"RF Control Solar Panel Base Robotic Vehicle"

A Project Report

Submitted By

Vishal A. Kale **Akshay Dalal**

Bhavesh Kasar **Rohit Ahir**

in fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

In the discipline

Mechanical Engineering

Under the Guidance of

Prof. K. M. Mahajan

Department of Mechanical Engineering

Godavari Foundation's

Godavari College of Engineering, Jalgaon

Affiliated to

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY

LONERE, DIST. RAIGAD - 402 103

2021-22

Godavari Foundation's

GODAVARI COLLEGE OF ENGINEERING, JALGAON

CERTIFICATE

This is to certify that this project report entitled **"RF Control Solar Panel Base Robotic Vehicle"** *by* **Vishal A.Kale, Akshay Dalal, Bhavesh Kasar and Rohit Ahir,** submitted in fulfillment of the requirements for the degree of Bachelor of Technology in Mechanical Engineering of the Dr. Babasaheb Ambedkar Technological University Lonere, Dist. Raigad, during the academic year 2021-22, is a Bonafede record of work carried out in a satisfactory way

Date:

Place: Jalgaon

Prof. K. M. Mahajan
Guide

Prof. T. A. Koli
H.O.D

Dr. V. H. Patil

Principal External Examiner

Godavari Foundation's

GODAVARI COLLEGE OF ENGINEERING, JALGAON

DECLARATION

We hereby declare that the work presented in this project "RF Control Solar Panel Base Robotic Vehicle" was carried out by us under the supervision of our guide from sept-2021 to July. 2022

This work or any part of this work is based on original research and has not been submitted by us to any University/Institution for the award of any degree.

Date:

Place: Jalgaon

Vishal Kale

Akshay Dalal

Bhavesh Kasar

Rohit Ahir

ACKNOWLEDGEMENT

We take this opportunity to express our profound gratitude to our esteemed project guide **Prof. K. M. Mahajan** for his excellent guidance, suggestions and constructive criticism. Working under his guidance greatly contributed in improving quality of our project work and our Engineering skills. Actually, he is one of such genuine people for whom our words will not be enough to express.

We are extremely fortunate be involved in an exciting and challenging research project. This project has improved our thinking and understanding capability.

We are also thankful to **Prof. T.A. Koli**, H.O.D, Mechanical Engineering Department of Godavari College of Engineering, Jalgaon for his constant support and encouragement. Also, We are very much grateful to the Principal **Dr. V.H. Patil** and Vice Principal **Prof**. **P. V. Phalak**, of our college, for their continuous inspiration and support.

We also extend our sincere thanks to all faculty members of Mechanical Engineering department for making our project as successful one, for their valuable advice in every stage and also giving us absolute working environment where we unlashed our potential. We would like to extend our sincere thanks to our friends and colleagues.

Last but not least we are indebted to many other such persons who have extended their hands of co-operation during our project. Although not mentioned in this acknowledgement, their names have been permanently engraved in our heart.

Vishal Kale

Akshay Dalal

Bhavesh Kasar

Rohit Aahir

ABSTRACT

The intention of designing a robot would be used to facilitate the human beings through giving security and working as a helping hand through reprieving. Surveillance is one among the valuable system in the security-based monitoring. In association with, the automation system works a vital role in surveillance-based security system. In this project, the main need is to design and develop a portable and efficiently useful solar robot for civilian and military applications. It aims to utilize solar power for operation and embedded controller for control of the robot. Usually, the powering of the robots for surveillance are based on conventional methods and shortest path algorithm based on increasing targets to reduce complexity. It consists of embedded controllers, H-bridge drivers and solar system. It can be applied to multipurpose household and war field applications.

CONTENTS

LIST OF FIGURES

LIST OF GRAPHS

CHAPTER 1

INTRODUCTION

What comes to mind when you hear the word “robot”? Do you picture a metallic humanoid in a spaceship in the distant future? Perhaps you imagine a dystopian future where humanity is enslaved by its robot overlords. Or maybe you think of an automobile assembly line with robot-like machines putting cars together.

Whatever you think, one thing is sure: robots are here to stay. Fortunately, it seems likely that robots will be more about doing repetitive or dangerous tasks than seizing supreme executive power. Let’s look at robotics, defining and classifying the term, figuring out the role of Artificial Intelligence in the field, the future of robotics, and how robotics will change our lives.

1.1 What Is Robotics?

Robotics is the engineering branch that deals with the conception, design, construction, operation, application, and usage of robots. Digging a little deeper, we see that robots are defined as an automatically operated machine that carries out a series of actions independently and does the work usually accomplished by a human.

