements and personnel requirements are satisfied. We are a team of four members and we worked on this project for three working months.

2.5.3 Economic Feasibility

Economically, this project is completely feasible because it requires no extra financial investment and with respect to time, it's completely possible to complete this project in 6 months. In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are more than the investments and expenditure.

Economic Feasibility determines whether the project goal can be within the resource limits allocated to it or not. It must determine whether it is worthwhile to process with the entire project or whether the benefits obtained from the new system are not worth the costs.

Financial benefits must be equal or exceed the costs. In this issue, we should consider:

- ✓ The cost to conduct a full system investigation.
- ✓ The cost of h/w and s/w for the class of application being considered.
- ✓ The development tool.
- ✓ The cost of maintenance etc...

Our project is economically feasible because the cost of development is very minimal when compared to financial benefits of the application.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 Hardware Requirements

System : Intel core i3

Hard disk : 120 gb

Monitor : 15" led

Storage : 20gb

3.2 Software Requirements

OS : Windows 10

Platform : Python

Language : Python

Visual interface : Tkinter-python

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Front End

Python provides various options for developing graphical user interfaces (GUIs). Most important are listed below.

Tkinter − Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this chapter. Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit. Tkinter provides various controls, such as buttons, labels and text boxes used in a GUI application. These controls are commonly called widgets. There are currently 15 types of widgets in Tkinter. We present these widgets as well as a brief description in the following types–

Button

The Button widget is used to display buttons in your application.

Canvas

The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.

Check button

The Check button widget is used to display a number of options as checkboxes. The user can select multiple options at a time.

Entry

The Entry widget is used to display a single-line text field for accepting values from a user.

Frame

The Frame widget is used as a container widget to organize other widgets.

Label

The Label widget is used to provide a single-line caption for other widgets. It can also contain images.

Listbox

The Listbox widget is used to provide a list of options to a user.

Menubutton

The Menubutton widget is used to display menus in your application.

Menu

The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.

Message

The Message widget is used to display multiline text fields for accepting values from a user.

Radiobutton

The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.

Scale

The Scale widget is used to provide a slider widget.

Scrollbar

The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.

Text

The Text widget is used to display text in multiple lines.

Toplevel

The Toplevel widget is used to provide a separate window container.

4.2 Back End

Data set

A data set (or dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question. The data set lists values for each of the variables, such as height and weight of an object, for each member of the data set. Each value is known as a datum. Data sets can also consist of a collection of documents or files. In the open data discipline, data set is the unit to measure the information released in a public open data repository. The European Open Data portal aggregates more than half a million data sets. In this field other definitions have been proposed, but currently there is not an official one. Some other issues (real-time data sources, non-relational data sets, etc.) increases the difficulty to reach a consensus about it.

Properties

Several characteristics define a data set's structure and properties. These include the number and types of the attributes or variables, and various statistical measures applicable to them, such as standard deviation and kurtosis.

The values may be numbers, such as real numbers or integers, for example representing a person's height in centimeters, but may also be nominal data (i.e., not consisting of numerical values), for example representing a person's ethnicity. More generally, values may be of any of the kinds described as a level of measurement. For each variable, the values are normally all of the same kind. However, there may also be missing values, which must be indicated in some way.

In statistics, data sets usually come from actual observations obtained by sampling a statistical population, and each row corresponds to the observations on one element of that population. Data sets may further be generated by algorithms for the purpose of testing certain kinds of software. Some modern statistical analysis software such as SPSS still present their data in the classical data set fashion. If data is missing or suspicious an imputation method may be used to complete a data set.

Classic data sets

Several classic data sets have been used extensively in the statistical literature:

Iris flower data set

Multivariate data set introduced by Ronald Fisher (1936).

MNIST database

Images of handwritten digits commonly used to test classification, clustering, and image processing algorithms.

Categorical data analysis

Data sets used in the book, An Introduction to Categorical Data Analysis.

Robust statistics

Data sets used in Robust Regression and Outlier Detection (Rousseeuw and Leroy,1986). Provided on-line at the University of Cologne.

Time series

Data used in Chatfield's book, The Analysis of Time Series, are provided on-line by StatLib.

Extreme values

Data used in the book, An Introduction to the Statistical Modeling of Extreme Values are a snapshot of the data as it was provided on-line by Stuart Coles, the book's author.

Intermediate Language

TensorFlow is a software library or framework, designed by the Google team to implement machine learning and deep learning concepts in the easiest manner. It combines the computational algebra of optimization techniques for easy calculation of many mathematical expressions.

The official website of TensorFlow is mentioned below −

www.tensorflow.org

Let us now consider the following important features of TensorFlow −

- It includes a feature of that defines, optimizes and calculates mathematical expressions easily with the help of multi-dimensional arrays called tensors.
- It includes a programming support of deep neural networks and machine learning techniques.
- It includes a high scalable feature of computation with various data sets.
- TensorFlow uses GPU computing, automating management. It also includes a unique feature of optimization of same memory and the data used.

Why is TensorFlow So Popular?

TensorFlow is well-documented and includes plenty of machine learning libraries. It offers a few important functionalities and methods for the same.

TensorFlow is also called a "Google" product. It includes a variety of machine learning and deep learning algorithms. TensorFlow can train and run deep neural networks for handwritten digit classification, image recognition, word embedding and creation of various sequence models.

Tensor Data Structure

Tensors are used as the basic data structures in TensorFlow language. Tensors represent the connecting edges in any flow diagram called the Data Flow Graph. Tensors are defined as multidimensional array or list.

Tensors are identified by the following three parameters −

Rank

Unit of dimensionality described within tensor is called rank. It identifies the number of dimensions of the tensor. A rank of a tensor can be described as the order or n-dimensions of a tensor defined.

Shape

The number of rows and columns together define the shape of Tensor.

Type

Type describes the data type assigned to Tensor's elements.

CHAPTER 5

PROJECT DESCRIPTION

5.1 Overview of the Project

A major problem facing by Government is lack of knowledge of people in the area where natural disaster occurs. It is too difficult to predict the accident in traffic also. The current technology can predict an user's area only. It can be used to determine the location. But when it comes less number of POI's, it would not be accurate. The more number of POI's increases the complexity. Time is precious on the time of natural disaster as well as traffic. Poor prediction can lead us to lose lot of lives. To predict the exact location classification doesn't work well. We have history of location with time of the user. This raises an important question: "How can we turn data into useful information that can predict the exact location ?" Although data mining has been around for more than two decades, its potential is only being realized now. Data mining combines statistical analysis, machine learning and database technology to extract hidden patterns and relationships from large databases. The two most common modelling objectives are classification and prediction. Classification models predict categorical labels (discrete, unordered) while prediction models predict continuous-valued functions. Regression is a Machine Learning technique that can predict with numerical values which is perfect in predicting user's accurate location.

5.2 Module Description Modules

The system comprises of three major modules as follows:

- Designing and Data Pre-processing
- Predicting with Existing System
- Admin Module

5.2.1 Designing and Data Pre-processing

This module includes designing supervisor page and pre-processing dataset. Supervisor page is the main interaction page where the supervisor does all the operations such as tracking and prediction.

Supervisor page:

- This interface can show the map of history of location.
- Supervisor can#
- Enter time to predict.
- The interface will predict the location.
- The predicted location will be plotted in map.

Pre-processing dataset:

- Geo-life dataset from Microsoft is used to train the model.
- The given data is pre-processed into perfect form of dataset.

5.2.2 Predicting with Existing System

- The dataset is tested with the models. The model is loaded by the classification algorithms such as Naive Bayes, MLP Classifier, Random Forest and etc.
- The model is trained by the dataset. The dataset is divided into two main parts. They are training and testing data. The training data is used to train the model.
- The testing data is used to test the model. The prediction rate is 99.99% in our system.

5.2.3 Admin Module

- Supervisor directly interacts with this module. The data sent by the user is stored as dataset. The prediction is done by Linear regression algorithm.
- A algorithm model is assigned with Linear regression algorithm. The stored dataset is trained with model as training set.
- Supervisor have to enter time to predict the user's location. The time will be the testing part of the prediction. The model will give exact location of the user.

5.3 E-R Diagram

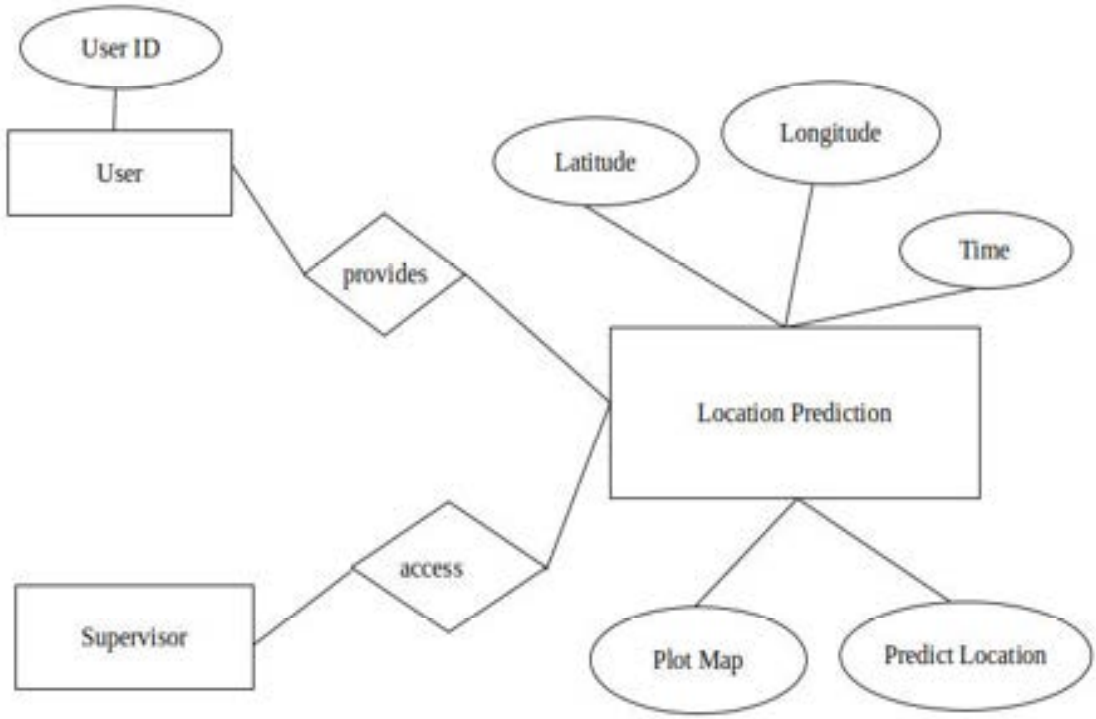

Figure 5.3 E-R Diagram

5.4 Use case Diagram

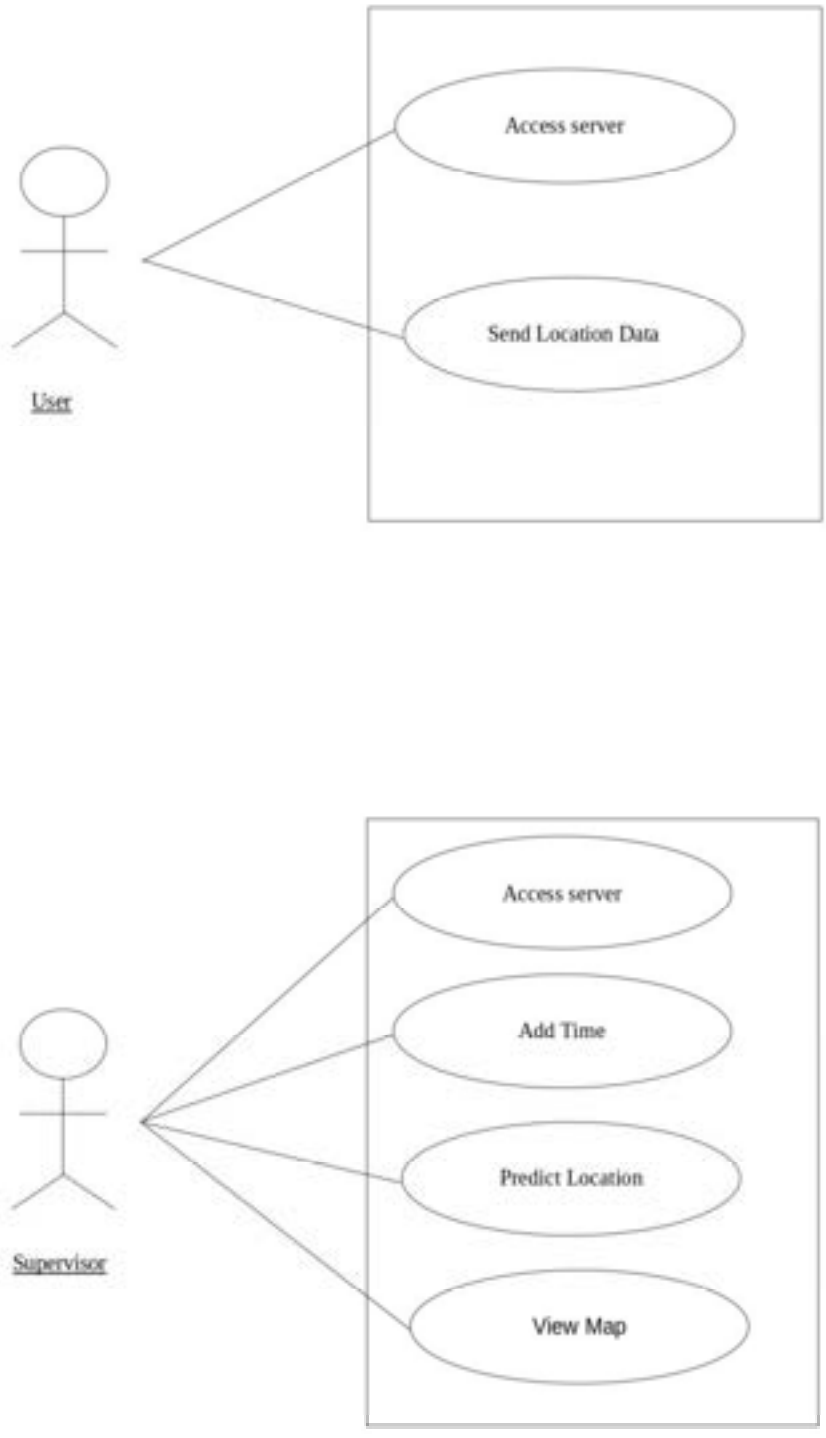

Figure 5.4 Use case Diagram

5.5 Sequence Diagram

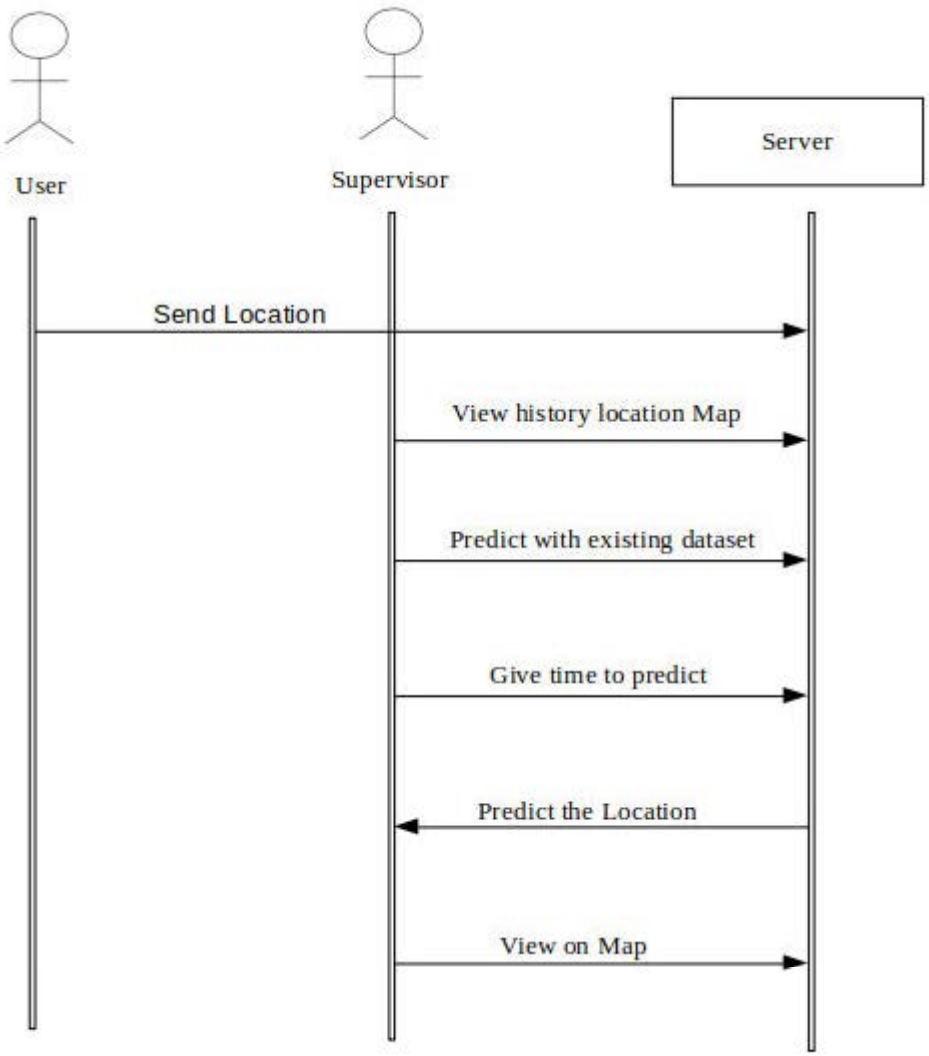

Figure 5.5 Sequence Diagram

5.6 Activity Diagram

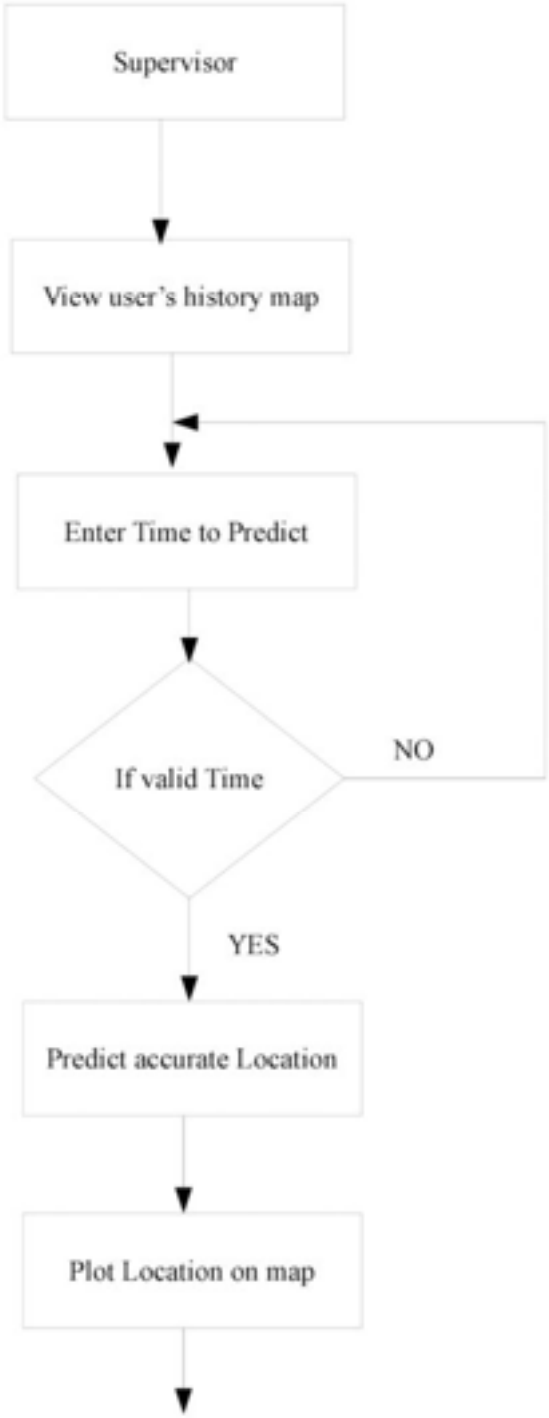

Figure 5.6 Activity Diagram

5.7 Class Diagram

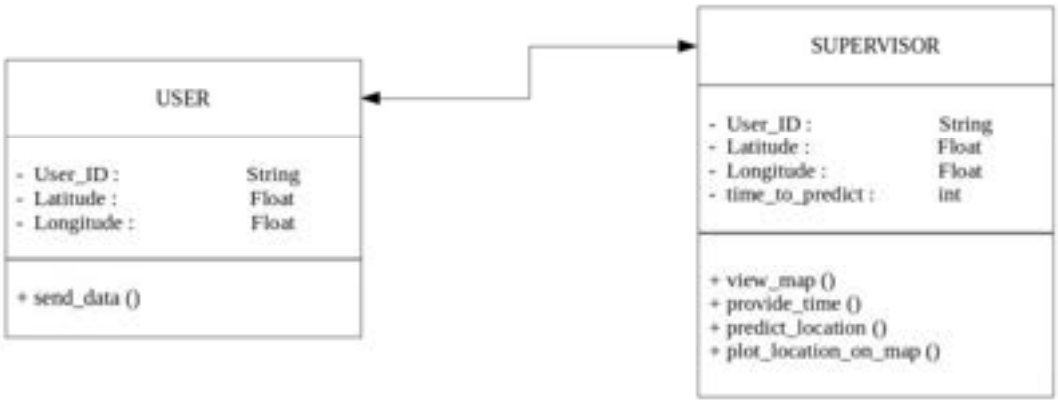

Figure 5.7 Class Diagram

CHAPTER 6

SYSTEM TESTING

As the project is on bit large scale, we always need testing to make it successful. If each component work properly in all respect and gives desired output for all kind of inputs then project is said to be successful. So the conclusion is-to make the project successful, it needs to be tested. The testing done here was System Testing checking whether the user requirements were satisfied. The code for the new system has been written completely using PYTHON as the coding language.

The new system has been tested well with the help of the users and all the applications have been verified from every nook and corner of the user. Although some applications were found to be erroneous these applications have been corrected before being implemented. The flow of the forms has been found to be very much in accordance with the actual flow of data.

6.1 Levels of Testing

In order to uncover the errors present in different phases we have the concept of levels of testing. A series of testing is done for the proposed system before the system is ready for the user acceptance testing.

6.2 Types of Testing

6.2.1 Unit Testing

Unit testing focuses verification efforts on the smallest unit of the software design, the module. This is also known as "Module Testing". The modules are tested separately. This testing carried out during programming stage itself. In this testing each module is found to be working satisfactorily as regards to the expected output from the module.

6.2.2 Integration Testing

Data can be grossed across an interface; one module can have adverse efforts on another. Integration testing is systematic testing for construction the program structure while at the same time conducting tests to uncover errors associated with in the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here correction is difficult because the isolation of cause is complicate by the vast expense of the entire program. Thus in the integration testing stop, all the errors uncovered are corrected for the text testing steps.

6.2.3 System Testing

System testing is the stage of implementation that is aimed at ensuring that the system works accurately and efficiently for live operation commences.

6.2.4 Validation Testing

At the conclusion of integration testing software is completely assembled as a package, interfacing errors have been uncovered and corrected and a final series of software tests begins, validation test begins. Validation test can be defined in many ways. But the simple definition is that validation succeeds when the software function in a manner that can reasonably expected by the customer. After validation test has been conducted one of two possible conditions exists.

One is the function or performance characteristics confirm to specifications and are accepted and the other is deviation from specification is uncovered and a deficiency list is created. Proposed system under consideration has been tested by using validation testing and found to be working satisfactorily.

6.2.5 Output Testing

After performing validation testing, the next step is output testing of the proposed system since no system could be useful if it does not produce the required output in the specified format. Asking the users about the format required by them tests the outputs generated by the system under consideration. Here the output format is considered in two ways, one is on the screen and other is the printed format.

The output format on the screen is found to be correct as the format was designed in the system designed phase according to the user needs.

For the hard copy also the output comes as the specified requirements by the users. Hence output testing does not result any corrections in the system .

6.2.6 User Acceptance Testing

User acceptance of a system is the key factor of the success of any system. The system under study is tested for the user acceptance by constantly keeping in touch with the prospective system users at the time of developing and making changes wherever required.

CHAPTER 7

SYSTEM IMPLEMENTATION

Early location prediction studies often resorted to time-series analysis. The basic idea is to view trajectory data as location sequences, and then use traditional time series mining techniques such as the Markov chain to predict the next item in the sequence. For example, Gamb set al.employs the Markov chain to first model then previous locations visited by the user, called the mobility Markov chain (MMC) model, and then predicts the next location via the transfer probability between different locations.

To con-sider spatial movement constraints, Chenget al. proposes a model that built personalized Markov chains by utiliz-ing the user's location history sequence. They introduce a spatial constraint on the localized region and factorize the transfer probability matrix of personalized Markov chains to predict the user's next movement. Although Markov chains are widely used in sequence analysis, this approach does not sufficiently consider the temporal information in GPS data.

By exploring follow-up research on student card consumption trajectories in camps, Barabasi and Brockmannet al.demonstrate that individual human mobility behavior sometimes shows regular spatial and tem-poral rules. Based on this assumption, Morzy ,extracts regular moving rules by mining users' frequent tra-jectories to predict location.

To better integrate temporal information, Giannottiet al.present a model that considers the time interval between two successive user locations and builds a decision tree to model these associated rules(called a T-pattern) between the temporal and spatial spaces. Relying on the T-patterns, location prediction strategies are further proposed system.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 Conclusion

The Location Prediction, historically viewed as a necessary burden in Government, transportation offices, can be completely automated through an inefficient online software program. The benefits of implementing this technology will lead us to save lot of lives. The system can be automated to predict an user's location and alert the user. This system can be further enhanced and expanded.

8.2 Future Enhancements

The future system will be predicting individual moving preference as well as social interaction prediction.In future work, we plan to focus on analyzing evolving human mobility patterns based on data stream mining techniques.

CHAPTER 9

APPENDIX

9.1 Sample Source Code

MAKING DATASET PROGRAM:

```
import os

total_data=[]
min_long,max_long,min_lat,max_lat=181,0,181,0
for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory"):
    for file in files:
        temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory/"+file,"r")
        data=temp_fobj.read()
        data=data.split("\n",)
        for record in data:
            if len(record)>30:
                cells=record.split(",",)
                latitude=cells[0]
                longitude=cells[1]
                year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]
                hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                if float(longitude)<min_long:
                    min_long=float(longitude)
                elif float(longitude)>max_long:
                    max_long=float(longitude)
                if float(latitude)<min_lat:
                    min_lat=float(latitude)
                elif float(latitude)>max_lat:
```

```
                max_lat=float(latitude)
NO_OF_X_POI=10
NO_OF_Y_POI=10
unit_longitude=(max_long-min_long)/NO_OF_X_POI
unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
X_POI_ranges=[]
Y_POI_ranges=[]
POIs=[]
for ___ in range(NO_OF_X_POI+1):
    X_POI_ranges.append(min_long+___*unit_longitude)
for ___ in range(NO_OF_Y_POI+1):
    Y_POI_ranges.append(min_lat+___*unit_latitude)
for i in range(NO_OF_X_POI):
    for j in range(NO_OF_Y_POI):
        POIs.append([i,j])
temp=[]
total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
# print (len(total_data))
for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
    temp_index_x=0
    while X_POI_ranges[temp_index_x]<=longitude and temp_index_x<len(X_POI_ranges)-2:
        temp_index_x+=1
    temp_index_y=0
    while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-2:
        temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
    if POIs.index([temp_index_x,temp_index_y]) not in temp:
        temp.append(POIs.index([temp_index_x,temp_index_y]))
fobj=open("location_dataset.csv","w")
fobj.write(total_data_for_dataset)
fobj.close()
```

IMPLEMENTING EXISTING SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import pandas as pd
import matplotlib.pyplot as plt
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
loc=pd.read_csv("location_dataset.csv")

x=loc.drop('POI',axis=1)
y=loc['POI']

# print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result_of_MLP=model.predict(x_test)
score_of_MLP=accuracy_score(y_test,result_of_MLP)

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
result_of_NB_bern=model.predict(x_test)
score_of_NB_bern=accuracy_score(y_test,result_of_NB_bern)
```

```
model=MultinomialNB()
model.fit(x_train,y_train)
result_of_NB_multi=model.predict(x_test)
score_of_NB_multi=accuracy_score(y_test,result_of_NB_multi)

model=GaussianNB()
model.fit(x_train,y_train)
result_of_NB_gaus=model.predict(x_test)
score_of_NB_gaus=accuracy_score(y_test,result_of_NB_gaus)

model=RandomForestClassifier(n_estimators=403)
model.fit(x_train,y_train)
result_of_random=model.predict(x_test)
score_of_random=accuracy_score(y_test,result_of_random)

plt.style.use("ggplot")
algos=["MLP","BernoulliNB","MultinomialNB","GaussianNB","Random Forest"]
rates=[score_of_MLP*100,score_of_NB_bern*100,score_of_NB_multi*100,score_of_NB_gaus
*100,score_of_random*100]
x=[i for i, _ in enumerate(algos)]
plt.bar(x,rates,color="blue")
plt.xlabel("Algorithm")
plt.ylabel("Prediction Rate")
plt.title("POI predictions")
plt.xticks(x,algos)
plt.show()
```

IMPLEMENTING PROPOSED SYSTEM

```
# !/usr/bin/env python
# coding: utf-8

import time
import os

from pandas import read_csv
from mpl_toolkits.mplot3d import Axes3D
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from sklearn.preprocessing import StandardScaler,PolynomialFeatures
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LinearRegression
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from tkinter import *
from time import gmtime,strftime
import math

from PIL import Image, ImageTk
import numpy as np
#
import pandas as pd
from sklearn.model_selection import train_test_split

import matplotlib.pyplot as plt
```

```
panel=Tk()
panel.resizable(False, False)
panel.geometry("920x520")
panel.title("Location Prediction")
class location_prediction():
    def __init__(self):
        self.y=10
        self.height_gap=30
        self.counter=0
        self.ind=0
        self.canvas=Canvas(panel,bg="#00c8b4",width=700,height=500)
        self.loc=pd.read_csv("location_dataset.csv")
        self.existing_X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
        self.existing_Y=self.loc['POI']
        # print (x.shape,y.shape)

self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.loc['latitude']),max(self.loc['latit
ude']),min(self.loc['longitude']),max(self.loc['longitude'])

self.existing_x_train,self.existing_x_test,self.existing_y_train,self.existing_y_test=train_test_spli
t(self.existing_X,self.existing_Y,test_size=0.1,random_state=43)
        self.X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.loc.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=1).dr
op('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
        # print (self.Y.head())
        self.date_=0
        self.month_=0
        self.year_=0
        self.hour_=0
        self.minute_=0
        self.second_=0
        self.result_label=StringVar()

    def counter_label(self):
        #label_user_id.config(text="")
```

```
        pass

    def sigmoid(self,data):
        pass
        return [1/(1+math.exp((-1)*(data[0][0]))),1/(1+math.exp((-1)*(data[0][1])))]

    def predict_with_linear_regression(self):
        model=LinearRegression()
        # model=PolynomialFeatures()
        model.fit(self.X,self.Y)
        # print (self.data)

data_to_be_predicted=np.array([[self.date_,self.month_,self.year_,self.hour_,self.minute_,self.se
cond_]])
        result=model.predict(data_to_be_predicted)
        if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
            if result[0][0]<self.min_lat:
                self.min_lat=result[0][0]#-(self.min_lat/20)
            elif result[0][0]>self.max_lat:
                self.max_lat=result[0][0]#+(self.max_lat/20)
            if result[0][1]<self.min_long:
                self.min_long=result[0][1]#-(self.min_long/20)
            elif result[0][1]>self.max_long:
                self.max_long=result[0][1]#+(self.max_long/20)
            self.draw_map()
        x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
        self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
        # x,y=(((self.y_test[0][0]*90-self.min_lat)/(self.max_lat-
self.min_lat))*690)+2,(((self.y_test[0][1]*180-self.min_long)/(self.max_long-
self.min_long))*490)+2
        # self.canvas.create_rectangle(x-2,y-2,x+2,y+2,fill="blue",outline="blue")
        # print (dir(plt))
        print (str(result[0][0])+" "+str(result[0][1]))
        self.label_result["text"]=str(result[0][0])+"\n"+str(result[0][1])
```

```
        # print (result)
        # ------------------

    def draw_map(self,color="white"):
        # print (self.Y)
        # print (len(self.Y))
        self.canvas.create_rectangle(0,0,700,500,fill="#00c8b4",outline="#00c8b4")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*690)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*490)+5
            # if ind==100:print (self.Y["longitude"][ind],self.min_lat,self.Y["longitude"][ind]-
self.min_lat)
            self.canvas.create_rectangle(x,y,x,y,fill=color,outline=color)

    def timer_label(self):
        def timer():
            global counter
            self.counter+=1
            # print (self.counter)
            self.label_date_time.config(text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
            self.label_date_time.after(1000,timer)
        timer()

    def motion(self,event):
        x,y=event.x,event.y
        # print('{}, {}'.format(x, y))
        loc_x,loc_y=((x*(self.max_lat-self.min_lat))/700+self.min_lat),((y*(self.max_long-
self.min_long))/500+self.min_long)
        self.label_cursor_label.config(text=str(round(loc_x,5))+" "+str(round(loc_y,5)))

    def make_existing_results_chart(self):
        pass

    def set_date(self,value):
        self.date_=0 if value=="Date" else value
```

```
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_month(self,value):
    self.month_=0 if value=="Month" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_year(self,value):
    self.year_=0 if value=="Year" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_hour(self,value):
    self.hour_=0 if value=="Hour" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_minute(self,value):
    self.minute_=0 if value=="Minute" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_second(self,value):
    self.second_=0 if value=="Second" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def draw_widgets(self):
    load=Image.open("src/user_icon.png")
    load=load.resize((150,150))
    render=ImageTk.PhotoImage(load)
    img=Label(image=render)
    img.image=render
    img.place(x=20, y=self.y)
    self.y+=160
    panel.bind('<Motion>',self.motion)

    label_user_id=Label(panel,text="Supervisor")
    self.counter_label()
    label_user_id.place(x=55,y=self.y)
    self.y+=self.height_gap
```

```
self.label_date_time=Label(panel,text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
self.timer_label()
self.label_date_time.place(x=10,y=self.y)
self.y+=self.height_gap

self.label_cursor_label=Label(panel,text="39.02332, 116.98266")
self.label_cursor_label.place(x=10,y=self.y)
self.y+=self.height_gap+20

# button_play_locations=Button(panel,text="play locations")
# button_play_locations.place(x=10,y=y,width=150)
# y+=height_gap+20

label_mouse=Label(panel,text="Enter time to predict")
label_mouse.place(x=10,y=self.y)
self.y+=self.height_gap

OPTIONS=["Date"]+list(range(1,32))
date=StringVar(panel)
date.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,date,*OPTIONS,command=self.set_date)
entry_time_date.place(x=10,y=self.y,width=80)

OPTIONS=["Month"]+list(range(1,13))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_month)
entry_time_date.place(x=90,y=self.y,width=80)
self.y+=self.height_gap

OPTIONS=["Year"]+list(range(2010,2101))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_year)
entry_time_date.place(x=10,y=self.y,width=80)
```

```
        OPTIONS=["Hour"]+list(range(0,24))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_hour)
        entry_time_date.place(x=90,y=self.y,width=80)
        self.y+=self.height_gap

        OPTIONS=["Minute"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_minute)
        entry_time_date.place(x=10,y=self.y,width=80)

        OPTIONS=["Second"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_second)
        entry_time_date.place(x=90,y=self.y,width=90)
        self.y+=self.height_gap+15

        button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        #
button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        # button_predict=Button(panel,text="predict",command=self.make_existing_results_chart)
        button_predict.place(x=20,y=self.y,width=100,height=40)
        self.y+=self.height_gap+20

        self.label_result=Label(panel,text=self.result_label)
        self.label_result.place(x=10,y=self.y)
        self.label_result["text"]=""
        self.y+=self.height_gap

        #canvas.create_rectangle(100,100,100,100,fill="white",outline="white")
        self.canvas.place(x=200,y=10)
        # canvas.delete("all")
```

```
        self.draw_map()
        panel.mainloop()

main=location_prediction()
main.draw_widgets()

#---------
```

PREPROCESSING

```
import pandas as pd
class preprocesss_dataset:
    def __init__(self):
        pass
    def make_dataset(self):
        total_data=[]
        min_long,max_long,min_lat,max_lat=181,0,181,0
        for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory"):
            pass
            for file in files:
                temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory/"+file,"r")
                data=temp_fobj.read()
                data=data.split("\n",)
                for record in data:
                    if len(record)>30:
                        cells=record.split(",",)
                        latitude=cells[0]
                        longitude=cells[1]
                        year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]

hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                        total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                        if float(longitude)<min_long:
                            min_long=float(longitude)
                        elif float(longitude)>max_long:
```

```
                max_long=float(longitude)
            if float(latitude)<min_lat:
                min_lat=float(latitude)
            elif float(latitude)>max_lat:
                max_lat=float(latitude)
    NO_OF_X_POI=10
    NO_OF_Y_POI=10
    unit_longitude=(max_long-min_long)/NO_OF_X_POI
    unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
    X_POI_ranges=[]
    Y_POI_ranges=[]
    POIs=[]
    for ___ in range(NO_OF_X_POI+1):
        X_POI_ranges.append(min_long+___*unit_longitude)
    for ___ in range(NO_OF_Y_POI+1):
        Y_POI_ranges.append(min_lat+___*unit_latitude)
    for i in range(NO_OF_X_POI):
        for j in range(NO_OF_Y_POI):
            POIs.append([i,j])
    temp=[]
    total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
    for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
        temp_index_x=0
        while X_POI_ranges[temp_index_x]<=longitude and
temp_index_x<len(X_POI_ranges)-2:
            temp_index_x+=1
        temp_index_y=0
        while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-
2:
            temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
```

```
            if POIs.index([temp_index_x,temp_index_y]) not in temp:
                temp.append(POIs.index([temp_index_x,temp_index_y]))
        fobj=open("location_dataset.csv","w")
        fobj.write(total_data_for_dataset)
        fobj.close()
object=preprocesss_dataset()
object.make_dataset()
```

EXISTING SYSTEM

```
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
from sklearn.linear_model import LinearRegression


loc=pd.read_csv("location_dataset.csv")

x=loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
y=loc['POI']

print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result=model.predict(x_test)
```

```
#print (confusion_matrix(y_test,result))
print ("MLPClassifier=",accuracy_score(y_test,result))

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
probs=model.predict_proba(x_test)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("BernoulliNB=",accuracy_score(y_test,result))

model=MultinomialNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("MultinomialNB=",accuracy_score(y_test,result))

model=GaussianNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("GaussianNB=",accuracy_score(y_test,result))

# model=LogisticRegression(solver="lbfgs")
# model.fit(x_train,y_train)
# result=model.predict(x_test)
# #print (confusion_matrix(y_test,result))
# print ("LogisticRegression=",accuracy_score(y_test,result))
#
model=RandomForestClassifier(n_estimators=201)
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("RandomForestClassifier=",accuracy_score(y_test,result))
model=LinearRegression()
model.fit(x_train[:-1],y_train[:-1])
result=model.predict(x_test)
```

```
# print ("RandomForestClassifier=",accuracy_score(y_test,result))

print (y_test,result)
```

PROPOSED SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import time,math,os,threading
import numpy as np
import pandas as pd
from time import gmtime,strftime
import time,math
from tkinter import *
root=Tk()
root.resizable(False, False)
root.geometry("1000x600")
root.title("Location Prediction")
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from keras.models import Sequential
from keras.layers import Dense
from keras.wrappers.scikit_learn import KerasRegressor
class location_prediction():
    def __init__(self):
        self.counter=0
        self.x_widget=100
        self.canvas=Canvas(root,bg="#FFFFFF",width=1000,height=550)
        self.dataset=pd.read_csv("location_dataset.csv")
        self.X=self.dataset.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.dataset.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=
1).drop('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
```

```
self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.dataset['latitude']),max(self.datas
et['latitude']),min(self.dataset['longitude']),max(self.dataset['longitude'])

self.x_train,self.x_test,self.y_train,self.y_test=train_test_split(self.X,self.Y,test_size=0.1,random
_state=43)
        self.date=StringVar()
        self.month=StringVar()
        self.year=StringVar()
        self.hour=StringVar()
        self.minute=StringVar()
        self.second=StringVar()
        self.error_label_value=StringVar()
    def draw_map(self):
        self.canvas.create_rectangle(0,0,1000,550,fill="#FFFFFF",outline="#FFFFFF")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*990)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*540)+5
            self.canvas.create_rectangle(x,y,x,y,fill="#000000",outline="#000000")
    def is_valid_inputs(self):
        try:
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            if 1<=date<=31 and 1<=month<=12 and 2008<=year<=2100 and 0<=hour<=23 and
0<=minute<=59 and 0<=second<=59:
                return True
            return False
        except:
            return False
    def predict_result(self):
        if self.is_valid_inputs():
```

```
            self.error_label['text']=""
            self.model=Sequential()
            self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
            self.model.add(Dense(2,kernel_initializer='normal'))
            self.model.compile(loss='mean_squared_error',optimizer='adam')
            self.model.fit(self.X,self.Y,epochs=3)
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            result=self.model.predict(np.array([[year,month,date,hour,minute,second]]))
            if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
                if result[0][0]<self.min_lat:
                    self.min_lat=result[0][0]
                elif result[0][0]>self.max_lat:
                    self.max_lat=result[0][0]
                if result[0][1]<self.min_long:
                    self.min_long=result[0][1]
                elif result[0][1]>self.max_long:
                    self.max_long=result[0][1]
                self.draw_map()
            x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
            self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
            self.error_label['text']=str(result[0][0])+" "+str(result[0][1])
        else:
            self.error_label['text']='error'

    def get_prediction_rate(self):
        self.model=Sequential()
        self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
        self.model.add(Dense(2,kernel_initializer='normal'))
        self.model.compile(loss='mean_squared_error',optimizer='adam')
```

```
    self.model.fit(self.x_train,self.y_train,epochs=3)
    result=self.model.predict(self.x_test)
def draw_widgets(self):
    self.date_entry=Entry(root,width=5,textvariable=self.date)
    self.date_entry.insert(0,"DD")
    self.date_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # month entry
    self.month_entry=Entry(root,width=5,textvariable=self.month)
    self.month_entry.insert(0,"MM")
    self.month_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # year entry
    self.year_entry=Entry(root,width=8,textvariable=self.year)
    self.year_entry.insert(0,"YYYY")
    self.year_entry.place(x=self.x_widget,y=20)
    self.x_widget+=150
    # hour entry
    self.hour_entry=Entry(root,width=5,textvariable=self.hour)
    self.hour_entry.insert(0,"HH")
    self.hour_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # time seperator
    self.sep=Label(root,text=":")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # minute entry
    self.minute_entry=Entry(root,width=5,textvariable=self.minute)
```

```
        self.minute_entry.insert(0,"MM")
        self.minute_entry.place(x=self.x_widget,y=20)
        self.x_widget+=50
        # time seperator
        self.sep=Label(root,text=":")
        self.sep.place(x=self.x_widget,y=20)
        self.x_widget+=15

        # second entry
        self.second_entry=Entry(root,width=5,textvariable=self.second)
        self.second_entry.insert(0,"SS")
        self.second_entry.place(x=self.x_widget,y=20)
        self.x_widget+=150
        # tracking button
        button_predict=Button(root,text="track",command=self.predict_result)
        button_predict.place(x=self.x_widget,y=5,width=100,height=40)
        self.x_widget+=150
        # time seperator
        self.error_label=Label(root,text=self.error_label_value)
        self.error_label.place(x=self.x_widget,y=20)
        # canvas
        # result=self.model.predict(np.array([[2019,10,6,3,38,43]]))
        self.canvas.place(x=0,y=50)#1
        self.draw_map()
        root.mainloop()
object=location_prediction()
object.draw_widgets()
# object.get_prediction_rate()
```

9.2 Sample Screen Shots

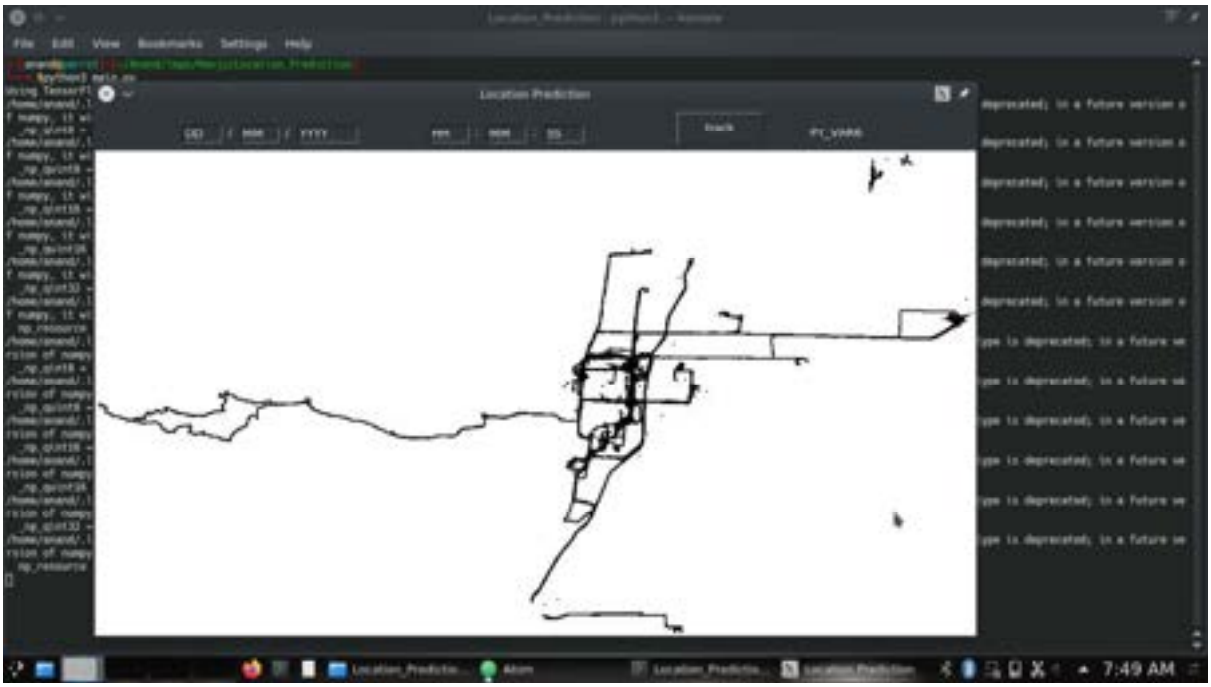

Fig. 1.1

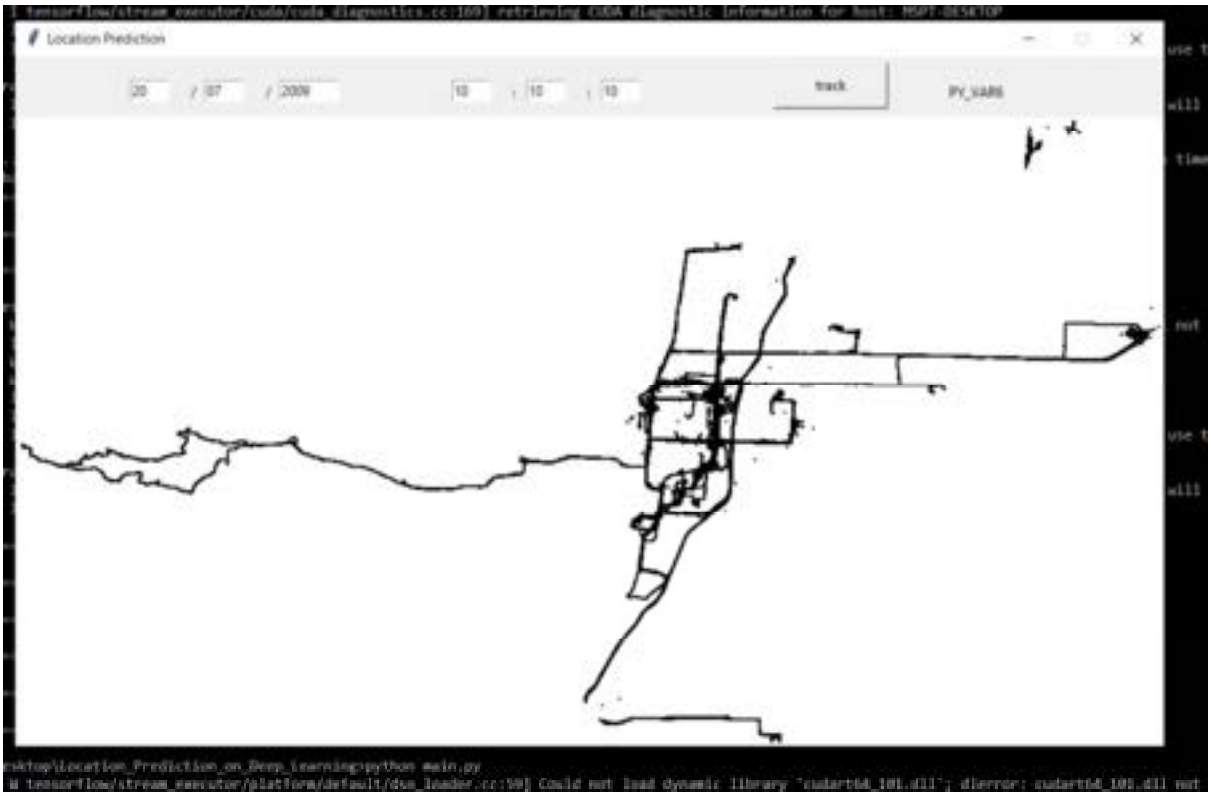

Fig. 1.2

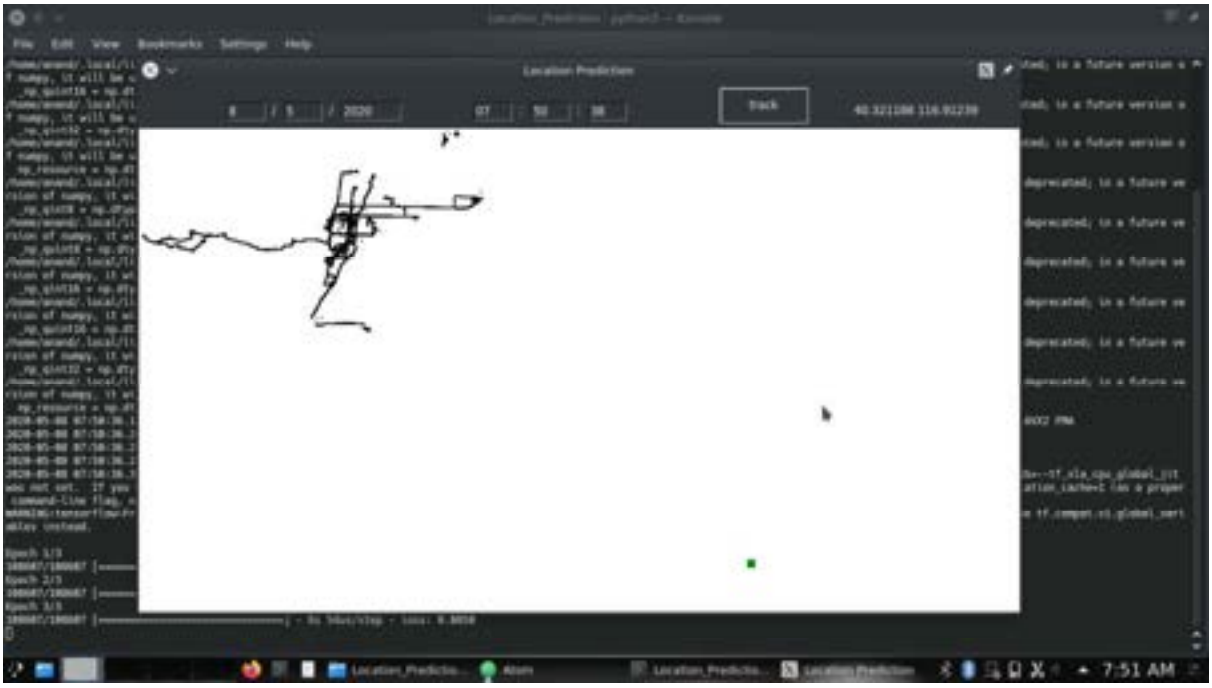

Fig. 1.3

CHAPTER 10

REFERENCE

[1] Cheng, H. Yang, M. R. Lyu, and I. King, ''Where you like to go next:Successive point-of-interest recommendation,'' inProc. IJCAI, vol. 13.2013, pp. 2605–2611.