Incidentally, robots don’t have to resemble humans, although some do. Look at images of automobile assembly lines for proof. Robots that appear human are typically referred to as “androids.” Although robot designers make their creations appear human so that people feel more at ease around them, it’s not always the case. Some people find robots, especially ones that resemble people, creepy.

Robotics is the most appropriate technology for surveillance purposes in order to identify the occurrence of related events. As we all know, robots are capable of performing surveillance tasks with a high level of integration while using a surveillance device. To develop long-range portable assistive-aided car system for user. This project presents a reconfigurable sensor network for structural monitoring of a user. In this project, we have built an all in one voice control car using custom mode PCB. This robotic car can perform as Bluetooth voice control robot, self-balancing robot, and obstacles avoidance robot. This robots batteries are powered using a solar panel. This robot can be useful for Industrial automated equipment carriers. This robot can be used for surveillance. All these things are done by Arduino UNO microcontroller.

1.2 Overview of robotics system

Robotics is the confluence of engineering and science that includes mechanical engineering, electrical engineering, computer science also it is no more an emerging field as it has evolved so much in the last 10 years and it is nearing an apex point. It is an ever-growing field and many avenues have opened up in recent past. The promise of robotics is easy to describe but hard for the mind to grasp.

A robot is a mechanical or virtual intelligent agent that can perform tasks automatically or with guidance, typically, by remote control. In practice a robot is usually an electro- mechanical machine that is guided by computer and electronic programming. Robots hold the promise of moving and transforming materials with the same ease as a computer program transforms data. But the grey spot remains wide when it comes to Research awareness in the field of Robotics and Automation. Sooner or later Robotics and automation will find its application in every facet of human life. The advancement in technology would bring a day of robot's omnipresence. They will soon sneak everywhere from gadgets to apparels and to our very own bodies. Hence it is the responsibility of engineering community to disseminate the knowledge about the future scope and application of Robotics.

The term robot is derived from Czech word "robota" which means forced labor. Nobody has ever given a precise explanation of what a robot is, although each of those definitions more or less means the same. To make things simpler, "Robot is a combination of electronics, mechanics and programming which senses it's surrounding through its sensors processes the sensor information and does something in response". The response can be locomotion or manipulation, like turning on a LED, rotating a wheel, moving an arm, raising an alarm and so on. The branch of computer science and engineering which deals with robot design, construction, application and operation is called Robotics with applications in computer science, physics, engineering, defense and even many household devices.

1.3 Types of Robots

Robots are versatile machines, evidenced by their wide variety of forms and functions. Here's a list of a few kinds of robots we see today:

1.3.1Healthcare: -Robots in the healthcare industry do everything from assisting in surgery to physical therapy to help people walk to moving through hospitals and delivering essential supplies such as meds or linens. Healthcare robots have even contributed to the ongoing fight against the pandemic, filling and sealing testing swabs and producing respirators.

1.**3.2 Homelife:** -You need look no further than a Roomba to find a robot in someone's house. But they do more now than vacuuming floors; home-based robots can mow lawns or augment tools like Alexa.

1.3.3 Manufacturing: - The field of manufacturing was the first to adopt robots, such as the automobile assembly line machines we previously mentioned. Industrial robots handle a various tasks like arc welding, material handling, steel cutting, and food packaging.

1.3.4 Logistics: - Everybody wants their online orders delivered on time, if not sooner. So companies employ robots to stack warehouse shelves, retrieve goods, and even conduct short-range deliveries.

1.3.5 Space Exploration: - Mars explorers such as Sojourner and Perseverance are robots. The Hubble telescope is classified as a robot, as are deep space probes like Voyager and Cassini.

1.3.6 Military: - Robots handle dangerous tasks, and it doesn't get any more difficult than modern warfare. Consequently, the military enjoys a diverse selection of robots equipped to address many of the riskier jobs associated with war. For example, there's the Centaur, an explosive detection/disposal robot that looks for mines and IEDs, the MUTT, which follows soldiers around and totes their gear, and SAFFiR, which fights fires that break out on naval vessels.

1.**3.7 Entertainment: -** We already have toy robots, robot statues, and robot restaurants. As robots become more sophisticated, expect their entertainment value to rise accordingly.

1.3.8 Travel: - We only need to say three words: self-driving vehicle

1.4 Future of robot

Remote control car technology has been around for decades in the history of technology. Nowadays, lots of research is going on in this area. The remote-control car using radio signals were introduced in the mid-sixties. Therefore, some major drawbacks were faced in these Radio Frequency (RF) systems such as limited frequency, blocking the infrared controller by large obstacles between paths.