[2] L. Barabasi, ''The origin of bursts and heavy tails in human dynamics,'' Nature, vol. 435, no. 7039, pp. 207–211, May 2005.

[3] D. Brockmann, L. Hufnagel, and T. Geisel, ''The scaling laws of human travel, ''Nature, vol. 439, no. 7075, pp. 462–465, 2006.

[4] F. Giannotti, M. Nanni, F. Pinelli, and D. Pedreschi, ''Trajectory pattern mining,'' inProc. 13th ACM SIGKDD Int. Conf. Knowl. Discovery Data Mining, 2007, pp. 330–339.

[5] Morzy, ''Prediction of moving object location based on frequent trajec-tories,'' in Proc. Int. Symp. Comput. Inf. Sci., 2006, pp. 583–592.

[6].S. Gambs, M.-O. Killijian, and M. N. del Prado Cortez, ''Next place prediction using mobility Markov chains,'' inProc. 1st Workshop Meas.,Privacy, Mobility, 2012, p. 3.

[7] M. Morzy, ''Mining frequent trajectories of moving objects for location prediction,'' inProc. Int. Workshop Mach. Learn. Data Mining Pattern Recognit., 2007, pp. 667–680.

[8] L. Wang, K. Hu, K. Tao, and X. Yan, ''Mining frequent trajectory pat-tern based on vague space partition,''Knowl.-Based Syst., vol. 50, no. 3,pp. 100–111, 2013.

[9] A. Monreale, F. Pinelli, R. Trasarti, and F. Giannotti, ''WhereNext: A loca-tion predictor on trajectory pattern mining,'' inProc. 15th ACM SIGKDDInt. Conf. Knowl. Discovery Data Mining, 2009, pp. 637–646.

LOCATION PREDICTION USING LEARNING INDIVIDUAL MOVING PREFERENCE AND DEEP LEARNING ALGORITHM

A PROJECT REPORT

Submitted by

RAJPRIYA.S (17601310)

In partial fulfillment for the award of the degree of

FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTER APPLICATIONS

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

May & 2020

<CODE INFINITE>
IT TRAINING SERVICE
Division of Sangam Soft Solutions

PROJECT COMPLETION CERTIFICATE

CODE INFINITE - IT TRAINING SERVICE

#6c- 1st Floor,

Chandrasekar Tower,

Opp KGiSL,

Saravanampatti,

Coimbatore – 35.

Subject: **COMPLETION OF ACADEMIC MAIN PROJECT**

Dear Sir/Madam

This is to certify that **Ms. S.RAJPRIYA (Reg NO: 17601310)**is a final year **MCA** student of **PAAVAI ENGINEERING COLLEGE** has successfully completed her academic main project entitled **"LOCATION PREDICTION FOR LEARNING INDIVIDUAL MOVING PREFERENCE USING DEEP LEARNING ALGORITHM"** in our concern during the period from Dec 2019 to Feb 2020.

Regards

Project Manager

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DECLARATION

I, **RAJPRIYA.S** hereby declare that the project report titled "**LOCATION PREDICTION USING LEARNING INDIVIDUAL MOVING PREFERENCE AND DEEP LEARNING ALGORITHM**" done by me under the guidance of Mrs.M.GEETHA and Mr.R.MANSOOR AHAMAD at **CODE INFINITE IT TRAINING SERVICE, Coimbatore** is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Pachal

S. Raj

SIGNATURE OF THECANDIDATE

ABSTRACT

In this modern era, we can see that there are lot of accidents occurs due to traffics. We lose lot of people because of natural disasters such as tsunami, turnado and etc. We can't prevent traffics and we can't stop natural disasters. But we can alert the people who are going to be in traffic and who are in the area of natural disaster occurrence. Predicting an user's exact location is a complex problem in past years. Till now what we could predict is an user's area where the user will be. The main objective of the paper is to predict an user's exact location using regression methods. The regression methods are supervised learning algorithms in Machine Learning. Through this exact location prediction technique we can know the people who are going to be in a particular traffic area. We can know the people who are in the area where natural disaster going to occur.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	EXPLANASION
1	CNN	Convolutional Neural Network
2	POI	Point Of Interest

CHAPTER 1

INTRODUCTION

1.1 Company Profile

Founded in 2017, CODE INFINITE IT TRAINING SERVICE located at COIMBATORE, has a rich background in developing academic student projects, especially in solving latest IEEE Papers, software Development and continues its entire attention on achieving transcending excellence in the Development , training and Maintenance of Software Projects and Products in Many Areas. Code Infinite vision is to emerge as a leading Software Training Development institute in Coimbatore by providing meticulous training development in the trending technologies. We strive to make the aspiring candidates realize their IT dreams through our job-oriented training development.

Our teams specialize in training, architecture, design, development and integration of large and small systems. A demonstrated ability to meet client needs for complex software solutions by successfully completing contracts and projects on budget is the consultants. We also went to be the most sought-after destination for software training development in Coimbatore .To fosters an environment of superior academic excellence for all aspiring participants which will make them ready to face practical challenges in the work area.

1.2 Objective

Classification makes limited prediction. In our case POI can only be predicted. Unfortunately, the current technology can't predict exact location of the user. Our main objective is to predict exact location using Deep Learning Regression technique.

CHAPTER 2

SYSTEM ANALYSIS

2.1 Existing System

The existing system can predict user's location with the classification machine learning technique. The systems predict only the user's area or POI. It classifies that the inputs belongs to one of the existing POIs. It makes limited prediction rate. There are many machine learning algorithms used in classification. Such as Naive Bayes, Random Forest and etc. The algorithm gives high accuracy of prediction. Supervisor can predict one's POI with a user's history of locations. The data is good enough to predict the user's future location of POI.

The POI can be determined by indexing methods. Indexing methods are deep learning algorithms that groups the inputs without considering its labels.

2.2 Disadvantages

- The existing system may give high accuracy rate of prediction .But unfortunately; the result would be the area of the user.

- Classification makes the system limited.

- Indexing takes high time complexity.

2.3 Proposed System and application

The proposed system can be more consistent in prediction. The system can predict user's accurate location. Instead of the POI, result provides exact latitude and longitude of the user. The proposed system can be used in traffic predictions. When supervisor predicts some people location and the locations are the same places, there will be traffic occurring which may lead accidents. The people can be alerted properly.

On the time of natural disaster occurrence people can be predicted with the time. People can be counted and alerted if they are on the location of natural disaster occurrence. The system predicts by collecting the history location by live tracking. User need to install the android app that sends the GPS location every second to the main server. The exact location prediction will be helpful in saving people.

2.4 Advantages

- There is no need of clustering, which reduces time complexity of clustering.
- The system will give accurate location of user with the attributes of latitude and longitude.
- Deep learning makes more efficient prediction as well as accurate location.

2.5 Feasibility study

Feasibility Study is a high level capsule version of the entire process intended to answer a number of questions like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? Feasibility study is conducted once the problem clearly understood. Feasibility study is necessary to determine that the proposed system is Feasible by considering the technical, Operational, and Economical factors. By having a detailed feasibility study the management will have a clear-cut view of the proposed system.

The following feasibilities are considered for the project in order to ensure that the project is variable and it does not have any major obstructions. Feasibility study encompasses the following things:

- Technical Feasibility
- Operation Feasibility
- Economic Feasibility

In this phase, we study the feasibility of all proposed systems, and pick the best feasible solution for the problem. The feasibility is studied based on three main factors as follows.

2.5.1 Technical Feasibility

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are available readily or not.

Technical Feasibility determines whether the organization has the technology and skills necessary to carry out the project and how this should be obtained. The system can be feasible because of the following grounds:

- ✓ All necessary technology exists to develop the system.
- ✓ This system is too flexible and it can be expanded further.
- ✓ This system can give guarantees of accuracy, ease of use, reliability and the data security.
- ✓ This system can give instant response to inquire.
- ✓ Our project is technically feasible because, all the technology needed for our project is readily available.

Operating System **:** Windows XP or higher

Languages **:** Python

Documentation Tool **:** MS – Word 2016

2.5.2 Operation Feasibility

In this step, we verify different operational factors of the proposed systems like manpower, time etc., whichever solution uses less operational resources, is the best operationally feasible solution.

The solution should also be operationally possible to implement. Operational Feasibility determines if the proposed system satisfied user objectives could be fitted into the current system operation.

- ✓ The methods of processing and presentation are completely accepted by the clients since they can meet all user requirements.
- ✓ The clients have been involved in the planning and development of the system.
- ✓ The proposed system will not cause any problem under any circumstances.
- ✓ Our project is operationally feasible because the time requirements and personnel requirements are satisfied. We are a team of four members and we worked on this project for three working months.

2.5.3 Economic Feasibility

Economically, this project is completely feasible because it requires no extra financial investment and with respect to time, it's completely possible to complete this project in 6 months. In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are more than the investments and expenditure.

Economic Feasibility determines whether the project goal can be within the resource limits allocated to it or not. It must determine whether it is worthwhile to process with the entire project or whether the benefits obtained from the new system are not worth the costs.

Financial benefits must be equal or exceed the costs. In this issue, we should consider:

- ✓ The cost to conduct a full system investigation.
- ✓ The cost of h/w and s/w for the class of application being considered.
- ✓ The development tool.
- ✓ The cost of maintenance etc...

Our project is economically feasible because the cost of development is very minimal when compared to financial benefits of the application.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 Hardware Requirements

System : Intel core i3

Hard disk : 120 gb

Monitor : 15" led

Storage : 20gb

3.2 Software Requirements

OS : Windows 10

Platform : Python

Language : Python

Visual interface : Tkinter-python

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Front End

Python provides various options for developing graphical user interfaces (GUIs). Most important are listed below.

Tkinter − Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this chapter. Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit. Tkinter provides various controls, such as buttons, labels and text boxes used in a GUI application. These controls are commonly called widgets. There are currently 15 types of widgets in Tkinter. We present these widgets as well as a brief description in the following types–

Button

The Button widget is used to display buttons in your application.

Canvas

The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.

Check button

The Check button widget is used to display a number of options as checkboxes. The user can select multiple options at a time.

Entry

The Entry widget is used to display a single-line text field for accepting values from a user.

Frame

The Frame widget is used as a container widget to organize other widgets.

Label

The Label widget is used to provide a single-line caption for other widgets. It can also contain images.

Listbox

The Listbox widget is used to provide a list of options to a user.

Menubutton

The Menubutton widget is used to display menus in your application.

Menu

The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.

Message

The Message widget is used to display multiline text fields for accepting values from a user.

Radiobutton

The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.

Scale

The Scale widget is used to provide a slider widget.

Scrollbar

The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.

Text

The Text widget is used to display text in multiple lines.

Toplevel

The Toplevel widget is used to provide a separate window container.

4.2 Back End

Data set

A data set (or dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question. The data set lists values for each of the variables, such as height and weight of an object, for each member of the data set. Each value is known as a datum. Data sets can also consist of a collection of documents or files. In the open data discipline, data set is the unit to measure the information released in a public open data repository. The European Open Data portal aggregates more than half a million data sets. In this field other definitions have been proposed, but currently there is not an official one. Some other issues (real-time data sources, non-relational data sets, etc.) increases the difficulty to reach a consensus about it.

Properties

Several characteristics define a data set's structure and properties. These include the number and types of the attributes or variables, and various statistical measures applicable to them, such as standard deviation and kurtosis.

The values may be numbers, such as real numbers or integers, for example representing a person's height in centimeters, but may also be nominal data (i.e., not consisting of numerical values), for example representing a person's ethnicity. More generally, values may be of any of the kinds described as a level of measurement. For each variable, the values are normally all of the same kind. However, there may also be missing values, which must be indicated in some way.

In statistics, data sets usually come from actual observations obtained by sampling a statistical population, and each row corresponds to the observations on one element of that population. Data sets may further be generated by algorithms for the purpose of testing certain kinds of software. Some modern statistical analysis software such as SPSS still present their data in the classical data set fashion. If data is missing or suspicious an imputation method may be used to complete a data set.

Classic data sets

Several classic data sets have been used extensively in the statistical literature:

Iris flower data set

Multivariate data set introduced by Ronald Fisher (1936).

MNIST database

Images of handwritten digits commonly used to test classification, clustering, and image processing algorithms.

Categorical data analysis

Data sets used in the book, An Introduction to Categorical Data Analysis.

Robust statistics

Data sets used in Robust Regression and Outlier Detection (Rousseeuw and Leroy,1986). Provided on-line at the University of Cologne.

Time series

Data used in Chatfield's book, The Analysis of Time Series, are provided on-line by StatLib.

Extreme values

Data used in the book, An Introduction to the Statistical Modeling of Extreme Values are a snapshot of the data as it was provided on-line by Stuart Coles, the book's author.

Intermediate Language

TensorFlow is a software library or framework, designed by the Google team to implement machine learning and deep learning concepts in the easiest manner. It combines the computational algebra of optimization techniques for easy calculation of many mathematical expressions.

The official website of TensorFlow is mentioned below −

www.tensorflow.org

Let us now consider the following important features of TensorFlow −

- It includes a feature of that defines, optimizes and calculates mathematical expressions easily with the help of multi-dimensional arrays called tensors.
- It includes a programming support of deep neural networks and machine learning techniques.
- It includes a high scalable feature of computation with various data sets.
- TensorFlow uses GPU computing, automating management. It also includes a unique feature of optimization of same memory and the data used.

Why is TensorFlow So Popular?

TensorFlow is well-documented and includes plenty of machine learning libraries. It offers a few important functionalities and methods for the same.

TensorFlow is also called a "Google" product. It includes a variety of machine learning and deep learning algorithms. TensorFlow can train and run deep neural networks for handwritten digit classification, image recognition, word embedding and creation of various sequence models.

Tensor Data Structure

Tensors are used as the basic data structures in TensorFlow language. Tensors represent the connecting edges in any flow diagram called the Data Flow Graph. Tensors are defined as multidimensional array or list.

Tensors are identified by the following three parameters −

Rank

Unit of dimensionality described within tensor is called rank. It identifies the number of dimensions of the tensor. A rank of a tensor can be described as the order or n-dimensions of a tensor defined.

Shape

The number of rows and columns together define the shape of Tensor.

Type

Type describes the data type assigned to Tensor's elements.

CHAPTER 5

PROJECT DESCRIPTION

5.1 Overview of the Project

A major problem facing by Government is lack of knowledge of people in the area where natural disaster occurs. It is too difficult to predict the accident in traffic also. The current technology can predict an user's area only. It can be used to determine the location. But when it comes less number of POI's, it would not be accurate. The more number of POI's increases the complexity. Time is precious on the time of natural disaster as well as traffic. Poor prediction can lead us to lose lot of lives. To predict the exact location classification doesn't work well. We have history of location with time of the user. This raises an important question: "How can we turn data into useful information that can predict the exact location ?" Although data mining has been around for more than two decades, its potential is only being realized now. Data mining combines statistical analysis, machine learning and database technology to extract hidden patterns and relationships from large databases. The two most common modelling objectives are classification and prediction. Classification models predict categorical labels (discrete, unordered) while prediction models predict continuous-valued functions. Regression is a Machine Learning technique that can predict with numerical values which is perfect in predicting user's accurate location.

5.2 Module Description Modules

The system comprises of three major modules as follows:

- Designing and Data Pre-processing
- Predicting with Existing System
- Admin Module

5.2.1 Designing and Data Pre-processing

This module includes designing supervisor page and pre-processing dataset. Supervisor page is the main interaction page where the supervisor does all the operations such as tracking and prediction.

Supervisor page:

- This interface can show the map of history of location.
- Supervisor can#
- Enter time to predict.
- The interface will predict the location.
- The predicted location will be plotted in map.

Pre-processing dataset:

- Geo-life dataset from Microsoft is used to train the model.
- The given data is pre-processed into perfect form of dataset.

5.2.2 Predicting with Existing System

- The dataset is tested with the models. The model is loaded by the classification algorithms such as Naive Bayes, MLP Classifier, Random Forest and etc.
- The model is trained by the dataset. The dataset is divided into two main parts. They are training and testing data. The training data is used to train the model.
- The testing data is used to test the model. The prediction rate is 99.99% in our system.

5.2.3 Admin Module

- Supervisor directly interacts with this module. The data sent by the user is stored as dataset. The prediction is done by Linear regression algorithm.
- A algorithm model is assigned with Linear regression algorithm. The stored dataset is trained with model as training set.
- Supervisor have to enter time to predict the user's location. The time will be the testing part of the prediction. The model will give exact location of the user.

5.3 E-R Diagram

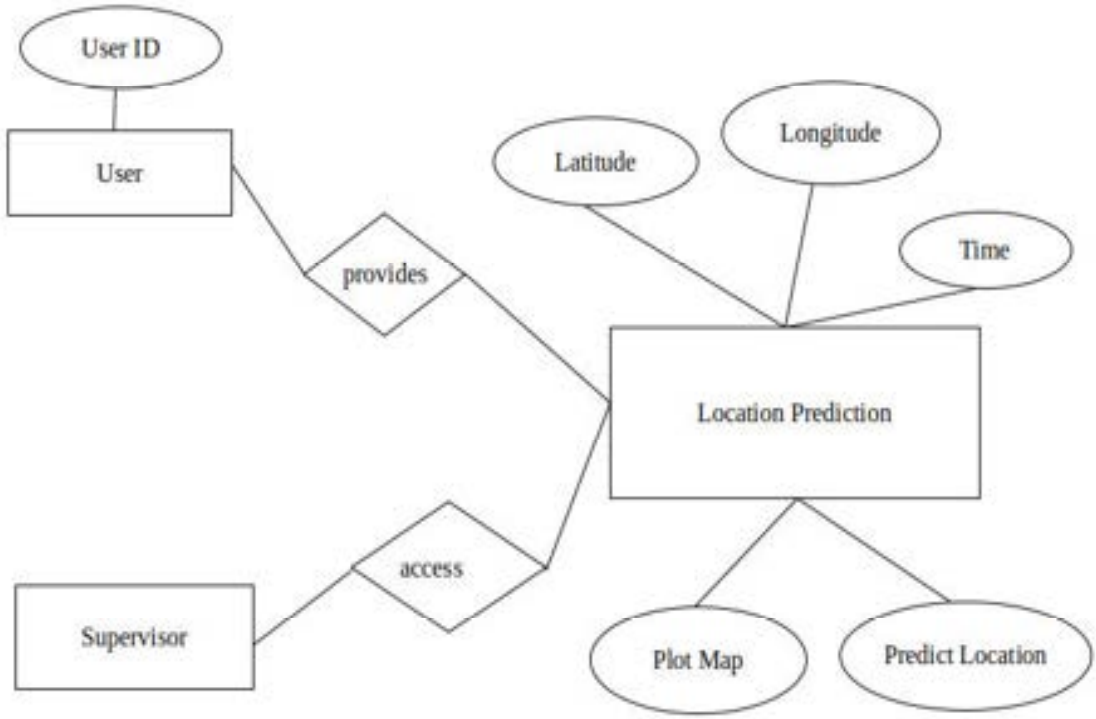

Figure 5.3 E-R Diagram

5.4 Use case Diagram

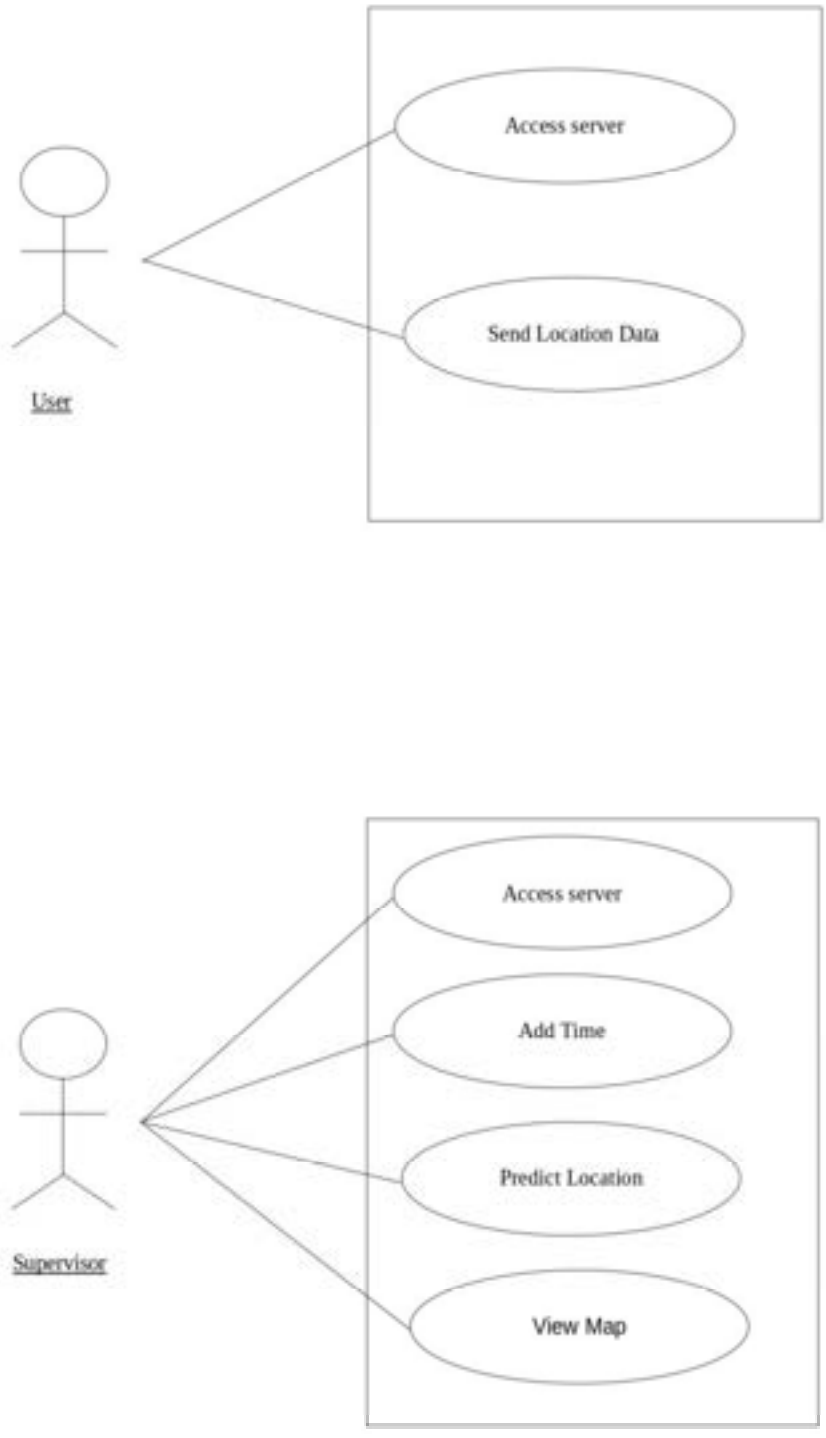

Figure 5.4 Use case Diagram

5.5 Sequence Diagram

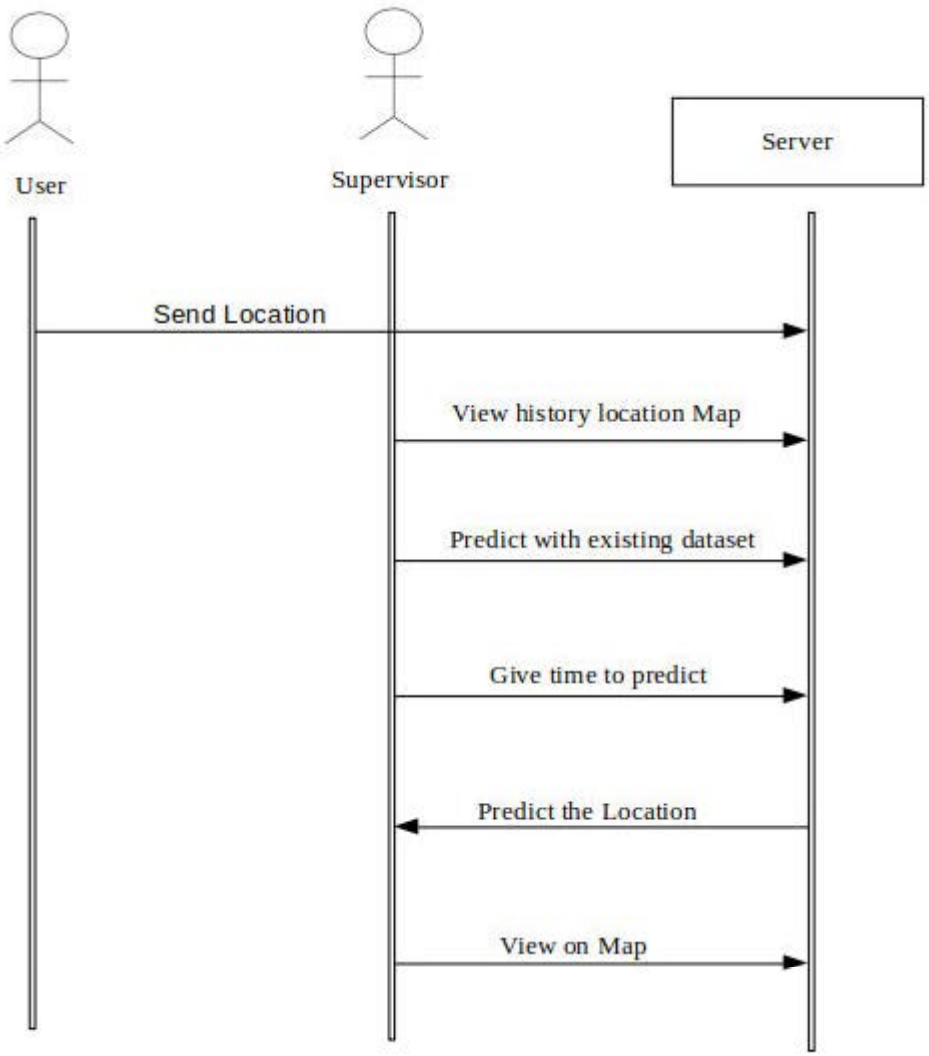

Figure 5.5 Sequence Diagram

5.6 Activity Diagram

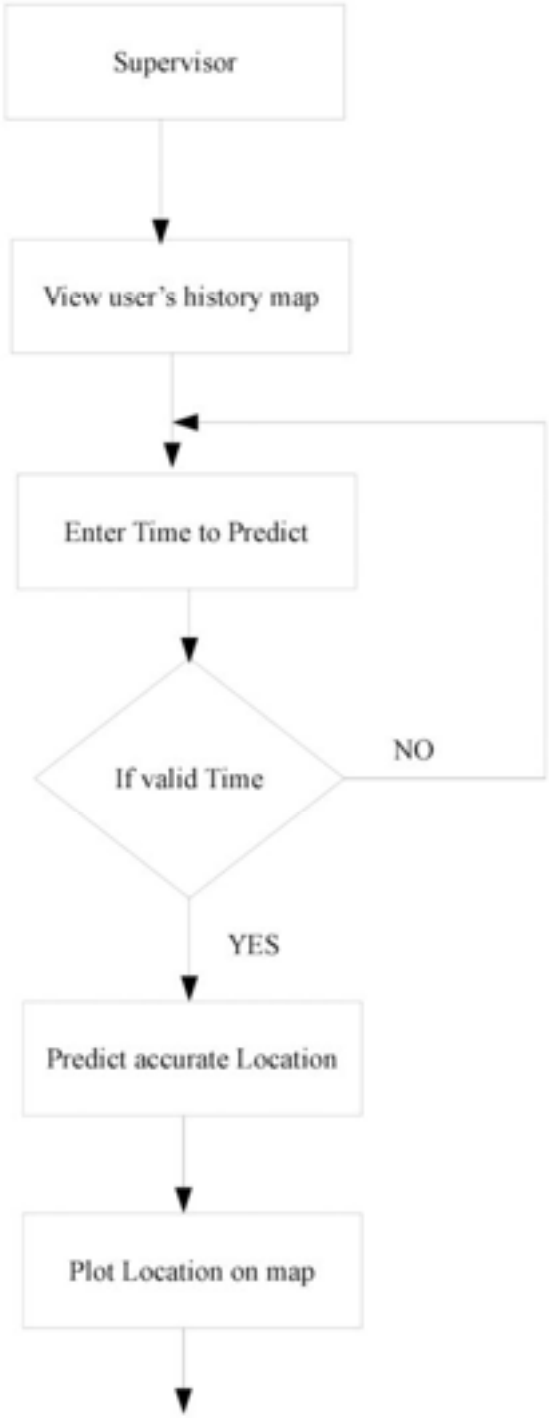

Figure 5.6 Activity Diagram

5.7 Class Diagram

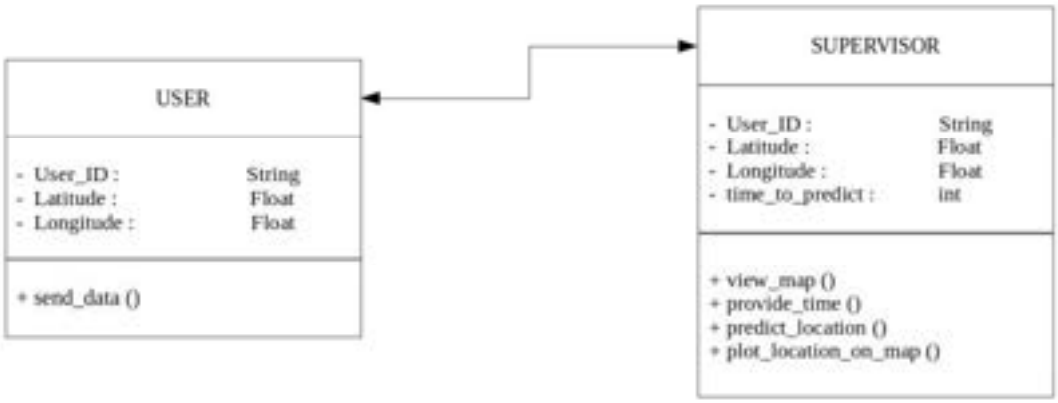

Figure 5.7 Class Diagram

CHAPTER 6

SYSTEM TESTING

As the project is on bit large scale, we always need testing to make it successful. If each component work properly in all respect and gives desired output for all kind of inputs then project is said to be successful. So the conclusion is-to make the project successful, it needs to be tested. The testing done here was System Testing checking whether the user requirements were satisfied. The code for the new system has been written completely using PYTHON as the coding language.

The new system has been tested well with the help of the users and all the applications have been verified from every nook and corner of the user. Although some applications were found to be erroneous these applications have been corrected before being implemented. The flow of the forms has been found to be very much in accordance with the actual flow of data.

6.1 Levels of Testing

In order to uncover the errors present in different phases we have the concept of levels of testing. A series of testing is done for the proposed system before the system is ready for the user acceptance testing.

6.2 Types of Testing

6.2.1 Unit Testing

Unit testing focuses verification efforts on the smallest unit of the software design, the module. This is also known as "Module Testing". The modules are tested separately. This testing carried out during programming stage itself. In this testing each module is found to be working satisfactorily as regards to the expected output from the module.

6.2.2 Integration Testing

Data can be grossed across an interface; one module can have adverse efforts on another. Integration testing is systematic testing for construction the program structure while at the same time conducting tests to uncover errors associated with in the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here correction is difficult because the isolation of cause is complicate by the vast expense of the entire program. Thus in the integration testing stop, all the errors uncovered are corrected for the text testing steps.

6.2.3 System Testing

System testing is the stage of implementation that is aimed at ensuring that the system works accurately and efficiently for live operation commences.

6.2.4 Validation Testing

At the conclusion of integration testing software is completely assembled as a package, interfacing errors have been uncovered and corrected and a final series of software tests begins, validation test begins. Validation test can be defined in many ways. But the simple definition is that validation succeeds when the software function in a manner that can reasonably expected by the customer. After validation test has been conducted one of two possible conditions exists.

One is the function or performance characteristics confirm to specifications and are accepted and the other is deviation from specification is uncovered and a deficiency list is created. Proposed system under consideration has been tested by using validation testing and found to be working satisfactorily.

6.2.5 Output Testing

After performing validation testing, the next step is output testing of the proposed system since no system could be useful if it does not produce the required output in the specified format. Asking the users about the format required by them tests the outputs generated by the system under consideration. Here the output format is considered in two ways, one is on the screen and other is the printed format.

The output format on the screen is found to be correct as the format was designed in the system designed phase according to the user needs.

For the hard copy also the output comes as the specified requirements by the users. Hence output testing does not result any corrections in the system .

6.2.6 User Acceptance Testing

User acceptance of a system is the key factor of the success of any system. The system under study is tested for the user acceptance by constantly keeping in touch with the prospective system users at the time of developing and making changes wherever required.

CHAPTER 7

SYSTEM IMPLEMENTATION

Early location prediction studies often resorted to time-series analysis. The basic idea is to view trajectory data as location sequences, and then use traditional time series mining techniques such as the Markov chain to predict the next item in the sequence. For example, Gamb set al.employs the Markov chain to first model then previous locations visited by the user, called the mobility Markov chain (MMC) model, and then predicts the next location via the transfer probability between different locations.

To con-sider spatial movement constraints, Chenget al. proposes a model that built personalized Markov chains by utiliz-ing the user's location history sequence. They introduce a spatial constraint on the localized region and factorize the transfer probability matrix of personalized Markov chains to predict the user's next movement. Although Markov chains are widely used in sequence analysis, this approach does not sufficiently consider the temporal information in GPS data.

By exploring follow-up research on student card consumption trajectories in camps, Barabasi and Brockmannet al.demonstrate that individual human mobility behavior sometimes shows regular spatial and tem-poral rules. Based on this assumption, Morzy ,extracts regular moving rules by mining users' frequent tra-jectories to predict location.

To better integrate temporal information, Giannottiet al.present a model that considers the time interval between two successive user locations and builds a decision tree to model these associated rules(called a T-pattern) between the temporal and spatial spaces. Relying on the T-patterns, location prediction strategies are further proposed system.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 Conclusion

The Location Prediction, historically viewed as a necessary burden in Government, transportation offices, can be completely automated through an inefficient online software program. The benefits of implementing this technology will lead us to save lot of lives. The system can be automated to predict an user's location and alert the user. This system can be further enhanced and expanded.

8.2 Future Enhancements

The future system will be predicting individual moving preference as well as social interaction prediction.In future work, we plan to focus on analyzing evolving human mobility patterns based on data stream mining techniques.

CHAPTER 9

APPENDIX

9.1 Sample Source Code

MAKING DATASET PROGRAM:

```
import os

total_data=[]
min_long,max_long,min_lat,max_lat=181,0,181,0
for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory"):
    for file in files:
        temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory/"+file,"r")
        data=temp_fobj.read()
        data=data.split("\n",)
        for record in data:
            if len(record)>30:
                cells=record.split(",",)
                latitude=cells[0]
                longitude=cells[1]
                year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]
                hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                if float(longitude)<min_long:
                    min_long=float(longitude)
                elif float(longitude)>max_long:
                    max_long=float(longitude)
                if float(latitude)<min_lat:
                    min_lat=float(latitude)
                elif float(latitude)>max_lat:
```

```
                max_lat=float(latitude)
NO_OF_X_POI=10
NO_OF_Y_POI=10
unit_longitude=(max_long-min_long)/NO_OF_X_POI
unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
X_POI_ranges=[]
Y_POI_ranges=[]
POIs=[]
for ___ in range(NO_OF_X_POI+1):
    X_POI_ranges.append(min_long+___*unit_longitude)
for ___ in range(NO_OF_Y_POI+1):
    Y_POI_ranges.append(min_lat+___*unit_latitude)
for i in range(NO_OF_X_POI):
    for j in range(NO_OF_Y_POI):
        POIs.append([i,j])
temp=[]
total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
# print (len(total_data))
for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
    temp_index_x=0
    while X_POI_ranges[temp_index_x]<=longitude and temp_index_x<len(X_POI_ranges)-2:
        temp_index_x+=1
    temp_index_y=0
    while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-2:
        temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
    if POIs.index([temp_index_x,temp_index_y]) not in temp:
        temp.append(POIs.index([temp_index_x,temp_index_y]))
fobj=open("location_dataset.csv","w")
fobj.write(total_data_for_dataset)
fobj.close()
```

IMPLEMENTING EXISTING SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import pandas as pd
import matplotlib.pyplot as plt
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
loc=pd.read_csv("location_dataset.csv")

x=loc.drop('POI',axis=1)
y=loc['POI']

# print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result_of_MLP=model.predict(x_test)
score_of_MLP=accuracy_score(y_test,result_of_MLP)

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
result_of_NB_bern=model.predict(x_test)
score_of_NB_bern=accuracy_score(y_test,result_of_NB_bern)
```

```
model=MultinomialNB()
model.fit(x_train,y_train)
result_of_NB_multi=model.predict(x_test)
score_of_NB_multi=accuracy_score(y_test,result_of_NB_multi)

model=GaussianNB()
model.fit(x_train,y_train)
result_of_NB_gaus=model.predict(x_test)
score_of_NB_gaus=accuracy_score(y_test,result_of_NB_gaus)

model=RandomForestClassifier(n_estimators=403)
model.fit(x_train,y_train)
result_of_random=model.predict(x_test)
score_of_random=accuracy_score(y_test,result_of_random)

plt.style.use("ggplot")
algos=["MLP","BernoulliNB","MultinomialNB","GaussianNB","Random Forest"]
rates=[score_of_MLP*100,score_of_NB_bern*100,score_of_NB_multi*100,score_of_NB_gaus
*100,score_of_random*100]
x=[i for i, _ in enumerate(algos)]
plt.bar(x,rates,color="blue")
plt.xlabel("Algorithm")
plt.ylabel("Prediction Rate")
plt.title("POI predictions")
plt.xticks(x,algos)
plt.show()
```

IMPLEMENTING PROPOSED SYSTEM

```
# !/usr/bin/env python
# coding: utf-8

import time
import os

from pandas import read_csv
from mpl_toolkits.mplot3d import Axes3D
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from sklearn.preprocessing import StandardScaler,PolynomialFeatures
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LinearRegression
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from tkinter import *
from time import gmtime,strftime
import math

from PIL import Image, ImageTk
import numpy as np
#
import pandas as pd
from sklearn.model_selection import train_test_split

import matplotlib.pyplot as plt
```

```
panel=Tk()
panel.resizable(False, False)
panel.geometry("920x520")
panel.title("Location Prediction")
class location_prediction():
    def __init__(self):
        self.y=10
        self.height_gap=30
        self.counter=0
        self.ind=0
        self.canvas=Canvas(panel,bg="#00c8b4",width=700,height=500)
        self.loc=pd.read_csv("location_dataset.csv")
        self.existing_X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
        self.existing_Y=self.loc['POI']
        # print (x.shape,y.shape)

self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.loc['latitude']),max(self.loc['latit
ude']),min(self.loc['longitude']),max(self.loc['longitude'])

self.existing_x_train,self.existing_x_test,self.existing_y_train,self.existing_y_test=train_test_spli
t(self.existing_X,self.existing_Y,test_size=0.1,random_state=43)
        self.X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.loc.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=1).dr
op('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
        # print (self.Y.head())
        self.date_=0
        self.month_=0
        self.year_=0
        self.hour_=0
        self.minute_=0
        self.second_=0
        self.result_label=StringVar()

    def counter_label(self):
        #label_user_id.config(text="")
```

```
        pass

    def sigmoid(self,data):
        pass
        return [1/(1+math.exp((-1)*(data[0][0]))),1/(1+math.exp((-1)*(data[0][1])))]

    def predict_with_linear_regression(self):
        model=LinearRegression()
        # model=PolynomialFeatures()
        model.fit(self.X,self.Y)
        # print (self.data)

data_to_be_predicted=np.array([[self.date_,self.month_,self.year_,self.hour_,self.minute_,self.se
cond_]])
        result=model.predict(data_to_be_predicted)
        if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
            if result[0][0]<self.min_lat:
                self.min_lat=result[0][0]#-(self.min_lat/20)
            elif result[0][0]>self.max_lat:
                self.max_lat=result[0][0]#+(self.max_lat/20)
            if result[0][1]<self.min_long:
                self.min_long=result[0][1]#-(self.min_long/20)
            elif result[0][1]>self.max_long:
                self.max_long=result[0][1]#+(self.max_long/20)
            self.draw_map()
        x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
        self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
        # x,y=(((self.y_test[0][0]*90-self.min_lat)/(self.max_lat-
self.min_lat))*690)+2,(((self.y_test[0][1]*180-self.min_long)/(self.max_long-
self.min_long))*490)+2
        # self.canvas.create_rectangle(x-2,y-2,x+2,y+2,fill="blue",outline="blue")
        # print (dir(plt))
        print (str(result[0][0])+" "+str(result[0][1]))
        self.label_result["text"]=str(result[0][0])+"\n"+str(result[0][1])
```

```
        # print (result)
        # ------------------

    def draw_map(self,color="white"):
        # print (self.Y)
        # print (len(self.Y))
        self.canvas.create_rectangle(0,0,700,500,fill="#00c8b4",outline="#00c8b4")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*690)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*490)+5
            # if ind==100:print (self.Y["longitude"][ind],self.min_lat,self.Y["longitude"][ind]-
self.min_lat)
            self.canvas.create_rectangle(x,y,x,y,fill=color,outline=color)

    def timer_label(self):
        def timer():
            global counter
            self.counter+=1
            # print (self.counter)
            self.label_date_time.config(text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
            self.label_date_time.after(1000,timer)
        timer()

    def motion(self,event):
        x,y=event.x,event.y
        # print('{}, {}'.format(x, y))
        loc_x,loc_y=((x*(self.max_lat-self.min_lat))/700+self.min_lat),((y*(self.max_long-
self.min_long))/500+self.min_long)
        self.label_cursor_label.config(text=str(round(loc_x,5))+" "+str(round(loc_y,5)))

    def make_existing_results_chart(self):
        pass

    def set_date(self,value):
        self.date_=0 if value=="Date" else value
```

```
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_month(self,value):
    self.month_=0 if value=="Month" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_year(self,value):
    self.year_=0 if value=="Year" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_hour(self,value):
    self.hour_=0 if value=="Hour" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_minute(self,value):
    self.minute_=0 if value=="Minute" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_second(self,value):
    self.second_=0 if value=="Second" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def draw_widgets(self):
    load=Image.open("src/user_icon.png")
    load=load.resize((150,150))
    render=ImageTk.PhotoImage(load)
    img=Label(image=render)
    img.image=render
    img.place(x=20, y=self.y)
    self.y+=160
    panel.bind('<Motion>',self.motion)

    label_user_id=Label(panel,text="Supervisor")
    self.counter_label()
    label_user_id.place(x=55,y=self.y)
    self.y+=self.height_gap
```

```
self.label_date_time=Label(panel,text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
self.timer_label()
self.label_date_time.place(x=10,y=self.y)
self.y+=self.height_gap

self.label_cursor_label=Label(panel,text="39.02332, 116.98266")
self.label_cursor_label.place(x=10,y=self.y)
self.y+=self.height_gap+20

# button_play_locations=Button(panel,text="play locations")
# button_play_locations.place(x=10,y=y,width=150)
# y+=height_gap+20

label_mouse=Label(panel,text="Enter time to predict")
label_mouse.place(x=10,y=self.y)
self.y+=self.height_gap

OPTIONS=["Date"]+list(range(1,32))
date=StringVar(panel)
date.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,date,*OPTIONS,command=self.set_date)
entry_time_date.place(x=10,y=self.y,width=80)

OPTIONS=["Month"]+list(range(1,13))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_month)
entry_time_date.place(x=90,y=self.y,width=80)
self.y+=self.height_gap

OPTIONS=["Year"]+list(range(2010,2101))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_year)
entry_time_date.place(x=10,y=self.y,width=80)
```

```
        OPTIONS=["Hour"]+list(range(0,24))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_hour)
        entry_time_date.place(x=90,y=self.y,width=80)
        self.y+=self.height_gap

        OPTIONS=["Minute"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_minute)
        entry_time_date.place(x=10,y=self.y,width=80)

        OPTIONS=["Second"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_second)
        entry_time_date.place(x=90,y=self.y,width=90)
        self.y+=self.height_gap+15

        button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        #
button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        # button_predict=Button(panel,text="predict",command=self.make_existing_results_chart)
        button_predict.place(x=20,y=self.y,width=100,height=40)
        self.y+=self.height_gap+20

        self.label_result=Label(panel,text=self.result_label)
        self.label_result.place(x=10,y=self.y)
        self.label_result["text"]=""
        self.y+=self.height_gap

        #canvas.create_rectangle(100,100,100,100,fill="white",outline="white")
        self.canvas.place(x=200,y=10)
        # canvas.delete("all")
```

```
        self.draw_map()
        panel.mainloop()

main=location_prediction()
main.draw_widgets()

#---------
```

PREPROCESSING

```
import pandas as pd
class preprocesss_dataset:
    def __init__(self):
        pass
    def make_dataset(self):
        total_data=[]
        min_long,max_long,min_lat,max_lat=181,0,181,0
        for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory"):
            pass
            for file in files:
                temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory/"+file,"r")
                data=temp_fobj.read()
                data=data.split("\n",)
                for record in data:
                    if len(record)>30:
                        cells=record.split(",",)
                        latitude=cells[0]
                        longitude=cells[1]
                        year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]

hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                        total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                        if float(longitude)<min_long:
                            min_long=float(longitude)
                        elif float(longitude)>max_long:
```

```
                max_long=float(longitude)
            if float(latitude)<min_lat:
                min_lat=float(latitude)
            elif float(latitude)>max_lat:
                max_lat=float(latitude)
    NO_OF_X_POI=10
    NO_OF_Y_POI=10
    unit_longitude=(max_long-min_long)/NO_OF_X_POI
    unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
    X_POI_ranges=[]
    Y_POI_ranges=[]
    POIs=[]
    for ___ in range(NO_OF_X_POI+1):
        X_POI_ranges.append(min_long+___*unit_longitude)
    for ___ in range(NO_OF_Y_POI+1):
        Y_POI_ranges.append(min_lat+___*unit_latitude)
    for i in range(NO_OF_X_POI):
        for j in range(NO_OF_Y_POI):
            POIs.append([i,j])
    temp=[]
    total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
    for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
        temp_index_x=0
        while X_POI_ranges[temp_index_x]<=longitude and
temp_index_x<len(X_POI_ranges)-2:
            temp_index_x+=1
        temp_index_y=0
        while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-
2:
            temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
```

```
            if POIs.index([temp_index_x,temp_index_y]) not in temp:
                temp.append(POIs.index([temp_index_x,temp_index_y]))
        fobj=open("location_dataset.csv","w")
        fobj.write(total_data_for_dataset)
        fobj.close()
object=preprocesss_dataset()
object.make_dataset()
```

EXISTING SYSTEM

```
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
from sklearn.linear_model import LinearRegression


loc=pd.read_csv("location_dataset.csv")

x=loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
y=loc['POI']

print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result=model.predict(x_test)
```

```
#print (confusion_matrix(y_test,result))
print ("MLPClassifier=",accuracy_score(y_test,result))

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
probs=model.predict_proba(x_test)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("BernoulliNB=",accuracy_score(y_test,result))

model=MultinomialNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("MultinomialNB=",accuracy_score(y_test,result))

model=GaussianNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("GaussianNB=",accuracy_score(y_test,result))

# model=LogisticRegression(solver="lbfgs")
# model.fit(x_train,y_train)
# result=model.predict(x_test)
# #print (confusion_matrix(y_test,result))
# print ("LogisticRegression=",accuracy_score(y_test,result))
#
model=RandomForestClassifier(n_estimators=201)
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("RandomForestClassifier=",accuracy_score(y_test,result))
model=LinearRegression()
model.fit(x_train[:-1],y_train[:-1])
result=model.predict(x_test)
```

```
# print ("RandomForestClassifier=",accuracy_score(y_test,result))

print (y_test,result)
```

PROPOSED SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import time,math,os,threading
import numpy as np
import pandas as pd
from time import gmtime,strftime
import time,math
from tkinter import *
root=Tk()
root.resizable(False, False)
root.geometry("1000x600")
root.title("Location Prediction")
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from keras.models import Sequential
from keras.layers import Dense
from keras.wrappers.scikit_learn import KerasRegressor
class location_prediction():
    def __init__(self):
        self.counter=0
        self.x_widget=100
        self.canvas=Canvas(root,bg="#FFFFFF",width=1000,height=550)
        self.dataset=pd.read_csv("location_dataset.csv")
        self.X=self.dataset.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.dataset.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=
1).drop('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
```

```
self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.dataset['latitude']),max(self.datas
et['latitude']),min(self.dataset['longitude']),max(self.dataset['longitude'])

self.x_train,self.x_test,self.y_train,self.y_test=train_test_split(self.X,self.Y,test_size=0.1,random
_state=43)
        self.date=StringVar()
        self.month=StringVar()
        self.year=StringVar()
        self.hour=StringVar()
        self.minute=StringVar()
        self.second=StringVar()
        self.error_label_value=StringVar()
    def draw_map(self):
        self.canvas.create_rectangle(0,0,1000,550,fill="#FFFFFF",outline="#FFFFFF")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*990)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*540)+5
            self.canvas.create_rectangle(x,y,x,y,fill="#000000",outline="#000000")
    def is_valid_inputs(self):
        try:
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            if 1<=date<=31 and 1<=month<=12 and 2008<=year<=2100 and 0<=hour<=23 and
0<=minute<=59 and 0<=second<=59:
                return True
            return False
        except:
            return False
    def predict_result(self):
        if self.is_valid_inputs():
```

```
            self.error_label['text']=""
            self.model=Sequential()
            self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
            self.model.add(Dense(2,kernel_initializer='normal'))
            self.model.compile(loss='mean_squared_error',optimizer='adam')
            self.model.fit(self.X,self.Y,epochs=3)
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            result=self.model.predict(np.array([[year,month,date,hour,minute,second]]))
            if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
                if result[0][0]<self.min_lat:
                    self.min_lat=result[0][0]
                elif result[0][0]>self.max_lat:
                    self.max_lat=result[0][0]
                if result[0][1]<self.min_long:
                    self.min_long=result[0][1]
                elif result[0][1]>self.max_long:
                    self.max_long=result[0][1]
                self.draw_map()
            x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
            self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
            self.error_label['text']=str(result[0][0])+" "+str(result[0][1])
        else:
            self.error_label['text']='error'

    def get_prediction_rate(self):
        self.model=Sequential()
        self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
        self.model.add(Dense(2,kernel_initializer='normal'))
        self.model.compile(loss='mean_squared_error',optimizer='adam')
```

```
    self.model.fit(self.x_train,self.y_train,epochs=3)
    result=self.model.predict(self.x_test)
def draw_widgets(self):
    self.date_entry=Entry(root,width=5,textvariable=self.date)
    self.date_entry.insert(0,"DD")
    self.date_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # month entry
    self.month_entry=Entry(root,width=5,textvariable=self.month)
    self.month_entry.insert(0,"MM")
    self.month_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # year entry
    self.year_entry=Entry(root,width=8,textvariable=self.year)
    self.year_entry.insert(0,"YYYY")
    self.year_entry.place(x=self.x_widget,y=20)
    self.x_widget+=150
    # hour entry
    self.hour_entry=Entry(root,width=5,textvariable=self.hour)
    self.hour_entry.insert(0,"HH")
    self.hour_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # time seperator
    self.sep=Label(root,text=":")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # minute entry
    self.minute_entry=Entry(root,width=5,textvariable=self.minute)
```

```
        self.minute_entry.insert(0,"MM")
        self.minute_entry.place(x=self.x_widget,y=20)
        self.x_widget+=50
        # time seperator
        self.sep=Label(root,text=":")
        self.sep.place(x=self.x_widget,y=20)
        self.x_widget+=15

        # second entry
        self.second_entry=Entry(root,width=5,textvariable=self.second)
        self.second_entry.insert(0,"SS")
        self.second_entry.place(x=self.x_widget,y=20)
        self.x_widget+=150
        # tracking button
        button_predict=Button(root,text="track",command=self.predict_result)
        button_predict.place(x=self.x_widget,y=5,width=100,height=40)
        self.x_widget+=150
        # time seperator
        self.error_label=Label(root,text=self.error_label_value)
        self.error_label.place(x=self.x_widget,y=20)
        # canvas
        # result=self.model.predict(np.array([[2019,10,6,3,38,43]]))
        self.canvas.place(x=0,y=50)#1
        self.draw_map()
        root.mainloop()
object=location_prediction()
object.draw_widgets()
# object.get_prediction_rate()
```