Also, during day time, sunlight could interface with infrared signals. Later this limitation was solved by using a mobile phone network system for robotic control. This improved system could cover a large working area and also no possibility of interfacing with other controllers. The robotic system also can share the moving structure and mechanical features under the same control. In this paper, a GSM network-based system has been designed where the GSM module is directly connected to the microcontroller. In this system, the instructions are given by SMS instead of the keypad so that we do not need to interface a DTMF decoder in the system. Besides, for the power source of the car, we have used renewable energy solar power to run the whole system. We have used Matlab and Simulink to design and simulate the Solar Photovoltaic cell (PV).

The testing results shows the efficiency of our designed solar panel that was good enough to run the car motor even on normal temperature. The Proteus software has been used to design the microcontroller and whole system circuits to get the input from a cell phone. The user ARIV can send the message from the cell phone to move the car. The results show the successful implementation of proposed design with appropriate testing. Our proposed control system of the solar car design has managed to overcome the limitations of standard DTMF technologies such as circuit complications, extra components required for filtering and restriction on the number of features.

1.5 Introduction to RF Controller System

An RF module (short for radio-frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio-frequency (RF) communication. For many applications, the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet. RF modules are typically fabricated using RF CMOS technology.

RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. Finally, radio circuits are usually subject to limits on radiated emissions, and require Conformance testing and certification by a standardization organization such as ETSI or the U.S. Federal Communications Commission (FCC). For these reasons, design engineers will often design a circuit for an application which requires radio communication and then "drop in" a pre-made radio module rather than attempt a discrete design, saving time and money on development.

RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm or monitoring systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infrared communication designs as they have the advantage of not requiring line-of-sight operation.

Several carrier frequencies are commonly used in commercially available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz. These frequencies are used because of national and international regulations governing the used of radio for

communication. Short Range Devices may also use frequencies available for unlicensed such as 315 MHz and 868 MHz.

1.4.1 Types of RF modules -The term RF module can be applied to many different types, shapes and sizes of small electronic sub assembly circuit board. It can also be applied to modules across a huge variation of functionality and capability. RF modules typically incorporate a printed circuit board, transmit or receive circuit, antenna, and serial interface for communication to the host processor.

Most standard, well known types are covered here:

1. Transmitter module,
2. Receiver module,
3. Transceiver module,
4. System on a chip module.

1.Transmitter modules- An RF transmitter module is a small PCB sub-assembly capable of transmitting a radio wave and modulating that wave to carry data. Transmitter modules are usually implemented alongside a microcontroller which will provide data to the module which can be transmitted. RF transmitters are usually subject to regulatory requirements which dictate the maximum allowable transmitter power output, harmonics, and band edge requirements.

2.Receiver module - An RF receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: superheterodyne receivers and super regenerative receivers. Super regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage.[citation needed] Superheterodyne receivers have a performance advantage over super regenerative; they offer increased accuracy and stability over a large voltage and temperature range. This stability comes from a fixed crystal design which in the past tended to mean a comparatively more expensive product. However, advances in receiver chip design now mean that currently there is little price difference between superheterodyne and super regenerative receiver modules.

3.Transceiver module: - An RF transceiver module incorporates both a transmitter and receiver. The circuit is typically designed for half-duplex operation, although full-duplex modules are available, typically at a higher cost due to the added complexity.

4.System on a chip (SoC) module: - An SoC module is the same as a transceiver module, but it is often made with an onboard microcontroller. The microcontroller is typically used to handle radio data packetisation or managing a protocol such as an IEEE 802.15.4 compliant module. This type of module is typically used for designs that require additional processing for compliance with a protocol when the designer does not wish to incorporate this processing into the host microcontroller.

1.4.2 Typical Applications: -

1 Vehicle monitoring

2 Remote control
3 Telemetry
4 Small-range wireless network
5 Wireless meter reading
6 Access control systems
7 Wireless home security systems
8 Area paging
9 Industrial data acquisition system
10 Radio tags reading
11 RF contactless smart cards
12 Wireless data terminals
13 Wireless fire protection systems
14 Biological signal acquisition

1.5 Introduction to solar energy -

Energy is an important component in economic infrastructure of a country. The Sources of conventional energy is limited. They are reducing day by day. By using solar vehicle, we can save conventional energy sources and control pollution. The explosion of the fossil fuel in the motor gives power to the wheels. For the solar car, the sun's energy is converted to electricity with the help of the solar cells. It is

very important for the car to be very efficient since its power source is the sun and it may not be present all the time.

A solar car is a solar vehicle used for land transport. Solar cars are usually run on only power from the sun, although some models will supplement that power using a battery, or use solar panels to recharge batteries or run auxiliary systems for a car that mainly uses battery power.

Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Some prototypes have been designed for public use, although no cars primarily powered by the sun are available commercially. Solar cars depend on a solar array that uses photovoltaic cells (PV cells) to convert sunlight into electricity. Unlike solar thermal energy

PV cells directly convert sunlight into electricity.[1] When sunlight (photons) strike PV cells, they excite electrons and allow them to flow, creating an electric current. PV cells are made of semiconductor materials such as silicon and alloys of indium, gallium and nitrogen. Crystalline silicon is the most common material used and has an efficiency rate of 15-20%. Solar cars can accomplish this through photovoltaic cells (PVC). PVCs are the components in solar panelling that convert the sun's energy to electricity. They're made up of semiconductors, usually made of silicon, that absorb the light. The sunlight's energy then frees electrons in the semiconductors, creating a flow of electrons. That flow generates the electricity that powers the battery or the specialized car motor in solar cars. For more details about solar energy, read How Solar Cells Work.

Solar power has great potential as an energy source for many different types of residential homes and businesses. Most people know that getting energy from the sun is a "clean", environmentally-friendly and renewable way to generate energy. What most people don't know, however, is that solar power is affordable for many homeowners.

1.6 Project outline/overview

RF controlled solar panel based robotic vehicle can be used for observing an area and can be used for security purposes. In this solar panel project, solar power-based robotic vehicle is integrated with360-degree camera. This robotic vehicle movement can be controlled using RF technology for remote operation. This system uses push buttons at the transmitting end. With the help of these push buttons, the receiver is able to receive commands. These commands that are sent are used to control the movement of the robot which gives instructions for either to move the robot forward, backward, left or right etc. It uses the Atmega 328 series of a microcontroller to achieve its desired operation. This robot car has a 360-degree camera that can be used as security surveillance and solar panel for charging the battery. The solar panel has an auto battery cut off system. The wireless camera will be streaming live on the android application.

1.7 Future of RF control Robot system: -

Robotics is the confluence of engineering and science that includes mechanical engineering, electrical engineering, computer science also it is no more an emerging field as it has evolved so much in the last 10 years and it is nearing an apex point. It is an ever-growing field and many avenues have opened up in recent past. The promise of robotics is easy to describe but hard for the mind to grasp. A robot is a mechanical or virtual intelligent agent that can perform tasks automatically or with guidance, typically by remote control. In practice a robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Robots hold the promise of moving and transforming materials with the same ease as a computer program transforms data. But the grey spot remains wide when it comes to Research awareness in the field of Robotics and Automation. Sooner or later Robotics and automation will find its application in every facet of human life. The advancement in technology would bring a day of robot's omnipresence. They will soon sneak everywhere from gadgets to apparels and to our very own bodies. Hence it is the responsibility of engineering community to disseminate the knowledge about the future scope and application of Robotics

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section introduces and provides a brief description of the major components and factors that will contribute to an efficiency functioning solar vehicle. These factors are solar power, PV cell, and battery. Later sections will provide a depth look onto the essence of each factor and its function and importance to overall operation of the solar vehicle.

Solar power in India is a fast-developing industry. The country's solar installed capacity reached 20 GW in February 2018. India expanded its solar-generation capacity 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018.The 20 GW capacities was initially targeted for 2022 but the government achieved the target four years ahead of schedule. The country added 3 GW of solar capacity in 2015-2016, 5 GW in 2016-2017 and over 10 GW in 2017-2018, with the average current price of solar electricity dropping to 18% below the average price of its coal-fired counterpart.

In January 2016, Prime Minister Narendra Modi and French President François Hollande laid the foundation stone for the headquarters of the International Solar Alliance (ISA) in Gwal Pahari, Gurgaon. The ISA will focus on promoting and developing solar energy and solar products for countries lying wholly or partially between the Tropic of Cancer and the Tropic of Capricorn. The alliance of over 120 countries was announced at the Paris COP21 climate summit. One hope of the ISA is that wider deployment will reduce production and development costs, facilitating the increased deployment of solar technologies to poor and remote regions.

Fifty-one solar radiation resource assessment stations have been installed across India by the Ministry of New and Renewable Energy (MNRE) to create a database of solar-energy potential. Data is collected and reported to the Centre for Wind Energy Technology (C-WET) to create a solar atlas. In June 2015, India began a ₹40 crore (US$6.1 million) project to measure solar radiation with a spatial resolution of 3 by 3 kilometers (1.9 mi × 1.9 mi). This solar-radiation measuring network will provide the basis for the Indian solar-radiation atlas. According to

National Institute of Wind Energy officials, the Solar Radiation Resource Assessment wing (121 ground stations) would measure solar radiation's three parameters—Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI)—to accurately measure a region's solar radiation.

The general idea of controlling a device or a system is a well-known fact in today's technology. Using a remote controller to control a single device from a short distance has been used for a long era of time. However, recently people have been progressing in technology and have been able to control large equipment or devices from the maximum possible distance. These developments have decreased the industrial cost by reducing manpower and also increased comfort, efficiency, and accuracy mentioned by Md. Shahinoor et al., (2014). WiFi technology has been used for controlling purposes along with transmitting and receiving data. Radio frequency has been used to operate this technology. However, this technology is limited to short range and may not operate when there are large obstacles between the device and the remote. On the other hand, Amey Kelkar (2014) discussed that WiFi stills remains in this modern era only to serve the purpose of transmitting data over smartphones. Along with Wifi, there is another technology called IR system which has been used to control large devices, even a vehicle. There have been a few implemented cars based on this system. This technology involves infrared rays to stay connected between the device and remote. Hence, in this case, large obstacles easily disconnected the system, which was a very dangerous issue, especially for cars. Moreover, this system too has range limitations as WiFi mentioned by Amey Kelkar (2014). Another approach of controlling long-distance devices was made prior to other modern technologies for home and office applications, which involved telephone line systems and personal computers. In this system, DTMF technology was introduced to send the commands to the controlled device. The systems deveopled by B. Koyuncy (1995), Coskun and H. Ardam (1998), the monitored device is not movable, and the system structure is far complicated. Nowadays, the modern networking system GSM is being used to control devices where an operator's cell phone could be used as a remote controller. This paper is all about proposing a simpler design to control a vehicle via the GSM network. The following section delivers an ARIV - International Journal of Technology Vol 1 Issue 2 2020 Page | 48 overview of all related approach in this project and addditionally, proposes a simple design to implement. In one of the papers

done by Sourangsu Banerji, (2013), the design of the remote controlling car has been proposed using the GSM network and cell phone. In this design, a microcontroller has been interfaced with DTMF decoder and a motor driver, which is connected to the car wheels. DTMF system of this project helps the operator to input the command by pressing the keypad of the cell phone. This project overcomes the distance limitations problem and can be operated from anywhere in the world. Though microcontroller requires programming, it is still used in this system as various applications can be added to the system. On the other hand, the DTMF system complexes the circuitry because it needs an extra filter to separate the frequencies. Another project was done by Arab Fakih, (2014). The design pattern is almost the same as the first one. The only difference is that, here, two wheels have been used instead of four. Besides, this paper offers various applications to add to the system to make the car more efficient. A few future scope also has been added to improve the design. The paper which was done by T.T. Oladimeji, (2013) proposed a design to prevent a car from being hijacked. This system uses the GSM network along with operators' cell phones to avoid stealing. The design involves the GSM module, interface box and vehicle sound system. Although the purpose of this system is not to control the car, it ensures a strong and reliable security system of the vehicle. In a paper done by Amey Kelkar, (2014) , presented a simple design using GSM and cell phone interfacing with a microcontroller. In this design, an Arduino microcontroller has been used to receive the input from the DTMF decoder and drive the motor driver accordingly. The advantage of using Arduino is that various shields like a prototype, Wifi and Bluetooth shields are added in this microcontroller, which makes it more convenient. This design also proposes various applications to implement in the car. ARIV - International Journal of Technology Vol 1 Issue 2 2020 Page | 49 The project was done by Pathik, et al., (2014), a controlling design using GSM and DTMF decoder has been proposed. Unlike other designs, this design does not involve any microcontroller. This design is only to control the car and overcome distance limitations. In this project, instead of a microcontroller, a four relay circuit has been used through which the commands from the DTMF decoder will pass and drive the motor accordingly. Since no microcontroller has been used, no other application other than controlling the vehicle can be implemented using this design. Moreover, this design introduced solar energy as the power source of the car battery. In the following

research paper, a Vehicle Security and Entertainment System was developed using Raspberry Pi Tabassum, et al., (2020) to monitor, track the vehicle, and to offer local entertainment system. Two embedded devices were used to split the entertainment system from the security system to provide isolation and safety. They developed a low-cost passenger safety system for vehicles to use in passenger buses, trains, and even cars. The development was economical and additional modules can be added. When a vehicle is stolen, the device will give an alert signal, through tracking device and camera, live data can be obtained from the vehicle to ensure the passenger's safety. A different method of control has been done in the paper made by Jen Hao Teng, et al., (2010). This design is based on an RFID controller which involves a microcontroller. This system operates according to the commands that are written in the RFID tag. After receiving the commands written in the tag, it sends the command to the microcontroller, which drives the car according to the commands. This particular method of design overcomes the distance limitations and can be used in various fields of technology. Another project was done by Sheik Mastavali, (2016) the similar design involving GSM, microcontroller and DTMF decoder has been proposed. Besides, this design allows the vehicle mounting in a 360-degree angle, which is very useful for shooting the target if there is any laser gun added. Moreover, this design adds an AV camera to the system which can display the surroundings of the vehicle.