9.2 Sample Screen Shots

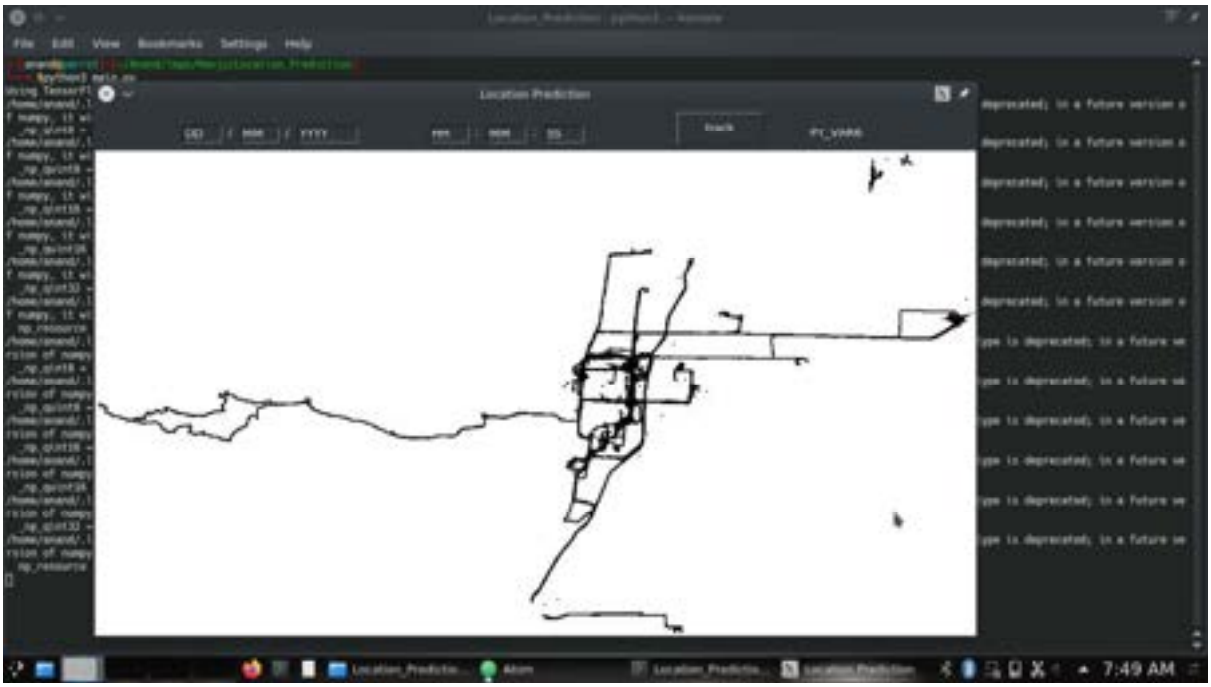

Fig. 1.1

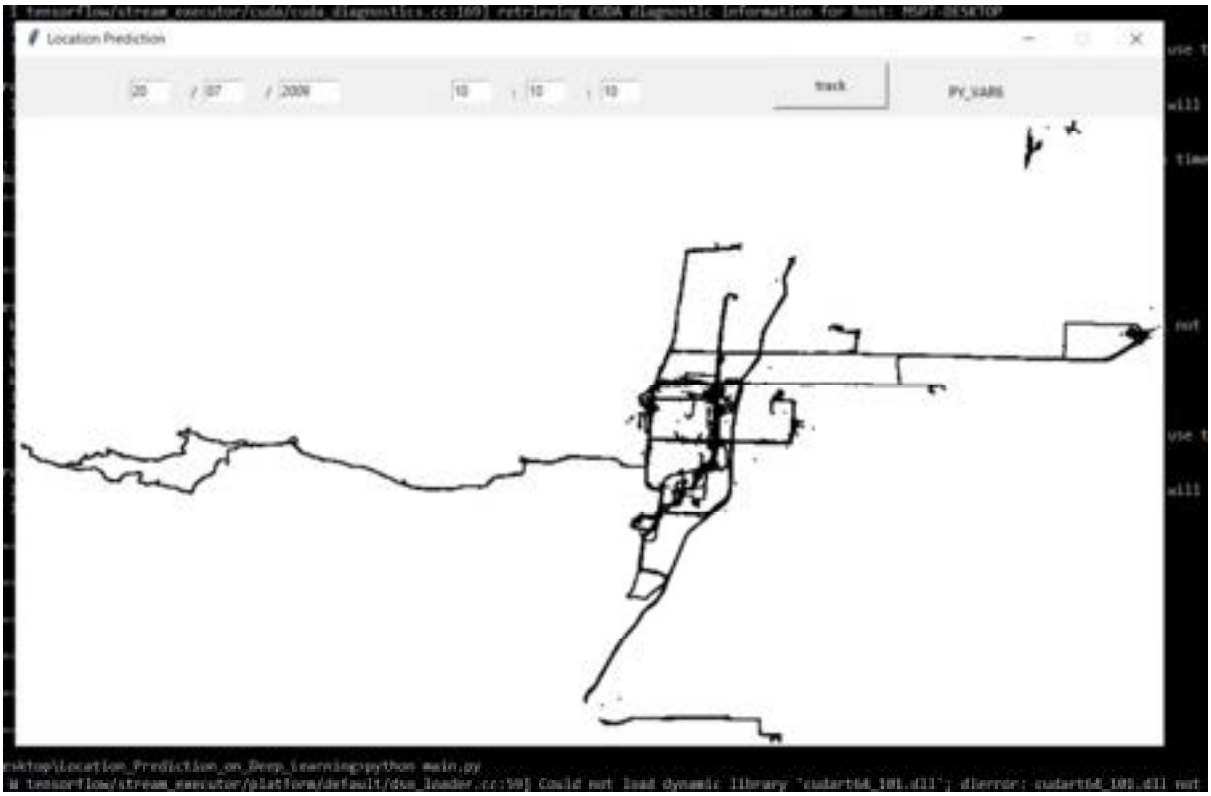

Fig. 1.2

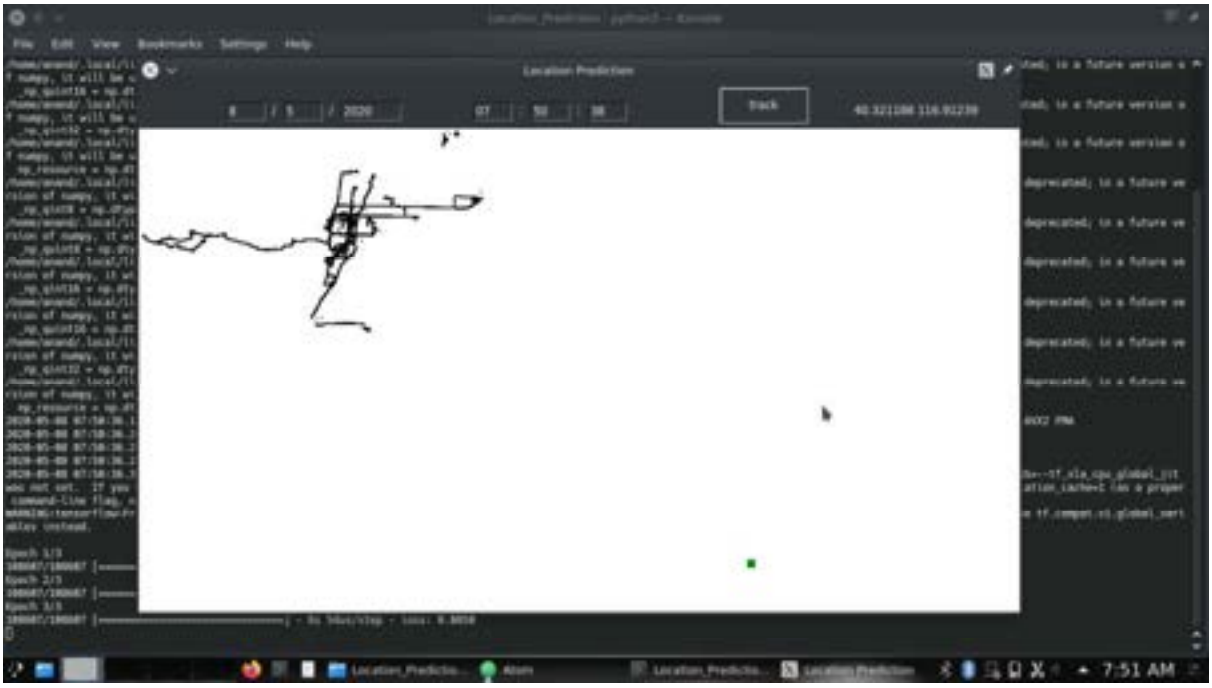

Fig. 1.3

CHAPTER 10

REFERENCE

[1] Cheng, H. Yang, M. R. Lyu, and I. King, ''Where you like to go next:Successive point-of-interest recommendation,'' inProc. IJCAI, vol. 13.2013, pp. 2605–2611.

[2] L. Barabasi, ''The origin of bursts and heavy tails in human dynamics,'' Nature, vol. 435, no. 7039, pp. 207–211, May 2005.

[3] D. Brockmann, L. Hufnagel, and T. Geisel, ''The scaling laws of human travel, ''Nature, vol. 439, no. 7075, pp. 462–465, 2006.

[4] F. Giannotti, M. Nanni, F. Pinelli, and D. Pedreschi, ''Trajectory pattern mining,'' inProc. 13th ACM SIGKDD Int. Conf. Knowl. Discovery Data Mining, 2007, pp. 330–339.

[5] Morzy, ''Prediction of moving object location based on frequent trajec-tories,'' in Proc. Int. Symp. Comput. Inf. Sci., 2006, pp. 583–592.

[6].S. Gambs, M.-O. Killijian, and M. N. del Prado Cortez, ''Next place prediction using mobility Markov chains,'' inProc. 1st Workshop Meas.,Privacy, Mobility, 2012, p. 3.

[7] M. Morzy, ''Mining frequent trajectories of moving objects for location prediction,'' inProc. Int. Workshop Mach. Learn. Data Mining Pattern Recognit., 2007, pp. 667–680.

[8] L. Wang, K. Hu, K. Tao, and X. Yan, ''Mining frequent trajectory pat-tern based on vague space partition,''Knowl.-Based Syst., vol. 50, no. 3,pp. 100–111, 2013.

[9] A. Monreale, F. Pinelli, R. Trasarti, and F. Giannotti, ''WhereNext: A loca-tion predictor on trajectory pattern mining,'' inProc. 15th ACM SIGKDDInt. Conf. Knowl. Discovery Data Mining, 2009, pp. 637–646.

CONFIDENTIALITY–PRESERVING DE-DUPLICATION CLOUD STORAGE WITH PUBLIC CLOUD AUDITING

A PROJECT REPORT

Submitted by

SHREEDHAR S (17601315)

In partial fulfillment for the award of the degree of

FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTERAPPLICATIONS

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

May &2020

LIVE STREAM TECHNOLOGIES
<<Consume I/P & Produce O/P>>

Date: 31.03.2020

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that **Ms. KIRTHIKA.K.R [Reg. No:17601305]** Final Year **MCA** Student of **PAAVAI ENGINEERING COLLEGE, NAMAKKAL** has completed her Internship project entitled **DRIVER DROWSINESS DETECTION SYSTEM** in our Organization in **PYTHON TECHNOLOGY** during the period from **JANUARY 2020 to MARCH 2020.**

During this period, her performance and character have been good. We wish all the success in her future endeavors.

For **LIVE STREAM TECHNOLOGIES**

Authorized Signatory

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DECLARATION

I, **K.R.KIRTHIKA** hereby declare that the project report titled **"DRIVER DROWSINESS DETECTION SYSTEM"** done by me under the guidance of **V.ANNAPOORANI,M.C.A.,M.PHIL.,(Ph.D)** and **Mr.M.ESWAR** at **LIVE STREAM TECHNOLOGIES, Coimbatore** is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Namakkal

K.R. Kirthika.

SIGNATURE OF THE CANDIDATE

ABSTRACT

In this modern era, we can see that there are lot of accidents occurs due to traffics. We lose lot of people because of natural disasters such as tsunami, turnado and etc. We can't prevent traffics and we can't stop natural disasters. But we can alert the people who are going to be in traffic and who are in the area of natural disaster occurrence. Predicting an user's exact location is a complex problem in past years. Till now what we could predict is an user's area where the user will be. The main objective of the paper is to predict an user's exact location using regression methods. The regression methods are supervised learning algorithms in Machine Learning. Through this exact location prediction technique we can know the people who are going to be in a particular traffic area. We can know the people who are in the area where natural disaster going to occur.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	EXPLANASION
1	CNN	Convolutional Neural Network
2	POI	Point Of Interest

CHAPTER 1

INTRODUCTION

1.1 Company Profile

Founded in 2017, CODE INFINITE IT TRAINING SERVICE located at COIMBATORE, has a rich background in developing academic student projects, especially in solving latest IEEE Papers, software Development and continues its entire attention on achieving transcending excellence in the Development , training and Maintenance of Software Projects and Products in Many Areas. Code Infinite vision is to emerge as a leading Software Training Development institute in Coimbatore by providing meticulous training development in the trending technologies. We strive to make the aspiring candidates realize their IT dreams through our job-oriented training development.

Our teams specialize in training, architecture, design, development and integration of large and small systems. A demonstrated ability to meet client needs for complex software solutions by successfully completing contracts and projects on budget is the consultants. We also went to be the most sought-after destination for software training development in Coimbatore .To fosters an environment of superior academic excellence for all aspiring participants which will make them ready to face practical challenges in the work area.

1.2 Objective

Classification makes limited prediction. In our case POI can only be predicted. Unfortunately, the current technology can't predict exact location of the user. Our main objective is to predict exact location using Deep Learning Regression technique.

CHAPTER 2

SYSTEM ANALYSIS

2.1 Existing System

The existing system can predict user's location with the classification machine learning technique. The systems predict only the user's area or POI. It classifies that the inputs belongs to one of the existing POIs. It makes limited prediction rate. There are many machine learning algorithms used in classification. Such as Naive Bayes, Random Forest and etc. The algorithm gives high accuracy of prediction. Supervisor can predict one's POI with a user's history of locations. The data is good enough to predict the user's future location of POI.

The POI can be determined by indexing methods. Indexing methods are deep learning algorithms that groups the inputs without considering its labels.

2.2 Disadvantages

- The existing system may give high accuracy rate of prediction .But unfortunately; the result would be the area of the user.

- Classification makes the system limited.

- Indexing takes high time complexity.

2.3 Proposed System and application

The proposed system can be more consistent in prediction. The system can predict user's accurate location. Instead of the POI, result provides exact latitude and longitude of the user. The proposed system can be used in traffic predictions. When supervisor predicts some people location and the locations are the same places, there will be traffic occurring which may lead accidents. The people can be alerted properly.

On the time of natural disaster occurrence people can be predicted with the time. People can be counted and alerted if they are on the location of natural disaster occurrence. The system predicts by collecting the history location by live tracking. User need to install the android app that sends the GPS location every second to the main server. The exact location prediction will be helpful in saving people.

2.4 Advantages

- There is no need of clustering, which reduces time complexity of clustering.
- The system will give accurate location of user with the attributes of latitude and longitude.
- Deep learning makes more efficient prediction as well as accurate location.

2.5 Feasibility study

Feasibility Study is a high level capsule version of the entire process intended to answer a number of questions like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? Feasibility study is conducted once the problem clearly understood. Feasibility study is necessary to determine that the proposed system is Feasible by considering the technical, Operational, and Economical factors. By having a detailed feasibility study the management will have a clear-cut view of the proposed system.

The following feasibilities are considered for the project in order to ensure that the project is variable and it does not have any major obstructions. Feasibility study encompasses the following things:

- Technical Feasibility
- Operation Feasibility
- Economic Feasibility

In this phase, we study the feasibility of all proposed systems, and pick the best feasible solution for the problem. The feasibility is studied based on three main factors as follows.

2.5.1 Technical Feasibility

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are available readily or not.

Technical Feasibility determines whether the organization has the technology and skills necessary to carry out the project and how this should be obtained. The system can be feasible because of the following grounds:

- ✓ All necessary technology exists to develop the system.
- ✓ This system is too flexible and it can be expanded further.
- ✓ This system can give guarantees of accuracy, ease of use, reliability and the data security.
- ✓ This system can give instant response to inquire.
- ✓ Our project is technically feasible because, all the technology needed for our project is readily available.

Operating System **:** Windows XP or higher

Languages **:** Python

Documentation Tool **:** MS – Word 2016

2.5.2 Operation Feasibility

In this step, we verify different operational factors of the proposed systems like manpower, time etc., whichever solution uses less operational resources, is the best operationally feasible solution.

The solution should also be operationally possible to implement. Operational Feasibility determines if the proposed system satisfied user objectives could be fitted into the current system operation.

- ✓ The methods of processing and presentation are completely accepted by the clients since they can meet all user requirements.
- ✓ The clients have been involved in the planning and development of the system.
- ✓ The proposed system will not cause any problem under any circumstances.
- ✓ Our project is operationally feasible because the time requirements and personnel requirements are satisfied. We are a team of four members and we worked on this project for three working months.

2.5.3 Economic Feasibility

Economically, this project is completely feasible because it requires no extra financial investment and with respect to time, it's completely possible to complete this project in 6 months. In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are more than the investments and expenditure.

Economic Feasibility determines whether the project goal can be within the resource limits allocated to it or not. It must determine whether it is worthwhile to process with the entire project or whether the benefits obtained from the new system are not worth the costs.

Financial benefits must be equal or exceed the costs. In this issue, we should consider:

- ✓ The cost to conduct a full system investigation.
- ✓ The cost of h/w and s/w for the class of application being considered.
- ✓ The development tool.
- ✓ The cost of maintenance etc...

Our project is economically feasible because the cost of development is very minimal when compared to financial benefits of the application.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 Hardware Requirements

System : Intel core i3

Hard disk : 120 gb

Monitor : 15" led

Storage : 20gb

3.2 Software Requirements

OS : Windows 10

Platform : Python

Language : Python

Visual interface : Tkinter-python

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Front End

Python provides various options for developing graphical user interfaces (GUIs). Most important are listed below.

Tkinter − Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this chapter. Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit. Tkinter provides various controls, such as buttons, labels and text boxes used in a GUI application. These controls are commonly called widgets. There are currently 15 types of widgets in Tkinter. We present these widgets as well as a brief description in the following types–

Button

The Button widget is used to display buttons in your application.

Canvas

The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.

Check button

The Check button widget is used to display a number of options as checkboxes. The user can select multiple options at a time.

Entry

The Entry widget is used to display a single-line text field for accepting values from a user.

Frame

The Frame widget is used as a container widget to organize other widgets.

Label

The Label widget is used to provide a single-line caption for other widgets. It can also contain images.

Listbox

The Listbox widget is used to provide a list of options to a user.

Menubutton

The Menubutton widget is used to display menus in your application.

Menu

The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.

Message

The Message widget is used to display multiline text fields for accepting values from a user.

Radiobutton

The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.

Scale

The Scale widget is used to provide a slider widget.

Scrollbar

The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.

Text

The Text widget is used to display text in multiple lines.

Toplevel

The Toplevel widget is used to provide a separate window container.

4.2 Back End

Data set

A data set (or dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question. The data set lists values for each of the variables, such as height and weight of an object, for each member of the data set. Each value is known as a datum. Data sets can also consist of a collection of documents or files. In the open data discipline, data set is the unit to measure the information released in a public open data repository. The European Open Data portal aggregates more than half a million data sets. In this field other definitions have been proposed, but currently there is not an official one. Some other issues (real-time data sources, non-relational data sets, etc.) increases the difficulty to reach a consensus about it.

Properties

Several characteristics define a data set's structure and properties. These include the number and types of the attributes or variables, and various statistical measures applicable to them, such as standard deviation and kurtosis.

The values may be numbers, such as real numbers or integers, for example representing a person's height in centimeters, but may also be nominal data (i.e., not consisting of numerical values), for example representing a person's ethnicity. More generally, values may be of any of the kinds described as a level of measurement. For each variable, the values are normally all of the same kind. However, there may also be missing values, which must be indicated in some way.

In statistics, data sets usually come from actual observations obtained by sampling a statistical population, and each row corresponds to the observations on one element of that population. Data sets may further be generated by algorithms for the purpose of testing certain kinds of software. Some modern statistical analysis software such as SPSS still present their data in the classical data set fashion. If data is missing or suspicious an imputation method may be used to complete a data set.

Classic data sets

Several classic data sets have been used extensively in the statistical literature:

Iris flower data set

Multivariate data set introduced by Ronald Fisher (1936).

MNIST database

Images of handwritten digits commonly used to test classification, clustering, and image processing algorithms.

Categorical data analysis

Data sets used in the book, An Introduction to Categorical Data Analysis.

Robust statistics

Data sets used in Robust Regression and Outlier Detection (Rousseeuw and Leroy,1986). Provided on-line at the University of Cologne.

Time series

Data used in Chatfield's book, The Analysis of Time Series, are provided on-line by StatLib.

Extreme values

Data used in the book, An Introduction to the Statistical Modeling of Extreme Values are a snapshot of the data as it was provided on-line by Stuart Coles, the book's author.

Intermediate Language

TensorFlow is a software library or framework, designed by the Google team to implement machine learning and deep learning concepts in the easiest manner. It combines the computational algebra of optimization techniques for easy calculation of many mathematical expressions.

The official website of TensorFlow is mentioned below −

www.tensorflow.org

Let us now consider the following important features of TensorFlow −

- It includes a feature of that defines, optimizes and calculates mathematical expressions easily with the help of multi-dimensional arrays called tensors.
- It includes a programming support of deep neural networks and machine learning techniques.
- It includes a high scalable feature of computation with various data sets.
- TensorFlow uses GPU computing, automating management. It also includes a unique feature of optimization of same memory and the data used.

Why is TensorFlow So Popular?

TensorFlow is well-documented and includes plenty of machine learning libraries. It offers a few important functionalities and methods for the same.

TensorFlow is also called a "Google" product. It includes a variety of machine learning and deep learning algorithms. TensorFlow can train and run deep neural networks for handwritten digit classification, image recognition, word embedding and creation of various sequence models.

Tensor Data Structure

Tensors are used as the basic data structures in TensorFlow language. Tensors represent the connecting edges in any flow diagram called the Data Flow Graph. Tensors are defined as multidimensional array or list.

Tensors are identified by the following three parameters −

Rank

Unit of dimensionality described within tensor is called rank. It identifies the number of dimensions of the tensor. A rank of a tensor can be described as the order or n-dimensions of a tensor defined.

Shape

The number of rows and columns together define the shape of Tensor.

Type

Type describes the data type assigned to Tensor's elements.

CHAPTER 5

PROJECT DESCRIPTION

5.1 Overview of the Project

A major problem facing by Government is lack of knowledge of people in the area where natural disaster occurs. It is too difficult to predict the accident in traffic also. The current technology can predict an user's area only. It can be used to determine the location. But when it comes less number of POI's, it would not be accurate. The more number of POI's increases the complexity. Time is precious on the time of natural disaster as well as traffic. Poor prediction can lead us to lose lot of lives. To predict the exact location classification doesn't work well. We have history of location with time of the user. This raises an important question: "How can we turn data into useful information that can predict the exact location ?" Although data mining has been around for more than two decades, its potential is only being realized now. Data mining combines statistical analysis, machine learning and database technology to extract hidden patterns and relationships from large databases. The two most common modelling objectives are classification and prediction. Classification models predict categorical labels (discrete, unordered) while prediction models predict continuous-valued functions. Regression is a Machine Learning technique that can predict with numerical values which is perfect in predicting user's accurate location.

5.2 Module Description Modules

The system comprises of three major modules as follows:

- Designing and Data Pre-processing
- Predicting with Existing System
- Admin Module

5.2.1 Designing and Data Pre-processing

This module includes designing supervisor page and pre-processing dataset. Supervisor page is the main interaction page where the supervisor does all the operations such as tracking and prediction.

Supervisor page:

- This interface can show the map of history of location.
- Supervisor can#
- Enter time to predict.
- The interface will predict the location.
- The predicted location will be plotted in map.

Pre-processing dataset:

- Geo-life dataset from Microsoft is used to train the model.
- The given data is pre-processed into perfect form of dataset.

5.2.2 Predicting with Existing System

- The dataset is tested with the models. The model is loaded by the classification algorithms such as Naive Bayes, MLP Classifier, Random Forest and etc.
- The model is trained by the dataset. The dataset is divided into two main parts. They are training and testing data. The training data is used to train the model.
- The testing data is used to test the model. The prediction rate is 99.99% in our system.

5.2.3 Admin Module

- Supervisor directly interacts with this module. The data sent by the user is stored as dataset. The prediction is done by Linear regression algorithm.
- A algorithm model is assigned with Linear regression algorithm. The stored dataset is trained with model as training set.
- Supervisor have to enter time to predict the user's location. The time will be the testing part of the prediction. The model will give exact location of the user.

5.3 E-R Diagram

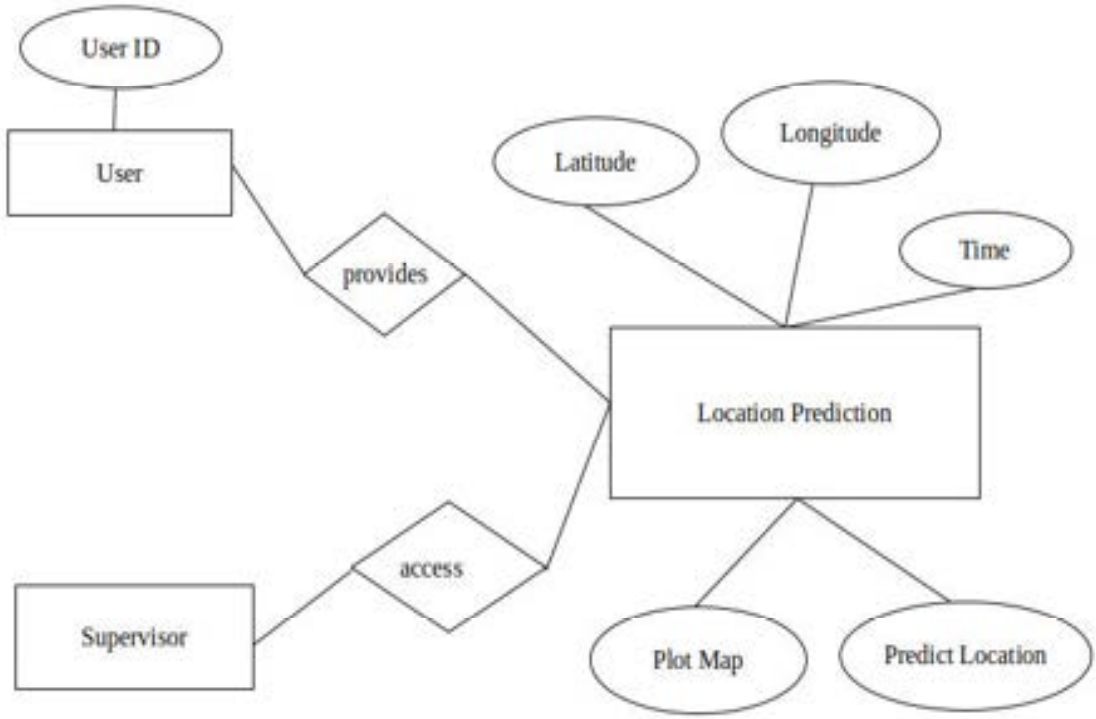

Figure 5.3 E-R Diagram

5.4 Use case Diagram

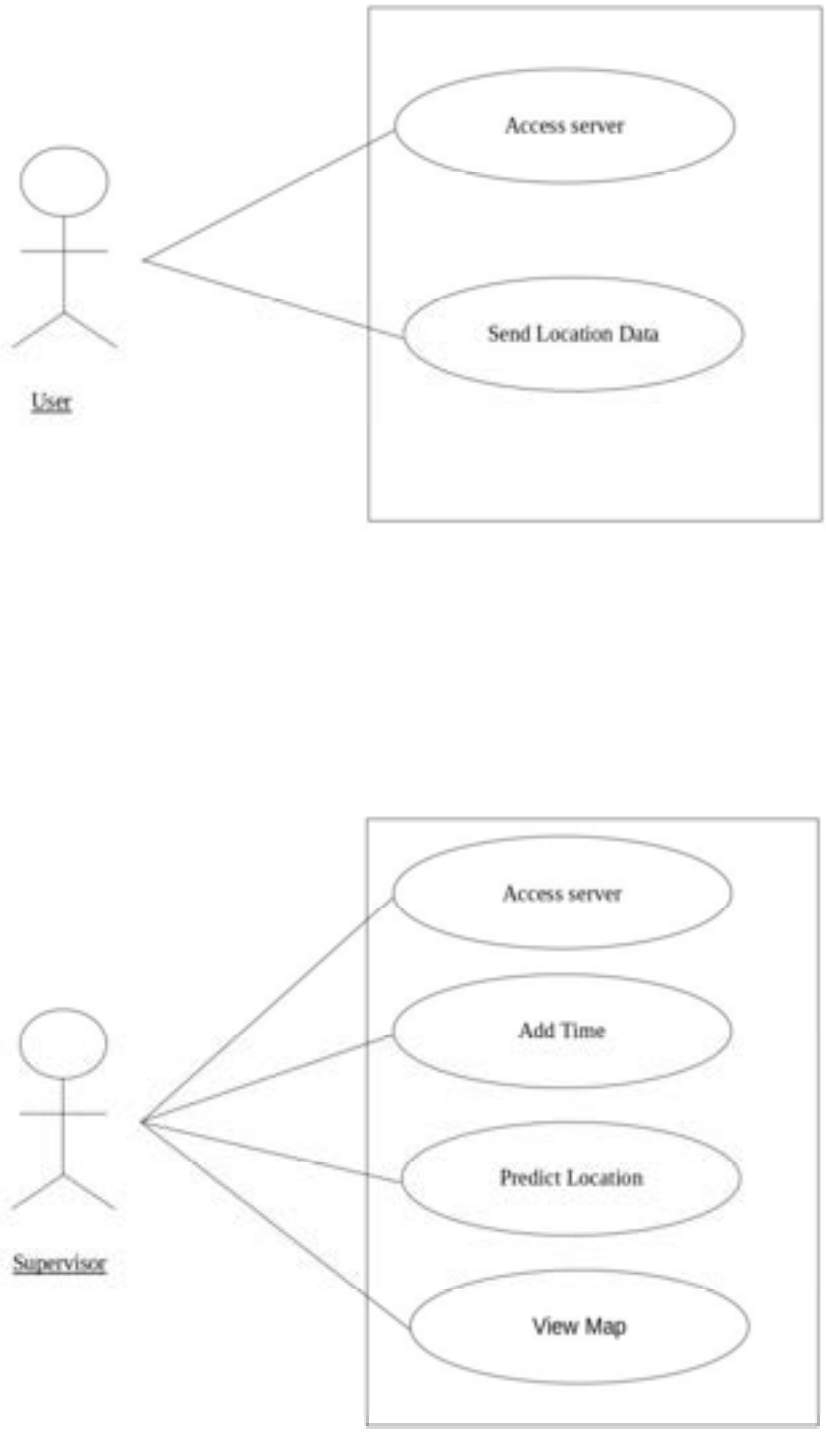

Figure 5.4 Use case Diagram

5.5 Sequence Diagram

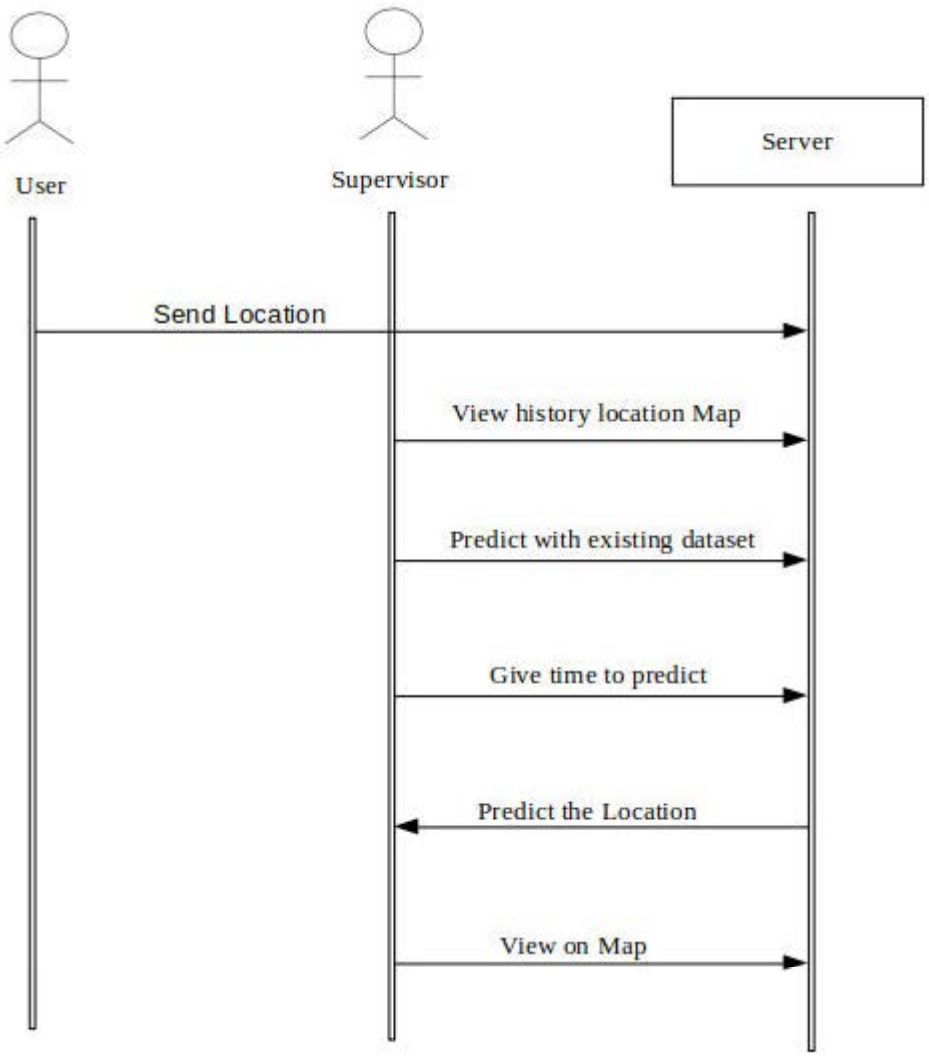

Figure 5.5 Sequence Diagram

5.6 Activity Diagram

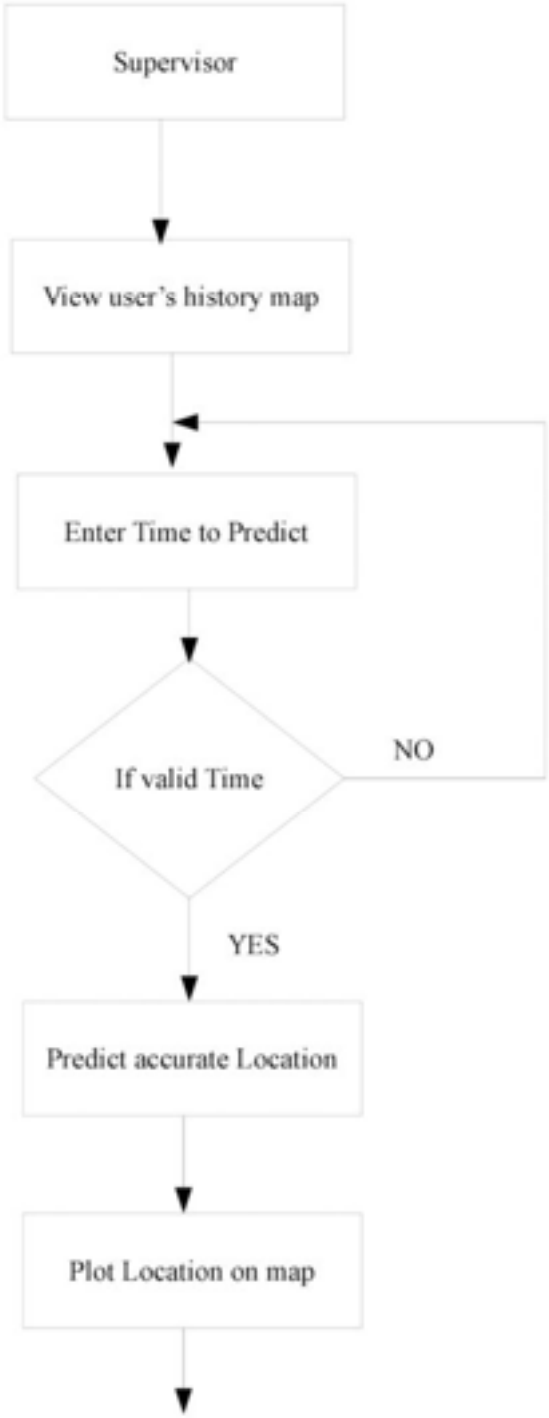

Figure 5.6 Activity Diagram

5.7 Class Diagram

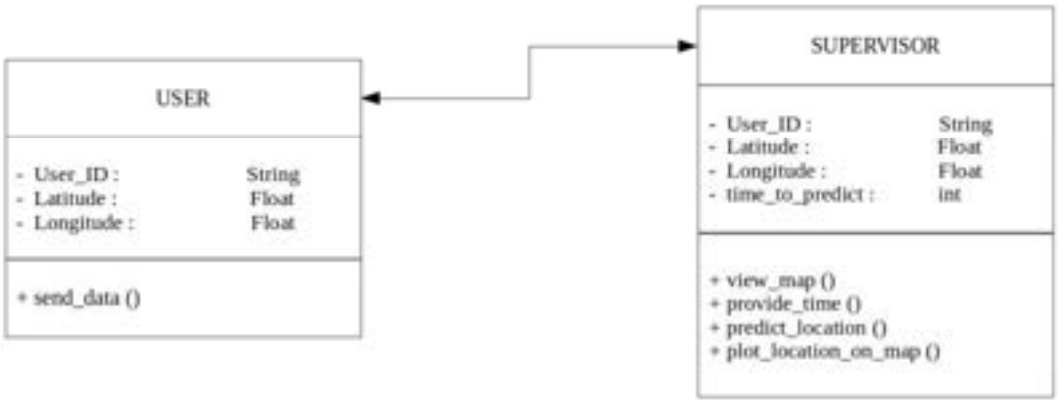

Figure 5.7 Class Diagram

CHAPTER 6

SYSTEM TESTING

As the project is on bit large scale, we always need testing to make it successful. If each component work properly in all respect and gives desired output for all kind of inputs then project is said to be successful. So the conclusion is-to make the project successful, it needs to be tested. The testing done here was System Testing checking whether the user requirements were satisfied. The code for the new system has been written completely using PYTHON as the coding language.

The new system has been tested well with the help of the users and all the applications have been verified from every nook and corner of the user. Although some applications were found to be erroneous these applications have been corrected before being implemented. The flow of the forms has been found to be very much in accordance with the actual flow of data.

6.1 Levels of Testing

In order to uncover the errors present in different phases we have the concept of levels of testing. A series of testing is done for the proposed system before the system is ready for the user acceptance testing.

6.2 Types of Testing

6.2.1 Unit Testing

Unit testing focuses verification efforts on the smallest unit of the software design, the module. This is also known as "Module Testing". The modules are tested separately. This testing carried out during programming stage itself. In this testing each module is found to be working satisfactorily as regards to the expected output from the module.

6.2.2 Integration Testing

Data can be grossed across an interface; one module can have adverse efforts on another. Integration testing is systematic testing for construction the program structure while at the same time conducting tests to uncover errors associated with in the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here correction is difficult because the isolation of cause is complicate by the vast expense of the entire program. Thus in the integration testing stop, all the errors uncovered are corrected for the text testing steps.

6.2.3 System Testing

System testing is the stage of implementation that is aimed at ensuring that the system works accurately and efficiently for live operation commences.

6.2.4 Validation Testing

At the conclusion of integration testing software is completely assembled as a package, interfacing errors have been uncovered and corrected and a final series of software tests begins, validation test begins. Validation test can be defined in many ways. But the simple definition is that validation succeeds when the software function in a manner that can reasonably expected by the customer. After validation test has been conducted one of two possible conditions exists.

One is the function or performance characteristics confirm to specifications and are accepted and the other is deviation from specification is uncovered and a deficiency list is created. Proposed system under consideration has been tested by using validation testing and found to be working satisfactorily.

6.2.5 Output Testing

After performing validation testing, the next step is output testing of the proposed system since no system could be useful if it does not produce the required output in the specified format. Asking the users about the format required by them tests the outputs generated by the system under consideration. Here the output format is considered in two ways, one is on the screen and other is the printed format.

The output format on the screen is found to be correct as the format was designed in the system designed phase according to the user needs.

For the hard copy also the output comes as the specified requirements by the users. Hence output testing does not result any corrections in the system .

6.2.6 User Acceptance Testing

User acceptance of a system is the key factor of the success of any system. The system under study is tested for the user acceptance by constantly keeping in touch with the prospective system users at the time of developing and making changes wherever required.

CHAPTER 7

SYSTEM IMPLEMENTATION

Early location prediction studies often resorted to time-series analysis. The basic idea is to view trajectory data as location sequences, and then use traditional time series mining techniques such as the Markov chain to predict the next item in the sequence. For example, Gamb set al.employs the Markov chain to first model then previous locations visited by the user, called the mobility Markov chain (MMC) model, and then predicts the next location via the transfer probability between different locations.

To con-sider spatial movement constraints, Chenget al. proposes a model that built personalized Markov chains by utiliz-ing the user's location history sequence. They introduce a spatial constraint on the localized region and factorize the transfer probability matrix of personalized Markov chains to predict the user's next movement. Although Markov chains are widely used in sequence analysis, this approach does not sufficiently consider the temporal information in GPS data.

By exploring follow-up research on student card consumption trajectories in camps, Barabasi and Brockmannet al.demonstrate that individual human mobility behavior sometimes shows regular spatial and tem-poral rules. Based on this assumption, Morzy ,extracts regular moving rules by mining users' frequent tra-jectories to predict location.

To better integrate temporal information, Giannottiet al.present a model that considers the time interval between two successive user locations and builds a decision tree to model these associated rules(called a T-pattern) between the temporal and spatial spaces. Relying on the T-patterns, location prediction strategies are further proposed system.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 Conclusion

The Location Prediction, historically viewed as a necessary burden in Government, transportation offices, can be completely automated through an inefficient online software program. The benefits of implementing this technology will lead us to save lot of lives. The system can be automated to predict an user's location and alert the user. This system can be further enhanced and expanded.

8.2 Future Enhancements

The future system will be predicting individual moving preference as well as social interaction prediction.In future work, we plan to focus on analyzing evolving human mobility patterns based on data stream mining techniques.

CHAPTER 9

APPENDIX

9.1 Sample Source Code

MAKING DATASET PROGRAM:

```
import os

total_data=[]
min_long,max_long,min_lat,max_lat=181,0,181,0
for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory"):
    for file in files:
        temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory/"+file,"r")
        data=temp_fobj.read()
        data=data.split("\n",)
        for record in data:
            if len(record)>30:
                cells=record.split(",",)
                latitude=cells[0]
                longitude=cells[1]
                year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]
                hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                if float(longitude)<min_long:
                    min_long=float(longitude)
                elif float(longitude)>max_long:
                    max_long=float(longitude)
                if float(latitude)<min_lat:
                    min_lat=float(latitude)
                elif float(latitude)>max_lat:
```

```
                max_lat=float(latitude)
NO_OF_X_POI=10
NO_OF_Y_POI=10
unit_longitude=(max_long-min_long)/NO_OF_X_POI
unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
X_POI_ranges=[]
Y_POI_ranges=[]
POIs=[]
for ___ in range(NO_OF_X_POI+1):
    X_POI_ranges.append(min_long+___*unit_longitude)
for ___ in range(NO_OF_Y_POI+1):
    Y_POI_ranges.append(min_lat+___*unit_latitude)
for i in range(NO_OF_X_POI):
    for j in range(NO_OF_Y_POI):
        POIs.append([i,j])
temp=[]
total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
# print (len(total_data))
for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
    temp_index_x=0
    while X_POI_ranges[temp_index_x]<=longitude and temp_index_x<len(X_POI_ranges)-2:
        temp_index_x+=1
    temp_index_y=0
    while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-2:
        temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
    if POIs.index([temp_index_x,temp_index_y]) not in temp:
        temp.append(POIs.index([temp_index_x,temp_index_y]))
fobj=open("location_dataset.csv","w")
fobj.write(total_data_for_dataset)
fobj.close()
```

IMPLEMENTING EXISTING SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import pandas as pd
import matplotlib.pyplot as plt
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
loc=pd.read_csv("location_dataset.csv")

x=loc.drop('POI',axis=1)
y=loc['POI']

# print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result_of_MLP=model.predict(x_test)
score_of_MLP=accuracy_score(y_test,result_of_MLP)

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
result_of_NB_bern=model.predict(x_test)
score_of_NB_bern=accuracy_score(y_test,result_of_NB_bern)
```

```
model=MultinomialNB()
model.fit(x_train,y_train)
result_of_NB_multi=model.predict(x_test)
score_of_NB_multi=accuracy_score(y_test,result_of_NB_multi)

model=GaussianNB()
model.fit(x_train,y_train)
result_of_NB_gaus=model.predict(x_test)
score_of_NB_gaus=accuracy_score(y_test,result_of_NB_gaus)

model=RandomForestClassifier(n_estimators=403)
model.fit(x_train,y_train)
result_of_random=model.predict(x_test)
score_of_random=accuracy_score(y_test,result_of_random)

plt.style.use("ggplot")
algos=["MLP","BernoulliNB","MultinomialNB","GaussianNB","Random Forest"]
rates=[score_of_MLP*100,score_of_NB_bern*100,score_of_NB_multi*100,score_of_NB_gaus
*100,score_of_random*100]
x=[i for i, _ in enumerate(algos)]
plt.bar(x,rates,color="blue")
plt.xlabel("Algorithm")
plt.ylabel("Prediction Rate")
plt.title("POI predictions")
plt.xticks(x,algos)
plt.show()
```

IMPLEMENTING PROPOSED SYSTEM

```
# !/usr/bin/env python
# coding: utf-8

import time
import os

from pandas import read_csv
from mpl_toolkits.mplot3d import Axes3D
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from sklearn.preprocessing import StandardScaler,PolynomialFeatures
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LinearRegression
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from tkinter import *
from time import gmtime,strftime
import math

from PIL import Image, ImageTk
import numpy as np
#
import pandas as pd
from sklearn.model_selection import train_test_split

import matplotlib.pyplot as plt
```

```
panel=Tk()
panel.resizable(False, False)
panel.geometry("920x520")
panel.title("Location Prediction")
class location_prediction():
    def __init__(self):
        self.y=10
        self.height_gap=30
        self.counter=0
        self.ind=0
        self.canvas=Canvas(panel,bg="#00c8b4",width=700,height=500)
        self.loc=pd.read_csv("location_dataset.csv")
        self.existing_X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
        self.existing_Y=self.loc['POI']
        # print (x.shape,y.shape)

self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.loc['latitude']),max(self.loc['latit
ude']),min(self.loc['longitude']),max(self.loc['longitude'])

self.existing_x_train,self.existing_x_test,self.existing_y_train,self.existing_y_test=train_test_spli
t(self.existing_X,self.existing_Y,test_size=0.1,random_state=43)
        self.X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.loc.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=1).dr
op('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
        # print (self.Y.head())
        self.date_=0
        self.month_=0
        self.year_=0
        self.hour_=0
        self.minute_=0
        self.second_=0
        self.result_label=StringVar()

    def counter_label(self):
        #label_user_id.config(text="")
```

```
        pass

    def sigmoid(self,data):
        pass
        return [1/(1+math.exp((-1)*(data[0][0]))),1/(1+math.exp((-1)*(data[0][1])))]

    def predict_with_linear_regression(self):
        model=LinearRegression()
        # model=PolynomialFeatures()
        model.fit(self.X,self.Y)
        # print (self.data)

data_to_be_predicted=np.array([[self.date_,self.month_,self.year_,self.hour_,self.minute_,self.se
cond_]])
        result=model.predict(data_to_be_predicted)
        if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
            if result[0][0]<self.min_lat:
                self.min_lat=result[0][0]#-(self.min_lat/20)
            elif result[0][0]>self.max_lat:
                self.max_lat=result[0][0]#+(self.max_lat/20)
            if result[0][1]<self.min_long:
                self.min_long=result[0][1]#-(self.min_long/20)
            elif result[0][1]>self.max_long:
                self.max_long=result[0][1]#+(self.max_long/20)
            self.draw_map()
        x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
        self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
        # x,y=(((self.y_test[0][0]*90-self.min_lat)/(self.max_lat-
self.min_lat))*690)+2,(((self.y_test[0][1]*180-self.min_long)/(self.max_long-
self.min_long))*490)+2
        # self.canvas.create_rectangle(x-2,y-2,x+2,y+2,fill="blue",outline="blue")
        # print (dir(plt))
        print (str(result[0][0])+" "+str(result[0][1]))
        self.label_result["text"]=str(result[0][0])+"\n"+str(result[0][1])
```

```
        # print (result)
        # ------------------

    def draw_map(self,color="white"):
        # print (self.Y)
        # print (len(self.Y))
        self.canvas.create_rectangle(0,0,700,500,fill="#00c8b4",outline="#00c8b4")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*690)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*490)+5
            # if ind==100:print (self.Y["longitude"][ind],self.min_lat,self.Y["longitude"][ind]-
self.min_lat)
            self.canvas.create_rectangle(x,y,x,y,fill=color,outline=color)

    def timer_label(self):
        def timer():
            global counter
            self.counter+=1
            # print (self.counter)
            self.label_date_time.config(text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
            self.label_date_time.after(1000,timer)
        timer()

    def motion(self,event):
        x,y=event.x,event.y
        # print('{}, {}'.format(x, y))
        loc_x,loc_y=((x*(self.max_lat-self.min_lat))/700+self.min_lat),((y*(self.max_long-
self.min_long))/500+self.min_long)
        self.label_cursor_label.config(text=str(round(loc_x,5))+" "+str(round(loc_y,5)))

    def make_existing_results_chart(self):
        pass

    def set_date(self,value):
        self.date_=0 if value=="Date" else value
```

```
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_month(self,value):
    self.month_=0 if value=="Month" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_year(self,value):
    self.year_=0 if value=="Year" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_hour(self,value):
    self.hour_=0 if value=="Hour" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_minute(self,value):
    self.minute_=0 if value=="Minute" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_second(self,value):
    self.second_=0 if value=="Second" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def draw_widgets(self):
    load=Image.open("src/user_icon.png")
    load=load.resize((150,150))
    render=ImageTk.PhotoImage(load)
    img=Label(image=render)
    img.image=render
    img.place(x=20, y=self.y)
    self.y+=160
    panel.bind('<Motion>',self.motion)

    label_user_id=Label(panel,text="Supervisor")
    self.counter_label()
    label_user_id.place(x=55,y=self.y)
    self.y+=self.height_gap
```

```
self.label_date_time=Label(panel,text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
self.timer_label()
self.label_date_time.place(x=10,y=self.y)
self.y+=self.height_gap

self.label_cursor_label=Label(panel,text="39.02332, 116.98266")
self.label_cursor_label.place(x=10,y=self.y)
self.y+=self.height_gap+20