2.2 Problem Identification and Experimental Plan -

2.2.1. Problem statement -In some cases, like hazards areas, some chemical factories where human can't do tasks. In these places robotic vehicles are used. Also, it requires to operate from some safe distance, because due to some chemical reaction some major disease like cancer, Astama are happened, and to avoid such cases we should need to design equipment like which is easily handle and control to operator.

2.2.2 Solution - In our project we have design and manufacture of a unique robot which can be operate from distance about 100 meters, also we have included solar panel for battery charging purpose. Also some electronic devices, DC motor, RF module and charging controller are to be used. Rather than electrical and electronic peripherals, we used frame, motor mounting clamps etc. This robot can be used in war field, agriculture and hazardous areas.

2.3. proposed system: -

Receiver

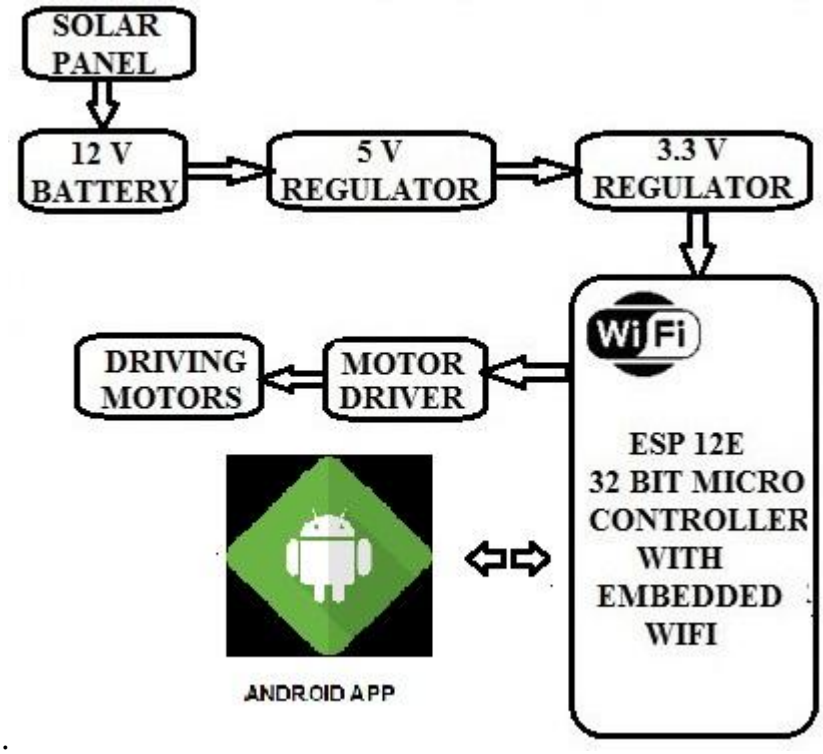


Figure: 1.1 system flow diagram

CHAPTER 3

PCB DESIGNING AND FABRICATION

It is called PCB in short printed circuit pattern applied to one or both sides of an insulating base, depending upon that, and it is called single sided PCB or double-sided PCB. Conductor materials available are silver, brass, aluminum and copper; copper is most widely used which is used here as well. The thickness of conducting material depends on the current carrying capacity of the circuit.

The printed circuit board usually serves three functions:

- It provides mechanical support to the components mounted on it.
- It provides necessary electrical interconnection.
- It acts as heat sink i.e.; it provides a conduction path leading to removal of most of the heat generated in the circuit.

3.1-CU CLAD

The base of laminate is either paper of glass fiber cloth. Cu foil, which is produced by the method of electroplating, is placed on laminate and both are kept under hydraulic pressure for proper adhesive pressure for proper adhesive. These Cu clad are easily available in the market.

3.2. Layout

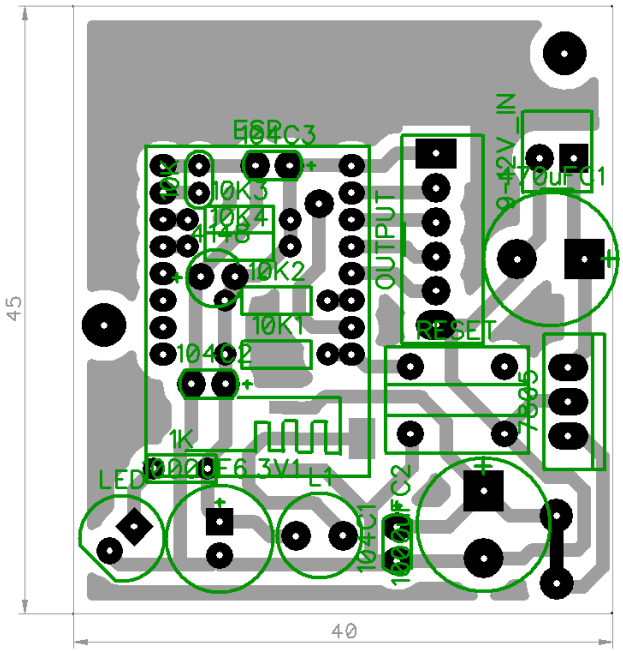


Fig 3.1.- CU-Clad layout (PCB)