# button_play_locations=Button(panel,text="play locations")
# button_play_locations.place(x=10,y=y,width=150)
# y+=height_gap+20

label_mouse=Label(panel,text="Enter time to predict")
label_mouse.place(x=10,y=self.y)
self.y+=self.height_gap

OPTIONS=["Date"]+list(range(1,32))
date=StringVar(panel)
date.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,date,*OPTIONS,command=self.set_date)
entry_time_date.place(x=10,y=self.y,width=80)

OPTIONS=["Month"]+list(range(1,13))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_month)
entry_time_date.place(x=90,y=self.y,width=80)
self.y+=self.height_gap

OPTIONS=["Year"]+list(range(2010,2101))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_year)
entry_time_date.place(x=10,y=self.y,width=80)
```

```
        OPTIONS=["Hour"]+list(range(0,24))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_hour)
        entry_time_date.place(x=90,y=self.y,width=80)
        self.y+=self.height_gap

        OPTIONS=["Minute"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_minute)
        entry_time_date.place(x=10,y=self.y,width=80)

        OPTIONS=["Second"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_second)
        entry_time_date.place(x=90,y=self.y,width=90)
        self.y+=self.height_gap+15

        button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        #
button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        # button_predict=Button(panel,text="predict",command=self.make_existing_results_chart)
        button_predict.place(x=20,y=self.y,width=100,height=40)
        self.y+=self.height_gap+20

        self.label_result=Label(panel,text=self.result_label)
        self.label_result.place(x=10,y=self.y)
        self.label_result["text"]=""
        self.y+=self.height_gap

        #canvas.create_rectangle(100,100,100,100,fill="white",outline="white")
        self.canvas.place(x=200,y=10)
        # canvas.delete("all")
```

```
        self.draw_map()
        panel.mainloop()

main=location_prediction()
main.draw_widgets()

#---------
```

PREPROCESSING

```
import pandas as pd
class preprocesss_dataset:
    def __init__(self):
        pass
    def make_dataset(self):
        total_data=[]
        min_long,max_long,min_lat,max_lat=181,0,181,0
        for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory"):
            pass
            for file in files:
                temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory/"+file,"r")
                data=temp_fobj.read()
                data=data.split("\n",)
                for record in data:
                    if len(record)>30:
                        cells=record.split(",",)
                        latitude=cells[0]
                        longitude=cells[1]
                        year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]

hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                        total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                        if float(longitude)<min_long:
                            min_long=float(longitude)
                        elif float(longitude)>max_long:
```

```
                max_long=float(longitude)
            if float(latitude)<min_lat:
                min_lat=float(latitude)
            elif float(latitude)>max_lat:
                max_lat=float(latitude)
    NO_OF_X_POI=10
    NO_OF_Y_POI=10
    unit_longitude=(max_long-min_long)/NO_OF_X_POI
    unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
    X_POI_ranges=[]
    Y_POI_ranges=[]
    POIs=[]
    for ___ in range(NO_OF_X_POI+1):
        X_POI_ranges.append(min_long+___*unit_longitude)
    for ___ in range(NO_OF_Y_POI+1):
        Y_POI_ranges.append(min_lat+___*unit_latitude)
    for i in range(NO_OF_X_POI):
        for j in range(NO_OF_Y_POI):
            POIs.append([i,j])
    temp=[]
    total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
    for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
        temp_index_x=0
        while X_POI_ranges[temp_index_x]<=longitude and
temp_index_x<len(X_POI_ranges)-2:
            temp_index_x+=1
        temp_index_y=0
        while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-
2:
            temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
```

```
            if POIs.index([temp_index_x,temp_index_y]) not in temp:
                temp.append(POIs.index([temp_index_x,temp_index_y]))
        fobj=open("location_dataset.csv","w")
        fobj.write(total_data_for_dataset)
        fobj.close()
object=preprocesss_dataset()
object.make_dataset()
```

EXISTING SYSTEM

```
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
from sklearn.linear_model import LinearRegression


loc=pd.read_csv("location_dataset.csv")

x=loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
y=loc['POI']

print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result=model.predict(x_test)
```

```
#print (confusion_matrix(y_test,result))
print ("MLPClassifier=",accuracy_score(y_test,result))

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
probs=model.predict_proba(x_test)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("BernoulliNB=",accuracy_score(y_test,result))

model=MultinomialNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("MultinomialNB=",accuracy_score(y_test,result))

model=GaussianNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("GaussianNB=",accuracy_score(y_test,result))

# model=LogisticRegression(solver="lbfgs")
# model.fit(x_train,y_train)
# result=model.predict(x_test)
# #print (confusion_matrix(y_test,result))
# print ("LogisticRegression=",accuracy_score(y_test,result))
#
model=RandomForestClassifier(n_estimators=201)
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("RandomForestClassifier=",accuracy_score(y_test,result))
model=LinearRegression()
model.fit(x_train[:-1],y_train[:-1])
result=model.predict(x_test)
```

```
# print ("RandomForestClassifier=",accuracy_score(y_test,result))

print (y_test,result)
```

PROPOSED SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import time,math,os,threading
import numpy as np
import pandas as pd
from time import gmtime,strftime
import time,math
from tkinter import *
root=Tk()
root.resizable(False, False)
root.geometry("1000x600")
root.title("Location Prediction")
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from keras.models import Sequential
from keras.layers import Dense
from keras.wrappers.scikit_learn import KerasRegressor
class location_prediction():
    def __init__(self):
        self.counter=0
        self.x_widget=100
        self.canvas=Canvas(root,bg="#FFFFFF",width=1000,height=550)
        self.dataset=pd.read_csv("location_dataset.csv")
        self.X=self.dataset.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.dataset.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=
1).drop('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
```

```
self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.dataset['latitude']),max(self.datas
et['latitude']),min(self.dataset['longitude']),max(self.dataset['longitude'])

self.x_train,self.x_test,self.y_train,self.y_test=train_test_split(self.X,self.Y,test_size=0.1,random
_state=43)
        self.date=StringVar()
        self.month=StringVar()
        self.year=StringVar()
        self.hour=StringVar()
        self.minute=StringVar()
        self.second=StringVar()
        self.error_label_value=StringVar()
    def draw_map(self):
        self.canvas.create_rectangle(0,0,1000,550,fill="#FFFFFF",outline="#FFFFFF")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*990)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*540)+5
            self.canvas.create_rectangle(x,y,x,y,fill="#000000",outline="#000000")
    def is_valid_inputs(self):
        try:
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            if 1<=date<=31 and 1<=month<=12 and 2008<=year<=2100 and 0<=hour<=23 and
0<=minute<=59 and 0<=second<=59:
                return True
            return False
        except:
            return False
    def predict_result(self):
        if self.is_valid_inputs():
```

```
            self.error_label['text']=""
            self.model=Sequential()
            self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
            self.model.add(Dense(2,kernel_initializer='normal'))
            self.model.compile(loss='mean_squared_error',optimizer='adam')
            self.model.fit(self.X,self.Y,epochs=3)
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            result=self.model.predict(np.array([[year,month,date,hour,minute,second]]))
            if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
                if result[0][0]<self.min_lat:
                    self.min_lat=result[0][0]
                elif result[0][0]>self.max_lat:
                    self.max_lat=result[0][0]
                if result[0][1]<self.min_long:
                    self.min_long=result[0][1]
                elif result[0][1]>self.max_long:
                    self.max_long=result[0][1]
                self.draw_map()
            x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
            self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
            self.error_label['text']=str(result[0][0])+" "+str(result[0][1])
        else:
            self.error_label['text']='error'

    def get_prediction_rate(self):
        self.model=Sequential()
        self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
        self.model.add(Dense(2,kernel_initializer='normal'))
        self.model.compile(loss='mean_squared_error',optimizer='adam')
```

```
    self.model.fit(self.x_train,self.y_train,epochs=3)
    result=self.model.predict(self.x_test)
def draw_widgets(self):
    self.date_entry=Entry(root,width=5,textvariable=self.date)
    self.date_entry.insert(0,"DD")
    self.date_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # month entry
    self.month_entry=Entry(root,width=5,textvariable=self.month)
    self.month_entry.insert(0,"MM")
    self.month_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # year entry
    self.year_entry=Entry(root,width=8,textvariable=self.year)
    self.year_entry.insert(0,"YYYY")
    self.year_entry.place(x=self.x_widget,y=20)
    self.x_widget+=150
    # hour entry
    self.hour_entry=Entry(root,width=5,textvariable=self.hour)
    self.hour_entry.insert(0,"HH")
    self.hour_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # time seperator
    self.sep=Label(root,text=":")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # minute entry
    self.minute_entry=Entry(root,width=5,textvariable=self.minute)
```

```
        self.minute_entry.insert(0,"MM")
        self.minute_entry.place(x=self.x_widget,y=20)
        self.x_widget+=50
        # time seperator
        self.sep=Label(root,text=":")
        self.sep.place(x=self.x_widget,y=20)
        self.x_widget+=15

        # second entry
        self.second_entry=Entry(root,width=5,textvariable=self.second)
        self.second_entry.insert(0,"SS")
        self.second_entry.place(x=self.x_widget,y=20)
        self.x_widget+=150
        # tracking button
        button_predict=Button(root,text="track",command=self.predict_result)
        button_predict.place(x=self.x_widget,y=5,width=100,height=40)
        self.x_widget+=150
        # time seperator
        self.error_label=Label(root,text=self.error_label_value)
        self.error_label.place(x=self.x_widget,y=20)
        # canvas
        # result=self.model.predict(np.array([[2019,10,6,3,38,43]]))
        self.canvas.place(x=0,y=50)#1
        self.draw_map()
        root.mainloop()
object=location_prediction()
object.draw_widgets()
# object.get_prediction_rate()
```

9.2 Sample Screen Shots

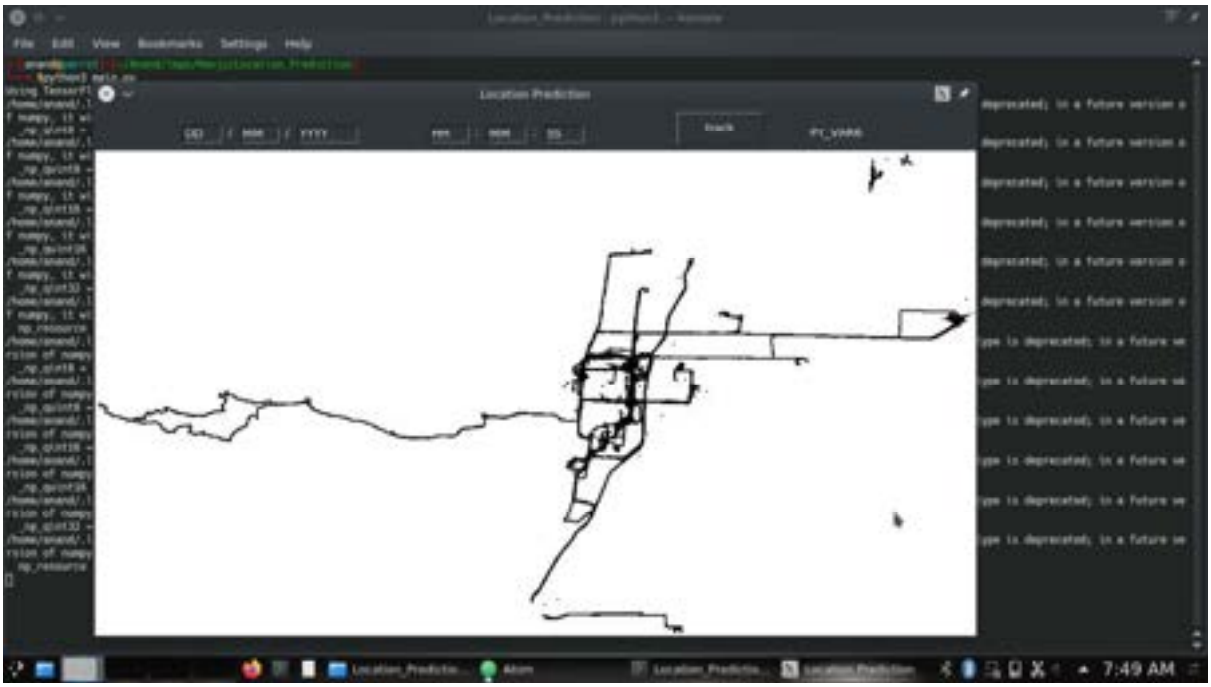

Fig. 1.1

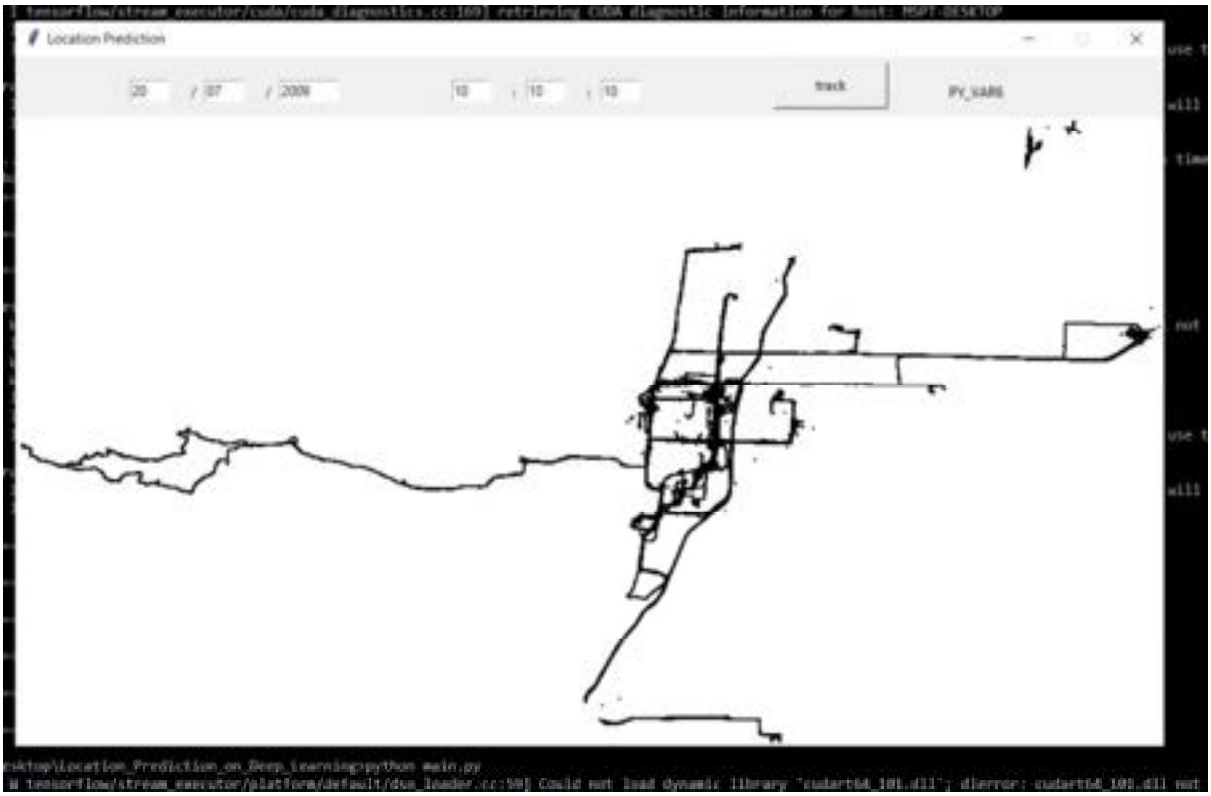

Fig. 1.2

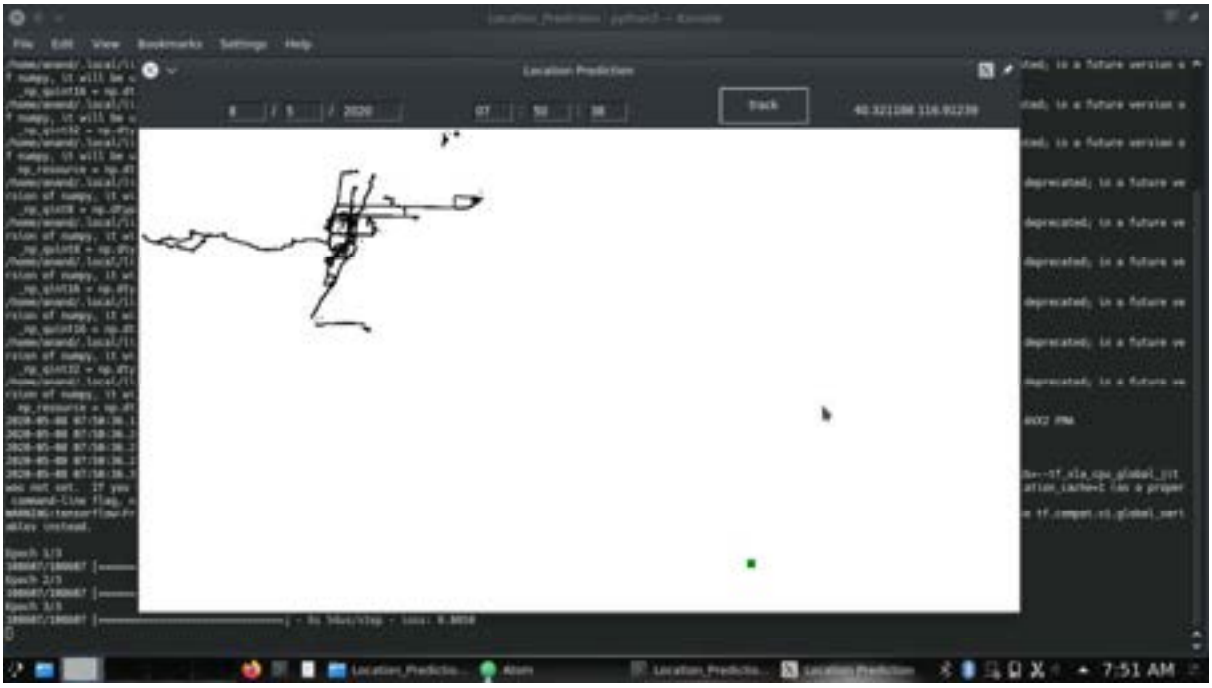

Fig. 1.3

CHAPTER 10

REFERENCE

[1] Cheng, H. Yang, M. R. Lyu, and I. King, ''Where you like to go next:Successive point-of-interest recommendation,'' inProc. IJCAI, vol. 13.2013, pp. 2605–2611.

[2] L. Barabasi, ''The origin of bursts and heavy tails in human dynamics,'' Nature, vol. 435, no. 7039, pp. 207–211, May 2005.

[3] D. Brockmann, L. Hufnagel, and T. Geisel, ''The scaling laws of human travel, ''Nature, vol. 439, no. 7075, pp. 462–465, 2006.

[4] F. Giannotti, M. Nanni, F. Pinelli, and D. Pedreschi, ''Trajectory pattern mining,'' inProc. 13th ACM SIGKDD Int. Conf. Knowl. Discovery Data Mining, 2007, pp. 330–339.

[5] Morzy, ''Prediction of moving object location based on frequent trajec-tories,'' in Proc. Int. Symp. Comput. Inf. Sci., 2006, pp. 583–592.

[6].S. Gambs, M.-O. Killijian, and M. N. del Prado Cortez, ''Next place prediction using mobility Markov chains,'' inProc. 1st Workshop Meas.,Privacy, Mobility, 2012, p. 3.

[7] M. Morzy, ''Mining frequent trajectories of moving objects for location prediction,'' inProc. Int. Workshop Mach. Learn. Data Mining Pattern Recognit., 2007, pp. 667–680.

[8] L. Wang, K. Hu, K. Tao, and X. Yan, ''Mining frequent trajectory pat-tern based on vague space partition,''Knowl.-Based Syst., vol. 50, no. 3,pp. 100–111, 2013.

[9] A. Monreale, F. Pinelli, R. Trasarti, and F. Giannotti, ''WhereNext: A loca-tion predictor on trajectory pattern mining,'' inProc. 15th ACM SIGKDDInt. Conf. Knowl. Discovery Data Mining, 2009, pp. 637–646.

LOCATION PREDICTION USING LEARNING INDIVIDUAL MOVING PREFERENCE AND DEEP LEARNING ALGORITHM

A PROJECT REPORT

Submitted by

RAJPRIYA.S (17601310)

In partial fulfillment for the award of the degree of

FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTER APPLICATIONS

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

May & 2020

<CODE INFINITE>
IT TRAINING SERVICE
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PROJECT COMPLETION CERTIFICATE

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Dear Sir/Madam

This is to certify that **Ms. S.RAJPRIYA (Reg NO: 17601310)**is a final year **MCA** student of **PAAVAI ENGINEERING COLLEGE** has successfully completed her academic main project entitled **"LOCATION PREDICTION FOR LEARNING INDIVIDUAL MOVING PREFERENCE USING DEEP LEARNING ALGORITHM"** in our concern during the period from Dec 2019 to Feb 2020.

Regards

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DECLARATION

I, **RAJPRIYA.S** hereby declare that the project report titled "**LOCATION PREDICTION USING LEARNING INDIVIDUAL MOVING PREFERENCE AND DEEP LEARNING ALGORITHM**" done by me under the guidance of Mrs.M.GEETHA and Mr.R.MANSOOR AHAMAD at **CODE INFINITE IT TRAINING SERVICE, Coimbatore** is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Pachal

S. Raj

SIGNATURE OF THECANDIDATE

ABSTRACT

In this modern era, we can see that there are lot of accidents occurs due to traffics. We lose lot of people because of natural disasters such as tsunami, turnado and etc. We can't prevent traffics and we can't stop natural disasters. But we can alert the people who are going to be in traffic and who are in the area of natural disaster occurrence. Predicting an user's exact location is a complex problem in past years. Till now what we could predict is an user's area where the user will be. The main objective of the paper is to predict an user's exact location using regression methods. The regression methods are supervised learning algorithms in Machine Learning. Through this exact location prediction technique we can know the people who are going to be in a particular traffic area. We can know the people who are in the area where natural disaster going to occur.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	EXPLANASION
1	CNN	Convolutional Neural Network
2	POI	Point Of Interest

CHAPTER 1

INTRODUCTION

1.1 Company Profile

Founded in 2017, CODE INFINITE IT TRAINING SERVICE located at COIMBATORE, has a rich background in developing academic student projects, especially in solving latest IEEE Papers, software Development and continues its entire attention on achieving transcending excellence in the Development , training and Maintenance of Software Projects and Products in Many Areas. Code Infinite vision is to emerge as a leading Software Training Development institute in Coimbatore by providing meticulous training development in the trending technologies. We strive to make the aspiring candidates realize their IT dreams through our job-oriented training development.

Our teams specialize in training, architecture, design, development and integration of large and small systems. A demonstrated ability to meet client needs for complex software solutions by successfully completing contracts and projects on budget is the consultants. We also went to be the most sought-after destination for software training development in Coimbatore .To fosters an environment of superior academic excellence for all aspiring participants which will make them ready to face practical challenges in the work area.

1.2 Objective

Classification makes limited prediction. In our case POI can only be predicted. Unfortunately, the current technology can't predict exact location of the user. Our main objective is to predict exact location using Deep Learning Regression technique.

CHAPTER 2

SYSTEM ANALYSIS

2.1 Existing System

The existing system can predict user's location with the classification machine learning technique. The systems predict only the user's area or POI. It classifies that the inputs belongs to one of the existing POIs. It makes limited prediction rate. There are many machine learning algorithms used in classification. Such as Naive Bayes, Random Forest and etc. The algorithm gives high accuracy of prediction. Supervisor can predict one's POI with a user's history of locations. The data is good enough to predict the user's future location of POI.

The POI can be determined by indexing methods. Indexing methods are deep learning algorithms that groups the inputs without considering its labels.

2.2 Disadvantages

- The existing system may give high accuracy rate of prediction .But unfortunately; the result would be the area of the user.

- Classification makes the system limited.

- Indexing takes high time complexity.

2.3 Proposed System and application

The proposed system can be more consistent in prediction. The system can predict user's accurate location. Instead of the POI, result provides exact latitude and longitude of the user. The proposed system can be used in traffic predictions. When supervisor predicts some people location and the locations are the same places, there will be traffic occurring which may lead accidents. The people can be alerted properly.

On the time of natural disaster occurrence people can be predicted with the time. People can be counted and alerted if they are on the location of natural disaster occurrence. The system predicts by collecting the history location by live tracking. User need to install the android app that sends the GPS location every second to the main server. The exact location prediction will be helpful in saving people.

2.4 Advantages

- There is no need of clustering, which reduces time complexity of clustering.
- The system will give accurate location of user with the attributes of latitude and longitude.
- Deep learning makes more efficient prediction as well as accurate location.

2.5 Feasibility study

Feasibility Study is a high level capsule version of the entire process intended to answer a number of questions like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? Feasibility study is conducted once the problem clearly understood. Feasibility study is necessary to determine that the proposed system is Feasible by considering the technical, Operational, and Economical factors. By having a detailed feasibility study the management will have a clear-cut view of the proposed system.

The following feasibilities are considered for the project in order to ensure that the project is variable and it does not have any major obstructions. Feasibility study encompasses the following things:

- Technical Feasibility
- Operation Feasibility
- Economic Feasibility

In this phase, we study the feasibility of all proposed systems, and pick the best feasible solution for the problem. The feasibility is studied based on three main factors as follows.

2.5.1 Technical Feasibility

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are available readily or not.

Technical Feasibility determines whether the organization has the technology and skills necessary to carry out the project and how this should be obtained. The system can be feasible because of the following grounds:

- ✓ All necessary technology exists to develop the system.
- ✓ This system is too flexible and it can be expanded further.
- ✓ This system can give guarantees of accuracy, ease of use, reliability and the data security.
- ✓ This system can give instant response to inquire.
- ✓ Our project is technically feasible because, all the technology needed for our project is readily available.

Operating System **:** Windows XP or higher

Languages **:** Python

Documentation Tool **:** MS – Word 2016

2.5.2 Operation Feasibility

In this step, we verify different operational factors of the proposed systems like manpower, time etc., whichever solution uses less operational resources, is the best operationally feasible solution.

The solution should also be operationally possible to implement. Operational Feasibility determines if the proposed system satisfied user objectives could be fitted into the current system operation.

- ✓ The methods of processing and presentation are completely accepted by the clients since they can meet all user requirements.
- ✓ The clients have been involved in the planning and development of the system.
- ✓ The proposed system will not cause any problem under any circumstances.
- ✓ Our project is operationally feasible because the time requirements and personnel requirements are satisfied. We are a team of four members and we worked on this project for three working months.

2.5.3 Economic Feasibility

Economically, this project is completely feasible because it requires no extra financial investment and with respect to time, it's completely possible to complete this project in 6 months. In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are more than the investments and expenditure.

Economic Feasibility determines whether the project goal can be within the resource limits allocated to it or not. It must determine whether it is worthwhile to process with the entire project or whether the benefits obtained from the new system are not worth the costs.

Financial benefits must be equal or exceed the costs. In this issue, we should consider:

- ✓ The cost to conduct a full system investigation.
- ✓ The cost of h/w and s/w for the class of application being considered.
- ✓ The development tool.
- ✓ The cost of maintenance etc...

Our project is economically feasible because the cost of development is very minimal when compared to financial benefits of the application.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 Hardware Requirements

System : Intel core i3

Hard disk : 120 gb

Monitor : 15" led

Storage : 20gb

3.2 Software Requirements

OS : Windows 10

Platform : Python

Language : Python

Visual interface : Tkinter-python

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 Front End

Python provides various options for developing graphical user interfaces (GUIs). Most important are listed below.

Tkinter − Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this chapter. Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit. Tkinter provides various controls, such as buttons, labels and text boxes used in a GUI application. These controls are commonly called widgets. There are currently 15 types of widgets in Tkinter. We present these widgets as well as a brief description in the following types–

Button

The Button widget is used to display buttons in your application.

Canvas

The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.

Check button

The Check button widget is used to display a number of options as checkboxes. The user can select multiple options at a time.

Entry

The Entry widget is used to display a single-line text field for accepting values from a user.

Frame

The Frame widget is used as a container widget to organize other widgets.

Label

The Label widget is used to provide a single-line caption for other widgets. It can also contain images.

Listbox

The Listbox widget is used to provide a list of options to a user.

Menubutton

The Menubutton widget is used to display menus in your application.

Menu

The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.

Message

The Message widget is used to display multiline text fields for accepting values from a user.

Radiobutton

The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.

Scale

The Scale widget is used to provide a slider widget.

Scrollbar

The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.

Text

The Text widget is used to display text in multiple lines.

Toplevel

The Toplevel widget is used to provide a separate window container.

4.2 Back End

Data set

A data set (or dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question. The data set lists values for each of the variables, such as height and weight of an object, for each member of the data set. Each value is known as a datum. Data sets can also consist of a collection of documents or files. In the open data discipline, data set is the unit to measure the information released in a public open data repository. The European Open Data portal aggregates more than half a million data sets. In this field other definitions have been proposed, but currently there is not an official one. Some other issues (real-time data sources, non-relational data sets, etc.) increases the difficulty to reach a consensus about it.

Properties

Several characteristics define a data set's structure and properties. These include the number and types of the attributes or variables, and various statistical measures applicable to them, such as standard deviation and kurtosis.

The values may be numbers, such as real numbers or integers, for example representing a person's height in centimeters, but may also be nominal data (i.e., not consisting of numerical values), for example representing a person's ethnicity. More generally, values may be of any of the kinds described as a level of measurement. For each variable, the values are normally all of the same kind. However, there may also be missing values, which must be indicated in some way.

In statistics, data sets usually come from actual observations obtained by sampling a statistical population, and each row corresponds to the observations on one element of that population. Data sets may further be generated by algorithms for the purpose of testing certain kinds of software. Some modern statistical analysis software such as SPSS still present their data in the classical data set fashion. If data is missing or suspicious an imputation method may be used to complete a data set.

Classic data sets

Several classic data sets have been used extensively in the statistical literature:

Iris flower data set

Multivariate data set introduced by Ronald Fisher (1936).

MNIST database

Images of handwritten digits commonly used to test classification, clustering, and image processing algorithms.

Categorical data analysis

Data sets used in the book, An Introduction to Categorical Data Analysis.

Robust statistics

Data sets used in Robust Regression and Outlier Detection (Rousseeuw and Leroy,1986). Provided on-line at the University of Cologne.

Time series

Data used in Chatfield's book, The Analysis of Time Series, are provided on-line by StatLib.

Extreme values

Data used in the book, An Introduction to the Statistical Modeling of Extreme Values are a snapshot of the data as it was provided on-line by Stuart Coles, the book's author.

Intermediate Language

TensorFlow is a software library or framework, designed by the Google team to implement machine learning and deep learning concepts in the easiest manner. It combines the computational algebra of optimization techniques for easy calculation of many mathematical expressions.

The official website of TensorFlow is mentioned below −

www.tensorflow.org

Let us now consider the following important features of TensorFlow −

- It includes a feature of that defines, optimizes and calculates mathematical expressions easily with the help of multi-dimensional arrays called tensors.
- It includes a programming support of deep neural networks and machine learning techniques.
- It includes a high scalable feature of computation with various data sets.
- TensorFlow uses GPU computing, automating management. It also includes a unique feature of optimization of same memory and the data used.

Why is TensorFlow So Popular?

TensorFlow is well-documented and includes plenty of machine learning libraries. It offers a few important functionalities and methods for the same.

TensorFlow is also called a "Google" product. It includes a variety of machine learning and deep learning algorithms. TensorFlow can train and run deep neural networks for handwritten digit classification, image recognition, word embedding and creation of various sequence models.

Tensor Data Structure

Tensors are used as the basic data structures in TensorFlow language. Tensors represent the connecting edges in any flow diagram called the Data Flow Graph. Tensors are defined as multidimensional array or list.

Tensors are identified by the following three parameters −

Rank

Unit of dimensionality described within tensor is called rank. It identifies the number of dimensions of the tensor. A rank of a tensor can be described as the order or n-dimensions of a tensor defined.

Shape

The number of rows and columns together define the shape of Tensor.

Type

Type describes the data type assigned to Tensor's elements.

CHAPTER 5

PROJECT DESCRIPTION

5.1 Overview of the Project

A major problem facing by Government is lack of knowledge of people in the area where natural disaster occurs. It is too difficult to predict the accident in traffic also. The current technology can predict an user's area only. It can be used to determine the location. But when it comes less number of POI's, it would not be accurate. The more number of POI's increases the complexity. Time is precious on the time of natural disaster as well as traffic. Poor prediction can lead us to lose lot of lives. To predict the exact location classification doesn't work well. We have history of location with time of the user. This raises an important question: "How can we turn data into useful information that can predict the exact location ?" Although data mining has been around for more than two decades, its potential is only being realized now. Data mining combines statistical analysis, machine learning and database technology to extract hidden patterns and relationships from large databases. The two most common modelling objectives are classification and prediction. Classification models predict categorical labels (discrete, unordered) while prediction models predict continuous-valued functions. Regression is a Machine Learning technique that can predict with numerical values which is perfect in predicting user's accurate location.

5.2 Module Description Modules

The system comprises of three major modules as follows:

- Designing and Data Pre-processing
- Predicting with Existing System
- Admin Module

5.2.1 Designing and Data Pre-processing

This module includes designing supervisor page and pre-processing dataset. Supervisor page is the main interaction page where the supervisor does all the operations such as tracking and prediction.

Supervisor page:

- This interface can show the map of history of location.
- Supervisor can#
- Enter time to predict.
- The interface will predict the location.
- The predicted location will be plotted in map.

Pre-processing dataset:

- Geo-life dataset from Microsoft is used to train the model.
- The given data is pre-processed into perfect form of dataset.

5.2.2 Predicting with Existing System

- The dataset is tested with the models. The model is loaded by the classification algorithms such as Naive Bayes, MLP Classifier, Random Forest and etc.
- The model is trained by the dataset. The dataset is divided into two main parts. They are training and testing data. The training data is used to train the model.
- The testing data is used to test the model. The prediction rate is 99.99% in our system.

5.2.3 Admin Module

- Supervisor directly interacts with this module. The data sent by the user is stored as dataset. The prediction is done by Linear regression algorithm.
- A algorithm model is assigned with Linear regression algorithm. The stored dataset is trained with model as training set.
- Supervisor have to enter time to predict the user's location. The time will be the testing part of the prediction. The model will give exact location of the user.

5.3 E-R Diagram

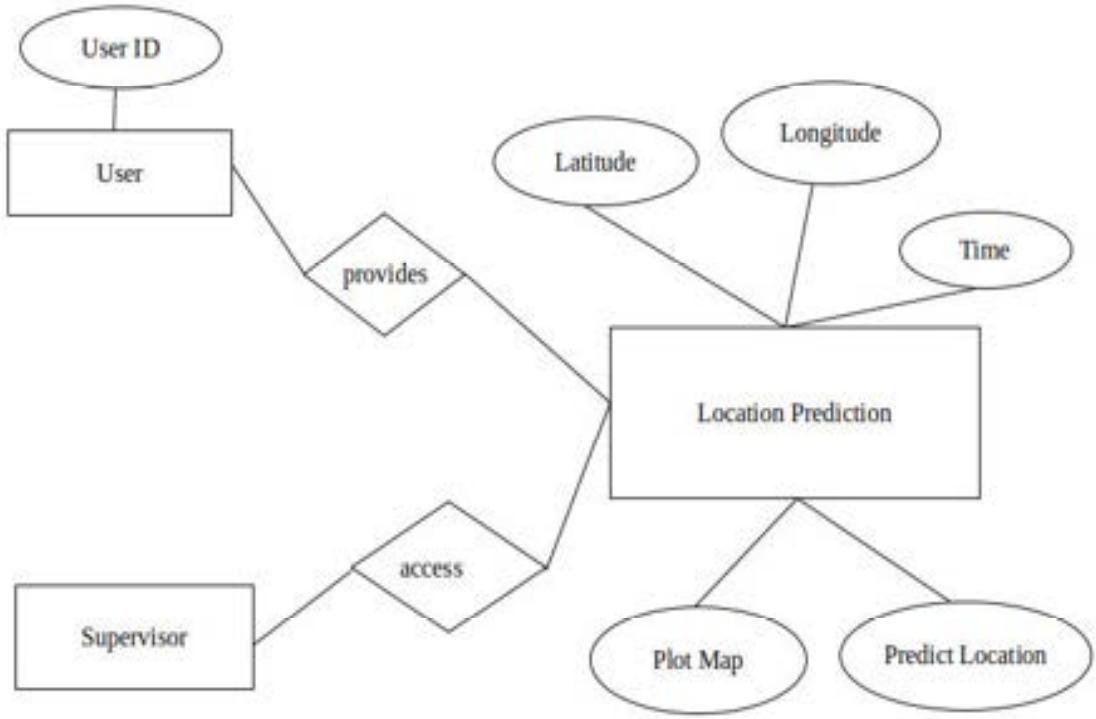

Figure 5.3 E-R Diagram

5.4 Use case Diagram

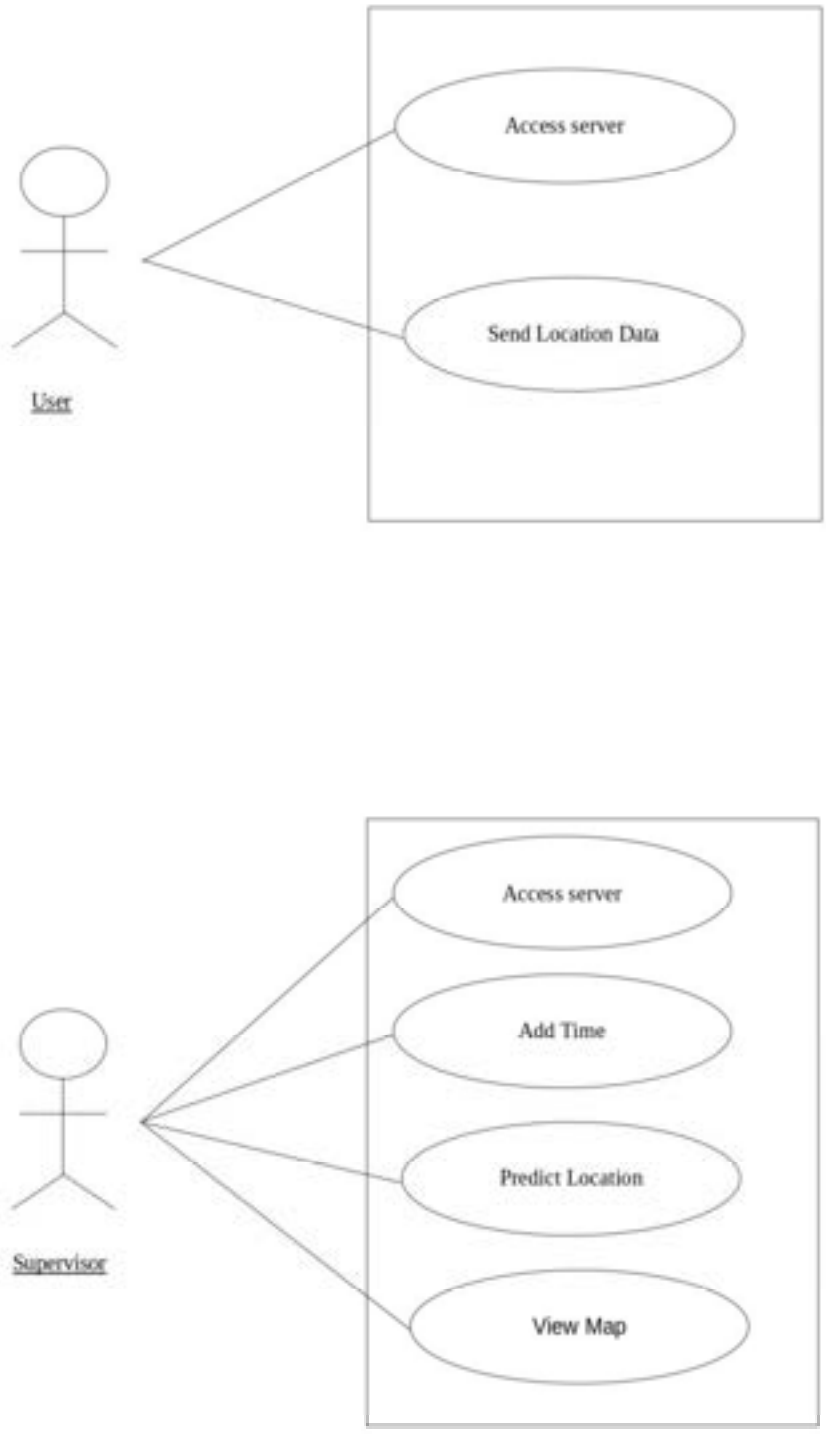

Figure 5.4 Use case Diagram

5.5 Sequence Diagram

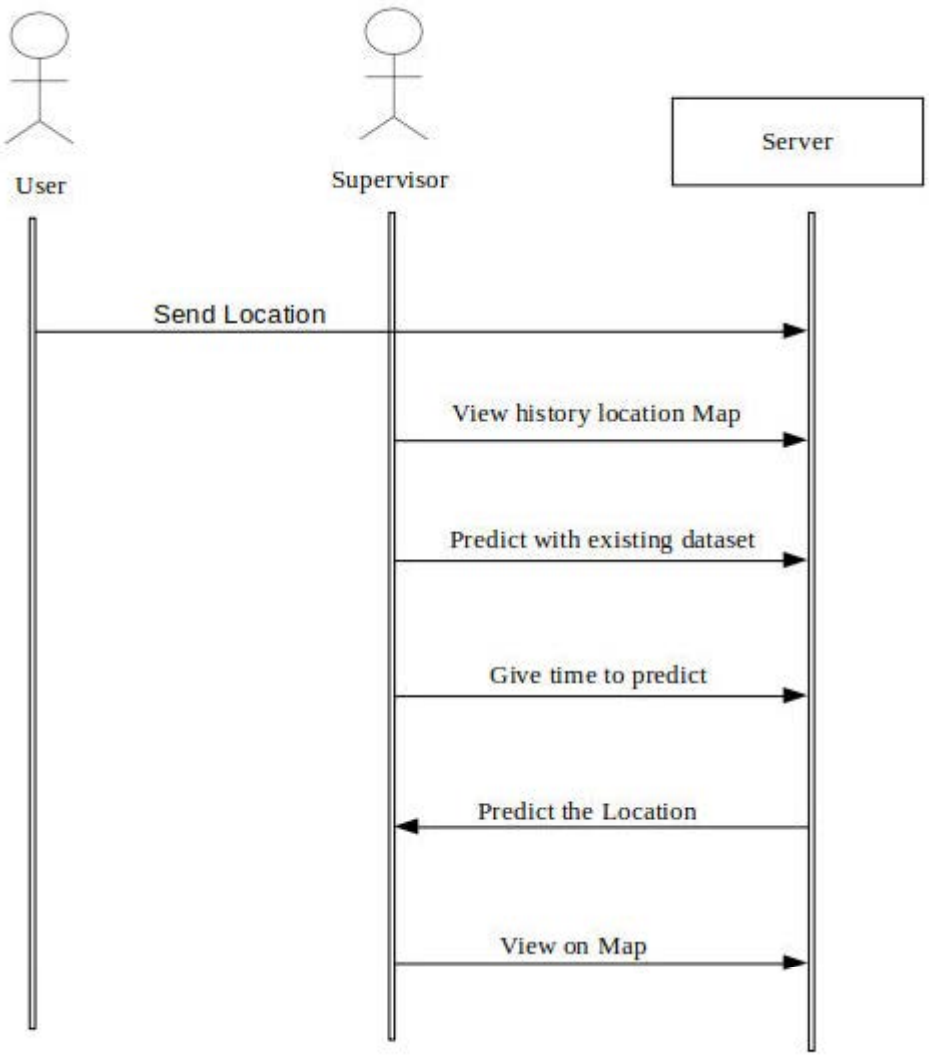

Figure 5.5 Sequence Diagram

5.6 Activity Diagram

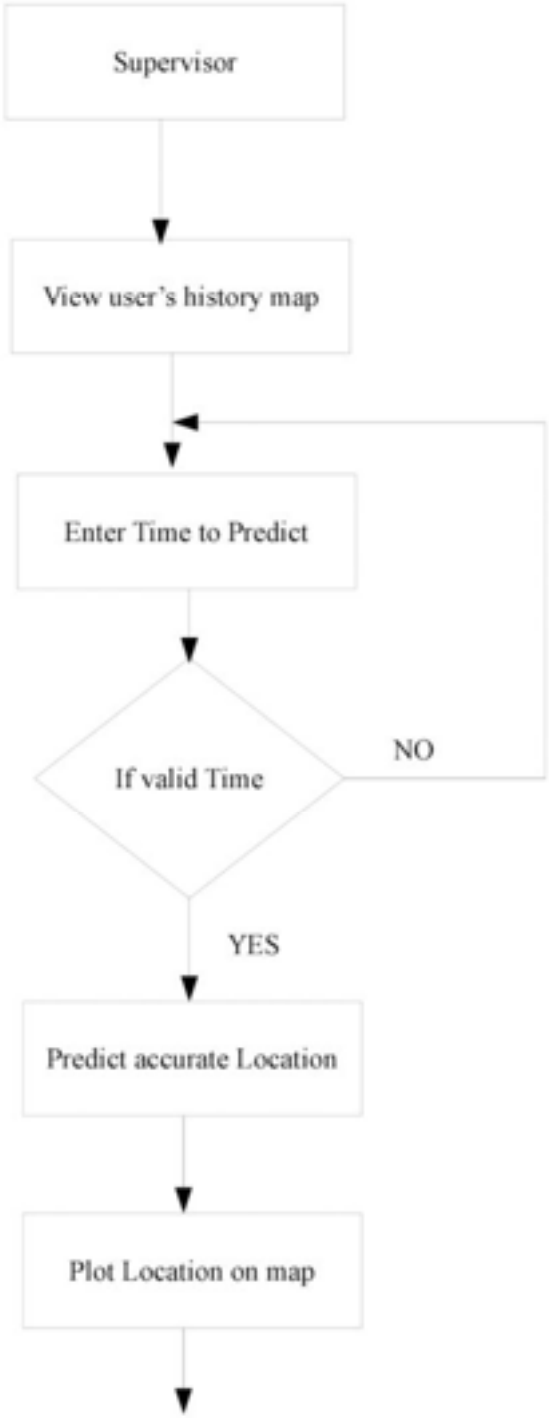

Figure 5.6 Activity Diagram

5.7 Class Diagram

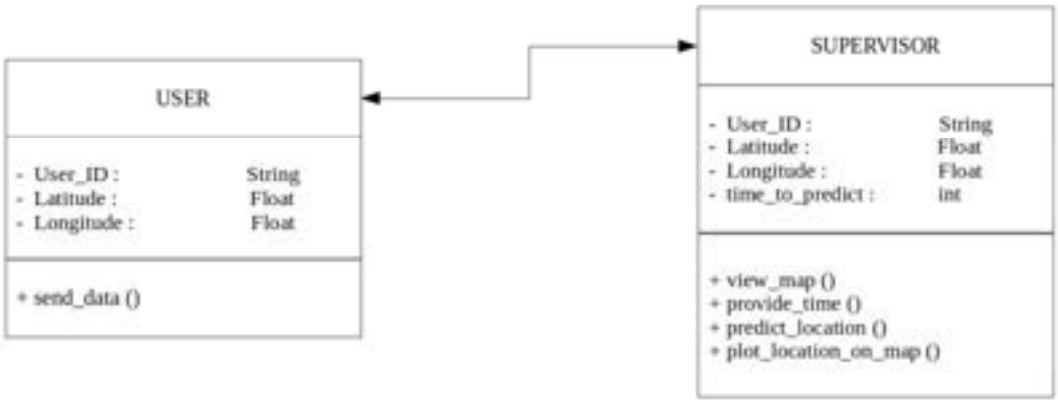

Figure 5.7 Class Diagram

CHAPTER 6

SYSTEM TESTING

As the project is on bit large scale, we always need testing to make it successful. If each component work properly in all respect and gives desired output for all kind of inputs then project is said to be successful. So the conclusion is-to make the project successful, it needs to be tested. The testing done here was System Testing checking whether the user requirements were satisfied. The code for the new system has been written completely using PYTHON as the coding language.

The new system has been tested well with the help of the users and all the applications have been verified from every nook and corner of the user. Although some applications were found to be erroneous these applications have been corrected before being implemented. The flow of the forms has been found to be very much in accordance with the actual flow of data.

6.1 Levels of Testing

In order to uncover the errors present in different phases we have the concept of levels of testing. A series of testing is done for the proposed system before the system is ready for the user acceptance testing.

6.2 Types of Testing

6.2.1 Unit Testing

Unit testing focuses verification efforts on the smallest unit of the software design, the module. This is also known as "Module Testing". The modules are tested separately. This testing carried out during programming stage itself. In this testing each module is found to be working satisfactorily as regards to the expected output from the module.

6.2.2 Integration Testing

Data can be grossed across an interface; one module can have adverse efforts on another. Integration testing is systematic testing for construction the program structure while at the same time conducting tests to uncover errors associated with in the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here correction is difficult because the isolation of cause is complicate by the vast expense of the entire program. Thus in the integration testing stop, all the errors uncovered are corrected for the text testing steps.

6.2.3 System Testing

System testing is the stage of implementation that is aimed at ensuring that the system works accurately and efficiently for live operation commences.

6.2.4 Validation Testing

At the conclusion of integration testing software is completely assembled as a package, interfacing errors have been uncovered and corrected and a final series of software tests begins, validation test begins. Validation test can be defined in many ways. But the simple definition is that validation succeeds when the software function in a manner that can reasonably expected by the customer. After validation test has been conducted one of two possible conditions exists.

One is the function or performance characteristics confirm to specifications and are accepted and the other is deviation from specification is uncovered and a deficiency list is created. Proposed system under consideration has been tested by using validation testing and found to be working satisfactorily.

6.2.5 Output Testing

After performing validation testing, the next step is output testing of the proposed system since no system could be useful if it does not produce the required output in the specified format. Asking the users about the format required by them tests the outputs generated by the system under consideration. Here the output format is considered in two ways, one is on the screen and other is the printed format.

The output format on the screen is found to be correct as the format was designed in the system designed phase according to the user needs.

For the hard copy also the output comes as the specified requirements by the users. Hence output testing does not result any corrections in the system .

6.2.6 User Acceptance Testing

User acceptance of a system is the key factor of the success of any system. The system under study is tested for the user acceptance by constantly keeping in touch with the prospective system users at the time of developing and making changes wherever required.

CHAPTER 7

SYSTEM IMPLEMENTATION

Early location prediction studies often resorted to time-series analysis. The basic idea is to view trajectory data as location sequences, and then use traditional time series mining techniques such as the Markov chain to predict the next item in the sequence. For example, Gamb set al.employs the Markov chain to first model then previous locations visited by the user, called the mobility Markov chain (MMC) model, and then predicts the next location via the transfer probability between different locations.

To con-sider spatial movement constraints, Chenget al. proposes a model that built personalized Markov chains by utiliz-ing the user's location history sequence. They introduce a spatial constraint on the localized region and factorize the transfer probability matrix of personalized Markov chains to predict the user's next movement. Although Markov chains are widely used in sequence analysis, this approach does not sufficiently consider the temporal information in GPS data.

By exploring follow-up research on student card consumption trajectories in camps, Barabasi and Brockmannet al.demonstrate that individual human mobility behavior sometimes shows regular spatial and tem-poral rules. Based on this assumption, Morzy ,extracts regular moving rules by mining users' frequent tra-jectories to predict location.

To better integrate temporal information, Giannottiet al.present a model that considers the time interval between two successive user locations and builds a decision tree to model these associated rules(called a T-pattern) between the temporal and spatial spaces. Relying on the T-patterns, location prediction strategies are further proposed system.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 Conclusion

The Location Prediction, historically viewed as a necessary burden in Government, transportation offices, can be completely automated through an inefficient online software program. The benefits of implementing this technology will lead us to save lot of lives. The system can be automated to predict an user's location and alert the user. This system can be further enhanced and expanded.

8.2 Future Enhancements

The future system will be predicting individual moving preference as well as social interaction prediction.In future work, we plan to focus on analyzing evolving human mobility patterns based on data stream mining techniques.

CHAPTER 9

APPENDIX

9.1 Sample Source Code

MAKING DATASET PROGRAM:

```
import os

total_data=[]
min_long,max_long,min_lat,max_lat=181,0,181,0
for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory"):
    for file in files:
        temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories
1.3/Data/001/Trajectory/"+file,"r")
        data=temp_fobj.read()
        data=data.split("\n",)
        for record in data:
            if len(record)>30:
                cells=record.split(",",)
                latitude=cells[0]
                longitude=cells[1]
                year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]
                hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                if float(longitude)<min_long:
                    min_long=float(longitude)
                elif float(longitude)>max_long:
                    max_long=float(longitude)
                if float(latitude)<min_lat:
                    min_lat=float(latitude)
                elif float(latitude)>max_lat:
```

```
                max_lat=float(latitude)
NO_OF_X_POI=10
NO_OF_Y_POI=10
unit_longitude=(max_long-min_long)/NO_OF_X_POI
unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
X_POI_ranges=[]
Y_POI_ranges=[]
POIs=[]
for ___ in range(NO_OF_X_POI+1):
    X_POI_ranges.append(min_long+___*unit_longitude)
for ___ in range(NO_OF_Y_POI+1):
    Y_POI_ranges.append(min_lat+___*unit_latitude)
for i in range(NO_OF_X_POI):
    for j in range(NO_OF_Y_POI):
        POIs.append([i,j])
temp=[]
total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
# print (len(total_data))
for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
    temp_index_x=0
    while X_POI_ranges[temp_index_x]<=longitude and temp_index_x<len(X_POI_ranges)-2:
        temp_index_x+=1
    temp_index_y=0
    while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-2:
        temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
    if POIs.index([temp_index_x,temp_index_y]) not in temp:
        temp.append(POIs.index([temp_index_x,temp_index_y]))
fobj=open("location_dataset.csv","w")
fobj.write(total_data_for_dataset)
fobj.close()
```

IMPLEMENTING EXISTING SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import pandas as pd
import matplotlib.pyplot as plt
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
loc=pd.read_csv("location_dataset.csv")

x=loc.drop('POI',axis=1)
y=loc['POI']

# print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result_of_MLP=model.predict(x_test)
score_of_MLP=accuracy_score(y_test,result_of_MLP)

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
result_of_NB_bern=model.predict(x_test)
score_of_NB_bern=accuracy_score(y_test,result_of_NB_bern)
```

```
model=MultinomialNB()
model.fit(x_train,y_train)
result_of_NB_multi=model.predict(x_test)
score_of_NB_multi=accuracy_score(y_test,result_of_NB_multi)

model=GaussianNB()
model.fit(x_train,y_train)
result_of_NB_gaus=model.predict(x_test)
score_of_NB_gaus=accuracy_score(y_test,result_of_NB_gaus)

model=RandomForestClassifier(n_estimators=403)
model.fit(x_train,y_train)
result_of_random=model.predict(x_test)
score_of_random=accuracy_score(y_test,result_of_random)

plt.style.use("ggplot")
algos=["MLP","BernoulliNB","MultinomialNB","GaussianNB","Random Forest"]
rates=[score_of_MLP*100,score_of_NB_bern*100,score_of_NB_multi*100,score_of_NB_gaus
*100,score_of_random*100]
x=[i for i, _ in enumerate(algos)]
plt.bar(x,rates,color="blue")
plt.xlabel("Algorithm")
plt.ylabel("Prediction Rate")
plt.title("POI predictions")
plt.xticks(x,algos)
plt.show()
```

IMPLEMENTING PROPOSED SYSTEM

```
# !/usr/bin/env python
# coding: utf-8

import time
import os

from pandas import read_csv
from mpl_toolkits.mplot3d import Axes3D
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
from sklearn.preprocessing import StandardScaler,PolynomialFeatures
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LinearRegression
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from tkinter import *
from time import gmtime,strftime
import math

from PIL import Image, ImageTk
import numpy as np
#
import pandas as pd
from sklearn.model_selection import train_test_split

import matplotlib.pyplot as plt
```

```
panel=Tk()
panel.resizable(False, False)
panel.geometry("920x520")
panel.title("Location Prediction")
class location_prediction():
    def __init__(self):
        self.y=10
        self.height_gap=30
        self.counter=0
        self.ind=0
        self.canvas=Canvas(panel,bg="#00c8b4",width=700,height=500)
        self.loc=pd.read_csv("location_dataset.csv")
        self.existing_X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
        self.existing_Y=self.loc['POI']
        # print (x.shape,y.shape)

self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.loc['latitude']),max(self.loc['latit
ude']),min(self.loc['longitude']),max(self.loc['longitude'])

self.existing_x_train,self.existing_x_test,self.existing_y_train,self.existing_y_test=train_test_spli
t(self.existing_X,self.existing_Y,test_size=0.1,random_state=43)
        self.X=self.loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.loc.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=1).dr
op('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
        # print (self.Y.head())
        self.date_=0
        self.month_=0
        self.year_=0
        self.hour_=0
        self.minute_=0
        self.second_=0
        self.result_label=StringVar()

    def counter_label(self):
        #label_user_id.config(text="")
```

```
        pass

    def sigmoid(self,data):
        pass
        return [1/(1+math.exp((-1)*(data[0][0]))),1/(1+math.exp((-1)*(data[0][1])))]

    def predict_with_linear_regression(self):
        model=LinearRegression()
        # model=PolynomialFeatures()
        model.fit(self.X,self.Y)
        # print (self.data)

data_to_be_predicted=np.array([[self.date_,self.month_,self.year_,self.hour_,self.minute_,self.se
cond_]])
        result=model.predict(data_to_be_predicted)
        if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
            if result[0][0]<self.min_lat:
                self.min_lat=result[0][0]#-(self.min_lat/20)
            elif result[0][0]>self.max_lat:
                self.max_lat=result[0][0]#+(self.max_lat/20)
            if result[0][1]<self.min_long:
                self.min_long=result[0][1]#-(self.min_long/20)
            elif result[0][1]>self.max_long:
                self.max_long=result[0][1]#+(self.max_long/20)
            self.draw_map()
        x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
        self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
        # x,y=(((self.y_test[0][0]*90-self.min_lat)/(self.max_lat-
self.min_lat))*690)+2,(((self.y_test[0][1]*180-self.min_long)/(self.max_long-
self.min_long))*490)+2
        # self.canvas.create_rectangle(x-2,y-2,x+2,y+2,fill="blue",outline="blue")
        # print (dir(plt))
        print (str(result[0][0])+" "+str(result[0][1]))
        self.label_result["text"]=str(result[0][0])+"\n"+str(result[0][1])
```

```
        # print (result)
        # ------------------

    def draw_map(self,color="white"):
        # print (self.Y)
        # print (len(self.Y))
        self.canvas.create_rectangle(0,0,700,500,fill="#00c8b4",outline="#00c8b4")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*690)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*490)+5
            # if ind==100:print (self.Y["longitude"][ind],self.min_lat,self.Y["longitude"][ind]-
self.min_lat)
            self.canvas.create_rectangle(x,y,x,y,fill=color,outline=color)

    def timer_label(self):
        def timer():
            global counter
            self.counter+=1
            # print (self.counter)
            self.label_date_time.config(text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
            self.label_date_time.after(1000,timer)
        timer()

    def motion(self,event):
        x,y=event.x,event.y
        # print('{}, {}'.format(x, y))
        loc_x,loc_y=((x*(self.max_lat-self.min_lat))/700+self.min_lat),((y*(self.max_long-
self.min_long))/500+self.min_long)
        self.label_cursor_label.config(text=str(round(loc_x,5))+" "+str(round(loc_y,5)))

    def make_existing_results_chart(self):
        pass

    def set_date(self,value):
        self.date_=0 if value=="Date" else value
```

```
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_month(self,value):
    self.month_=0 if value=="Month" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_year(self,value):
    self.year_=0 if value=="Year" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_hour(self,value):
    self.hour_=0 if value=="Hour" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_minute(self,value):
    self.minute_=0 if value=="Minute" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def set_second(self,value):
    self.second_=0 if value=="Second" else value
    # print (self.date_,self.month_,self.year_,self.hour_,self.minute_,self.second_)

def draw_widgets(self):
    load=Image.open("src/user_icon.png")
    load=load.resize((150,150))
    render=ImageTk.PhotoImage(load)
    img=Label(image=render)
    img.image=render
    img.place(x=20, y=self.y)
    self.y+=160
    panel.bind('<Motion>',self.motion)

    label_user_id=Label(panel,text="Supervisor")
    self.counter_label()
    label_user_id.place(x=55,y=self.y)
    self.y+=self.height_gap
```

```
self.label_date_time=Label(panel,text=strftime("%d-%m-%Y %H:%M:%S", gmtime()))
self.timer_label()
self.label_date_time.place(x=10,y=self.y)
self.y+=self.height_gap

self.label_cursor_label=Label(panel,text="39.02332, 116.98266")
self.label_cursor_label.place(x=10,y=self.y)
self.y+=self.height_gap+20

# button_play_locations=Button(panel,text="play locations")
# button_play_locations.place(x=10,y=y,width=150)
# y+=height_gap+20

label_mouse=Label(panel,text="Enter time to predict")
label_mouse.place(x=10,y=self.y)
self.y+=self.height_gap

OPTIONS=["Date"]+list(range(1,32))
date=StringVar(panel)
date.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,date,*OPTIONS,command=self.set_date)
entry_time_date.place(x=10,y=self.y,width=80)

OPTIONS=["Month"]+list(range(1,13))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_month)
entry_time_date.place(x=90,y=self.y,width=80)
self.y+=self.height_gap

OPTIONS=["Year"]+list(range(2010,2101))
variable=StringVar(panel)
variable.set(OPTIONS[0])
entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_year)
entry_time_date.place(x=10,y=self.y,width=80)
```

```
        OPTIONS=["Hour"]+list(range(0,24))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_hour)
        entry_time_date.place(x=90,y=self.y,width=80)
        self.y+=self.height_gap

        OPTIONS=["Minute"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_minute)
        entry_time_date.place(x=10,y=self.y,width=80)

        OPTIONS=["Second"]+list(range(0,61))
        variable=StringVar(panel)
        variable.set(OPTIONS[0])
        entry_time_date=OptionMenu(panel,variable,*OPTIONS,command=self.set_second)
        entry_time_date.place(x=90,y=self.y,width=90)
        self.y+=self.height_gap+15

        button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        #
button_predict=Button(panel,text="predict",command=self.predict_with_linear_regression)
        # button_predict=Button(panel,text="predict",command=self.make_existing_results_chart)
        button_predict.place(x=20,y=self.y,width=100,height=40)
        self.y+=self.height_gap+20

        self.label_result=Label(panel,text=self.result_label)
        self.label_result.place(x=10,y=self.y)
        self.label_result["text"]=""
        self.y+=self.height_gap

        #canvas.create_rectangle(100,100,100,100,fill="white",outline="white")
        self.canvas.place(x=200,y=10)
        # canvas.delete("all")
```

```
        self.draw_map()
        panel.mainloop()

main=location_prediction()
main.draw_widgets()

#---------
```

PREPROCESSING

```
import pandas as pd
class preprocesss_dataset:
    def __init__(self):
        pass
    def make_dataset(self):
        total_data=[]
        min_long,max_long,min_lat,max_lat=181,0,181,0
        for ___,__,files in os.walk(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory"):
            pass
            for file in files:
                temp_fobj=open(os.getcwd()+"/Geolife Trajectories 1.3/Geolife Trajectories 1.3/Data/001/Trajectory/"+file,"r")
                data=temp_fobj.read()
                data=data.split("\n",)
                for record in data:
                    if len(record)>30:
                        cells=record.split(",",)
                        latitude=cells[0]
                        longitude=cells[1]
                        year,month,date=cells[5].split("-",)[0],cells[5].split("-",)[1],cells[5].split("-",)[2]

hour,minute,second=cells[6].split(":",)[0],cells[6].split(":",)[1],cells[6].split(":",)[2]
                        total_data.append([year,month,date,hour,minute,second,latitude,longitude])
                        if float(longitude)<min_long:
                            min_long=float(longitude)
                        elif float(longitude)>max_long:
```

```
                max_long=float(longitude)
            if float(latitude)<min_lat:
                min_lat=float(latitude)
            elif float(latitude)>max_lat:
                max_lat=float(latitude)
    NO_OF_X_POI=10
    NO_OF_Y_POI=10
    unit_longitude=(max_long-min_long)/NO_OF_X_POI
    unit_latitude=(max_lat-min_lat)/NO_OF_Y_POI
    X_POI_ranges=[]
    Y_POI_ranges=[]
    POIs=[]
    for ___ in range(NO_OF_X_POI+1):
        X_POI_ranges.append(min_long+___*unit_longitude)
    for ___ in range(NO_OF_Y_POI+1):
        Y_POI_ranges.append(min_lat+___*unit_latitude)
    for i in range(NO_OF_X_POI):
        for j in range(NO_OF_Y_POI):
            POIs.append([i,j])
    temp=[]
    total_data_for_dataset="year,month,date,hour,minute,second,latitude,longitude,POI\n"
    for record in total_data:

year,month,date,hour,minute,second,latitude,longitude=record[0],record[1],record[2],record[3],r
ecord[4],record[5],float(record[6]),float(record[7])
        temp_index_x=0
        while X_POI_ranges[temp_index_x]<=longitude and
temp_index_x<len(X_POI_ranges)-2:
            temp_index_x+=1
        temp_index_y=0
        while Y_POI_ranges[temp_index_y]<=latitude and temp_index_y<len(Y_POI_ranges)-
2:
            temp_index_y+=1

total_data_for_dataset+=year+","+month+","+date+","+hour+","+minute+","+second+","+str(lat
itude)+","+str(longitude)+","+str(POIs.index([temp_index_x,temp_index_y]))+"\n"
```

```
            if POIs.index([temp_index_x,temp_index_y]) not in temp:
                temp.append(POIs.index([temp_index_x,temp_index_y]))
        fobj=open("location_dataset.csv","w")
        fobj.write(total_data_for_dataset)
        fobj.close()
object=preprocesss_dataset()
object.make_dataset()
```

EXISTING SYSTEM

```
from sklearn.svm import *
from sklearn.ensemble import *
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import *
from sklearn.metrics import *
from sklearn.neural_network import *
from sklearn.model_selection import train_test_split
from sklearn.neighbors import NearestNeighbors
from sklearn import preprocessing
from sklearn.multioutput import MultiOutputClassifier
from sklearn.linear_model import LinearRegression


loc=pd.read_csv("location_dataset.csv")

x=loc.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)
y=loc['POI']

print (x.shape,y.shape)

x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.1,random_state=43)

model=MLPClassifier(hidden_layer_sizes=(2,2,1),max_iter=30000)
model.fit(x_train,y_train)
result=model.predict(x_test)
```

```
#print (confusion_matrix(y_test,result))
print ("MLPClassifier=",accuracy_score(y_test,result))

model=BernoulliNB(binarize=0.1)
model.fit(x_train,y_train)
probs=model.predict_proba(x_test)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("BernoulliNB=",accuracy_score(y_test,result))

model=MultinomialNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("MultinomialNB=",accuracy_score(y_test,result))

model=GaussianNB()
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("GaussianNB=",accuracy_score(y_test,result))

# model=LogisticRegression(solver="lbfgs")
# model.fit(x_train,y_train)
# result=model.predict(x_test)
# #print (confusion_matrix(y_test,result))
# print ("LogisticRegression=",accuracy_score(y_test,result))
#
model=RandomForestClassifier(n_estimators=201)
model.fit(x_train,y_train)
result=model.predict(x_test)
#print (confusion_matrix(y_test,result))
print ("RandomForestClassifier=",accuracy_score(y_test,result))
model=LinearRegression()
model.fit(x_train[:-1],y_train[:-1])
result=model.predict(x_test)
```

```
# print ("RandomForestClassifier=",accuracy_score(y_test,result))

print (y_test,result)
```

PROPOSED SYSTEM

```
#!/usr/bin/env python
# coding: utf-8

import time,math,os,threading
import numpy as np
import pandas as pd
from time import gmtime,strftime
import time,math
from tkinter import *
root=Tk()
root.resizable(False, False)
root.geometry("1000x600")
root.title("Location Prediction")
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from keras.models import Sequential
from keras.layers import Dense
from keras.wrappers.scikit_learn import KerasRegressor
class location_prediction():
    def __init__(self):
        self.counter=0
        self.x_widget=100
        self.canvas=Canvas(root,bg="#FFFFFF",width=1000,height=550)
        self.dataset=pd.read_csv("location_dataset.csv")
        self.X=self.dataset.drop('latitude',axis=1).drop('longitude',axis=1).drop('POI',axis=1)

self.Y=self.dataset.drop('year',axis=1).drop('month',axis=1).drop('date',axis=1).drop('hour',axis=
1).drop('minute',axis=1).drop('second',axis=1).drop('POI',axis=1)
```

```
self.min_lat,self.max_lat,self.min_long,self.max_long=min(self.dataset['latitude']),max(self.datas
et['latitude']),min(self.dataset['longitude']),max(self.dataset['longitude'])

self.x_train,self.x_test,self.y_train,self.y_test=train_test_split(self.X,self.Y,test_size=0.1,random
_state=43)
        self.date=StringVar()
        self.month=StringVar()
        self.year=StringVar()
        self.hour=StringVar()
        self.minute=StringVar()
        self.second=StringVar()
        self.error_label_value=StringVar()
    def draw_map(self):
        self.canvas.create_rectangle(0,0,1000,550,fill="#FFFFFF",outline="#FFFFFF")
        for ind in range(len(self.Y)):
            x,y=(((self.Y["longitude"][ind]-self.min_long)/(self.max_long-
self.min_long))*990)+5,(((self.Y["latitude"][ind]-self.min_lat)/(self.max_lat-
self.min_lat))*540)+5
            self.canvas.create_rectangle(x,y,x,y,fill="#000000",outline="#000000")
    def is_valid_inputs(self):
        try:
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            if 1<=date<=31 and 1<=month<=12 and 2008<=year<=2100 and 0<=hour<=23 and
0<=minute<=59 and 0<=second<=59:
                return True
            return False
        except:
            return False
    def predict_result(self):
        if self.is_valid_inputs():
```

```
            self.error_label['text']=""
            self.model=Sequential()
            self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
            self.model.add(Dense(2,kernel_initializer='normal'))
            self.model.compile(loss='mean_squared_error',optimizer='adam')
            self.model.fit(self.X,self.Y,epochs=3)
            date=int(self.date.get())
            month=int(self.month.get())
            year=int(self.year.get())
            hour=int(self.hour.get())
            minute=int(self.minute.get())
            second=int(self.second.get())
            result=self.model.predict(np.array([[year,month,date,hour,minute,second]]))
            if result[0][0]<self.min_lat or result[0][0]>self.max_lat or result[0][1]<self.min_long or
result[0][1]>self.max_long:
                if result[0][0]<self.min_lat:
                    self.min_lat=result[0][0]
                elif result[0][0]>self.max_lat:
                    self.max_lat=result[0][0]
                if result[0][1]<self.min_long:
                    self.min_long=result[0][1]
                elif result[0][1]>self.max_long:
                    self.max_long=result[0][1]
                self.draw_map()
            x,y=(((result[0][0]-self.min_lat)/(self.max_lat-self.min_lat))*690)+5,(((result[0][1]-
self.min_long)/(self.max_long-self.min_long))*490)+5
            self.canvas.create_rectangle(x-4,y-4,x+4,y+4,fill="green",outline="green")
            self.error_label['text']=str(result[0][0])+" "+str(result[0][1])
        else:
            self.error_label['text']='error'

    def get_prediction_rate(self):
        self.model=Sequential()
        self.model.add(Dense(13,input_dim=6,kernel_initializer='normal'))
        self.model.add(Dense(2,kernel_initializer='normal'))
        self.model.compile(loss='mean_squared_error',optimizer='adam')
```

```
    self.model.fit(self.x_train,self.y_train,epochs=3)
    result=self.model.predict(self.x_test)
def draw_widgets(self):
    self.date_entry=Entry(root,width=5,textvariable=self.date)
    self.date_entry.insert(0,"DD")
    self.date_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # month entry
    self.month_entry=Entry(root,width=5,textvariable=self.month)
    self.month_entry.insert(0,"MM")
    self.month_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # date seperator
    self.sep=Label(root,text="/")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # year entry
    self.year_entry=Entry(root,width=8,textvariable=self.year)
    self.year_entry.insert(0,"YYYY")
    self.year_entry.place(x=self.x_widget,y=20)
    self.x_widget+=150
    # hour entry
    self.hour_entry=Entry(root,width=5,textvariable=self.hour)
    self.hour_entry.insert(0,"HH")
    self.hour_entry.place(x=self.x_widget,y=20)
    self.x_widget+=50
    # time seperator
    self.sep=Label(root,text=":")
    self.sep.place(x=self.x_widget,y=20)
    self.x_widget+=15
    # minute entry
    self.minute_entry=Entry(root,width=5,textvariable=self.minute)
```

```
        self.minute_entry.insert(0,"MM")
        self.minute_entry.place(x=self.x_widget,y=20)
        self.x_widget+=50
        # time seperator
        self.sep=Label(root,text=":")
        self.sep.place(x=self.x_widget,y=20)
        self.x_widget+=15

        # second entry
        self.second_entry=Entry(root,width=5,textvariable=self.second)
        self.second_entry.insert(0,"SS")
        self.second_entry.place(x=self.x_widget,y=20)
        self.x_widget+=150
        # tracking button
        button_predict=Button(root,text="track",command=self.predict_result)
        button_predict.place(x=self.x_widget,y=5,width=100,height=40)
        self.x_widget+=150
        # time seperator
        self.error_label=Label(root,text=self.error_label_value)
        self.error_label.place(x=self.x_widget,y=20)
        # canvas
        # result=self.model.predict(np.array([[2019,10,6,3,38,43]]))
        self.canvas.place(x=0,y=50)#1
        self.draw_map()
        root.mainloop()
object=location_prediction()
object.draw_widgets()
# object.get_prediction_rate()
```

9.2 Sample Screen Shots

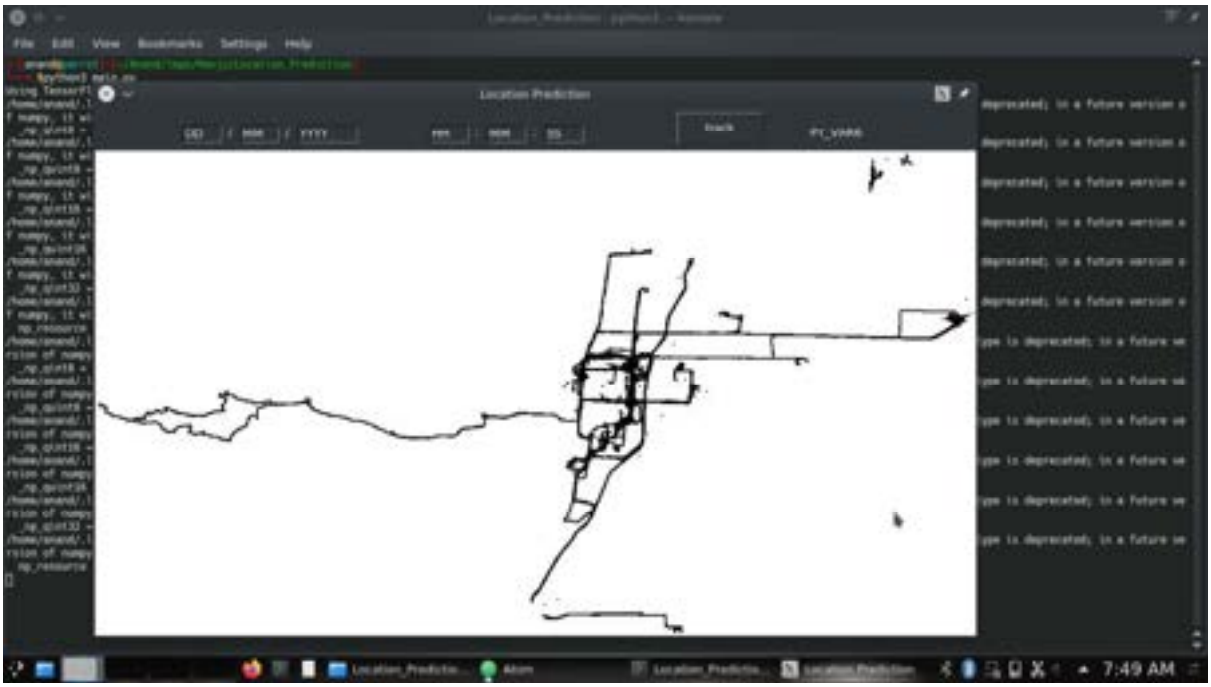

Fig. 1.1

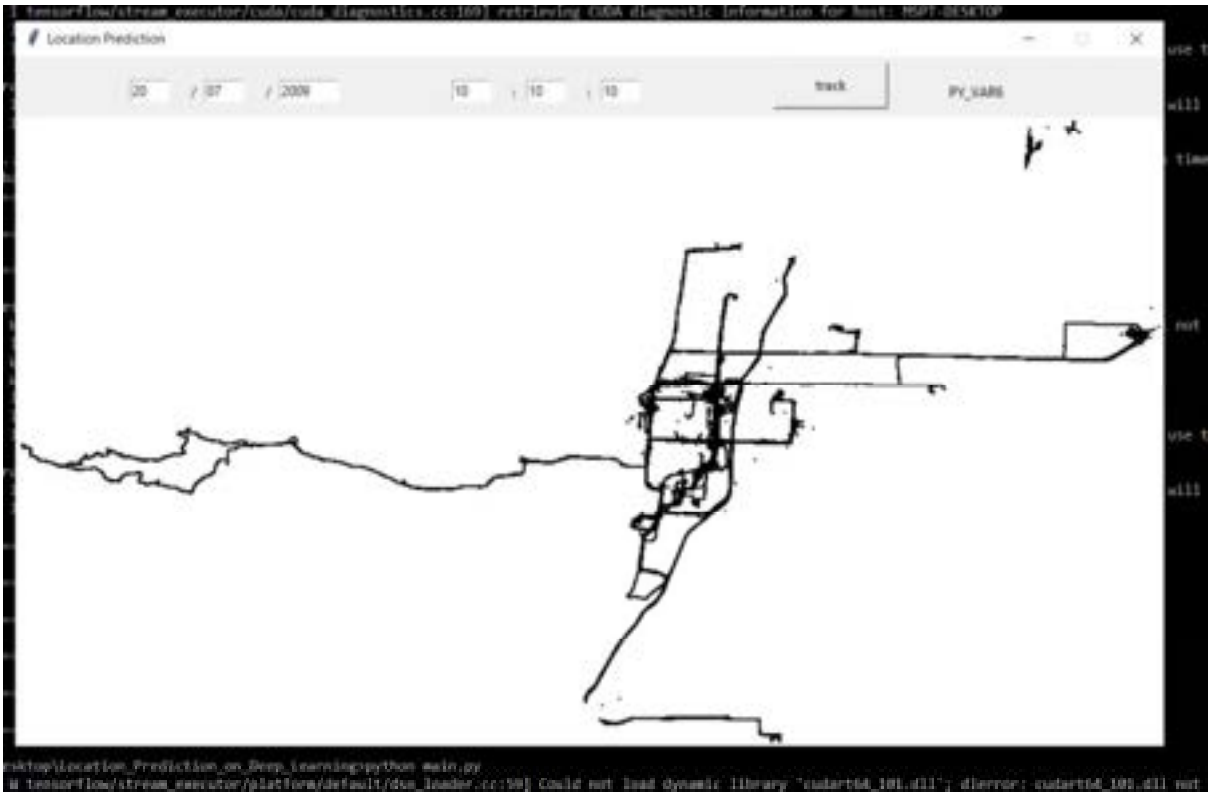

Fig. 1.2

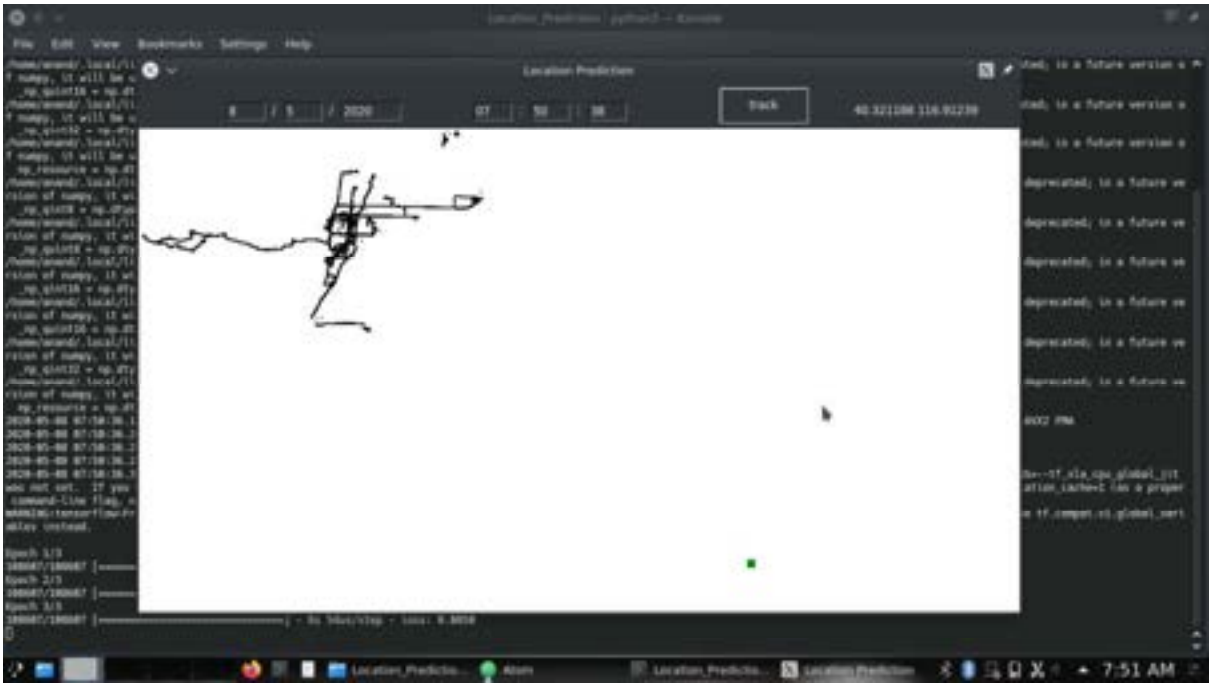

Fig. 1.3

CHAPTER 10

REFERENCE

[1] Cheng, H. Yang, M. R. Lyu, and I. King, ''Where you like to go next:Successive point-of-interest recommendation,'' inProc. IJCAI, vol. 13.2013, pp. 2605–2611.

[2] L. Barabasi, ''The origin of bursts and heavy tails in human dynamics,'' Nature, vol. 435, no. 7039, pp. 207–211, May 2005.

[3] D. Brockmann, L. Hufnagel, and T. Geisel, ''The scaling laws of human travel, ''Nature, vol. 439, no. 7075, pp. 462–465, 2006.

[4] F. Giannotti, M. Nanni, F. Pinelli, and D. Pedreschi, ''Trajectory pattern mining,'' inProc. 13th ACM SIGKDD Int. Conf. Knowl. Discovery Data Mining, 2007, pp. 330–339.

[5] Morzy, ''Prediction of moving object location based on frequent trajec-tories,'' in Proc. Int. Symp. Comput. Inf. Sci., 2006, pp. 583–592.

[6].S. Gambs, M.-O. Killijian, and M. N. del Prado Cortez, ''Next place prediction using mobility Markov chains,'' inProc. 1st Workshop Meas.,Privacy, Mobility, 2012, p. 3.

[7] M. Morzy, ''Mining frequent trajectories of moving objects for location prediction,'' inProc. Int. Workshop Mach. Learn. Data Mining Pattern Recognit., 2007, pp. 667–680.

[8] L. Wang, K. Hu, K. Tao, and X. Yan, ''Mining frequent trajectory pat-tern based on vague space partition,''Knowl.-Based Syst., vol. 50, no. 3,pp. 100–111, 2013.

[9] A. Monreale, F. Pinelli, R. Trasarti, and F. Giannotti, ''WhereNext: A loca-tion predictor on trajectory pattern mining,'' inProc. 15th ACM SIGKDDInt. Conf. Knowl. Discovery Data Mining, 2009, pp. 637–646.

CONFIDENTIALITY–PRESERVING DE-DUPLICATION CLOUD STORAGE WITH PUBLIC CLOUD AUDITING

A PROJECT REPORT

Submitted by

SHREEDHAR S (17601315)

In partial fulfillment for the award of the degree of

FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTERAPPLICATIONS

PAAVAI ENGINEERING COLLEGE
(AUTONOMOUS)

May &2020

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TO WHOMSOEVER IN MAY CONCERN

This is to certify that **[SHREEDHAR.S] [Reg.No: 17601315] MCA** Final year student of **[PAAVAI ENGINEERING COLLEGE]** has done project work in the company on **"CONFIDENTIALITY-PRESERVING DEDUPLICATION CLOUD STORAGE WITH PUBLIC CLOUD AUDITING "** under the guidance of **Mr.S.ILAYARAJA** Technical Support, **[SHARPSCRIPT TECHNOLOGY SOLUTIONS]** and COIMBATORE, towards the fulfillment of the award of during the period from December 2019 to Feb 2020.

Sharpscript Technology Solutions COIMBATORE

Regards

HR Manager

DECLARATION

I, S.SHREEDHAR hereby declare that the project report titled **"CONFIDENTIALITY–PRESERVING DE-DUPLICATION CLOUD STORAGE WITH PUBLIC CLOUD AUDITING"** done by me under the guidance of Mrs.M.SIVAKAMI and Mr.S.ILAYARAJA at SHARPSCRIPT TECHNOLOGY SOLUTIONS COIMBATORE is submitted in partial fulfillment of the requirements for the award of Master of Engineering degree in Master of Computer Applications. Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

DATE: 22.09.2020

PLACE: Pachal

S. Shy

SIGNATURE OF THECANDIDATE

ABSTRACT

With growing popularity of cloud storage, the number of users of outsourcing data to cloud servers has increased dramatically. On the one hand, the rapidly increasing volume of data in the cloud is accompanied by a lot of data duplication. On the other hand, the cloud server stores only a unique copy of outsourced data in de-duplication cloud storage system and the corruption or missing of the unique copy may bring immeasurable loss. Therefore, the file de-duplication and integrity auditing are very important and how to securely and efficiently achieve them simultaneously needs to be settled urgently in academia and industry. In this paper, we propose confidentiality-preserving de-duplication cloud storage with public cloud auditing (CPDA). Firstly, our CPDA scheme achieves secure file de-duplication on encrypted file, which supports public integrity auditing for the unique copy in the de-duplication cloud storage system. Particularly, our CPDA scheme also realizes secure authentication tag de-duplication. Secondly, our CPDA scheme utilizes the convergent encryption and random masking techniques to ensure data confidentiality during the file de-duplication and integrity auditing process. Thirdly, our scheme not only supports each data owner to independently launch the integrity auditing of their own files, but also supports cloud server to periodically delegate the third party auditor to concurrently handle multiple auditing tasks to ensure the integrity of the outsourced files. Finally, the security of our scheme is formally proved and its performance is confirmed by numerical analyses and simulation experiments.

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LIST OF ABBREVIATION

S.NO.	ABBREVIATION	EXPLANASION
1	XML	Extensible Markup Language
2	CLR	Common Language Runtime
3	IL	Intermediate Language
4	CLS	Common Language Specification
5	SQL	Structured Query Language
6	OLAP	Online Analytical Processing
7	CSP	Cloud Service Provider

CHAPTER 1

INTRODUCTION

1.1. COMPANY PROFILE

Sharp script Technology solutions., do Certification courses, In-Plant trainings, Workshops, Seminars, Faculty Development Programmers, Real time Project development and Placement assistance along with Web Hosting and Outsourcing. We established our Company in the year 2003, Head Office in Chennai and branch offices in Coimbatore.

Our team consists of Highly proficient and Experienced Managing Director, Excellent HR Manager, and Qualified Trainers in various streams. We have good Industrial and teaching exposure and so we transform students and learners to experts.

1.2 OBJECTIVE

Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.

It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in such a way that all the data manipulates can be performed. It also provides record viewing facilities.

When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the user will not be in maize of instant.

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

Data de-duplication is one of important data compression techniques for eliminating duplicate copies of repeating data, and has been widely used in cloud storage to reduce the amount of storage space and save bandwidth. To protect the confidentiality of sensitive data while supporting de-duplication, Cloud computing provides seemingly unlimited "virtualized" resources to users as services across the whole Internet, while hiding platform and implementation details.

Today's cloud service providers offer both highly available storage and massively parallel computing resources at relatively low costs. As cloud computing becomes prevalent, an increasing amount of data is being stored in the cloud and shared by users with specified privileges, which define the access rights of the stored data.

2.1.1 Disadvantages:

- ✓ The authorized de-duplication system unable to be widely used and limited.
- ✓ Secure convergent encryption for efficient encryption, without considering issues of the key-management and block level de-duplication.

2.2 PROPOSED SYSTEM

The convergent encryption technique has been proposed to encrypt the data before outsourcing. To better protect data security, this paper makes the first attempt to formally address the problem of authorized data de-duplication. Different from traditional de-duplication systems, the differential privileges of users are further considered in duplicate check besides the data itself.

We also present several new de-duplication constructions supporting authorized duplicate check in a hybrid cloud architecture. Security analysis demonstrates that our scheme is secure in terms of the definitions specified in the proposed security model. As a proof of concept, we implement a prototype of our proposed authorized duplicate check scheme and conduct test bed experiments using our prototype. We show that our proposed authorized duplicate check scheme incurs minimal overhead compared to normal operations.

2.2.1 Advantages:

- One critical challenge of cloud storage services is the management of the ever-increasing volume of data.
- Present an advanced scheme to support stronger security by encrypting the file with differential privilege keys.
- De-duplication system supporting authorized duplicate check.

2.3 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- Economical feasibility
- Technical feasibility
- Social feasibility

2.3.1 ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited.

The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

2.3.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

2.3.3 SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 HARDWARE REQUIREMENT:

- System : Pentium IV 2.4 GHz.
- Hard Disk : 500 GB.
- Monitor : 17 " TFT
- Mouse : Logitech.
- Ram : 2 GB.

3.2 SOFTWARE REQUIREMENT:

- Operating system : Windows XP.
- Front End : Visual Studio 2012
- Coding Language : ASP.Net with C#
- Data Base : SQL Server 2005.

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 FRONT END

FEATURES OF .NET

Microsoft .NET is a set of Microsoft software technologies for rapidly building and integrating XML Web services, Microsoft Windows-based applications, and Web solutions. The .NET Framework is a language-neutral platform for writing programs that can easily and securely interoperate. There's no language barrier with .NET there are numerous languages available to the developer including Managed C++, C#, Visual Basic and Java Script. The .NET framework provides the foundation for components to interact seamlessly, whether locally or remotely on different platforms. It standardizes common data types and communications protocols so that components created in different languages can easily interoperate."NET" is also the collective name given to various software components built upon the .NET platform.

THE .NET FRAMEWORK

The .NET Framework has two main parts:

- The Common Language Runtime (CLR).
- A hierarchical set of class libraries.

The CLR is described as the "execution engine" of .NET. It provides the environment within which programs run. The most important features are

- Conversion from a low-level assembler-style language, called Intermediate Language (IL), into code native to the platform being executed on.
- Memory management, notably including garbage collection.
- Checking and enforcing security restrictions on the running code.
- Loading and executing programs, with version control and other such features.

- The following features of the .NET framework are also worth description:

Managed Code

The code that targets .NET, and which contains certain extra Information - "metadata" to describe it self.

Whilst both managed and unmanaged code can run in the runtime, only managed code contains the information that allows the CLR to guarantee, for instance, safe execution and interoperability.

Managed Data

With Managed Code comes Managed Data. CLR provides memory allocation and Deal location facilities, and garbage collection. Some .NET languages use Managed Data by default, such as C#, Visual Basic.NET and JScript.NET, whereas others, namely C++, do not. Targeting CLR can, depending on the language you're using, impose certain constraints on the features available. As with managed and unmanaged code, one can have both managed and unmanaged data in .NET applications - data that doesn't get garbage collected but instead is looked after by unmanaged code.

LANGUAGES SUPPORTED BY .NET

The multi-language capability of the .NET Framework and Visual Studio .NET enables developers to use their existing programming skills to build all types of applications and XML Web services. The .NET framework supports new versions of Microsoft's old favorites Visual Basic and C++ (as VB.NET and Managed C++), but there are also a number of new additions to the family.

Visual Basic .NET has been updated to include many new and improved language features that make it a powerful object-oriented programming language. These features include inheritance, interfaces, and overloading, among others. Visual Basic also now supports structured exception handling, custom attributes and also supports multi-threading.

Visual Basic .NET is also CLS compliant, which means that any CLS-compliant language can use the classes, objects, and components you create in Visual Basic .NET. Managed Extensions for C++ and attributed programming are just some of the enhancements made to the C++ language. Managed Extensions simplify the task of migrating existing C++ applications to the new .NET Framework.

Microsoft Visual J# .NET provides the easiest transition for Java-language developers into the world of XML Web Services and dramatically improves the interoperability of Java-language programs with existing software written in a variety of another programming languages .

Active State has created Visual Perl and Visual Python, which enable .NET-aware applications to be built in either Perl or Python. Both products can be integrated into the Visual Studio .NET environment. Visual Perl includes support for Active State's Perl Dev Kit.

Other languages for which .NET compilers are available include

- ★ FORTRAN
- ★ COBOL
- ★ Eiffel

<table>
<tr><td>ASP.NET
XML WEB SERVICES</td><td>Windows Forms</td></tr>
<tr><td colspan="2">Base Class Libraries</td></tr>
<tr><td colspan="2">Common Language Runtime</td></tr>
<tr><td colspan="2">Operating System</td></tr>
</table>

FIG5.1: .NET FRAMEWORK

C#.NET is also compliant with CLS (Common Language Specification) and supports structured exception handling. CLS is set of rules and constructs that are supported by the CLR (Common Language Runtime).

C#.NET is a CLS-compliant language. Any objects, classes, or components that created in C#.NET can be used in any other CLS-compliant language. In addition, we can use objects, classes, and components created in other CLS-compliant languages in C#.NET. The use of CLS ensures complete interoperability among applications, regardless of the languages used to create the application.

OVERLOADING

Overloading is another feature in C#. Overloading enables us to define multiple procedures with the same name, where each procedure has a different set of arguments. Besides using overloading for procedures, we can use it for constructors and properties in a class.

MULTITHREADING

C#.NET also supports multithreading. An application that supports multithreading can handle multiple tasks simultaneously, we can use multithreading to decrease the time taken by an application to respond to user interaction.

STRUCTURED EXCEPTION HANDLING

C#.NET supports structured handling, which enables us to detect and remove errors at runtime. In C#.NET, we need to use Try...Catch...Finally statements to create exception handlers. Using Try...Catch...Finally statements, we can create robust and effective exception handlers to improve the performance of our application.

THE .NET FRAMEWORK

The .NET Framework is a new computing platform that simplifies application development in the highly distributed environment of the Internet.

OBJECTIVES OF .NET FRAMEWORK:

- ✓ To provide a consistent object-oriented programming environment whether object codes is stored and executed locally on Internet-distributed, or executed remotely.
- ✓ To provide a code-execution environment to minimizes software deployment and guarantees safe execution of code.

There are different types of application,

- Windows-based applications
- Web-based applications.

4.2 BACK END

Features of SQL-Server:

The OLAP Services feature available in SQL Server version 7.0 is now called SQL Server 2000 Analysis Services. The term OLAP Services has been replaced with the term Analysis Services. Analysis Services also includes a new data mining component.

The Repository component available in SQL Server version 7.0 is now called Microsoft SQL Server 2000 Meta Data Services. References to the component now use the term Meta Data Services. The term repository is used only in reference to the repository engine within Meta Data Services SQL-SERVER database consist of five type of objects,

They are,

- ✓ TABLE
- ✓ QUERY
- ✓ FORM
- ✓ REPORT

TABLE:

A database is a collection of data about a specific topic.

VIEWS OF TABLE:

We can work with a table in two types,

- ✓ Design View
- ✓ Datasheet View

Design View:

To build or modify the structure of a table we work in the table design view. We can specify what kind of data will be hold.

Datasheet View:

To add, edit or analyses the data itself we work in tables datasheet view mode.

QUERY:

A query is a question that has to be asked the data. Access gathers data that answers the question from one or more table. The data that make up the answer is either dynast (if you edit it) or a snapshot. Each time we run query, we get latest information in the dynast.

CHAPTER 5

PROJECT DESCRIPTION

5.1 PROBLEM DEFINITION

Data de-duplication is a technique for eliminating duplicate copies of data, and has been widely used in cloud storage to reduce storage space and upload bandwidth. However, there is only one copy for each file stored in cloud even if such a file is owned by a huge number of users. As a result, de-duplication system improves storage utilization while reducing reliability. Furthermore, the challenge of privacy for sensitive data also arises when they are outsourced by users to cloud.

Aiming to address the above security challenges, this paper makes the first attempt to formalize the notion of distributed reliable de-duplication system. We propose new distributed de-duplication systems with higher reliability in which the data chunks are distributed across multiple cloud servers. The security requirements of data confidentiality and tag consistency are also achieved by introducing a deterministic secret sharing scheme in distributed storage systems, instead of using convergent encryption as in previous de-duplication systems.

5.2 OVERVIEW OF THE PROJECT

De-duplication techniques can be categorized into two different approaches: de-duplication over unencrypted data and de-duplication over encrypted data. In the former approach, most of the existing schemes have been proposed in order to perform a PoW process in an efficient and robust manner, since the hash of the file, which is treated as a "proof" for the entire file, is vulnerable to being leaked to outside adversaries because of its relatively small size. Where as in the latter approach, data privacy is the primary security requirement to protect against not only outside adversaries but also inside the cloud server.

Thus, most of the schemes have been proposed to provide data encryption, while still benefiting from a de-duplication technique, by enabling data owners to share the encryption keys in the presence of the inside and outside adversaries.

Since encrypted data are given to a user, data access control can be additionally implemented by selective key distribution after the POW process. However, not much work has yet been done to address dynamic ownership management and its related security problem.

Data reliability is actually a very critical issue in a de-duplication storage system .Though de-duplication technique can save the storage space for the cloud storage service providers, it reduces the reliability of the system. Data reliability is actually a very critical issue in a de-duplication storage system because there is only one copy for each file stored in the server shared by all the owners. If such a shared file/chunk was lost, a disproportionately large amount of data becomes inaccessible because of the unavailability of all the files that share this file/chunk.

If the value of a chunk were measured in terms of the amount of file data that would be lost in case of losing a single chunk, then the amount of user data lost when a chunk in the storage system is corrupted grows with the number of the commonality of the chunk.

Thus, how to guarantee high data reliability in de-duplication system is a critical problem. Most of the previous de-duplication systems have only been considered in a single-server setting. However, as lots of de-duplication systems and cloud storage systems are intended by users and applications for higher reliability, especially in archival storage systems where data are critical and should be preserved over long time periods. This requires that the de-duplication storage systems provide reliability comparable to other high systems.

AUTHORIZED DE-DUPLICATION

De-duplication can be frequently used in these settings for data backup and disaster recovery applications while greatly reducing storage space. Such systems are widespread and are often more suitable to user file backup and synchronization applications than richer storage abstractions. There are three entities defined in our system, that is, users, private cloud and S-CSP in public cloud .The S-CSP performs de-duplication by checking if the contents of two files are the same and stores only one of them.

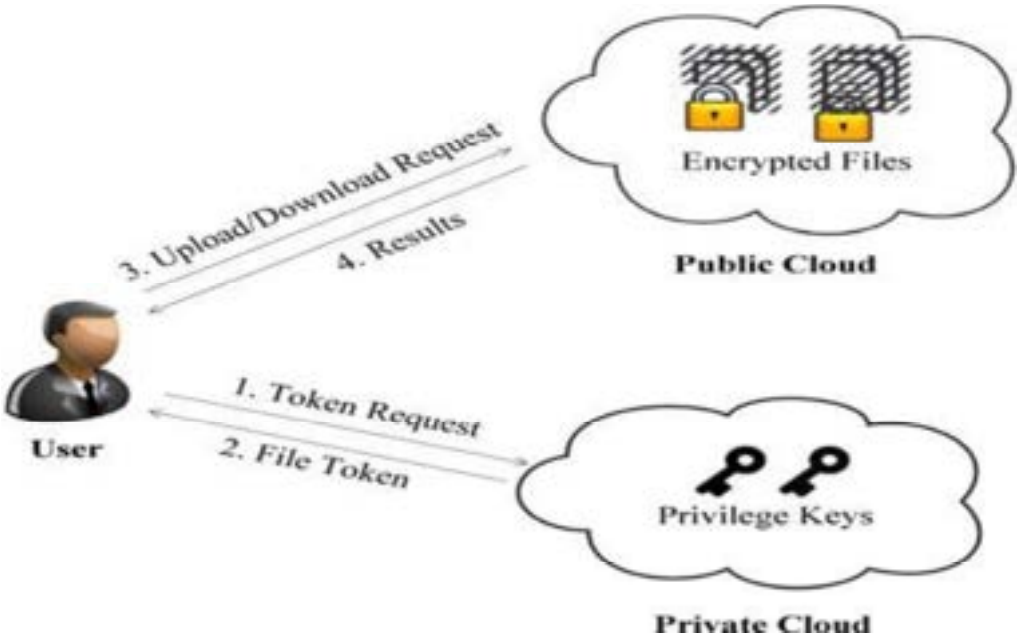


FIG 5.2:ARCHITECTURE OF APPLICATION BASED DE-DUPLICATION

5.3 MODULE DESCRIPTION:

- User Module
- Secure De-duplication System
- Security Of Duplicate Check Token
- Send Key

5.3.1 User Module:

In this module, Users are having authentication and security to access the detail which is presented in the ontology system. Before accessing or searching the details user should have the account in that otherwise they should register first.

5.3.2 Secure De-duplication System:

To support authorized de-duplication, the tag of a file F will be determined by the file F and the privilege. To show the difference with traditional notation of tag, we call it file token instead. To support authorized access, a secret key kp will be bounded with a privilege p to generate a file token.

Let ϕ' F;p = TagGen(F, kp) denote the token of F that is only allowed to access by user with privilege p. In another word, the token ϕ' F;p could only be computed by the users with privilege p.

As a result, if a file has been uploaded by a user with a duplicate token ϕ' F;p, then a duplicate check sent from another user will be successful if and only if he also has the file F and privilege p. Such a token generation function could be easily implemented as H(F, kp), where H(_) denotes a cryptographic hash function.

5.3.3 Security of Duplicate Check Token:

We consider several types of privacy we need protect, that is, enforceability of duplicate-check token: There are two types of adversaries, that is, external adversary and internal adversary. As shown below, the external adversary can be viewed as an internal adversary without any privilege.

If a user has privilege p, it requires that the adversary cannot forge and output a valid duplicate token with any other privilege p′ on any file F, where p does not match p′. Furthermore, it also requires that if the adversary does not make a request of token with its own privilege from private cloud server, it cannot forge and output a valid duplicate token with p on any F that has been queried.

5.3.4. Send Key:

Once the key request was received, the sender can send the key or he can decline it. With this key and request id which was generated at the time of sending key request the receiver can decrypt the message.

5.4 DATA FLOW DIAGRAM

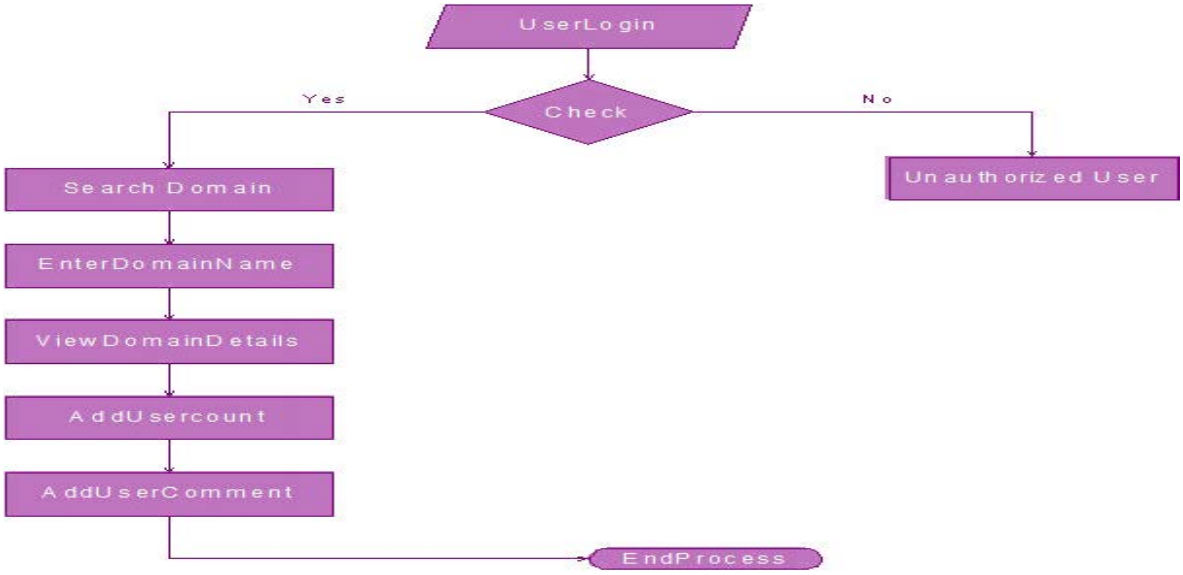


FIG 5.3: DATA FLOW DIAGRAM

5.5 CLASS DIAGRAM

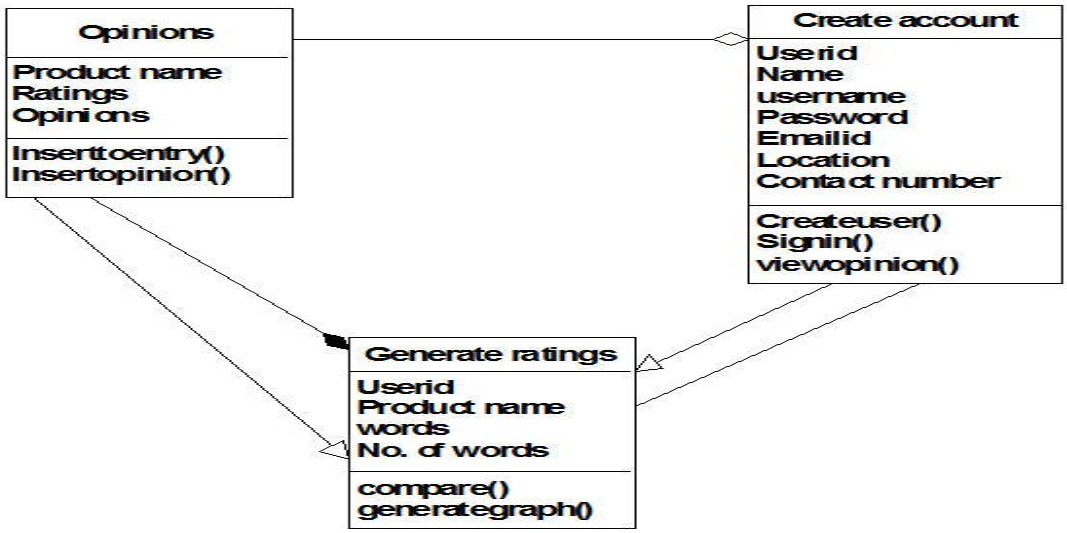


FIG5.4: CLASS DIAGRAM

5.6 SEQUENCE DIAGRAM

(Admin):

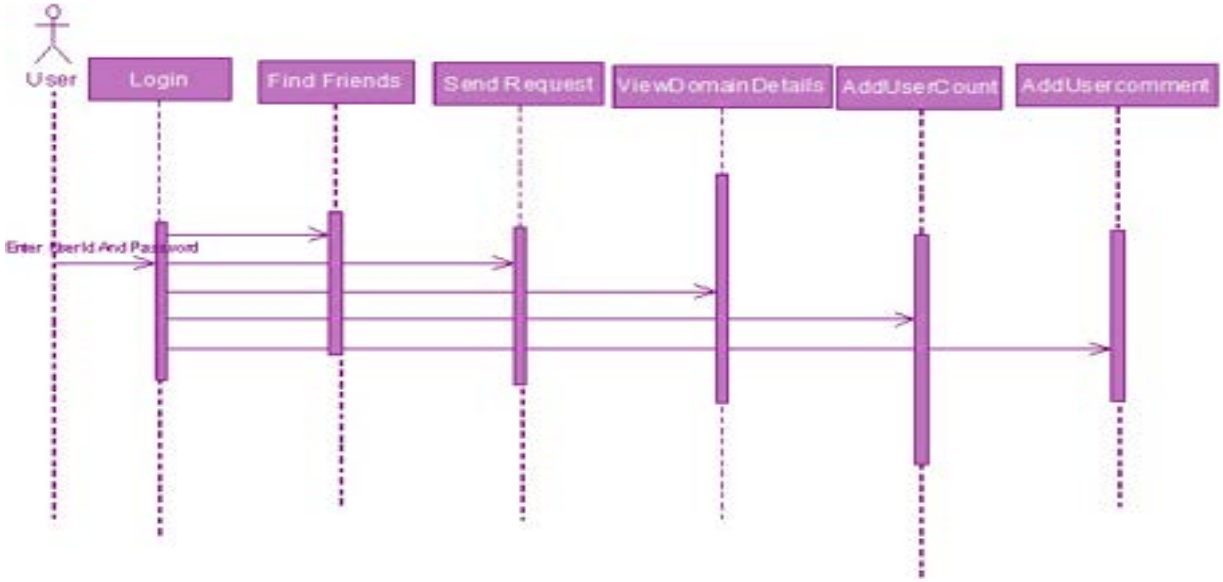


FIG5.5.: SEQUENCE DIAGRAM (Admin)

(User):

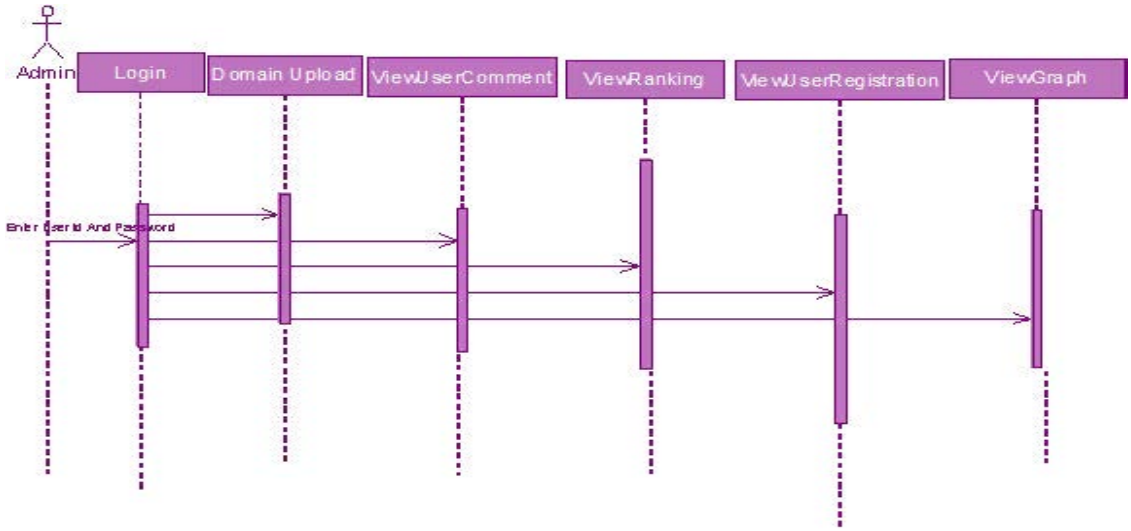


FIG5.6: SEQUENCE DIAGRAM (User)

5.7 ACTIVITY DIAGRAM

(Admin)

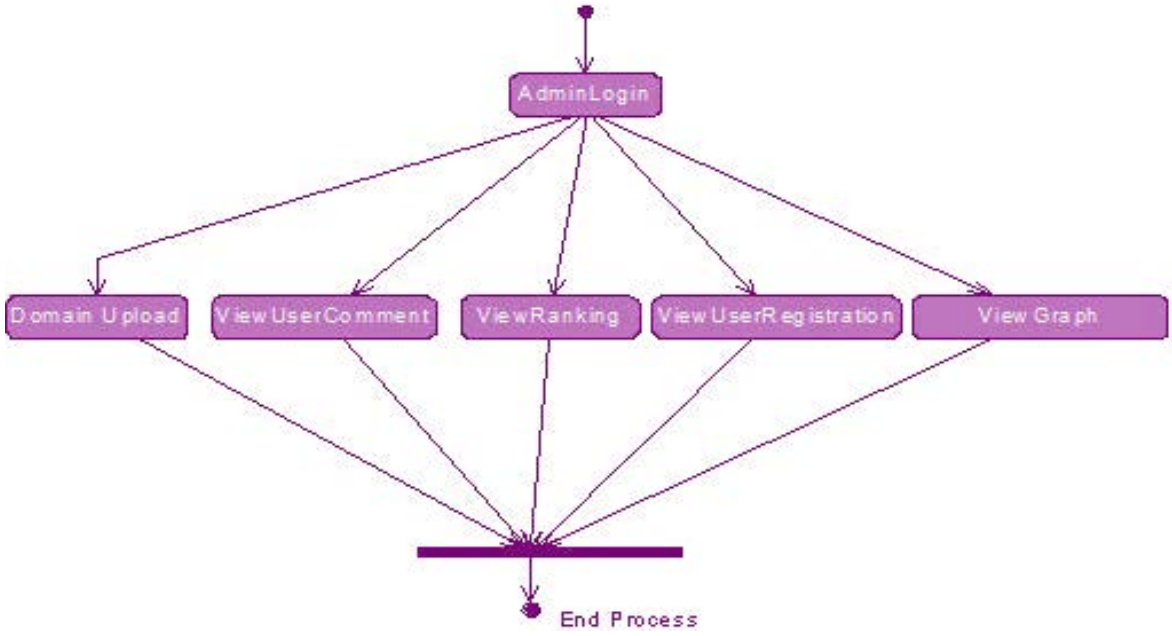


FIG 5.7: ACTIVITY DIAGRAM (Admin)

(User):

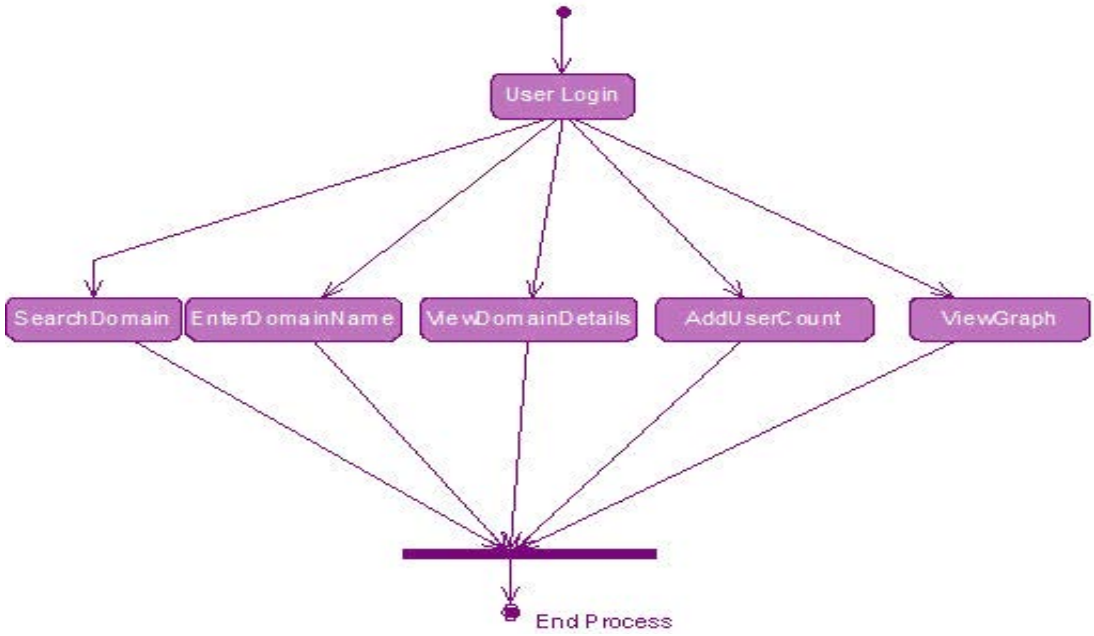


FIG 5.8: ACTIVITY DIAGRAM (User)

5.8 COMPONENT DIAGRAM

Admin:

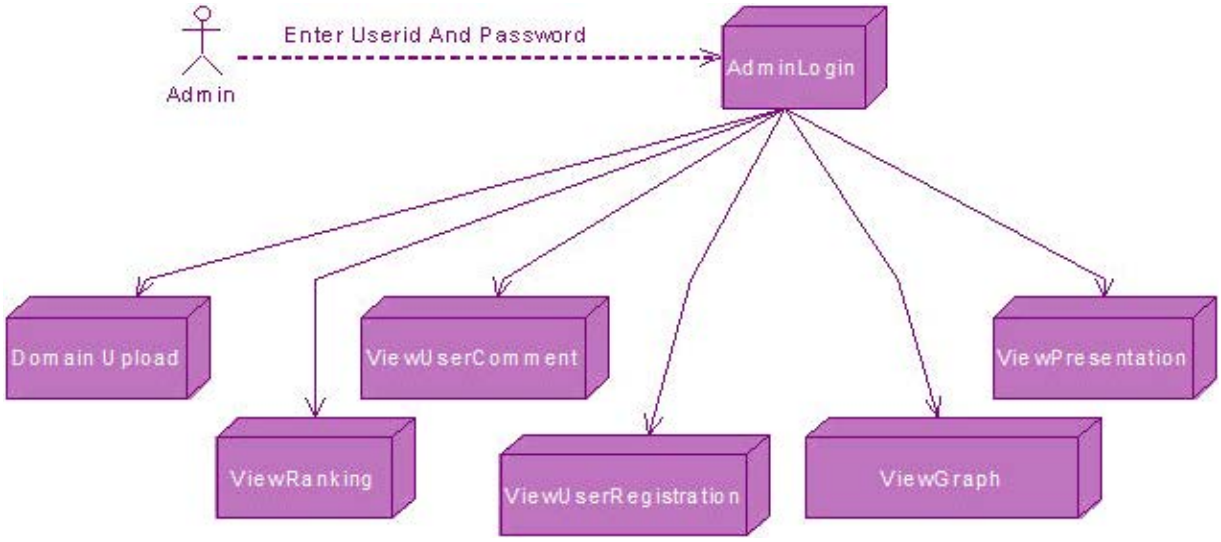


FIG 5.9: COMPONENT DIAGRAM (Admin)

User:

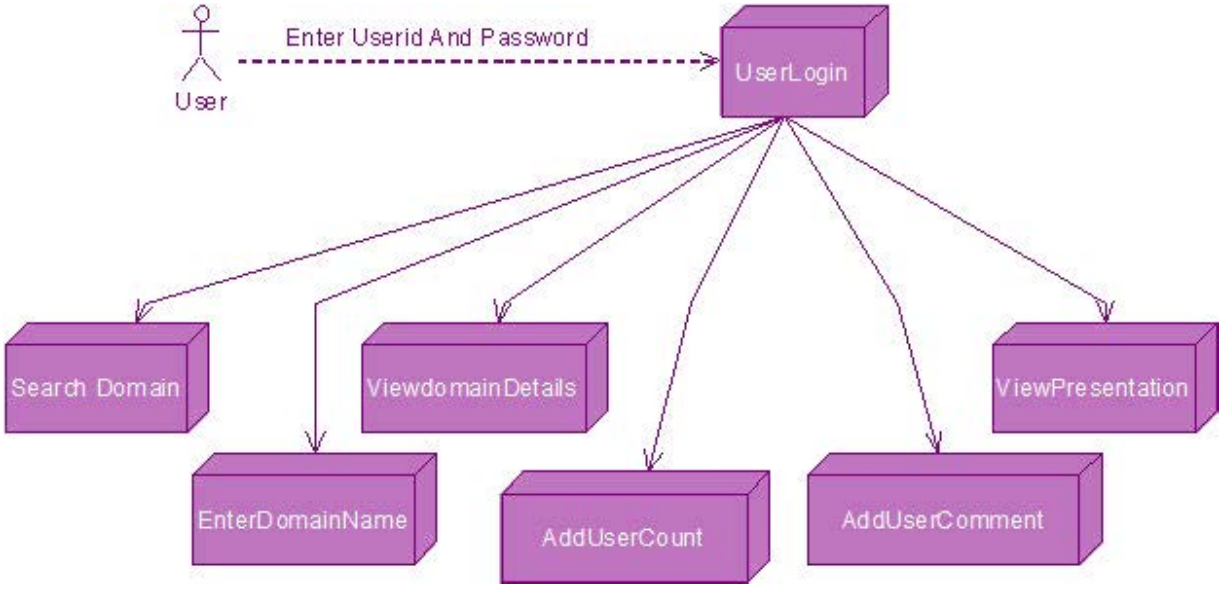


FIG 5.10: COMPONENT DIAGRAM (User)

5.9 INPUT DESIGN

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system.

The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy.

5.10 OUTPUT DESIGN

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

CHAPTER 6

SYSTEM TESTING

6.1 UNIT TESTING

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

Test strategy and approach

Field testing will be performed manually and functional tests will be written in detail.

Test objectives

- ✓ All field entries must work properly.
- ✓ Pages must be activated from the identified link.
- ✓ The entry screen, messages and responses must not be delayed.

Features to be testing

- ✓ Verify that the entries are of the correct format
- ✓ No duplicate entries should be allowed
- ✓ All links should take the user to the correct page.

6.2 INTEGRATION TESTING

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects. The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.3 SYSTEM TESTING

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

6.4 USER ACCEPTANCE TESTING

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Test Results: All the test cases mentioned above passed successfully. No defects encountered.

6.5 WHITE BOX TESTING

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

6.6 BLACK BOX TESTING

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document.

It is a testing in which the software under test is treated, as a black box .you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

CHAPTER 7

SYSTEM IMPLEMENTATION

7.1 RESULT AND PERFORMANCE

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective.

The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of ethos to achieve changeover and evaluation of changeover methods.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 CONCLUSION

Cloud storage using de-duplication techniques and their performance and suggests a variation in the index of chunk level de-duplication and improving backup performance and Reduce the system overhead, improve the data transfer efficiency on cloud is essential so presented approach on application based de-duplication and indexing scheme that preserved caching which maintains the locality of duplicate content to achieve high hit ratio with the help of the hashing algorithm and improve the cloud backup performance. This proposed a novel variation in the de-duplication technique and showed that this achieves better performance.

8.2 FUTURE ENHANCEMENT

We pointed out the potential risks of cross-user source based-de-duplication. We described how such de-duplication can be used as a side channel to reveal information about the contents of files of other users, and as a covert channel by which malicious software can communicate with the outside world, regardless the firewall settings of the attacked machine. Since de-duplication offers substantial savings in both disk capacity and network bandwidth, we suggested and analyzed a mechanism that provides higher privacy guarantees while slightly reducing bandwidth savings.

Future work includes a more rigorous analysis of the privacy guarantees provided by our mechanism and a study of alternative solutions that maximize privacy while having minimal influence on de-duplication efficiency. Furthermore, our observations give motivation to an evaluation of the risks induced by other de-duplication technologies, and of cross-user technologies in general. The goal must be to ensure clients that their data remains private, by showing that uploading their data to the cloud has a limited effect on what an adversary may learn about them.

CHAPTER 9

APPENDICES

9.1 SAMPLE SOURCE CODE