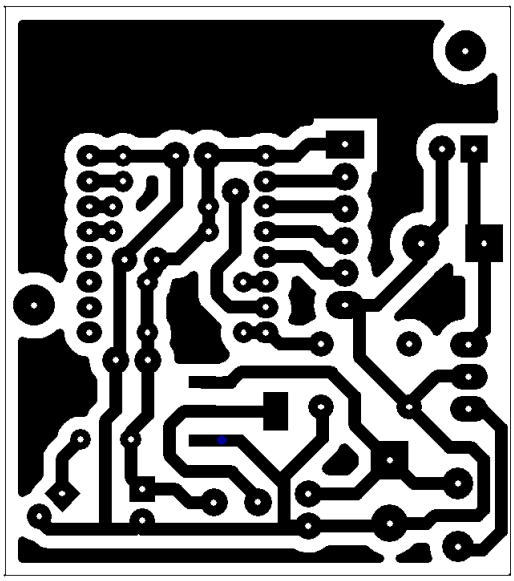


Fig 3.2- PCB Layout Fig.

The layout of a PCB has to incorporate all the board before one can go onto the all-work preparation. Detailed circuit diagram, the design concept and the philosophy behind the equipment are very important for the layout.

3.3- Layout Scale

Depending on the accuracy required artwork should be produced at a 1:1 or 2:1 or even 4:1 scale. The layout is best prepared on the same scale as the artwork to prevent the entire problem, which might be caused by redrawing of the layout to the artwork scale. The layout/ artwork scale commonly applied is 2:1 with a 1:1 scale, no demanding single sided boards can be designed but sufficient care should be taken, particularly during the artwork preparation.

3.4. Procedure

The first rule is to replace each and every PCB layout as viewed from the component side. This rule must be strictly followed to avoid confusion, which would otherwise be caused. Another important rule is not to start the designing of a layout unless an absolutely clear circuit diagram is available.

Among the components, the larger ones are placed first and the space in between is filled with smaller ones. Components requiring input/output connecting come near the connector. All components are placed in such a manner that de-soldering of other components is not necessary if they have to be replaced.

3.4.1-Layout Sketch

The end product of the layout designing is the pencil sketched component and conductor drawing which is caller ‘layout sketched’. It contains all the information for the preparation of the network.

3.4.2 Component Holes

In a given, PCB most all the holes required are one particular diameter. Holes of a different are shown with a code in the actual layout sketch.

3.4.3. Pattern Transfer onto The Screen

There are two different methods in use, and each method has its own advantages and disadvantages.

With the direct method, the screen is prepared by coating a photographic emulsion directly onto the screen fabric and exposing it in the pattern area. The indirect method makes use of a separate screen process film, supported on a backing sheet. The film on its backing sheet that is there after pressed onto the screen fabric and sticks there. Finally, the backing sheet is peeled off, opening all those screen meshes, which are not covered by the film pattern.

The direct method provides very durable screen stencils with a higher dimensional accuracy but the finest details are not reproduced. The indirect method is more suitable for smaller series and where the finest details to be reproduced. The indirect method is faster but dimensionally less accurate and the screen stencils are less durable, more sensitive to mechanical damages and interruption in printing.

3.4.4. Etching

In all subtractive PCB process, etching is one of the most important steps. The final copper pattern is formed by selective removal of all the unwanted copper, which is not protected by an etching unit.

Solutions, which are used in etching process, are known as enchants.

- Ferric Chloride
- Cupric Chloride
- Chromic Acid

- Alkaline Ammonia.

Of these Ferric Chloride is widely used because it has short etching time and it can be stored for a long time. Etching of PCBs as required in modern electronic equipment production, is usually done in spray type etching machines.

Tank or bubble etching, in which the boards kept in tank, were lowered and fully immersed into the agitated, has almost disappeared.

- Careful mounting of components on PCB increases the reliability of assembly.
  1. The leads must be cleaned before they are inserted in PCB holes. Asymmetric lead bending must be avoided; the ENT leads must fit into holes properly so that they can be soldered.
  2. When space is to be saved then vertical mounting is to be preferred. The vertical leads must have an insulating sleeve.
  3. Where jumper wire crosses over conductors, they must be insulated.
  4. For mounting of PCBs, TO5, DIP packages special jigs must be used of easy insertion.
  5. While mounting transistors, each lead must insulating sleeve. All the flat radial components such as resistors, diodes and inductors are mounted and soldered. Then IC bases are soldered. The vertical components such as transistors, gang condenser and FET are mounted & soldered.