```
<%@PageTitle="About"Language="C#"MasterPageFile="~/Site.Master"
AutoEventWireup="true"CodeBehind="About.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.About" %>
<asp:Content runat="server" ID="BodyContent" ContentPlaceHolderID="MainContent">
</asp:Content>
<?xml version="1.0" encoding="utf-8" ?>
<bundles version="1.0">
  <styleBundle path="~/Content/css">
    <include path="~/Content/Site.css" />
  </styleBundle>  <styleBundle path="~/Content/themes/base/css">
    <include path="~/Content/themes/base/jquery.ui.core.css" />
    <include path="~/Content/themes/base/jquery.ui.resizable.css" />
    <include path="~/Content/themes/base/jquery.ui.selectable.css" />
    <include path="~/Content/themes/base/jquery.ui.accordion.css" />
    <include path="~/Content/themes/base/jquery.ui.autocomplete.css" />
    <include path="~/Content/themes/base/jquery.ui.button.css" />
    <include path="~/Content/themes/base/jquery.ui.dialog.css" />
    <include path="~/Content/themes/base/jquery.ui.slider.css" />
    <include path="~/Content/themes/base/jquery.ui.tabs.css" />
    <include path="~/Content/themes/base/jquery.ui.datepicker.css" />
    <include path="~/Content/themes/base/jquery.ui.progressbar.css" />
    <include path="~/Content/themes/base/jquery.ui.theme.css" />
  </styleBundle>
</bundles>
```

```
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Category.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.Category" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
    <style type="text/css">
        .GridviewDiv
        {
            font-size: 100%;
            font-family: 'Lucida Grande', 'Lucida Sans Unicode', Verdana, Arial,
Helevetica, sans-serif;
            color: black;
            background-color: white;
        }

        .headerstyle
        {
            color: #FFFFFF;
            border-right-color: #abb079;
            border-bottom-color: #abb079;
            background-color: #df5015;
            padding: 0.5em 0.5em 0.5em 0.5em;
            text-align: center;
        }
        .footerstyle
        {
            color: #FFFFFF;
            background-color: red !important;
```

```
    padding: 0.5em 0.5em 0.5em 0.5em;
    text-align: right;
}
.grid
{
    border: solid 1px Red;
    height: 150px !important;
    overflow-y: auto;
}
.grid td
    {
        border-top: solid 1px blue;
    }
    .grid th
    {
        border-top: solid 1px red !important;
    }
   .grid th.first
        {
            border-right: solid 1px blue !important;
        }
    .grid th.last
        {
            border-left: solid 1px blue !important;
        }
   .grid td.first
    {
        border-right: solid 1px blue !important;
    }
   .grid td.last
    {
```

```
            border-left: solid 1px blue !important;
        }
        .grid td
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
        .grid th
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
      .GridviewDiv
      {
        height: 410px;
        overflow-y: scroll !important;
      }
  </style>
  <div id="divdata" runat="server">
    <div style="float: left; width: 40%;  height: 450px; margin-left: 50px; margin-top: 10px;
margin-bottom: 10px;">
        <fieldset>
          <legend>Add new category</legend>
          <div style="margin-left: 10px;">
            <table>
              <tr>
                <td colspan="2" style="text-align: center"><b style="font-size: 18px; color:
white; font-weight: bold">Add new category</b></td>
              </tr>
```

```
                <tr>
                    <td colspan="2">
                        <br />
                    </td>
                </tr>
                <tr>
                    <td style="font-size: 12px; color: white; font-weight: bold"><span
style="color: red; font-weight: bold">*</span> Category Name</td>
                    <td>
                        <asp:TextBox ID="txtcategory" runat="server"></asp:TextBox>
                    </td>
                </tr>
                <tr>
                    <td></td>
                    <td>
<asp:ImageButton ID="btnSave" ImageUrl="~/Images/Save.png" runat="server" Width="80"
Height="40" OnClick="btnSave_Click" />     
<asp:ImageButton ID="btnreset" ImageUrl="~/Images/Rest.png" runat="server" Width="80"
Height="40" OnClick="btnreset_Click" />
                    </td>
                </tr>
                <tr>
 <td colspan="2"style="text-align:center;"><asp:Image ID="Image1"
ImageUrl="~/Images/upload_bg.png" runat="server" Width="365px" Height="172px" />
                    </td>
                </tr>
                <tr>
 <td colspan="2" style="text-align: center;"><a href="Users.aspx" style="color: blue; font-
weight: bold; font-size: 15px;">Go to login/Registraion page</a> <br />
<span style="color: red; font-weight: bold">* denotes Required fields</span></td>
                </tr>
```

```
            </table>
          </div>
        </fieldset>
      </div>
      <div style="float: left; width: 50%;  height: 450px; margin-left: 10px; margin-top: 10px;
margin-bottom: 10px;">
        <div style="font-weight: bold; color: whitesmoke; font-size: 20px;">
          <div style="float: left;">
            Welcome :
            <asp:Label ID="lblUserName" runat="server"></asp:Label>
          </div>
          Category Details
          <div style="float: right;">
            <asp:LinkButton ID="btnlogout" runat="server" ForeColor="#00ffff"
Style="padding-right: 15px;" OnClick="btnlogout_Click">logout</asp:LinkButton>
          </div>
        </div>
        <div class="GridviewDiv" runat="server" id="divGridrows">
          <asp:GridView runat="server" ID="gvDetails" GridLines="None"
            AutoGenerateColumns="false" Width="575px" CssClass="grid">
            <HeaderStyle CssClass="headerstyle" />
            <Columns>
              <asp:BoundField DataField="CategoryId" HeaderText="Category ID" />
              <asp:BoundField DataField="Name" HeaderText="category Name" />
              <asp:BoundField DataField="CreatedBy" HeaderText="Created By" />
              <asp:BoundField DataField="CreatedOn" HeaderText="Created Date" />
            </Columns>
          </asp:GridView>
        </div>
        <div id="divGrodnorow" runat="server" style="text-align: center; color: white; font-size:
16px; font-weight: bold;">
```

```
            <br />
            <br />
            <asp:Label runat="server" Text="No Records to display"></asp:Label>
          </div>
        </div>
    </div>
    <div style="text-align: center; vertical-align: middle; font-weight: bold; font-size: 20px;"
id="divNoData" runat="server">
        <br />
<label id="lblnodata" style="font-weight: bold; color: red;">Restricted page access ...
</label>
        <br />
        <a id="A1" href="Users.aspx" runat="server">Click here to login as Admin</a>
    </div>
</asp:Content>
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="CloudServer.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm4" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
    <div id="divData" runat="server">
        <div style="float: left; width: 35%; height: 450px; margin-left: 50px; margin-top: 10px;
margin-bottom: 10px;">
            <table>
                <tr>
                    <td style="font-size: 12px; color: white; font-weight: bold">File Name</td>
                    <td>
                        <asp:TextBox runat="server" ID="txtfileName"></asp:TextBox>
```

```
            </td>
          </tr>
          <tr>
            <td style="font-size: 12px; color: white; font-weight: bold">Category Name</td>
            <td>
              <asp:DropDownList ID="ddlcategory" runat="server" Style="width: 280px;
height: 25px;"></asp:DropDownList>
            </td>
          </tr>
          <tr>
            <td></td>
            <td>
 <asp:ImageButton ID="btnView" runat="server" ImageUrl="~/Images/button_view.png"
Width="80" Height="40" OnClick="btnView_Click" />     
            <asp:ImageButton ID="btnReset" runat="server" ImageUrl="~/Images/Rest.png"
Width="80" Height="40" OnClick="btnReset_Click" />
            </td>

          </tr>
          <tr>
            <td colspan="2">
              <asp:Image runat="server" ImageUrl="~/Images/cloud-server-free-trial.png"
Width="365" Height="228" /></td>
          </tr>
        </table>
      </div>
      <div style="float: left; width: 59%; height: 450px; margin-left: 10px; margin-top: 10px;
margin-bottom: 10px;">
        <div style="font-weight: bold; color: whitesmoke; font-size: 20px;">
          <div style="float: left;">
            Welcome :
```

```
            <asp:Label ID="lblUserName" runat="server"></asp:Label>
          </div>
          <div style="float: right;">
            <asp:LinkButton ID="btnlogout" runat="server" ForeColor="#00ffff"
Style="padding-right: 15px;" OnClick="btnlogout_Click">logout</asp:LinkButton>
          </div>
        </div>
        <div style="text-align: center; color: white;"><b>File View</b></div>
        <div style="width: 100%; height: 430px; overflow-y: scroll; background-color: white;"
id="divlist" runat="server">
          <%--<textarea id="txtarea" runat="server" style="height: 430px; width:
97%;"></textarea>--%>
        </div>
      </div>
    </div>
    <div style="text-align: center; vertical-align: middle; font-weight: bold; font-size: 20px;"
id="divNoData" runat="server">
      <br />
      <label id="lblnodata" style="font-weight: bold; color: red;">Restricted page access ...
</label>
      <br />
      <a id="A1" href="Users.aspx" runat="server">Click here to login as User/Admin</a>
    </div>
</asp:Content>
<%@ Page Title="Contact" Language="C#" MasterPageFile="~/Site.Master"
AutoEventWireup="true" CodeBehind="Contact.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.Contact" %>
<asp:Content runat="server" ID="BodyContent" ContentPlaceHolderID="MainContent">
</asp:Content>
```

```
<%@ Page Title="Home Page" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true" CodeBehind="Default.aspx.cs" Inherits="IdentityBasedDistibution_Provable_DataPossion.Default" %>
<asp:Content runat="server" ID="FeaturedContent" ContentPlaceHolderID="FeaturedContent">
</asp:Content>
<asp:Content runat="server" ID="BodyContent" ContentPlaceHolderID="MainContent">
    <div style="width: 100%;">
        <div style="float: left; width: 35%;  color: white; height: 450px; margin-left: 50px; margin-top: 10px; margin-bottom: 10px;">
            <br />
            <b> </b>
            <br />
            <br />
            <b>   
            <br />
                <br />
<br />
                <br />
 <br />
                <br />
  <br />
                <br />
 <br />
                <br />
            </b>
        </div>
        <div style="float: left; width: 59%;  height: 450px; margin-left: 10px; margin-top: 10px; margin-bottom: 10px;">
            <div style="font-weight: bold; color: whitesmoke; font-size: 20px;">
                <div style="float: left;">
```

```
            <asp:Label ID="lblUserName" runat="server"></asp:Label>
          </div>
          <div style="float: right;">
            <asp:LinkButton ID="btnlogout" runat="server" ForeColor="#00ffff"
Style="padding-right: 15px;" OnClick="btnlogout_Click">logout</asp:LinkButton>
          </div>
        </div>
        <div >
          <asp:Image ID="txtCloudImage" ImageUrl="~/Images/cloud_bg.jpg" runat="server"
Width="700px" Height="439px" />
        </div>
      </div>
    </div >
</asp:Content>
<%@ Page Language="C#" AutoEventWireup="true" CodeBehind="Fileview.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.Fileview" %>
<!DOCTYPE html>
<html xmlns="http://www.w3.org/1999/xhtml">
<head runat="server">
  <title></title>
</head>
<body>
  <form id="form1" runat="server">
    <div runat="server" id="divData">
      <%--<textarea id="txtarea" runat="server" style="height: 430px; width:
97%;"></textarea>--%>
    </div>
  </form>
</body>
</html>
```

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.Optimization;
using System.Web.Routing;
using System.Web.Security;
using IdentityBasedDistibution_Provable_DataPossion;
namespace IdentityBasedDistibution_Provable_DataPossion
{
   public class Global : HttpApplication
   {
      void Application_Start(object sender, EventArgs e)
      {
         // Code that runs on application startup
         BundleConfig.RegisterBundles(BundleTable.Bundles);
         AuthConfig.RegisterOpenAuth();
      }
      void Application_End(object sender, EventArgs e)
      {
         //  Code that runs on application shutdown
      }
      void Application_Error(object sender, EventArgs e)
      {
         // Code that runs when an unhandled error occurs
      }
   }
}
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Login.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm5" %>
```

```
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
</asp:Content>
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Owner.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm2" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
    <style type="text/css">
        .GridviewDiv
        {
            font-size: 100%;
            font-family: 'Lucida Grande', 'Lucida Sans Unicode', Verdana, Arial, Helevetica, sans-
serif;
            color: black;
            background-color: white;
        }
        .headerstyle
        {
            color: #FFFFFF;
            border-right-color: #abb079;
            border-bottom-color: #abb079;
            background-color: #df5015;
            padding: 0.5em 0.5em 0.5em 0.5em;
            text-align: center;
```

```
}
.footerstyle
{
    color: #FFFFFF;
    background-color: red !important;
    padding: 0.5em 0.5em 0.5em 0.5em;
    text-align: right;
}
.grid
{
    border: solid 1px Red;
    height: 150px !important;
    overflow-y: auto;
}
    .grid td
    {
        border-top: solid 1px blue;
    }
    .grid th
    {
        border-top: solid 1px red !important;
    }
  .grid th.first
        {
            border-right: solid 1px blue !important;
        }
        .grid th.last
        {
            border-left: solid 1px blue !important;
        }
    .grid td.first
```

```
        {
            border-right: solid 1px blue !important;
        }
        .grid td.last
        {
            border-left: solid 1px blue !important;
        }
        .grid td
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
        .grid th
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
    .GridviewDiv
    {
        height: 410px;
        overflow-y: scroll !important;
    }
</style>
<div style="width: 100%;" id="divGrodrow" runat="server">
    <div style="float: left; width: 40%;  height: 450px; margin-left: 50px; margin-top: 10px;
margin-bottom: 10px;">
        <fieldset>
            <legend>Owner</legend>
            <div style="margin-left: 10px;">
```

```
<table>
  <tr>
<td colspan="2" style="text-align: center"><b style="font-size: 18px; color: white; font-weight: bold">File Upload</b></td>
  </tr>
  <tr>
    <td colspan="2">
      <br />
    </td>
  </tr>
  <tr>
    <td style="font-size: 12px; color: white; font-weight: bold">Title</td>
    <td>
      <asp:TextBox ID="txttitle" runat="server"></asp:TextBox>
    </td>
  </tr>
  <tr>
    <td style="font-size: 12px; color: white; font-weight: bold">Category</td>
    <td>
      <asp:DropDownList ID="ddlCategory" runat="server" Style="width: 310px; height: 30px;">
      </asp:DropDownList>
    </td>
  </tr>
  <tr>
    <td style="font-size: 12px; color: white; font-weight: bold">Upload File</td>
    <td>
      <asp:FileUpload ID="Uplodfile" runat="server" />
    </td>
  </tr>
  <tr>
```

```
                    <td></td>
                    <td>
 <asp:ImageButton ID="btnupload" ImageUrl="~/Images/button_upload.png" runat="server"
Width="80" Height="40" OnClick="btnupload_Click" />     
<asp:ImageButton ID="btnreset" ImageUrl="~/Images/Rest.png" runat="server" Width="80"
Height="40" OnClick="btnreset_Click" /></td>
                </tr>
                <tr>
                    <td colspan="2" style="text-align: center;">
                        <asp:Image ImageUrl="~/Images/upload_bg.png" runat="server"
Width="365px" Height="172px" />
                    </td>
                </tr>
            </table>
        </div>
    </fieldset>
</div>
<div style="float: left; width: 50%; height: 450px; margin-left: 10px; margin-top: 10px;
margin-bottom: 10px;">
    <div style="font-weight: bold; color: blue; font-size: 20px;">
        <div style="float: left;">
            Welcome :
            <asp:Label ID="lblUserName" runat="server"></asp:Label>
        </div>
        <div style="float: right;">
<asp:LinkButton ID="btnlogout" runat="server" ForeColor="#00ffff" Style="padding-right:
15px;" OnClick="btnlogout_Click">logout</asp:LinkButton>
        </div>
    </div>
    <div id="divGridrows" runat="server" style="background-color: white; width: 630px;">
```

```
            <div style="background-color: white; overflow-y: auto; height: 430px; width: 630px;">
                <asp:GridView runat="server" ID="gvDetails" GridLines="None"
                  AutoGenerateColumns="false" Width="610px" CssClass="grid">
                  <HeaderStyle CssClass="headerstyle" />
                  <Columns>
                    <asp:BoundField DataField="FileID" HeaderText="FileID" />
                    <asp:BoundField DataField="Tittle" HeaderText="Tittle" />
                    <asp:BoundField DataField="FileName" HeaderText="FileName" />
                    <asp:BoundField DataField="FileCategory" HeaderText="FileCategory" />
                    <asp:BoundField DataField="CreatedBy" HeaderText="CreatedBy" />
                    <asp:BoundField DataField="CreatedOn" HeaderText="Created Date" />
                  </Columns>
                </asp:GridView>
              </div>
            </div>
            <div id="divGridNorows" runat="server">
              <br />
              <br />
              <asp:Label ID="lblNoRecord" runat="server" Text="No Records found..."></asp:Label>
            </div>
          </div>
        </div>
        <div id="divNoGrid" runat="server" style="text-align: center; vertical-align: middle; font-weight: bold; font-size: 20px;">
          <br />
          <br />
          <asp:Label ID="Label1" runat="server" Text="Page access Restricted !..." Style="font-weight: bold; color: red;"></asp:Label>
          <br />
```

```
        <a href="Users.aspx" >Click here to login as Admin</a>
    </div>
</asp:Content>
<?xml version="1.0" encoding="utf-8"?>
<packages>
  <package id="AspNet.ScriptManager.jQuery" version="1.7.1" targetFramework="net45" />
  <package      id="AspNet.ScriptManager.jQuery.UI.Combined"    version="1.8.20"
targetFramework="net45" />
  <package id="DotNetOpenAuth.AspNet" version="4.0.3.12153" targetFramework="net45" />
  <package id="DotNetOpenAuth.Core" version="4.0.3.12153" targetFramework="net45" />
  <package id="DotNetOpenAuth.OAuth.Consumer"          version="4.0.3.12153"
targetFramework="net45" />
  <package id="DotNetOpenAuth.OAuth.Core"       version="4.0.3.12153"
targetFramework="net45" />
  <package      id="DotNetOpenAuth.OpenId.Core"           version="4.0.3.12153"
targetFramework="net45" />
  <package      id="DotNetOpenAuth.OpenId.RelyingParty"          version="4.0.3.12153"
targetFramework="net45" />
  <package id="EntityFramework" version="5.0.0" targetFramework="net45" />
  <package id="jQuery" version="1.7.1.1" targetFramework="net45" />
  <package id="jQuery.UI.Combined" version="1.8.20.1" targetFramework="net45" />
  <package id="Microsoft.AspNet.Membership.OpenAuth" version="1.0.0"
targetFramework="net45" />
  <package id="Microsoft.AspNet.Providers.Core" version="1.1" targetFramework="net45" />
  <package  id="Microsoft.AspNet.Providers.LocalDB"  version="1.1"  targetFramework="net45"
/>
  <package id="Microsoft.AspNet.ScriptManager.MSAjax" version="4.5.6"
targetFramework="net45" />
  <package id="Microsoft.AspNet.ScriptManager.WebForms"       version="4.5.6"
targetFramework="net45" />
```

```
  <package id="Microsoft.AspNet.Web.Optimization" version="1.0.0" targetFramework="net45"
/>
  <package id="Microsoft.AspNet.Web.Optimization.WebForms"  version="1.0.0"
targetFramework="net45" />
  <package id="Microsoft.Web.Infrastructure" version="1.0.0.0" targetFramework="net45" />
  <package id="Modernizr" version="2.5.3" targetFramework="net45" />
  <package id="WebGrease" version="1.1.0" targetFramework="net45" />
</packages>
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Registration.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm6" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>    <asp:Content    ID="Content2"    ContentPlaceHolderID="FeaturedContent"
runat="server"> </asp:Content> <asp:Content        ID="Content3"
ContentPlaceHolderID="MainContent" runat="server">
   <script type="text/javascript">
      function Validateform() {
         alert("test");
         var Name = jQuery("#txtName").val().trim();
         alert(Name);
         var UserName = $("#txtUserName").val().trim();
         var password = $("#txtpassword").val().trim();
         var email = $("#txtemail").val().trim();
         var mobile = $("#txtmobile").val().trim();
         var City = $("#txtCity").val().trim();
         alert(Name);
         var isvalid = validateEmail(email);
         if (Name == "") {
            alert("Name should not be left blank");
            return false;
         }
```

```
        else if (UserName == "") {
            alert("UserName should not be left blank");
            return false;
        }
        else if (password == "") {
            alert("Password should not be left blank");
            return false;
        }
        else if (email == "") {
            alert("Email should not be left blank");
            return false;
        }
        else if (isvalid == false) {
            alert("EmailId not in valid format");
            return false;
        }
        else if (mobile == "") {
            alert("Mobile should not be left blank");
            return false;
        }
        else if (City == "") {
            alert("City should not be left blank");
            return false;
        }
        else {
            return true;
        }
        return false;
    }
    function validateEmail(email)
{
```

```
        var valid = emailReg.test(email);
        if (!valid) {
            return false;
        } else {
            return true;
        }
    }
</script>
<div style="width: 100%;">
    <div style="float: left; width: 55%;  height: 450px; margin-left: 50px; margin-top: 10px; margin-bottom: 10px;">
        <fieldset>
            <legend>Login</legend>
            <div style="margin-left: 60px;">
                <table>
                    <tr>
                        <td colspan="2" style="text-align: center"><b style="font-size: 18px; color: white; font-weight: bold">Registration</b></td>
                    </tr>
                    <tr>
                        <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-weight: bold">*</span> Name</td>
                        <td>
                            <asp:TextBox ID="txtName" runat="server"></asp:TextBox>
                        </td>
                    </tr>
                    <tr>
                        <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-weight: bold">*</span> UserName</td>
                        <td>
                            <asp:TextBox ID="txtUserName" runat="server"></asp:TextBox></td>
```

```
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-
weight: bold">*</span> Password</td>
                    <td>
 <asp:TextBox ID="txtpassword" runat="server" TextMode="Password"></asp:TextBox></td>
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-
weight: bold">*</span> Email</td>
                    <td>
 <asp:TextBox ID="txtemail" runat="server"></asp:TextBox></td>
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-
weight: bold">*</span> Mobile</td>
                    <td>
 <asp:TextBox ID="txtmobile" runat="server"></asp:TextBox></td>
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-
weight: bold">*</span> City</td>
                    <td>
 <asp:TextBox ID="txtCity" runat="server"></asp:TextBox></td>
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-
weight: bold">*</span> UserType</td>
                    <td>
 <asp:DropDownList ID="ddlUsertype" runat="server" Style="width: 310px;">
 <asp:ListItem Value="1" Text="User">User</asp:ListItem>
```

```
<asp:ListItem Value="2" Text="Admin">Admin</asp:ListItem>
                    </asp:DropDownList>
                  </td>
                </tr>
                <tr>
                  <td></td>
                  <td>
<asp:ImageButton     ID="ImageButton1"   ImageUrl="~/Images/button_registration.jpg"
runat="server" Width="80" Height="40" OnClick="ImageButton1_Click" />
                         
<asp:ImageButton     ID="ImageButton2"     ImageUrl="~/Images/Rest.png"     runat="server"
Width="80" Height="40" OnClick="ImageButton2_Click" />
                  </td>
                </tr>
                <tr>
<td colspan="2"><span style="color: red; font-weight: bold">*    Required fields</span>
<a id="achorRegister" runat="server" href="Users.aspx" style="color: blue; font-weight: bold;
font-size: 12px;">Click here to Login</a></td>
                </tr>
                <tr>
<td colspan="2">      </td>
                </tr>
              </table>
              <table>
              </table>
            </div>
          </fieldset>
        </div>
<div style="float: left; width: 35%; height: 450px; margin-left: 10px; margin-top: 10px; margin-
bottom: 10px;">
```

```
        <asp:Image ID="txtCloudImage" ImageUrl="~/Images/registration1.jpg" runat="server"
Style="margin-top: 20px;" />
      </div>
   </div>
</asp:Content>
<%@ Master Language="C#" AutoEventWireup="true" CodeBehind="Site.master.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.SiteMaster" %>
<!DOCTYPE html>
<html lang="en">
<head runat="server">
   <meta charset="utf-8" />
   <title>IDP_DPD</title>
   <asp:PlaceHolder runat="server">
      <%: Scripts.Render("~/bundles/modernizr") %>
   </asp:PlaceHolder>
   <webopt:BundleReference runat="server" Path="~/Content/css" />
   <link href="~/favicon.ico" rel="shortcut icon" type="image/x-icon" />
   <meta name="viewport" content="width=device-width" />
   <style type="text/css">
      .bgImage
      {
      }
      .bodybgImage
      {
      }
      html
      {
         background: url("../Images/baground1.jpg") repeat !important;
        /*  background: url("../Images/baground.jpg") repeat !important;*/
      }
   </style>
```

```
    <script src="Scripts/jquery-1.4.1.js"></script>
    <%--<script src="Scripts/jquery-1.7.2.min.js"></script>--%>
    <script src="Scripts/jquery-1.4.1.min.js"></script>
    <asp:ContentPlaceHolder runat="server" ID="HeadContent" />
</head>
<body class="bodybgImage">
    <form runat="server">
        <asp:ScriptManager runat="server" ID="srtptMgr">
            <Scripts>
                <%--Framework Scripts--%>
                <asp:ScriptReference Name="MsAjaxBundle" />
                <asp:ScriptReference Name="jquery" />
                <asp:ScriptReference Name="jquery.ui.combined" />
                <asp:ScriptReference Name="WebForms.js" Assembly="System.Web"
Path="~/Scripts/WebForms/WebForms.js" />
                <asp:ScriptReference Name="WebUIValidation.js" Assembly="System.Web"
Path="~/Scripts/WebForms/WebUIValidation.js" />
                <asp:ScriptReference Name="MenuStandards.js" Assembly="System.Web"
Path="~/Scripts/WebForms/MenuStandards.js" />
                <asp:ScriptReference Name="GridView.js" Assembly="System.Web"
Path="~/Scripts/WebForms/GridView.js" />
                <asp:ScriptReference Name="DetailsView.js" Assembly="System.Web"
Path="~/Scripts/WebForms/DetailsView.js" />
                <asp:ScriptReference Name="TreeView.js" Assembly="System.Web"
Path="~/Scripts/WebForms/TreeView.js" />
                <asp:ScriptReference Name="WebParts.js" Assembly="System.Web"
Path="~/Scripts/WebForms/WebParts.js" />
                <asp:ScriptReference Name="Focus.js" Assembly="System.Web"
Path="~/Scripts/WebForms/Focus.js" />
                <asp:ScriptReference Name="WebFormsBundle" />
                <%--Site Scripts--%>
```

```
        </Scripts>
    </asp:ScriptManager>
    <div style="width: 95%; vertical-align: central; margin: 20px;" class="bgImage">
        <div style="text-align: center; border: solid 3px white; height: 60px;">
            <b style="font-weight: bold; font-size: 26px; color: white; margin-top: 5px;">CPDA :
A Confidentiality -Preserving Dede-duplication Cloud Storage With Public Cloud Auditing</b>
        </div>
        <div style="border-left: solid 3px white; border-right: solid 3px white; height: 20px;
font-size: 15px !important; font-weight: bold !important;">
            <nav>
                <ul id="menu">
                    <li><a id="liHome" runat="server" href="~/">Home</a></li>
                    <li><a id="liUser" runat="server" href="~/Users.aspx?Type=1">User
login</a></li>
<%--<li><a id="A1" runat="server" href="Registration.aspx">Registration</a></li>--%>
<li><%--<a id="A2" runat="server" href="Category.aspx">New Category</a>--%></li>
 <li><a id="liOwner" runat="server" href="~/Owner.aspx?Type=2">Admin</a></li>
 <li><a id="liVerify" runat="server" href="~/Verifier.aspx?Type=3">User</a></li>
<li><a id="liCloud" runat="server" href="~/CloudServer.aspx?Type=0"> Server</a></li>
</ul>
            </nav>
        </div>
<asp:ContentPlaceHolder runat="server" ID="FeaturedContent" />
        <label runat="server" id="lblUserNamess"></label>
        <div style="border: solid 3px white; height: 500px;">
            <asp:ContentPlaceHolder runat="server" ID="MainContent" />
        </div>
    </div>
  </form>
</body>
</html>
```

```
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Users.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm1" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
    <style type="text/css">
        .cls_Login
        {
            background-image: url(~/button_login.jpg);
        }
        .cls_Reset
        {
        }
    </style>
    <div style="width: 100%;">
        <div  style="float: left; width: 45%; height: 450px; margin-left: 50px; margin-top: 10px;
margin-bottom: 10px;">
            <fieldset>
                <legend>Login</legend>
                <div style="margin-left: 30px;">
                    <table>
                        <tr>
                            <td colspan="2">
                                <br />
                            </td>
                        </tr>
                        <tr>
```

```
<td colspan="2" style="text-align: center"><b style="font-size: 18px; color: white; font-weight: bold">Login</b></td>
                </tr>
                <tr>
                    <td colspan="2">
                        <br />
                    </td>
                </tr>
                <tr>
<td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-weight: bold">*</span>UserName</td>
                    <td>
<asp:TextBox ID="txtUserName" runat="server"></asp:TextBox></td>
                </tr>
                <tr>
<td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-weight: bold">*</span>Password</td>
                    <td>
 <asp:TextBox ID="txtPassword" runat="server" TextMode="Password"></asp:TextBox></td>
                </tr>
                <tr>
 <td style="font-size: 12px; color: white; font-weight: bold"><span style="color: red; font-weight: bold">*</span>Type</td>
                    <td>
<asp:DropDownList ID="ddlUsertype" runat="server" Style="width: 310px; height: 25px;">
<asp:ListItem Value="1" Text="User">User</asp:ListItem>
<asp:ListItem Value="2" Text="Admin">Admin</asp:ListItem></asp:DropDownList>
                    </td>
                </tr>
                <tr>
                    <td></td>
```

```
                    <td>
<asp:ImageButton ImageUrl="~/Images/button_login.png" runat="server" Width="80" Height="40" OnClick="btnLogin_Click" />     <asp:ImageButton ID="ImageButton1" ImageUrl="~/Images/Rest.png" runat="server" Width="80" Height="40" OnClick="btnReset_Click" />
                    </td>
                </tr>
            </table>
            <table>
                <tr>
<td>     <a id="achorRegister" runat="server" href="Registration.aspx" style="color: blue; font-weight: bold; font-size: 15px;">New user? Register here</a></td>
                </tr>
                <tr>
<td>      <a id="a1" runat="server" href="Category.aspx" style="color: blue; font-weight: bold; font-size: 15px;">Click here to add new category</a>
                    </td>
                </tr>
<tr><td><span style="color: red; font-weight: bold">*   Required fields</span></td></tr>
            </table>
        </div>
    </fieldset>
</div>
<div style="float: left; width: 49%;  height: 450px; margin-left: 10px; margin-top: 10px; margin-bottom: 10px;">
<asp:Image ID="txtCloudImage" ImageUrl="~/Images/login_img.gif" runat="server" Width="585px" Height="439px" />
</div>
</div>
</asp:Content>
```

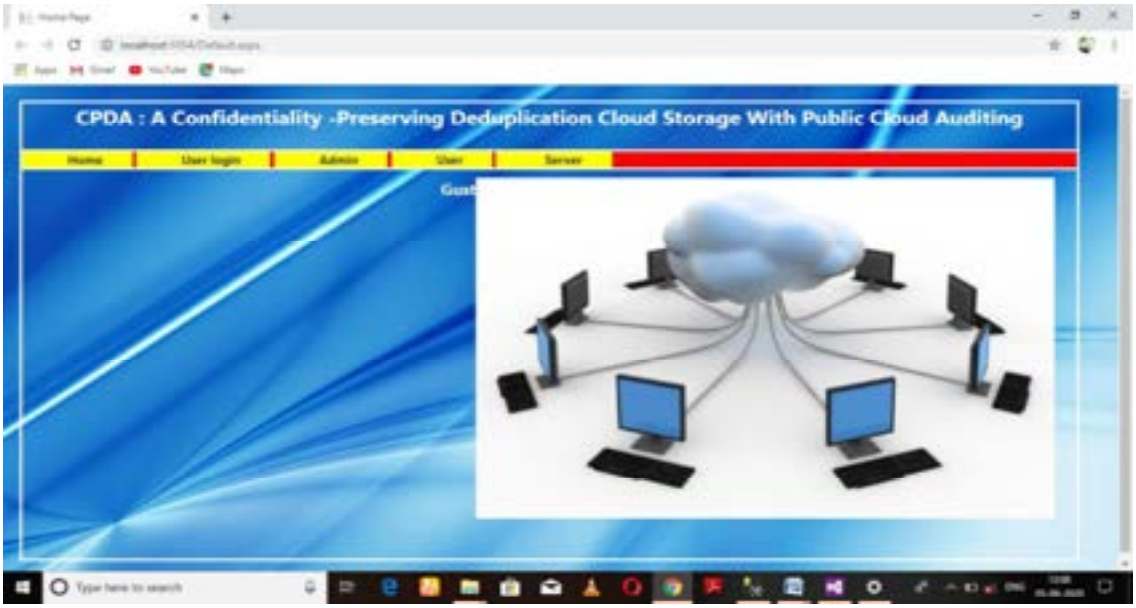
```
<%@ Page Title="" Language="C#" MasterPageFile="~/Site.Master" AutoEventWireup="true"
CodeBehind="Verifier.aspx.cs"
Inherits="IdentityBasedDistibution_Provable_DataPossion.WebForm3" %>
<asp:Content ID="Content1" ContentPlaceHolderID="HeadContent" runat="server">
</asp:Content>
<asp:Content ID="Content2" ContentPlaceHolderID="FeaturedContent" runat="server">
</asp:Content>
<asp:Content ID="Content3" ContentPlaceHolderID="MainContent" runat="server">
    <style type="text/css">
        .GridviewDiv
        {
            font-size: 100%;
            font-family: 'Lucida Grande', 'Lucida Sans Unicode', Verdana, Arial, Helevetica, sans-
serif;
            color: black;
            background-color: white;
        }
        .headerstyle
        {
            color: #FFFFFF;
            border-right-color: #abb079;
            border-bottom-color: #abb079;
            background-color: #df5015;
            padding: 0.5em 0.5em 0.5em 0.5em;
            text-align: center;
        }
        .footerstyle
        {
            color: #FFFFFF;
            background-color: red !important;
            padding: 0.5em 0.5em 0.5em 0.5em;
```

```
    text-align: right;
}
.grid
{
    border: solid 1px Red;
    height: 150px !important;
    overflow-y: auto;
}
    .grid td
    {
        border-top: solid 1px blue;
    }
    .grid th
    {
        border-top: solid 1px red !important;
    }
        .grid th.first
        {
            border-right: solid 1px blue !important;
        }
        .grid th.last
        {
            border-left: solid 1px blue !important;
        }
    .grid td.first
    {
        border-right: solid 1px blue !important;
    }
    .grid td.last
    {
        border-left: solid 1px blue !important;
```

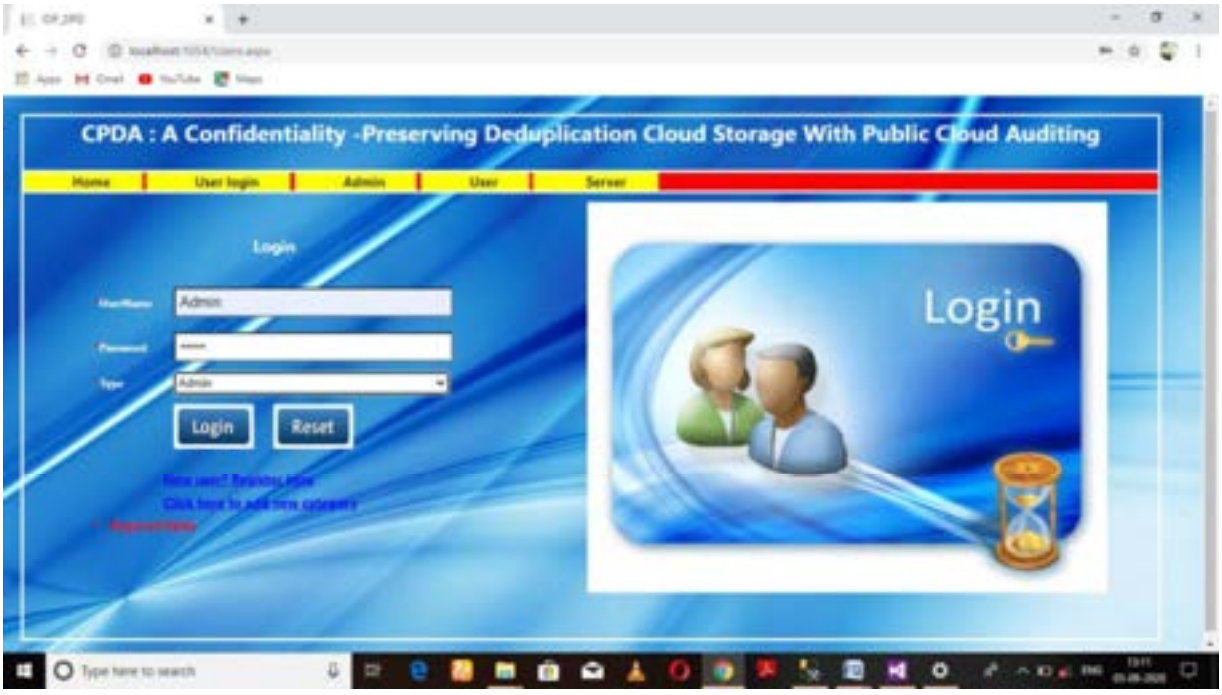
```
        }
        .grid td
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
        .grid th
        {
            padding: 2px 5px 2px 5px;
            margin: 0px;
            border: 2px solid Blue;
        }
      .GridviewDiv
      {
          height: 410px;
          overflow-y: scroll !important;
      }
   </style>
   <div id="divData" runat="server">
  <div style="float: left; width: 30%;  height: 450px; margin-left: 50px; margin-top: 10px; margin-bottom: 10px;">
<asp:Image ID="Image1" ImageUrl="~/Images/verifier_bg.jpg" runat="server" Width="360px" Height="450px" />
      </div>
<div style="float: left; width: 59%;  height: 450px; margin-left: 10px; margin-top: 10px; margin-bottom: 10px;">
<div style="font-weight: bold; color: blue; font-size: 20px;">
            <div style="float: left;">
                Welcome :
                <asp:Label ID="lblUserName" runat="server"></asp:Label>
```

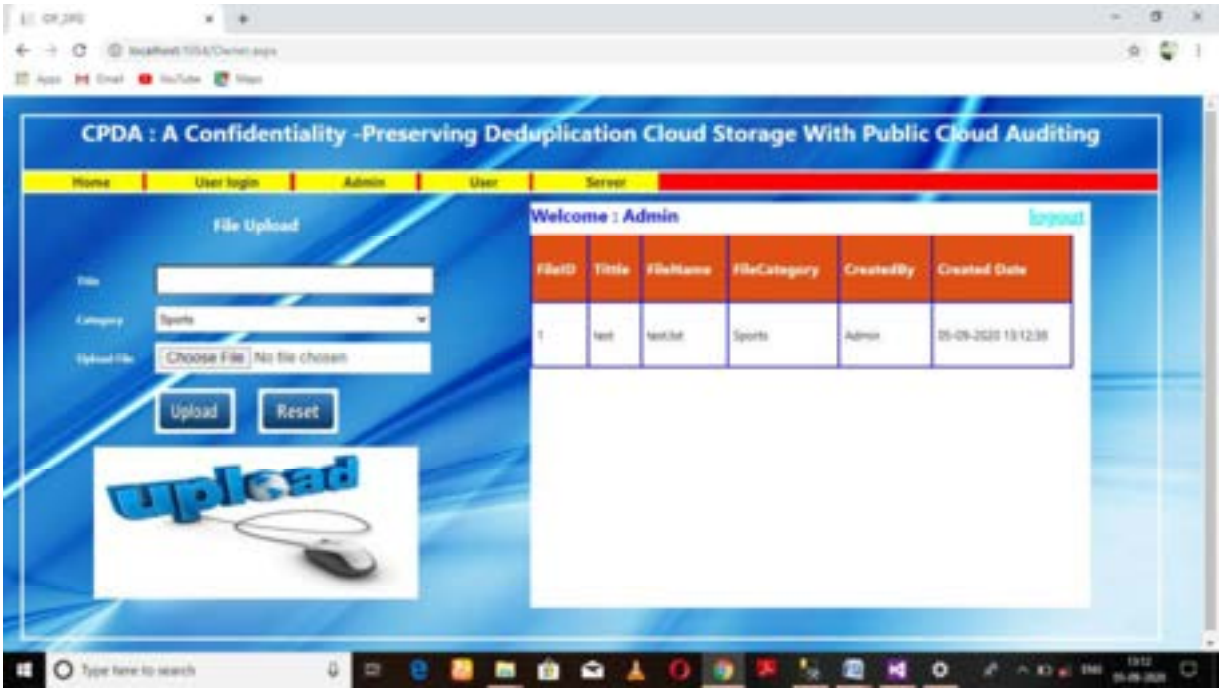
```
            </div>
            <div style="float: right;">
                <asp:LinkButton ID="btnlogout" runat="server" ForeColor="#00ffff"
Style="padding-right: 15px;" OnClick="btnlogout_Click">logout</asp:LinkButton>
            </div>
        </div>
```

9.2 SAMPLE SCREENSHOTS

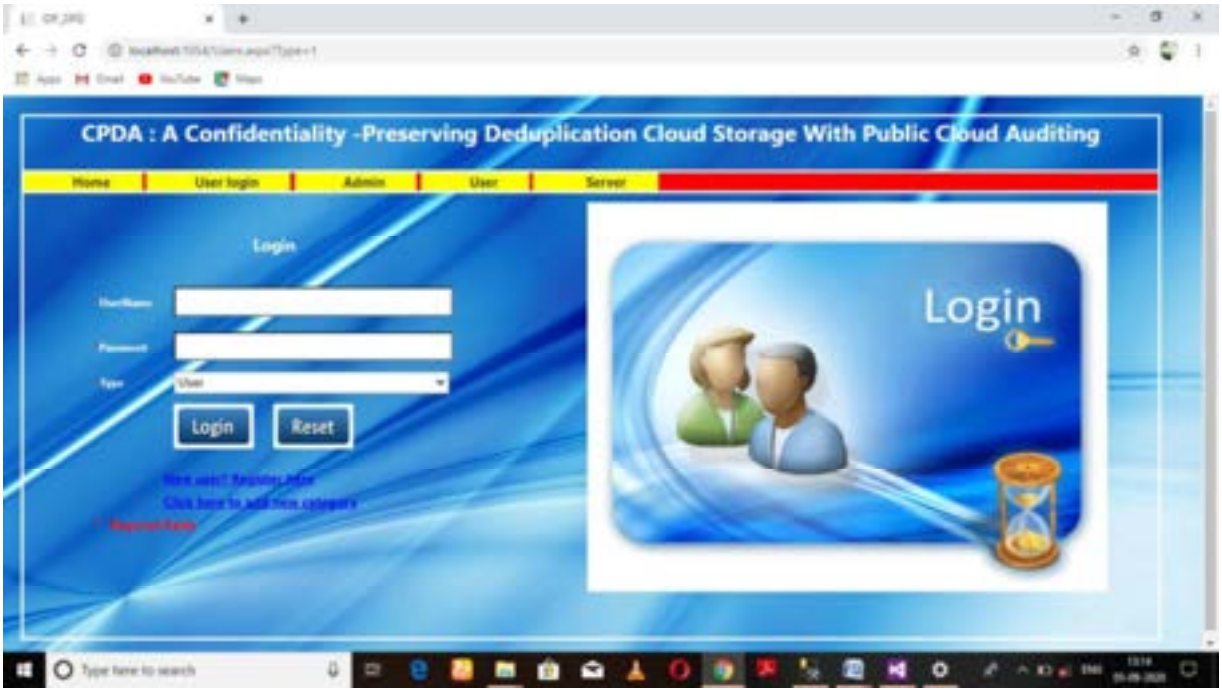


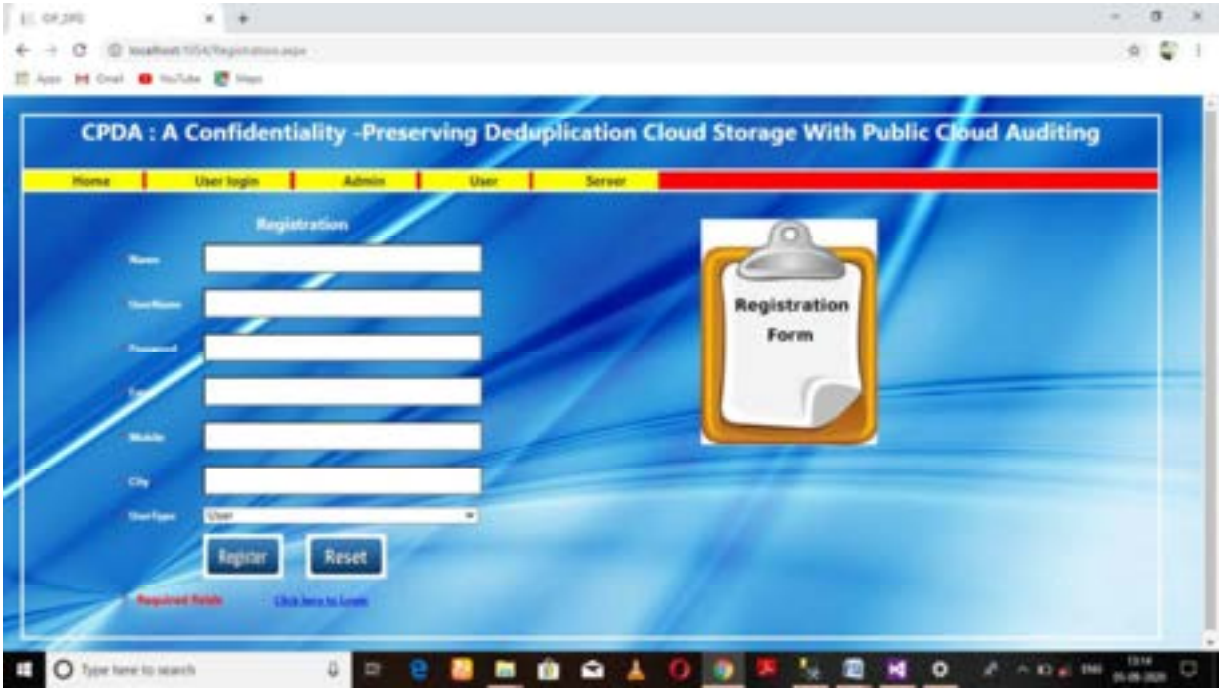
CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
Login
Login
Reset

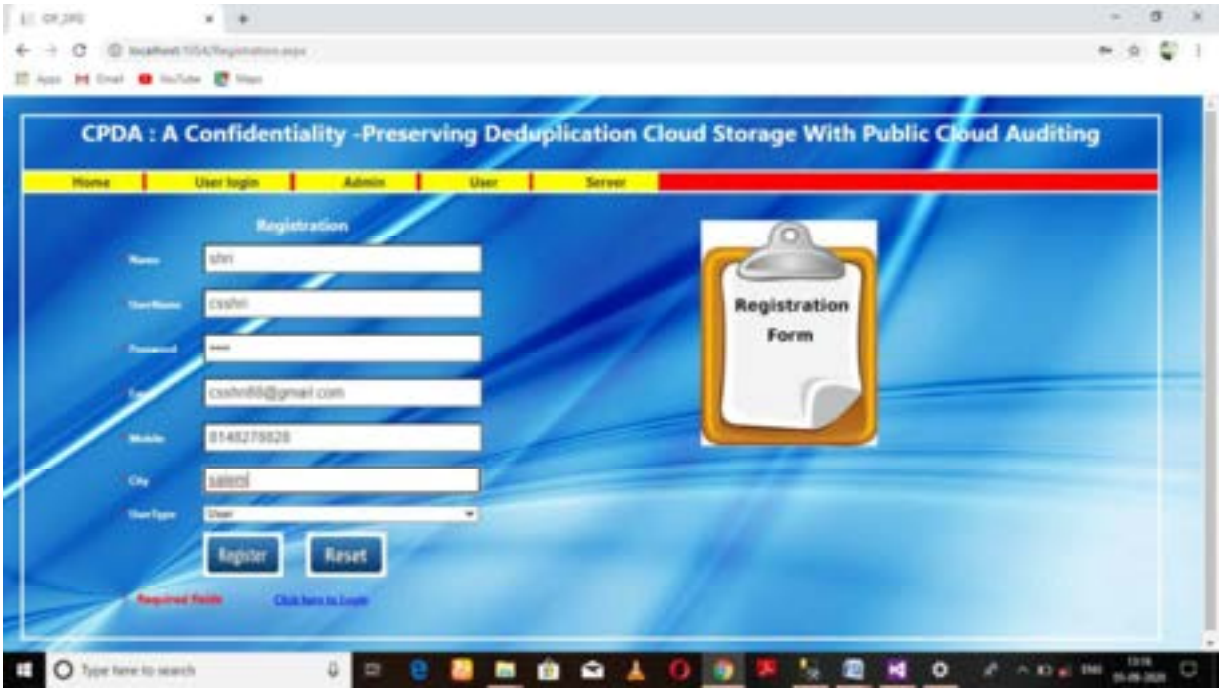

CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
Login
Admin
Admin
Login
Reset
Login

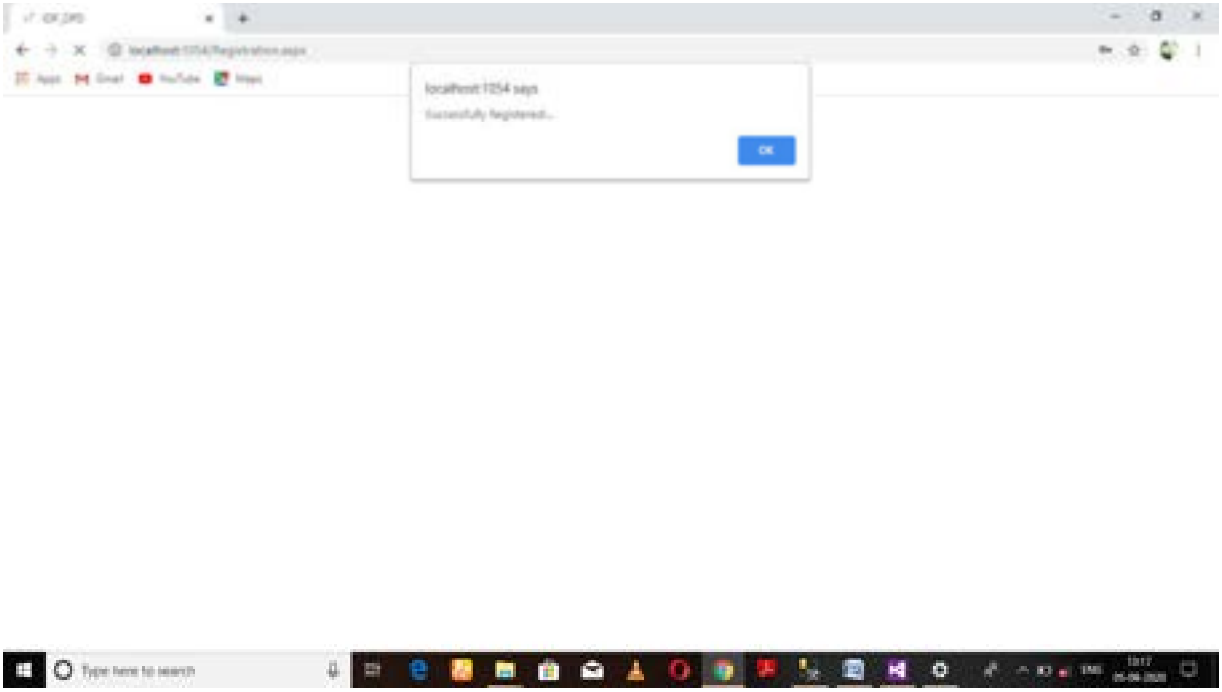

CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
File Upload
Sports
Choose File
No file chosen
Upload
Reset
upload
Welcome : Admin
logout
FileID
Title
FileName
FileCategory
CreatedBy
Created Date

localhost:1054 says
OK


CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
Login
Login
Reset
Login


CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
Registration
Register
Reset
Registration
Form


CPDA : A Confidentiality -Preserving Deduplication Cloud Storage With Public Cloud Auditing
Home
User login
Admin
User
Server
Registration
Registration Form
Register
Reset
Click here to Login


localhost:1254 says
OK

CHAPTER10

REFERENCES

[1] G. S. Aujla, R. Chaudhary, N. Kumar, A. K. Das, and J. J. P. C. Rodrigues, ''SecSVA: Secure storage, verification, and auditing of big data in the cloud environment,'' IEEE Commun. Mag., vol. 56, no. 1, pp. 78–85, Jan. 2018.

[2] Q. Wang, C. Wang, K. Ren, W. Lou, and J. Li, ''Enabling public auditability and data dynamics for storage security in cloud computing,'' IEEE Trans. Parallel Distrib. Syst., vol. 22, no. 5, pp. 847–859, May 2011.

[3] M. Wazid, A. K. Das, R. Hussain, G. Succi, and J. J. P. C. Rodrigues, ''Authentication in cloud-driven IoT-based big data environment: Survey and outlook,'' J. Syst. Architect., vol. 97, pp. 185–196, Aug. 2019.

[4] H. Hou, J. Yu, and R. Hao, ''Cloud storage auditing with dede-duplication supporting different security levels according to data popularity,'' J. Netw. Comput. Appl., vol. 134, pp. 26–39, May 2019.

[5] J. Gants and D. Reinsel. Digital Universe Decade—Are You Ready?'' [Online]. Available: https://www.emc.com/collateral/analyst-reports/idcdigital-universe-are-you-ready.pdf

[6] X. Jia and J. Zhou, ''Leakage resilient proofs of ownership in cloud storage, revisited,'' in Applied Cryptography and Network Security. Lausanne, Switzerland: Springer, 2014, pp.

PERSONALIZED PROJECT RECOMMENDATION SYSTEM

A PROJECT REPORT

Submitted by

SOWNDHARYA.S (17601318)

In partial fulfillment for the award of the degree of

FACULTY OF INFROMATION AND COMMUNICATION ENGINEERING

in

MASTER OF COMPUTER APPLICATIONS

PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

May&2020

LIVE STREAM TECHNOLOGIES
<<Consume I/P & Produce O/P>>

Date: 31.03.2020

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that **Ms. SOWNDHARYA.S [Reg. No:17601318]** Final Year **MCA** Student of **PAAVAI ENGINEERING COLLEGE, NAMAKKAL** has completed her Internship project entitled **PERSONALIZED PROJECT RECOMMENDATION SYSTEM** in our Organization in **PYTHON TECHNOLOGY** during the period from **JANUARY 2020 to MARCH 2020.**

During this period, her performance and character have been good. We wish all the success in her future endeavors.

For **LIVE STREAM TECHNOLOGIES**

LIVE STREAM TECHNOLOGIES

Authorized Signatory

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Ph:+91 422 4952001

DECLARATION

I, **SOWNDHARYA.S** hereby declare that the project report titled "**PERSONALIZED PROJECT RECOMMENDATION SYSTEM** "done by me under the guidance of **Mr.C.RATHNAKUMAR,M.C.A., M.Phil.,M.E.,(Ph.D)** and **Mr.M.ESWAR** at **LIVE STREAM TECHNOLOGIES**,Combatore is submitted in partial fulfillment of the requirements for the award of Master of Computer Applicatsons.Certified further that, to the best of my knowledge, the work reported herein does not form part of any other project on the basis of which a degree was conferred on an earlier occasion on this or any other candidate.

DATE : 22.09.2020

PLACE : PEC

S Sowndh

SIGNATURE OF THE CANDIDATE

ABSTRACT

In this project, we are recommending suitable projects for developers can save their time. However, finding suitable projects among many projects on GitHub is difficult. Typically, developers search for relevant projects in order to reuse functions and identify useful features. In addition, different users may have different requirements. A recommendation system would help developers by reducing the time required to find suitable projects. In this paper, we propose an approach to recommend projects that considers developer behaviours and project features. The proposed approach automatically recommends the top-*N* most relevant software projects. We also integrate user feedback to improve recommendation accuracy. The results of an empirical study using data crawled from GitHub demonstrate that the proposed approach can efficiently recommend relevant software projects with relatively high precision.

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LIST OF ABBREVIATIONS

S.NO.	ABBREVIATION	EXPLANASION
1	CLI	COMMAND LINE INTERFACE
2	NLP	NATURAL LANGUAGE PROCESSING

CHAPTER 1

INTRODCTION

1.1 COMPANY PROFILE

LIVE STREAM Technologies (LST) is a software development company headquartered in Coimbatore, India. The cornerstone of the company's outsourcing strategy is a balancing combination of onsite presence and service delivery. LST is a leading software development company, which is into customized software applications, website development services based on a range of platforms and technologies.

LST Management is passionate about its operations & team. Short years have led to a long track record and ever green relationships with its clients. The company's management has experience in delivering projects to several companies. They have managed team's people effectively delivering projects in time and to stipulated norms.

Fig 1.1 Company logo

1.2 OBJECTIVES

The way in which people now a day's search for information, products and even other people is changing with the advent of Recommender Systems. Recommender Systems study patterns of behaviour to predict what someone may prefer from among a collection of items that he/she has never experienced. The technology behind the Recommender systems has evolved over the past 15 years into a rich collection of tools that now enables the researcher or users or practitioner to develop effective Recommender Systems. Recommender systems are now pervasive in consumers lives. They help users to find items/products that they would consider or would like to buy on the basis of huge amounts of collected data. Websites like Facebook, Netflix, Last.fm and other social networking and commercial websites are using these systems. Working on a huge data set to predict a user's similarity with other users or his/her ratings is the core objective of any recommender system. There are various approaches to implementing a recommender system such as Content-based Filtering, Collaborative Filtering and Hybrid filtering. The goal of this project is to apply a collaborative filtering algorithm in a website that can collect various users' information from the user, such as Name, Email id, his location, gender, Movies Information and the rating for movies by that user. There are many algorithms that could be applied on data to predict a user preference. Some of the algorithms of predicting a user preference are User-based 2 Collaborative Filtering, Item-based Collaborative Filtering, and Model-based Collaborative Filtering methods are ways of predicting a user preference. The number of users, items, or clusters in each one respectively will determine the function performance. However, the most well-known and common one is User-based Collaborative Filtering. In this algorithm, we predict an items rate for a user by collecting information about this user and similar users.

We need several concepts of Collaborative filtering techniques to describe our problem domain and also to analyze the system requirements. Other recommender methods also share these concepts. The users who have rated the various items in our dataset serves as the information domain for a collaborative filtering system. A rating or preference that is expressed by a user for an item/movie is called a rating and is often represented in (User, Item, Rating) triple format. The format of these rating can change according to the system in question. One can find systems using an integer-valued rating such as 0-5 stars or real-valued rating scales, while some systems use binary (like/dislike) or ternary scales. Unary ratings, such as has purchased, are particularly common in e-commerce deployments as they express

well the users purchasing history absent ratings data. A sparse matrix is formed using this set of all rating triples referred to as the rating matrix. The (User, Item) pairs where the user has not rated the item are unknown values in this matrix. We commonly focus on two tasks when we describing the use and evaluation of recommender systems, including collaborative filtering systems, first being the prediction task: given a user and an item/movie, what is the users likely preference for the item? The prediction task for a recommender system can be equivalent to a matrix missing values problem if the ratings matrix is viewed as a sampling of values from a user item p rating matrix.

The second task is the recommend task. In this task, given a user, our recommender system has to produce the best ranked list of n items for the new test case user. An n-item recommendation list does not guarantee that it will contain the n items with the highest predicted rating, as predicted rating may not be the only criteria used to produce the recommendation list.

A recommender system is a type of information filtering system that predict the rating or preference that a user would give to an item. Recommender systems are sometime referred to as recommendation system. Recommendation system describes web applications that predicted response to options. Recommender Systems are targeted to individuals who do not have enough personal experience to evaluate the potentially overwhelming alternatives that a web site for instance may offer.

Some companies such as Amazon, Facebook and google are already are already utilizing the power of recommender systems in building their new and existing systems. Recommender systems often provide personalized recommendation of items (to users) using a ranked list of predicted items. According to study, individuals rely on recommendations provided by others in making routine daily decisions. As examples, it is common to rely on peer recommendations when selecting a project to develop; employers use recommendation letters in their recruiting decisions; and when selecting a movie to watch, individuals do read and rely on the movie reviews that a film critic has written.

In attempt to replicate these behaviours, the first Recommender System used algorithms to create a prototype of recommendations produced by a community of users to deliver recommendations to an active user. These recommendations were designed for every item that similar users had liked. This approach is popularly known as collaborative-filtering and its aim is to ensure that if the active user agreed in the past with some users, then the other recommendations coming from these similar users should be relevant as well and of interest to the active user.

In this project, we introduce a novel architecture for the implementation of recommender system algorithm which can be used to improve the recommendation of projects to users.

1.2.1 Recent Application of Recommender Systems

Machine learning constitutes one of the most recently researched and applied field in artificial intelligence and its capabilities has been applied in diverse areas. The following list will better explain the recently applied area of machine learning and recommender systems today.

1. Wildlife Preservation: Machine learning has been applied in marine to help identify whales in the oceans based on audio recording so that ships can avoid hitting them.

2. Anomaly Detection: Machine Learning is applied to flag any malpractice in very high-volume high frequency data transactions / communications. Machine learning systems can today detect a possible insider trading in a stock market; also, machine learning can flag a malicious customer transaction as a fraudulent transaction in high volume business doing market place websites.

3. Classification: Machine learning helps to group online questions asked by visitors in to different categories that can be easily accessible by new users. The same classification (or topic modelling) algorithms are behind how news articles from thousands of sources gets neatly segregated under topics in Google News or any major news aggregating portals.

4. Financial Trading: Today, people are attempting to predict stock market capitals but machine learning algorithms are presenting better attempts. Stock market prediction systems uses probabilities but a trade with a low probability at a high volume can turn generate much gain for an organization. And this machine out-performs humans in big data consumption and speed of execution.

5. Search Engines: Search engines are perhaps the most widely known application of recommender systems and machine learning. Each time search query is executed on search

engines like Google, the application observes how the user responds to the results. If the user clicked the results at the top and remains on the web page, it assumes that the user was satisfied with the information searched for. Inversely, if the user clicks to the next page of the results or inputs a new search string without clicking on any of the displayed results, it can be concluded that the required results was not presented to the user and the program automatically learns from the current mistake to increment on knowledge and deliver a better result subsequently.

6. Natural Language Processing (NLP): Natural Language processing is applied in many applications across different disciplines. Machine learning algorithms with natural language replicate a customer service agent and direct customers to the needed information faster

7. Smart Cars: Smart cars are developed today by automobile companies to utilize Internet of Things (IoT) by learning about the owner and the environment.

8. Computer Vision/ Personal Security: Machine learning could help security staff in public places such as airport/stadia detect defaulters faster. Machine learning can help eliminate false alarms and spot things human might not be able to see in security screenings at airports, stadiums, concerts, and other venues.

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

Generally, developers use search engines (e.g., Google or Bing) to find similar projects. However search engines typically focus on text matching based on similarity measures . A small number of keywords may not fully describe the characteristics of a software project. In addition, selecting suitable keywords may be difficult .Some previous studies have focused on software project recommendation systems. However, such systems tend to recommend software projects based on project descriptions or source code and do not consider personalized developer requirements. Different developers may have different requirements, thus the recommendation results may be inaccurate, which wastes time and causes developers to mistrust such systems.

2.1.1 DISADVANTAGES :

- A small number of keyword may not fully describe the project
- Waste of time
- Result may be inaccurate
- Mistrust to developers

2.2 PROPOSED SYSTEM

A recommendation system would help developers by reducing the time required to find suitable projects. In this paper, we propose an approach to recommend projects that considers developer behaviours and project features. The proposed approach automatically recommends the top-*N* most relevant
software projects. We also integrate user feedback to improve recommendation accuracy.

2.2.1 ADVANTAGES

- Reduce time
- Provides most relevant project
- Consider user recommendation
- Highly efficient

2.3 FEASIBILITY STUDY

A feasibility study is a high-level capsule version of the entire System analysis and Design Process. The study begins by classifying the problem definition. Feasibility is to determine if it's worth doing. Once an acceptance problem definition has been generated, the analyst develops a logical model of the system. A search for alternatives is analysed carefully. There are 3 parts in feasibility study.

2.3.1 Operational Feasibility

Question that going to be asked are

- Will the system be used if it developed and implemented?
- If there was sufficient support for the project from the management and from the users.
- Have the users been involved in planning and development of the Project.

2.3.2 Technical feasibility

- Does the necessary technology exist to do what is been suggested?
- Does the proposed equipment have the technical capacity for using the new system?
- Are there technical guarantees of accuracy, reliability and data security?
- The project is developed on Pentium III with 128 MB RAM.
- The environment required in the development of system is any windows platform.
- The observer pattern along with factory pattern will update the results eventually.
- The language used in the development is JAVA J2SDK1.4.0, Servlets, JDBC, Tomcat Server and database as Oracle 8i.

2.3.3 Economical Feasibility

To decide whether a project is economically feasible, to consider various factors as cost benefit analysis, long-term returns and maintenance costs.

2.4 Functional Requirements

Functional requirement defines a function of a software system or its component. A function is described as a set of inputs, the behaviour, and outputs. Functional requirements may be calculations, technical details, data manipulation and processing and other specific

functionality that define what a system is supposed to accomplish. Behavioural requirements describing all the cases where the system uses the functional requirements are captured in use cases.

2.5 Non-Functional Requirements

Performance Requirements: Performance is measured in terms of the output provided by the application. Requirement specification plays an important part in the analysis of a system. Only when the requirement specifications are properly given, it is possible to design a system, which will fit into required environment. It rests largely with the users of the existing system to give the requirement specifications because they are the people who finally use the system. This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements.

CHAPTER 3

SYSTEM SPECIFICATION

3.1 HARDWARE CONFIGURATION

Processor	: Core i3
RAM	: 4GB
Speed	: 1.3GHz or above
Hard Disk	: 500 GB
I/O Devices	: Standard Keyboard & Logitech Mouse

3.2 SOFTWARE CONFIGURATION

Anaconda 3 python

Jupyter notebook

3.3 MODULE INTERFACED:

- Pandas
- Sklearn
- NumPy

CHAPTER 4

SOFTWARE DESCRIPTION

4.1 ANACONDA

Anaconda is a free and open-source distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), that aims to simplify package management and deployment. The distribution includes data-science packages suitable for Windows, Linux, and macOS. It is developed and maintained by Anaconda, Inc., which was founded by Peter Wang and Travis Oliphant in 2012. As an Anaconda, Inc. product, it is also known as Anaconda Distribution or Anaconda Individual Edition, while other products from the company are Anaconda Team Edition and Anaconda Enterprise Edition, which are both not free.

Package versions in Anaconda are managed by the package management system conda. This package manager was spun out as a separate open-source package as it ended up being useful on its own and for other things than Python. There is also a small, bootstrap version of Anaconda called Miniconda, which includes only conda, Python, the packages they depend on, and a small number of other packages.

Anaconda distribution comes with 1,500 packages selected from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI).

The big difference between conda and the pip package manager is in how package dependencies are managed, which is a significant challenge for Python data science and the reason conda exists.

When pip installs a package, it automatically installs any dependent Python packages without checking if these conflict with previously installed packages. It will install a package and any of its dependencies regardless of the state of the existing installation. Because of this, a user with a working installation of, for example, Google Tensorflow, can find that it stops working having used pip to install a different package that requires a different version of the dependent numpy library than the one used by Tensorflow. In some cases, the package may appear to work but produce different results in detail.

In contrast, conda analyses the current environment including everything currently installed, and, together with any version limitations specified (e.g. the user may wish to have

Tensorflow version 2,0 or higher), works out how to install a compatible set of dependencies, and shows a warning if this cannot be done.

Open source packages can be individually installed from the Anaconda repository, Anaconda Cloud (anaconda.org), or the user's own private repository or mirror, using the conda install command. Anaconda, Inc. compiles and builds the packages available in the Anaconda repository itself, and provides binaries for Windows 32/64 bit, Linux 64 bit and MacOS 64-bit. Anything available on PyPI may be installed into a conda environment using pip, and conda will keep track of what it has installed itself and what pip has installed.

Custom packages can be made using the conda build command, and can be shared with others by uploading them to Anaconda Cloud, PyPI or other repositories.

The default installation of Anaconda2 includes Python 2.7 and Anaconda3 includes Python 3.7. However, it is possible to create new environments that include any version of Python packaged with conda.

Anaconda Navigator is a desktop graphical user interface (GUI) included in Anaconda distribution that allows users to launch applications and manage conda packages, environments and channels without using command-line commands. Navigator can search for packages on Anaconda Cloud or in a local Anaconda Repository, install them in an environment, run the packages and update them. It is available for Windows, macOS and Linux.

The following applications are available by default in Navigator

- JupyterLab
- Jupyter Notebook
- QtConsole
- Spyder
- Glue
- Orange
- RStudio
- Visual Studio Code

4.1.1 Jupyter Notebook

Project Jupyter is a non-profit organization created to "develop open-source software, open-standards, and services for interactive computing across dozens of programming languages". Spun-off from IPython in 2014 by Fernando Pérez, Project Jupyter supports execution environments in several dozen languages. Project Jupyter's name is a reference to the three core programming languages supported by Jupyter, which are Julia, Python and R, and also a homage to Galileo's notebooks recording the discovery of the moons of Jupiter. Project Jupyter has developed and supported the interactive computing products Jupyter Notebook, JupyterHub, and JupyterLab, the next-generation version of Jupyter Notebook.

4.1.2 Python

Python is a widely used general-purpose, high level programming language. It was initially designed by Guido van Rossum in 1991 and developed by Python Software Foundation. Python is one of the top 10 popular programming languages of 2017. The simple syntax rules of the programming language further make it easier for you to keep the code base readable and application maintainable. It was mainly developed for emphasis on code readability, and its syntax allows programmers to express concepts in fewer lines of code. Since most modern OS are written in C, compilers/interpreters for modern high-level languages are also written in C. Python is not an exception - its most popular/"traditional" implementation is called CPython and is written in C. Python is a general-purpose programming language. Hence, you can use the programming language for developing both desktop and web applications. Also, you can use Python for developing complex scientific and numeric applications. Python is designed with features to facilitate data analysis and visualization. All general-purpose languages can be used at both front end and back end. Java, C#, C, C++ etc. are general purpose languages. It can be used both as back end as well as front end. API's using Django/Flask can be made as back end. Python is a general-purpose language, which means it can be used to build just about anything, which will be made easy with the right tools/libraries. Professionally, Python is great for backend web development, data analysis, artificial intelligence, and scientific computing.

Applications of Python is used to simplifying the complex software development process as it is a general-purpose programming language. It is used for developing the complex application like scientific and numeric application, and for both desktop and web applications. You can use Python for developing desktop GUI applications, websites and web applications. Also, Python, as a high-level programming language, allows you to focus on

core functionality of the application by taking care of common programming tasks.

Benefits of Python

- Interactive
- Interpreted
- Modular
- Dynamic
- Object-oriented
- Portable
- High level
- Extensible in C++ & C

Features of Python

1) Readable and Maintainable Code: While writing a software application, you must focus on the quality of its source code to simplify maintenance and updates. The syntax rules of Python allow you to express concepts without writing additional code. At the same time, Python, unlike other programming languages, emphasizes on code readability, and allows you to use English keywords instead of punctuations. Hence, you can use Python to build custom applications without writing additional code. The readable and clean code base will help you to maintain and update the software without putting extra time and effort.

2) Multiple Programming Paradigms: Like other modern programming languages, Python also supports several programming paradigms. It supports object oriented and structured programming fully. Also, its language features support various concepts in functional and aspect-oriented programming. At the same time, Python also features a dynamic type system and automatic memory management. The programming paradigms and language features help you to use Python for developing large and complex software applications.

3) Compatible with Major Platforms and Systems: At present, Python is supporting many operating systems. You can even use Python interpreters to run the code on specific platforms and tools. Also, Python is an interpreted programming language. It allows you to you to run the same code on multiple platforms without recompilation. Hence, you are not required to recompile the code after making any alteration. You can run the modified application code without recompiling and check the impact of changes made to the code immediately. The

feature makes it easier for you to make changes to the code without increasing development time.

4) Robust Standard Library: Its large and robust standard library makes Python score over other programming languages. The standard library allows you to choose from a wide range of modules according to your precise needs. Each module further enables you to add functionality to the Python application without writing additional code. For instance, while writing a web application in Python, you can use specific modules to implement web services, perform string operations, manage operating system interface or work with internet protocols. You can even gather information about various modules by browsing through the Python Standard Library documentation.

5) Many Open Source Frameworks and Tools: As an open source programming language, Python helps you to curtail software development cost significantly. You can even use several open source Python frameworks, libraries and development tools to curtail development time without increasing development cost. You even have option to choose from a wide range of open source Python frameworks and development tools according to your precise needs. For instance, you can simplify and speedup web application development by using robust Python web frameworks like Django, Flask, Pyramid, Bottle and Cherrypy. Likewise, you can accelerate desktop GUI application development using Python GUI frameworks and toolkits like PyQT, PyJs, PyGUI, Kivy, PyGTK and WxPython.

6) Simplify Complex Software Development: Python is a general-purpose programming language. Hence, you can use the programming language for developing both desktop and web applications. Also, you can use Python for developing complex scientific and numeric applications. Python is designed with features to facilitate data analysis and visualization. You can take advantage of the data analysis features of Python to create custom big data solutions without putting extra time and effort. At the same time, the data visualization libraries and APIs provided by Python help you to visualize and present data in a more appealing and effective way. Many Python developers even use Python to accomplish artificial intelligence (AI) and natural language processing tasks.

7) Adopt Test Driven Development: You can use Python to create prototype of the software application rapidly. Also, you can build the software application directly from the prototype simply by refactoring the Python code. Python even makes it easier for you to perform coding and testing simultaneously by adopting test driven development (TDD) approach. You can

easily write the required tests before writing code and use the tests to assess the application code continuously. The tests can also be used for checking if the application meets predefined requirements based on its source code.

Advantages of Python

1) Extensive Support Libraries: It provides large standard libraries that include the areas like string operations, Internet, web service tools, operating system interfaces and protocols. Most of the highly used programming tasks are already scripted into it that limits the length of the codes to be written in Python.

2) Integration Feature: Python integrates the Enterprise Application Integration that makes it easy to develop Web services by invoking COM or COBRA components. It has powerful control capabilities as it calls directly through C, C++ or Java via Jython. Python also processes XML and other mark-up languages as it can run on all modern operating systems through same byte code.

3) Improved Programmer's Productivity: The language has extensive support libraries and clean object-oriented designs that increase two to ten fold of programmer's productivity while using the languages like Java, VB, Perl, C, C++ and C#.

4) Productivity: With its strong process integration features, unit testing framework and enhanced control capabilities contribute towards the increased speed for most applications and productivity of applications. It is a great option for building scalable multi-protocol network applications.

Machine learning:

Machine learning is the kind of programming which gives computers the capability to automatically learn from data without being explicitly programmed. This means in other words that these programs change their behaviour by learning from data. Python is clearly one of the best languages for machine learning. Python does contain special libraries for machine learning namely scipy, pandas and numpy which great for linear algebra and getting to know kernel methods of machine learning. The language is great to use when working with machine learning algorithms and has easy syntax relatively.

4.1.3 Pandas

In computer programming, pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series. It is free software released under the three-clause BSD license. The name is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals.

4..1.4 Sklearn

Scikit-learn provides a range of supervised and unsupervised learning algorithms via a consistent interface in Python. It is licensed under a permissive simplified BSD license and is distributed under many Linux distributions, encouraging academic and commercial use.

The library is built upon the SciPy (Scientific Python) that must be installed before you can use scikit-learn. This stack that includes:

- NumPy: Base n-dimensional array package
- SciPy: Fundamental library for scientific computing
- Matplotlib: Comprehensive 2D/3D plotting
- IPython: Enhanced interactive console
- Sympy: Symbolic mathematics
- Pandas: Data structures and analysis

Extensions or modules for SciPy care conventionally named SciKits. As such, the module provides learning algorithms and is named scikit-learn.
The vision for the library is a level of robustness and support required for use in production systems. This means a deep focus on concerns such as easy of use, code quality, collaboration, documentation and performance.

Although the interface is Python, c-libraries are leverage for performance such as numpy for arrays and matrix operations, LAPACK, LibSVM and the careful use of cython.

The library is focused on modelling data. It is not focused on loading, manipulating and summarizing data. For these features, refer to NumPy and Pandas.

- **Clustering**: for grouping unlabelled data such as KMeans.

- **Cross Validation**: for estimating the performance of supervised models on unseen data.
- **Datasets**: for test datasets and for generating datasets with specific properties for investigating model behaviour.
- **Dimensionality Reduction**: for reducing the number of attributes in data for summarization, visualization and feature selection such as Principal component analysis.
- **Ensemble methods**: for combining the predictions of multiple supervised models.
- **Feature extraction**: for defining attributes in image and text data.
- **Feature selection**: for identifying meaningful attributes from which to create supervised models.
- **Parameter Tuning**: for getting the most out of supervised models.
- **Manifold Learning**: For summarizing and depicting complex multi-dimensional data.
- **Supervised Models**: a vast array not limited to generalized linear models, discriminate analysis, naive Bayes, lazy methods, neural networks, support vector machines and decision trees.

4.1.5 NumPy

NumPy is a Python package. It stands for 'Numerical Python'. It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

Numeric, the ancestor of NumPy, was developed by Jim Hugunin. Another package Numarray was also developed, having some additional functionalities. In 2005, Travis Oliphant created NumPy package by incorporating the features of Numarray into Numeric package. There are many contributors to this open source project.

Using NumPy, a developer can perform the following operations −

- Mathematical and logical operations on arrays.
- Fourier transforms and routines for shape manipulation.
- Operations related to linear algebra. NumPy has in-built functions for linear algebra and random number generation.

NumPy is often used along with packages like SciPy (Scientific Python) and Mat-plotlib (plotting library). This combination is widely used as a replacement for MatLab, a

popular platform for technical computing. However, Python alternative to MatLab is now seen as a more modern and complete programming language. It is open source, which is an added advantage of NumPy.

CHAPTER 5

PROJECT DESCRIPTION

5.1 PROBLEM DEFINITION

Recommender Systems (RS) are tools and techniques which uses software to provide suggestions of useful items to a user . The suggestions identify with different decision-making processes, such as what things to purchase, what music to tune in to, what online news to peruse, or even which book to lease/purchase, etc. The recommender systems are concerned with identifying the learning about the comparable client or the occasion and infer the favourable predictions or suggestions using the context. It is the condition of "individualized" and "intriguing and helpful" that distinguishes the recommender system from search engines .

The term "Item" is generally used to represent what the system suggests to users. A Recommender System typically canters around a specific kind of thing (for example, CDs, or news) and as needs be its outline, its graphical UI, and the core recommendation technique applied to obtain the recommendations are altogether modified to give valuable and successful recommendations to that specific sort of item . Recommender systems assist e-commerce sites increase their deals, recommender systems intermittently create a rundown of recommendations in three ways which is enlisted as; through collaborative, content based, and knowledge-based filtering . A common practice in recommender systems research is the hybridization of recommendation techniques to accomplish top execution or rebuild a current model. These systems can be utilized independently or consolidated together in various ways. Figure 1 explains the different classes of techniques commonly used in building recommendation (or recommender) systems.

5.2 MODULE DESCRIPTION

i. Data Extraction

ii. Pre-Processing
   - Lexical analysis
   - Syntax analysis
   - Semantic analysis
   - Feature extraction

iii. Correlation Based Recommender
   - Computed matrix
   - Top N most similar projects using integer-location based indexing.

iv. Popularity Based Recommender

- First N project details
- Recommendation based on no. of ratings
- Most rated projects
- Description for most rated project

5.3.1 Data Extraction

First of all, before deriving reviewer's feature preferences, we first analyze raw textual reviews and convert them into structured form to extract opinion-based feature. Reviews from any website are usually extracted into a Json file which is then loaded into the system database. We have studied different types of methods for mining the feature-based opinions from textual reviews and found that NLTK package is most appropriate tool to extract features from project reviews. Natural language toolkit NLTK is a Python library to make programs that work with natural language., e library can perform different operations such as tokenizing, stemming, classification, parsing, tagging, and semantic reasoning.

5.3.1 Pre-Processing

The review data are converted in comma separated values to be available in easily readable form, i.e., natural language data format. Proposed system needs to perform a natural language processing to extract project features based on the previous reviews opinion. We have performed following four steps to process a natural language text review as follows:

Lexical Analysis: In lexical analysis, the streams of characters are taken as input and streams of tokens are generated as an output.

The project reviews are available in the form of paragraph which contains a number of sentences or strings. These strings are tokenized into tokens or lexicons. These tokens are usually words but can also be numbers or symbols. Usually all whitespace characters are removed from the sentences, and alphabets or numbers are considered as a single token. These tokens further go through POS tagger to get different parts of speech called as morphemes. For example, a verb "feels" is stored as "feel + s" and a noun "vegetables" is stored as "vegetable + s." Afterwards, morphemes are lexically analyzed by a parse tree.

Syntax Analysis: In this step of analysis, all the sentences and the phrases of the paragraph of reviews are authenticated in consultation with the defined grammatical rules in the English language. This paper uses Google Spell Check to correct the grammatical errors and typos in the crawled reviews. The misspelled words in review text are corrected by using a statistical spell checker (http://norvig. com/spell-correct.html) and removing the duplicates and unnecessary punctuation marks in sentences, e.g., !, ?, etc. We have used the publicly recognized POS tagger to remove some noisy information contained in the review text such as syntactical errors and mistakes. The principal parts of all sentences are also identified in this phase, i.e., object part, subject part, and verb part. Parse tree and typed dependencies are also generated in this phase. Syntactic dependency parser (http://nlp.stanford.edu/software/lexparser.shtml.) can also return the syntactic dependency relations between the words in a sentence.

Semantic Analysis: In the semantic analysis, all the tagged words among the sentences of the review are extracted in some sort of tabular form. It is decided in this particular stage that what actions are performed by the particular subject and a number of attributes related to every object are also identified. Output of the semantic analyzer contains a semantic table which is generated by the input review text on the basis of the parse tree generated in the previous phase. If there is a noun in the sentence, then we take it as a feature and store current sentence under this feature. The extracted information in the semantic table is used to express the features of the project. To find the polarity value for all the features from the user reviews using opinion mining approaches, a project feature matrix is obtained.

Feature Extraction: We identify the polarity of each review in the collection reviews using the NLTK library and calculate aggregated polarity score for each feature based on each review for every project from selected websites. We have started conducting feature-based opinion mining of every review, where opinion indicates positive, neutral, or negative sentiment that a reviewer expressed on a feature based on opinion words, as there are multiple opinion words (innovative, user friendly, and knowledgeable) that are related with each feature (related projects) in a review. We assess every opinion word's sentiment strength which is also called polarity value. In this analysis, the values of review features and their associated opinions in terms of polarity are derived.

5.3.2 Correlation Based Recommender

In this model, projects are recommended to a user based on the fact that the projects have been liked by users similar to the user. For example, if Derrick and Dennis like the same movies and a new movie comes out that Derick likes, then we can recommend that movie to Dennis because Derrick and Dennis seem to like the same movies.

These methods are based on matrix factorization and are better at dealing with sparsity. They are developed using data mining, machine learning algorithms to predict users' rating of unrated items. In this approach techniques such as dimensionality reduction are used to improve the accuracy.

5.3.3 Popularity Based Recommender

These systems identify similar items based on users' previous ratings. For example if users A,B and C gave a 5 star rating to projects X and Y then when a user D buys project Y they also get a recommendation to purchase project X because the system identifies project X and Y as similar based on the ratings of users A,B and C. Use meta data such as genre, producer, actor, musician to recommend items say movies or music. Such a recommendation would be for instance recommending Infinity War that featured Vin Diesel because someone watched and liked The Fate of the Furious. Similarly, you can get music recommendations from certain artists because you liked their music. Content based systems are based on the idea that if you liked a certain item you are most likely to like something that is similar to it.

5.4 DATA FLOW DIAGRAMS

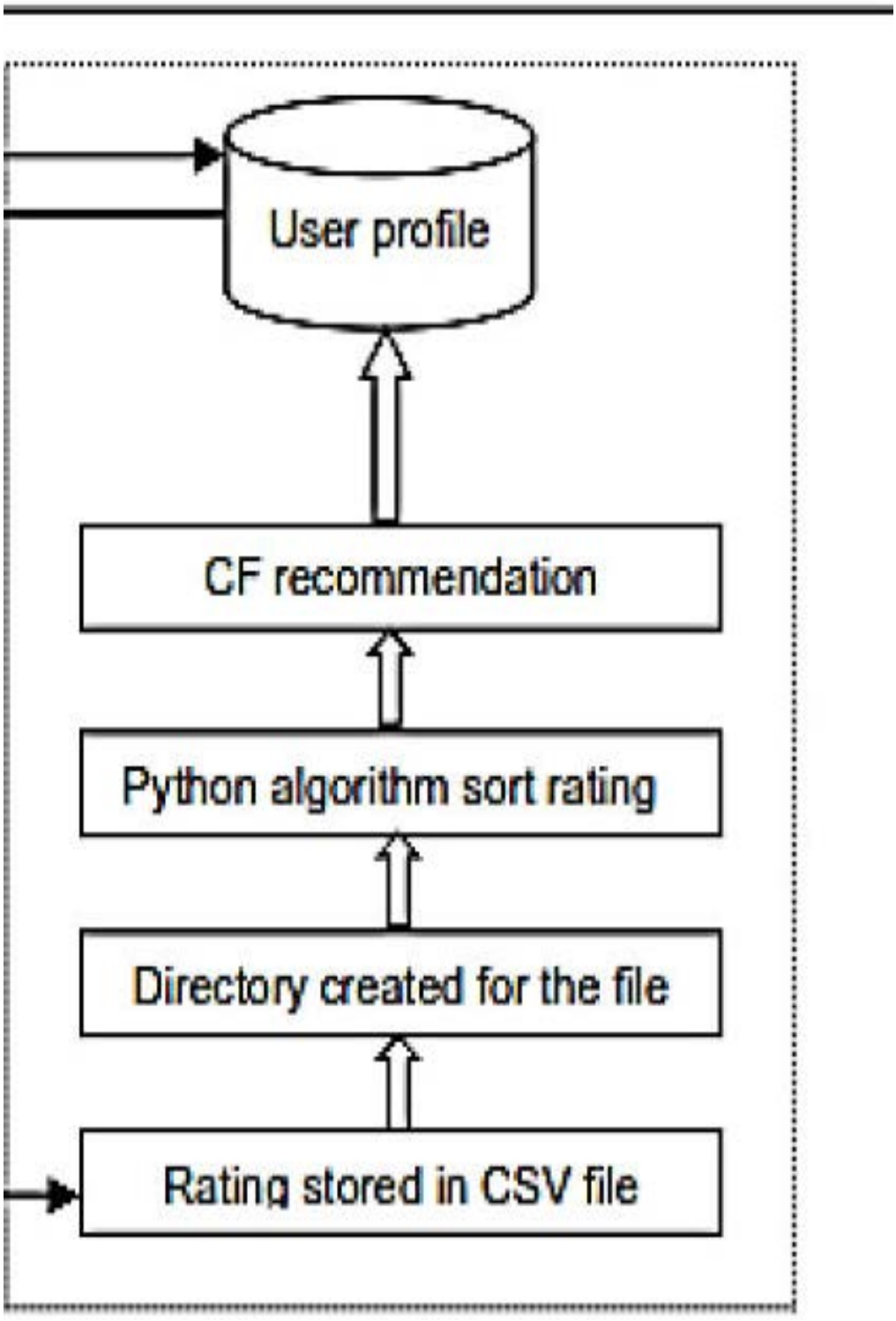


Figure-5.1 Data Flow Diagram

5.5 ENTITY RELATIONSHIP DIAGRAM

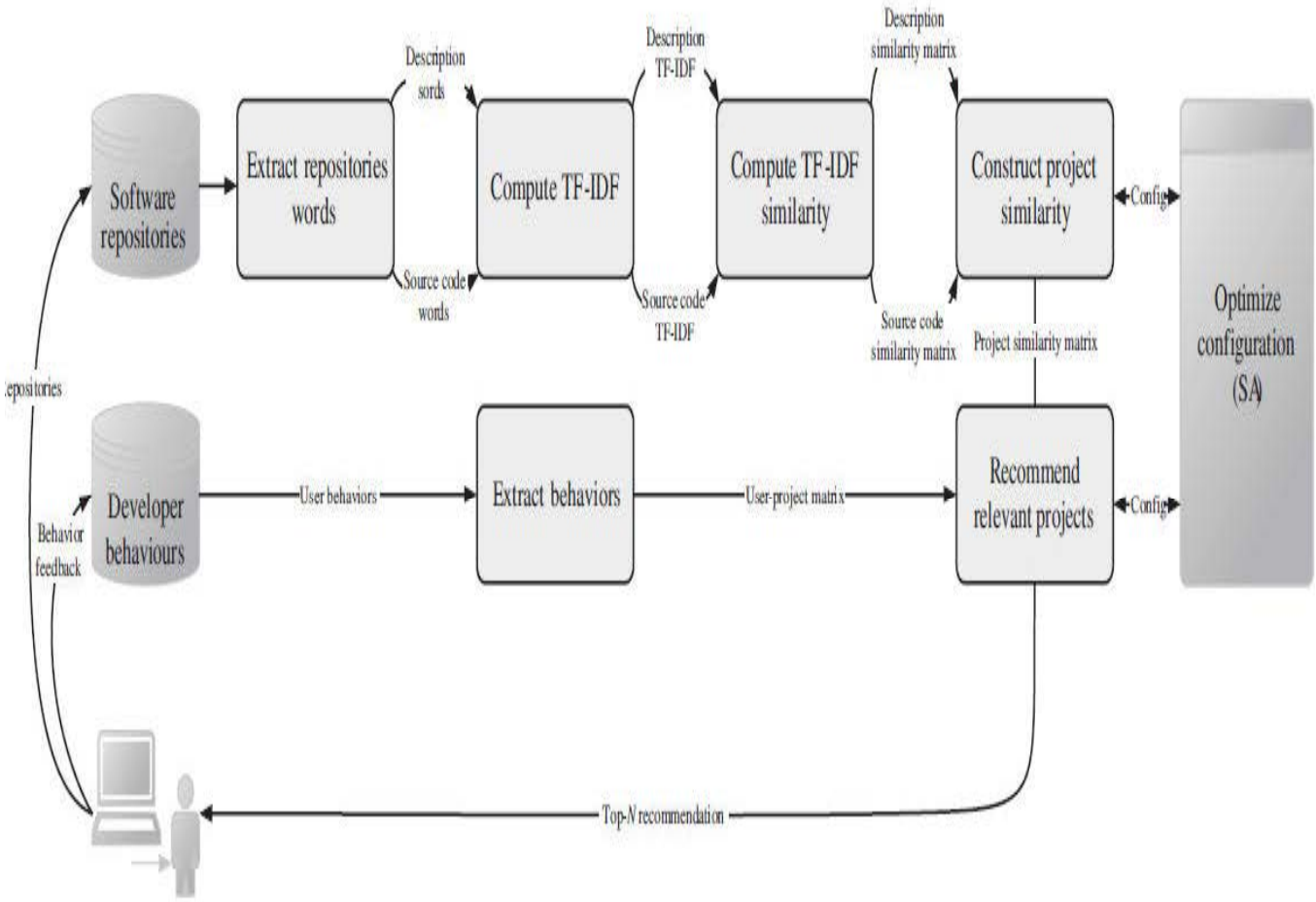


Figure 5.2 Entity Relationship Diagram

5.6 DATA BASE DESIGN

First, we extract keywords from each repository and calculate a project similarity matrix. Then, we extract developer behaviours to form a user-project matrix. Finally, we combine the similarity and user-project matrices by leveraging SA to obtain optimal parameters to produce the top-*N* software project recommendations. In GitHub, each project has its own repository, and each repository contains different types of files, such as source code and description files. For example, description files show the information and usage of a project, and source code files show a program's implementation. First, we extract project features from these files in each repository.

The proposed approach automatically recommends the top-*N* most relevant software projects. We also integrate user feedback to improve recommendation accuracy. The results of an empirical study using data crawled from GitHub demonstrate that the proposed approach can efficiently recommend relevant software projects with relatively high precision.

Recommendation systems use a number of different technologies. We can classify these systems into two broad groups.

- **Content-based systems** examine properties of the items recommended. For instance, if a Netflix user has watched many cowboy movies, then recommend a movie classified in the database as having the "cowboy" genre.
- **Collaborative filtering systems** recommend items based on similarity measures between users and/or items. The items recommended to a user are those preferred by similar users. This sort of recommendation system can use the groundwork laid on similarity search and on clustering. However, these technologies by themselves are not sufficient, and there are some new algorithms that have proven effective for recommendation systems.

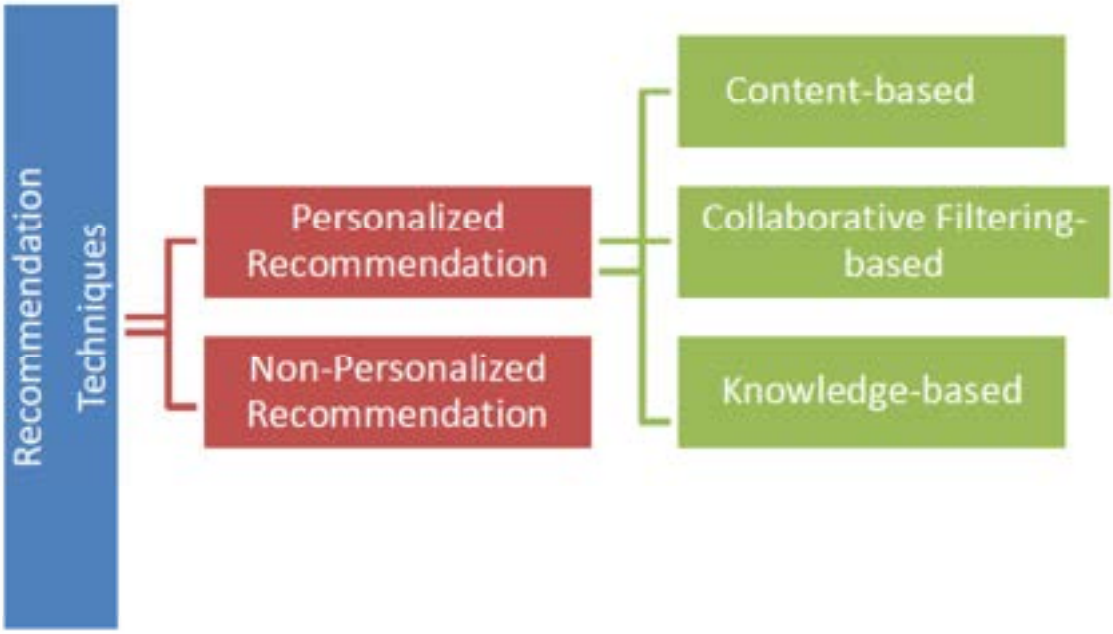


Figure- 5.3 Data Design

5.7 INPUT DESIGN

Input design is the process of converting the user-oriented input to a computer-based format. The goal of the input design is to make the data entry easier, logical and free of error. Errors in the input data are controlled by the input design. The quality of the input determines the quality of the system output.

The entire data entry screen is interactive in nature, so that the user can directly enter into data according to the prompted messages. The user also can directly enter into data according to the prompted messages. The users are also provided with option of selecting an appropriate input from a list of values. This will reduce the number of errors, which are otherwise likely to arise if they were to be entered by the user itself.

Input design is one of the most important phases of the system design. Input design is the process where the input received in the system are planned and designed, so as to get necessary information from the user, eliminating the information that is not required. The aim of the input design is to ensure the maximum possible levels of accuracy and also ensures that the input is accessible that understood by the user.

The input design is the part of overall system design, which requires very careful attention. If the data going into the system is incorrect then the processing and output will magnify the errors.

Input design features can ensure the reliability of the system and produce result from accurate data or they can result in the production of erroneous information.

In our project, the input design as follows:

5.7.1 Importing Libraries

```
import pandas as pd
from sklearn.metrics.pairwise import linear_kernel
from sklearn.feature_extraction.text import TfidfVectorizer
```

5.7.2 Reading file

```
project_description = pd.read_csv('description.csv', encoding = 'latin-1')
data = pd.read_csv('listing.csv', encoding = 'latin-1')
projects = pd.read_csv('projects.csv', encoding = 'latin-1')
```

5.7.3 Checking if we have the right data

```
print("\nChecking if we have the right data\n")
print(project_description.head())
```

5.7.4 Removing the stop words

```
projects_tfidf = TfidfVectorizer(stop_words='english')
```

5.7.5 Replace NaN with empty strings

```
project_description['description']=project_description['description'].fillna('')
```

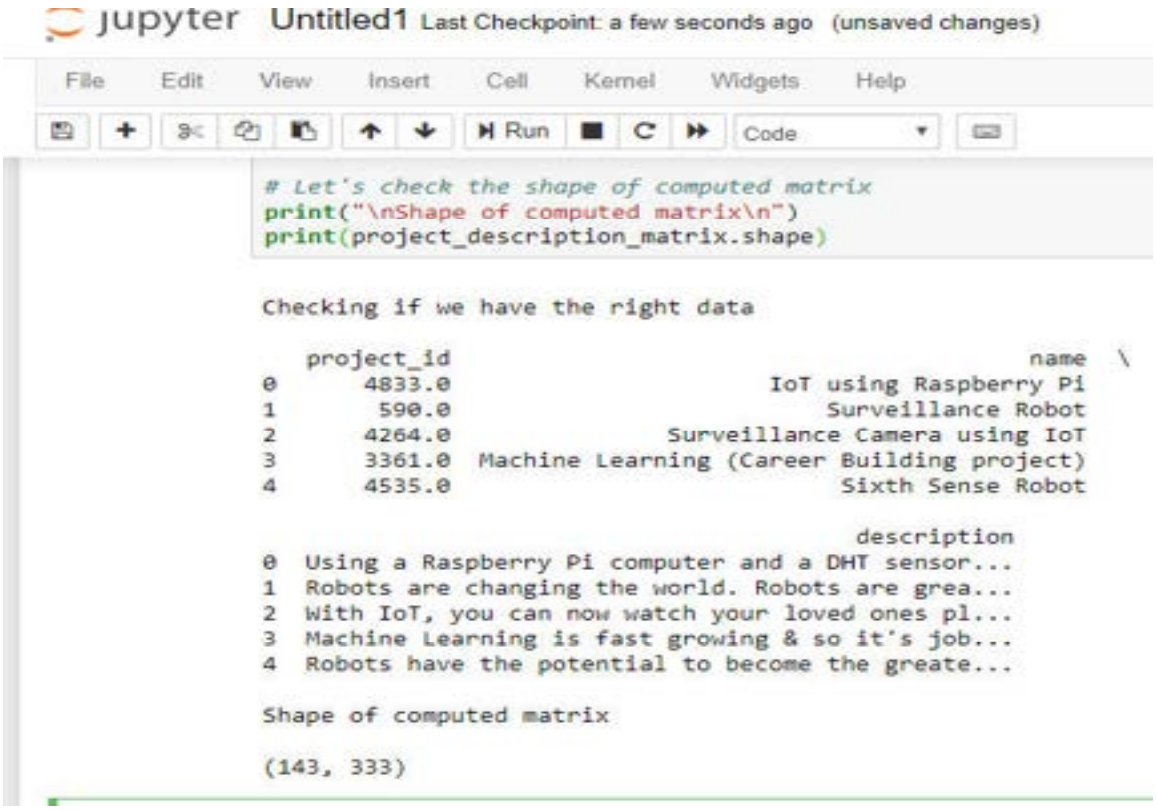


Figure-5.4 Empty String Diagram

5.8 OUTPUT DESIGN

Output design is very important concept in the computerized system, without reliable output the user may feel the entire system is unnecessary and avoids using it. The proper output design is important in any system and facilitates effective decision-making.

Computer output is the most important and direct source of information the user. Efficient, intelligible output design should improve the system's relationships with the user and help in decision making. A major form of output is the hardcopy from the printer.

Output requirements are designed during system analysis. A good starting point for the output design is the data flow diagram. Human factors reduce issues for design involved addressing internal controls to ensure readability.

An application is successful only when it can provide efficient and effective reports. Reports are actually presentable form of the data. The report generation should be useful to the management for future reference. The report is the main source of information for user's operators and management. Report generated are a permanent record of the transaction occurred. After any valid transactions; have commenced the report of the same is generation and: filed for future reference. Great care has been taken when designation the report as it plays an important role in decision-marking.

In our project, the output design as follows:

5.8.1 Computing TF-IDF matrix required for calculating cosine similarity

project_description_matrix=projects_tfidf.fit_transform(project_description['description'])

5.8.2 Let's check the shape of computed matrix

print("\nShape of computed matrix\n")

print(project_description_matrix.shape)

5.8.3 compuing cosine similarity matrix using linear_kernal of sklearn

cosine_similarity=linear_kernel(project_description_matrix,project_description_matrix)

5.8.4 Get the pairwise similarity scores of all projects compared to the project passed by index, sorting them and getting top 5

(here 2 is the index of the project in dataset)

similarity_scores = list(enumerate(cosine_similarity[2]))

similarity_scores = sorted(similarity_scores, key=lambda x: x[1], reverse=True)

similarity_scores = similarity_scores[1:6]

5.8.5 Get the similar projects index

projects_index = [i[0] for i in similarity_scores]

5.8.6 Return the top 5 most similar projects using integer-location based indexing (iloc)

print("\nTop 5 most similar projects using integer-location based indexing (iloc)\n")

print (project_description['name'].iloc[projects_index])

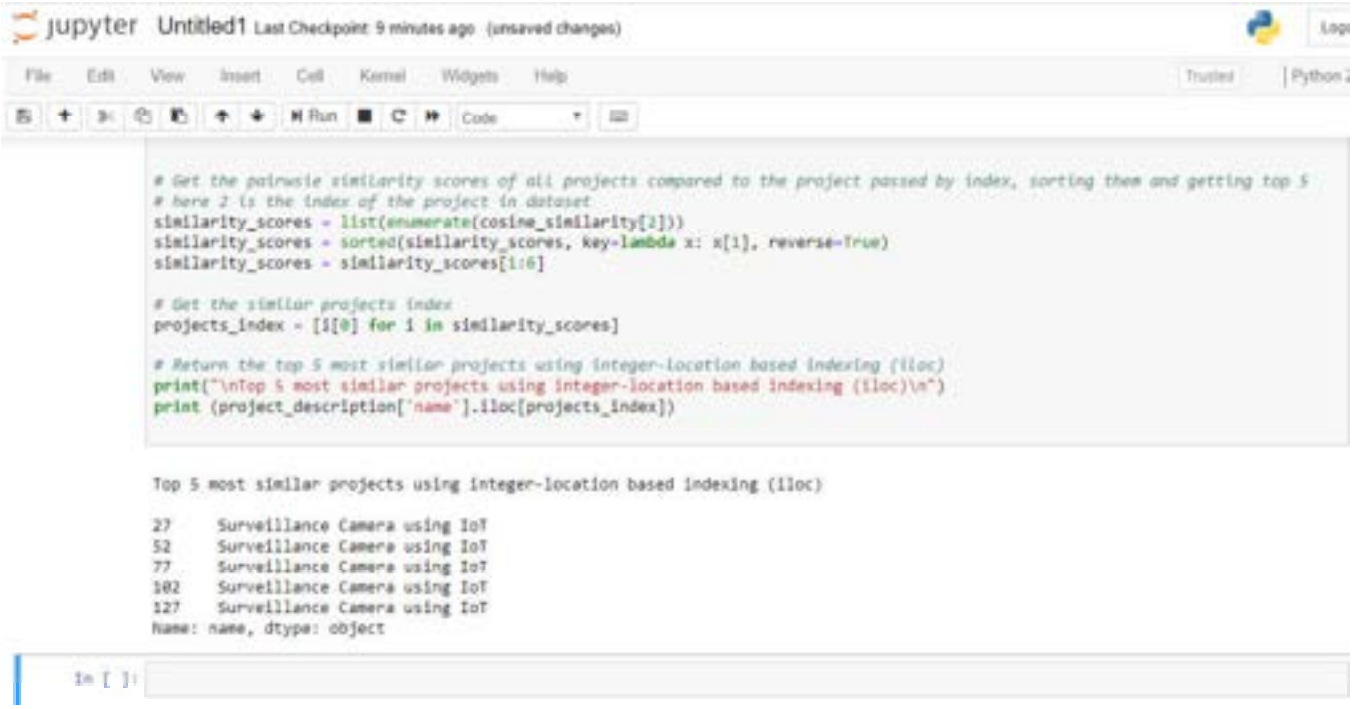


Figure-5.5 Integer-Location Based Indexing

5.8.7 Using head() function to view first 5 rows for the object based on position. Just to test if we have right data.

```
print("\nFirst 5 rows for the object based on position\n")

print(data.head())

print("\nFirst 5 Project Details\n")

print(projects.head())
```

5.8.8 Getting recommendation based on No. Of ratings

```
rating_count = pd.DataFrame(projects, columns=['project_id','no_of_ratings'])

print("\nRecommendation based on No. Of ratings\n")

print(rating_count.sort_values('no_of_ratings', ascending=False).drop_duplicates().head(10))
```

5.8.9 Getting the detail of most rated projects

```
most_rated_projects = pd.DataFrame([4755, 2409, 2194, 4696, 1616], index=np.arange(5), columns=['project_id'])
```

```
detail = pd.merge(most_rated_projects, data, on='project_id')

print("\nDetail of most rated projects\n")

print(detail)
```

5.8.10 Getting the most rated project

```
most_rated_project = pd.DataFrame(projects, columns=['project_id', 'user_id', 'avg_rating', 'no_of_ratings'])

print("\nMost rated project\n")

print(most_rated_project.max())
```

5.8.11 Getting description for most rated project

```
print("\nDescription for most rated project\n")

print(most_rated_project.describe())
```

5.8.12 Can also get the description for author

```
print("\nDescription for author\n")

print(data['author'].describe())
```

jupyter Untitled1 Last Checkpoint: 16 minutes ago (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help

Run Code

First 5 rows for the object based on position

	project_id	genre	name	author
0	4833	IoT	IoT using Raspberry Pi	Jeannette Walls
1	590	Machine Learning	Surveillance Robot	Elie Wiesel
2	4264	Raspberry Pi	Surveillance Camera using IoT	Frank McCourt
3	3361	Block Chain	Machine Learning (Career Building Course)	Elizabeth Gilbert
4	4535	Artificial Intelligence	Sixth Sense Robot	Jon Krakauer

First 5 Project Details

	project_id	avg_rating	no_of_ratings	user_id	user_rating
0	4833	4.25	7156.0	3466	0
1	590	4.31	7821.0	3466	5
2	4264	4.08	3836.0	3453	5
3	3361	3.52	1245.0	3453	4
4	4535	4.13	3107.0	3453	0

Recommendation based on No. Of ratings

	project_id	no_of_ratings
529	4755	9936.0
707	2409	9768.0
1252	2194	9754.0
1384	4696	9754.0
747	1616	9542.0
713	722	9542.0
1093	3004	9533.0
1124	3073	9533.0
2222	2240	9460.0
282	433	9451.0

Detail of most rated projects

	project_id	genre	name	author
0	4755	Machine Learning	Sixth Sense Robot	Robert M. Goldman
1	2409	Data Science	Computer Vision (Career Building Course)	Richard J. Evans
2	2194	Raspberry Pi	Python for Web Development	ExamREVIEW
3	4696	Machine Learning	IoT using Raspberry Pi	Teresa Mills
4	1616	Block Chain	Python for Image Processing	Mark Cotta Vaz

```
Most rated project

project_id       4999.0
user_id          7131.0
avg_rating          5.0
no_of_ratings    9936.0
dtype: float64

Description for most rated project

        project_id      user_id   avg_rating  no_of_ratings
count  2312.000000  2312.000000  2310.000000    2310.000000
mean   2515.098616  3108.624135     3.867026    2145.869264
std    1453.933954  1111.356799     1.010567    2746.151516
min       6.000000   117.000000     0.000000       0.000000
25%    1257.000000  3221.000000     3.000000     101.000000
50%    2610.000000  3471.000000     4.000000     660.500000
75%    3729.000000  3476.000000     4.730000    3608.000000
max    4999.000000  7131.000000     5.000000    9936.000000

Description for author

count                       1011
unique                       992
top       McGraw-Hill Education
freq                           3
Name: author, dtype: object
```

Figure-5.6 Discription Of Author

CHAPTER 6

SYSTEM TESTING

6.1 UNIT TESTING

Unit testing focuses the verification effort on the smallest unit of S/W design i.e., the module. The unit testing is always white-box oriented and the step can be conducted in parallel for modules.

During unit test, testers can use the same project or projects as the developers, if functional units organize the project, or separate projects have been created for functional units. The project or projects can also be exported, so unit test can take place in a variety of environments and on a variety of platforms.

Unit testing comprises the set of tests performed by an individual programmer prior to integration of the unit into a larger system. There are different types of tests to be performed on a programming unit. These may be classified as follows:

- **Functional Tests**
- **Performance Tests**
- **Stress Tests**
- **Structure Tests**

Functional Test cases involves exercising the code with normal input values for which the expected results are known, as well as boundary values and special values.

Performance Testing determines the amount of execution time spent in various parts of the unit, program throughput, response time and device utilization by the program unit.

Stress Tests are those tests designed to intentionally break the limit. A great deal can be learnt about the strengths and limitations of a program by examining the manner in which a program unit breaks.

Structure Tests are concerned with exercising the internal logic of a program and traversing particular execution paths to exercise, deriving test date, determining the criterion to be used, executing test cases.

Unit Test Considerations

The tests that occur as part of unit testing. The module 'interface' is tested to ensure that information properly flows into and out of the program unit under test. The 'local data structures' are examined to ensure that data stored temporarily maintains its integrity during all steps in an algorithms execution.

'Boundary Conditions' are tested to ensure that the module operates properly at boundaries established to limit or restrict processing. All 'independent paths' through the control structures are exercised to ensure that all statements in a module have been executed at least once. Finally, all 'error-handling paths' are tested.

Unit Test Procedures

Unit testing is considered an equivalent to the coding step. After the source level code has been developed, reviewed and verified for correct syntax, unit test case design begins since a module is not a standalone program, 'driver' and/or 'stub' S/W must be developed for each unit test.

In most applications, a driver is nothing more than a main program that accepts test case data, passes such data to the module to be tested, and prints the relevant results. The stubs serve to replace modules that are subordinates called by the modules to be tested. A stub or a dummy stub or a dummy subprogram uses the subordinate modules interface, may do minimal data manipulation, prints verification of entry, and returns. The drivers and scrubs represent overhead i.e., both are S/W that must be written but that is not delivered with the final S/W product. If the drivers and the stub are kept simple, then the overhead is low.

6.2 INTEGRATION TESTING

It addresses the issues associated with the dual problems of verification and program construction. Black box test case design techniques are the most prevalent during integration, although a limited amount of white box testing may be used to ensure converge of major control paths. Integration testing is a systematic technique for constructing the program structure while at the same time conducting tests to uncover errors associated with interfacing. The objective is to take unit-tested modules and build a program structure that has been depicted by design.

Incremental Integration Strategies are

- Top-Down Integration

- Bottom-Up Integration

Test cases were designed so that all units tested modules were executed from the main module and the reports were generated to check the results with the expected results.

After has been integrated, a set of high order tests are conducted, validation criteria must be tested.

6.3 VALIDATION TESTING

Validation testing is one, which checks the given data is a valid one, or not. In our system, first stage username and password are checked. If it is a valid one, then the services will be provided to the user. Hence validation testing takes place at the earlier part of our project. This is one of the most crucial one, which takes place at the all kind of projects.

6.4 ACCEPTANCE TESTING

This test was performed with the users of the system and made sure that it performed as they expected. It was verified that all functionality required by the user have been satisfied. So, for, the system has been found defect free and is working well.

CHAPTER 7

SYSTEM IMPLEMENTATION

7.1 IMPLEMENTATION FLOW

This section describes about the Implementation of the Safe application and the details of how to access this control from any application.Implementation is the process of assuring that the information system is operational and then allowing users take over its operation for use and evaluation. Implementation includes the following activities.

- Obtaining and installing the system hardware.
- Installing the system and making it run on its intended hardware.
- Providing user access to the system.
- Creating and updating the database.
- Documenting the system for its users and for those who will be responsible for maintaining it in the future.
- Making arrangements to support the users as the system is used.
- Transferring ongoing responsibility for the system from its developers to the operations or maintenance part.
- Evaluating the operation and use of the system.

7.2 IMPLEMENTATION PHASE IN THIS PROJECT:

In this Python project, we will be using csv for gathering the data and feed them into a **Machine Learning** model which will classify projects based on ratings and content based on project description. The approach we will be using for this Python project is as follows:

Step 1: Import Library Files (sklearn, pandas, numpy)

Step 2: Fetch data from data set obtained from various project sites or GitHub

Step 3: Pre-Process the data for filtering (correlative or popularity based)

Step 4: Classifying the data based on index value or most repetitions using content-based filtering.

Step 5: Obtaining top N number of projects based on content.

Step 6: Classifying the data based on reviews and ratings using Collaborative filtering (Popularity Based filtering)

Step 7: Obtaining top N most rated projects.

Step 8: Obtaining top N most rated projects description details with author information.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

This personalized recommendation is performed based on developer behaviours and features extracted from the description documents and source code of each project. The proposed approach also considers user feedback to improve recommendations. In addition, we optimize parameter configurations automatically using the SA algorithm to achieve higher accuracy. We evaluated
the proposed approach using four groups of data from GitHub. The results demonstrate that this approach can accurately recommend software projects to developers.

Although we have demonstrated the effectiveness of the proposed approach, there is room for improvement. First, we must perform additional experiments, particularly survey-based online experiments with actual developers, to determine whether the proposed recommendation approach is actually useful. In addition, we will consider other user behaviours, e.g., search history, watch, and pull-request behaviours, to help developers find more suitable projects.

CHAPTER 9

APPENDICES I

CORRELATION BASED RECOMMENDATION SOURCE CODE

```
# importing libraries
import pandas as pd
from sklearn.metrics.pairwise import linear_kernel
from sklearn.feature_extraction.text import TfidfVectorizer

# reading file
project_description = pd.read_csv('description.csv', encoding = 'latin-1')

# checking if we have the right data
print("\nChecking if we have the right data\n")
print(project_description.head())

# removing the stop words
projects_tfidf = TfidfVectorizer(stop_words='english')

# replace NaN with empty strings
project_description['description'] = project_description['description'].fillna('')

# computing TF-IDF matrix required for calculating cosine similarity
project_description_matrix = projects_tfidf.fit_transform(project_description['description'])

# Let's check the shape of computed matrix
print("\nShape of computed matrix\n")
print(project_description_matrix.shape)

# compuing cosine similarity matrix using linear_kernal of sklearn
cosine_similarity = linear_kernel(project_description_matrix, project_description_matrix)
```

```
# Get the pairwsie similarity scores of all projects compared to the project passed by index, sorting them and getting top 5
# here 2 is the index of the project in dataset
similarity_scores = list(enumerate(cosine_similarity[2]))
similarity_scores = sorted(similarity_scores, key=lambda x: x[1], reverse=True)
similarity_scores = similarity_scores[1:6]

# Get the similar projects index
projects_index = [i[0] for i in similarity_scores]

# Return the top 5 most similar projects using integer-location based indexing (iloc)
print("\nTop 5 most similar projects using integer-location based indexing (iloc)\n")
print (project_description['name'].iloc[projects_index])
```

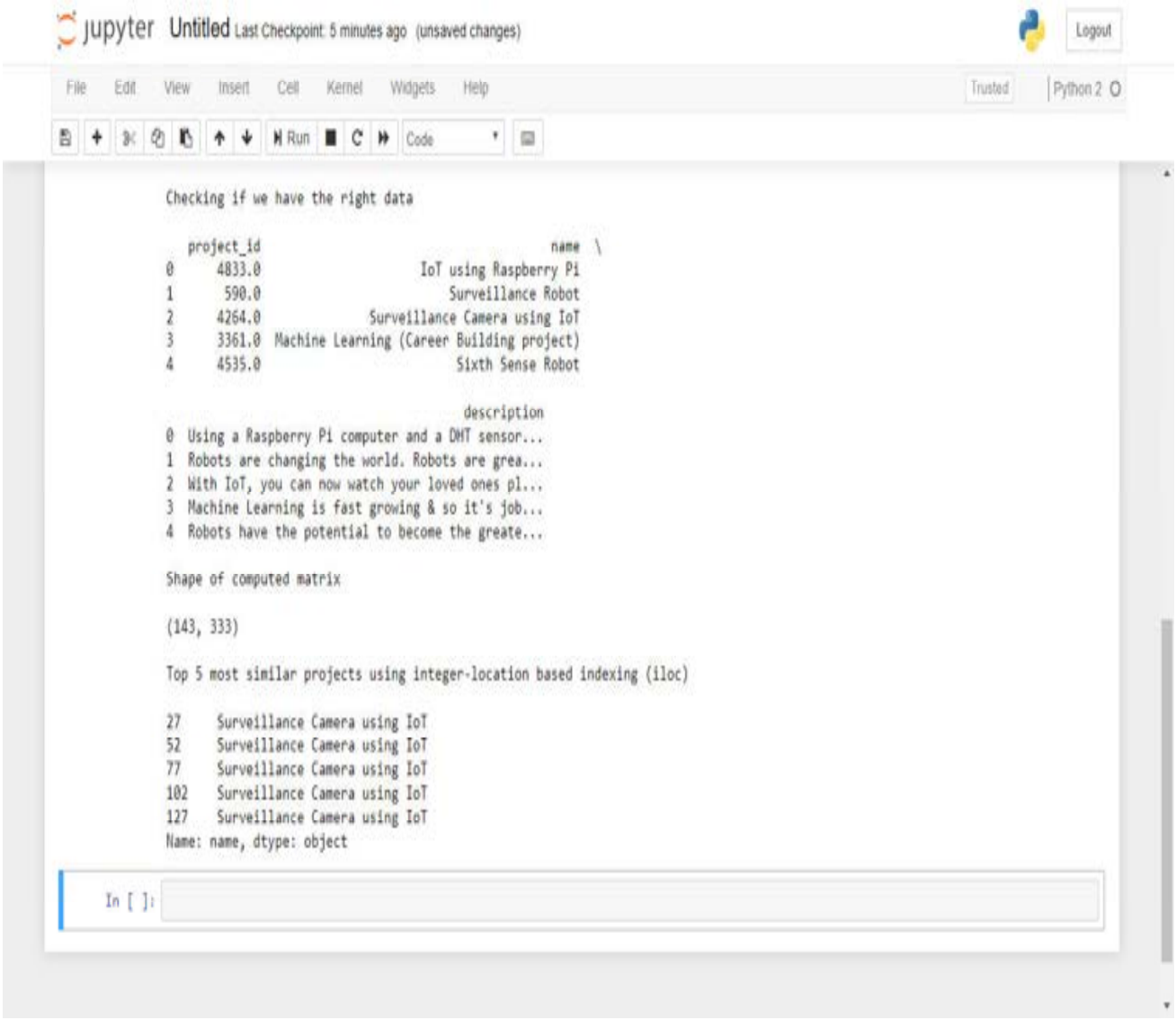
POPULARITY BASED RECOMMENDATION

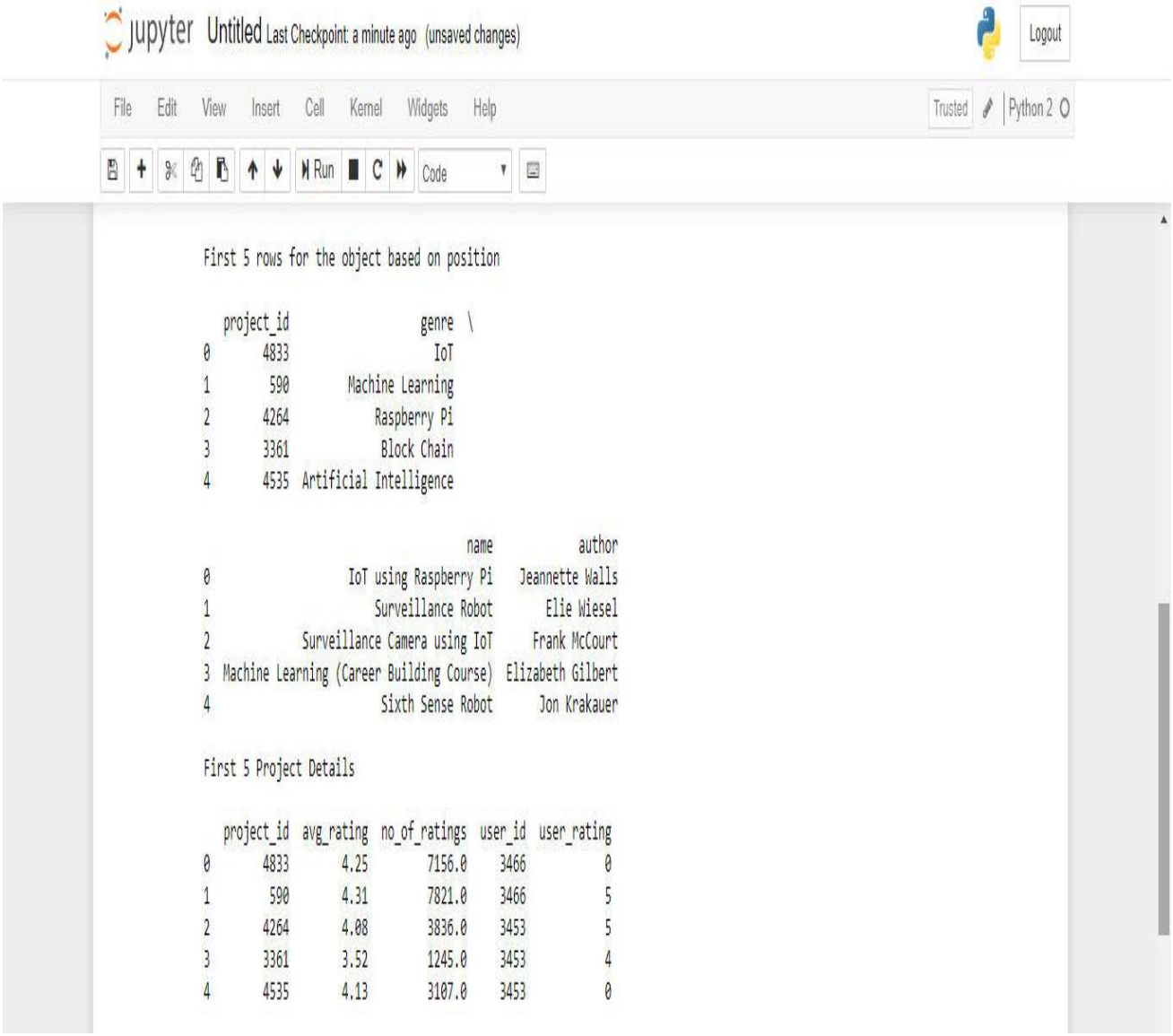
```
#importing libraries
import pandas as pd
import numpy as np

#reading the files
data = pd.read_csv('listing.csv', encoding = 'latin-1')
projects = pd.read_csv('projects.csv', encoding = 'latin-1')

#using head() function to view first 5 rows for the object based on position. Just to test if we have right data.
print("\nFirst 5 rows for the object based on position\n")
print(data.head())

print("\nFirst 5 Project Details\n")
print(projects.head())

# Getting recommendation based on No. Of ratings
rating_count = pd.DataFrame(projects, columns=['project_id','no_of_ratings'])
print("\nRecommendation based on No. Of ratings\n")
print(rating_count.sort_values('no_of_ratings', ascending=False).drop_duplicates().head(10))

# getting the detail of most rated projects
most_rated_projects = pd.DataFrame([4755, 2409, 2194, 4696, 1616], index=np.arange(5),
columns=['project_id'])

detail = pd.merge(most_rated_projects, data, on='project_id')
print("\nDetail of most rated projects\n")
print(detail)

# getting the most rated project
most_rated_project = pd.DataFrame(projects, columns=['project_id', 'user_id', 'avg_rating',
'no_of_ratings'])
```

```
print("\nMost rated project\n")
print(most_rated_project.max())

#getting description for most rated project
print("\nDescription for most rated project\n")
print(most_rated_project.describe())

# can also get the description for author
print("\nDescription for author\n")
print(data['author'].describe())
```

APPENDIX-9.2

SAMPLE SCREENSHOTS





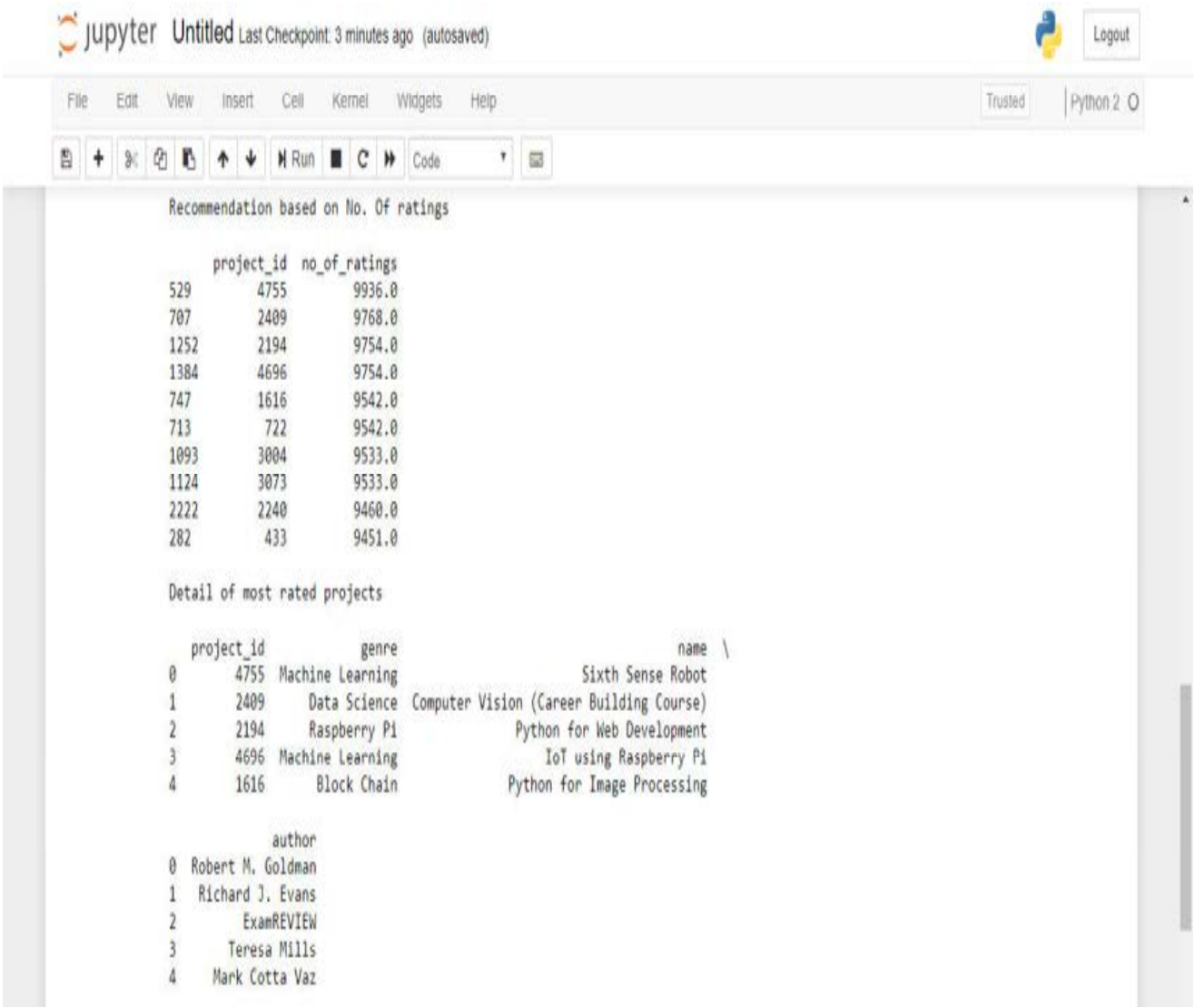
First 5 rows for the object based on position

	project_id	genre
0	4833	IoT
1	590	Machine Learning
2	4264	Raspberry Pi
3	3361	Block Chain
4	4535	Artificial Intelligence

	name	author
0	IoT using Raspberry Pi	Jeannette Walls
1	Surveillance Robot	Elie Wiesel
2	Surveillance Camera using IoT	Frank McCourt
3	Machine Learning (Career Building Course)	Elizabeth Gilbert
4	Sixth Sense Robot	Jon Krakauer

First 5 Project Details

	project_id	avg_rating	no_of_ratings	user_id	user_rating
0	4833	4.25	7156.0	3466	0
1	590	4.31	7821.0	3466	5
2	4264	4.08	3836.0	3453	5
3	3361	3.52	1245.0	3453	4
4	4535	4.13	3107.0	3453	0

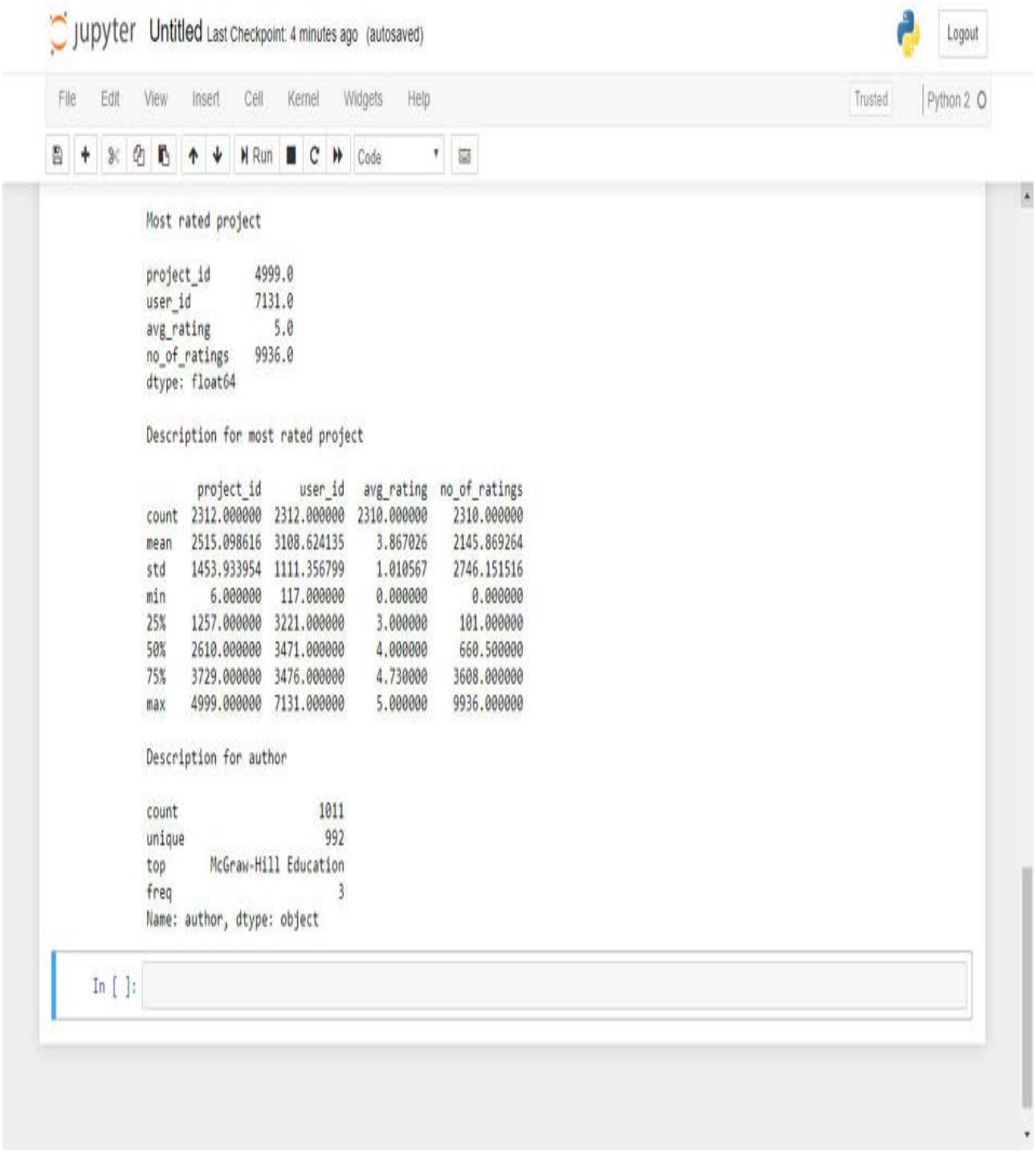


Recommendation based on No. Of ratings

	project_id	no_of_ratings
529	4755	9936.0
707	2409	9768.0
1252	2194	9754.0
1384	4696	9754.0
747	1616	9542.0
713	722	9542.0
1093	3004	9533.0
1124	3073	9533.0
2222	2240	9460.0
282	433	9451.0

Detail of most rated projects

	project_id	genre	name	author
0	4755	Machine Learning	Sixth Sense Robot	Robert M. Goldman
1	2409	Data Science	Computer Vision (Career Building Course)	Richard J. Evans
2	2194	Raspberry Pi	Python for Web Development	ExamREVIEW
3	4696	Machine Learning	IoT using Raspberry Pi	Teresa Mills
4	1616	Block Chain	Python for Image Processing	Mark Cotta Vaz



Most rated project

```
project_id      4999.0
user_id         7131.0
avg_rating         5.0
no_of_ratings   9936.0
dtype: float64
```

Description for most rated project

	project_id	user_id	avg_rating	no_of_ratings
count	2312.000000	2312.000000	2310.000000	2310.000000
mean	2515.098616	3108.624135	3.867026	2145.869264
std	1453.933954	1111.356799	1.010567	2746.151516
min	6.000000	117.000000	0.000000	0.000000
25%	1257.000000	3221.000000	3.000000	101.000000
50%	2610.000000	3471.000000	4.000000	660.500000
75%	3729.000000	3476.000000	4.730000	3608.000000
max	4999.000000	7131.000000	5.000000	9936.000000

Description for author

```
count                  1011
unique                  992
top       McGraw-Hill Education
freq                      3
Name: author, dtype: object
```

In [ ]:

10.BIBLIOGRAPHY

Reference

[1] Akshita, J., and Smita, A. (2013). Recommender system: review. International Journal of computer application, 71(24), 38-42.

[2] Burke, R. (2007). Hybrid web recommender systems. The Adaptive Web, Springer Berlin, Heidelberg, 377–408.

[3] Cheng, Z., and Hurley, N. (2010). Effective diverse and obfuscated attacks on model-based recommender systems. RecSys '09: Proceedings of the Third ACM Conference on Recommender Systems, ACM, New York, NY, USA, 141–148.

[4] Desrosier, C., and Karypis, G. (2012). A comprehensive survey of neighbourhood-based recommendation methods. Department of Computer Science and Engineering. University of Minnesota, Mineapolis, USA. 5-33.

[5] Linden, G., Smith, B., and York, J. (2003). Amazon.com recommendations: Item-to-item collaborative filtering. IEEE Internet Computing, 7(1), 76–80.

[6] Mahmood, T., and Ricci, F. (2009). Improving recommender systems with adaptive conversational strategies. Hypertext ACM publications, 73–82.

[7] Marlin, B. (2004). Collaborative filtering: a machine learning perspective. Thes is research. Department of computer science, University of Toronto. 1-118.

[8] Melville, P., Mooney, R. J., and Nagarajan, R. (2002). Content-boosted collaborative filtering for improved recommendations. In Proceedings of the eighteenth national conference on artificial intelligence (AAAI-02), Edmonton, Alberta, 187-192.

[9] Onah, D. and Sinclair, J. (2015). Collaborative filtering recommendation system: a framework in massive online courses. Proceedings of the 9th International Technology, Education and Development Conference, Madrid, Spain. 1249-1257. isbn:9788460657637.