3.4.- SOLDERING

The next process after the component mounting is soldering; solder pint is achieved by heating the solder and base metal about the melting point of the solders used.

The necessary heat depends upon:

- The nature and type of joints
- Melting temperature of solder
- Flux

Soldering techniques are of so many types but we are using iron soldering.

3.5. Iron Soldering:

Soldering iron consists of an insulating handle connected through a metal shaft, as a bit accurately makes contact with the component parts of the joint and solder and heats them up. The electrical heating element is located in the hollow shank or handle to heat the bit.

3.6. Functions Of the Bit:

It stored heat and convey it from the heat source to the work. It may be required to store surplus solder from the joint. It may be required to store molten solder and flux to the work.

The surface must be lined and wetted; this encourages flow of solder into the joint. When the surface of the work becomes tested by the solder, a continuous flow of liquid metal between the bit and the work provides a path of high thermal conductivity through which heat can flow into the work piece.

Solder bit are made up of copper; this metal has good wetting properly, heat capability and thermal conductivity. Tin-lead solder affects copper during soldering operation. Production of copper bit can be made with thick iron coating followed by Ni/Tin plating. The life of the bit is increased by a factor of 10 to 15. Solder irons are specified in terms of wattage. Depending on heat input intended for working and types of work (continuous or individual) the choice of the solder iron can be made.

3.7. Procedure Of Soldering

The points to be joined must be cleaned first and fluxed. The hard solder iron and solder wire is applied to the work. The melted solder becomes bright and fluid. The iron must be removed after sufficient time and joint is allowed to coal.

At the end, finishing is done.

3.8 PCB Designing Using Computer Aided Designing (Cad)

CAD has many advantages over manual designing, important among them is:

- Changes can be easily made because we don't have to erase our pencil work on paper repeatedly.
- Time is saved.

- Before taking printout, we can have preview of the design etc.

The software which we have used is PCB Creator.

CHAPTER 4

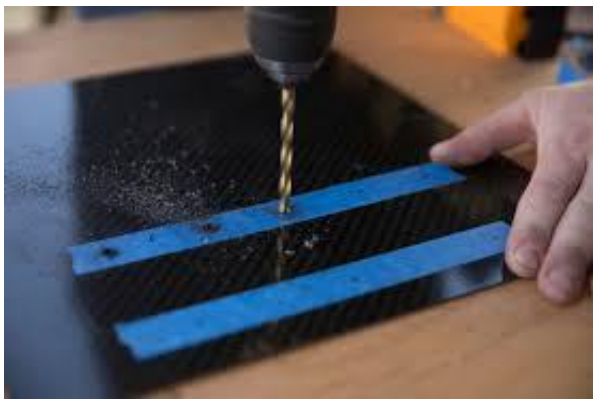
Manufacturing Process Used and Cost Estimation

4.1.Frame manufacturing-

A) Cutting

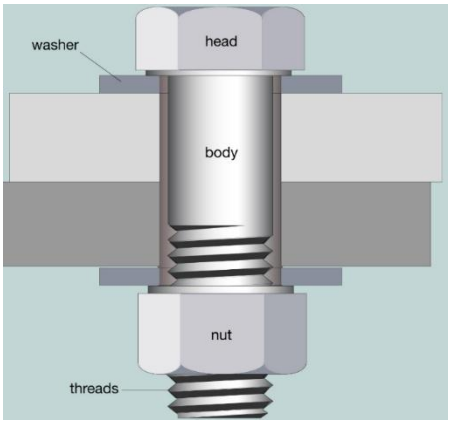
B) Welding

C) Drilling



4.2. Assembly-

A) Nut Bolt fastening

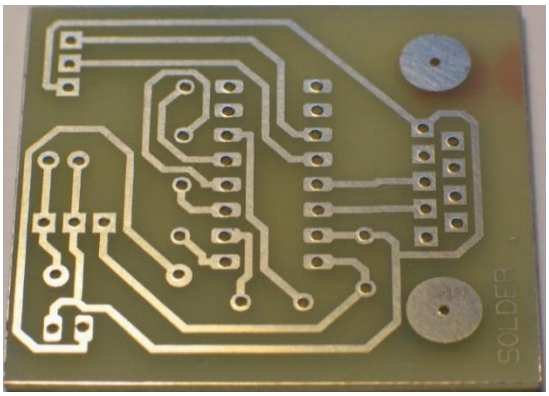


1) Motor mounting and electrical connections

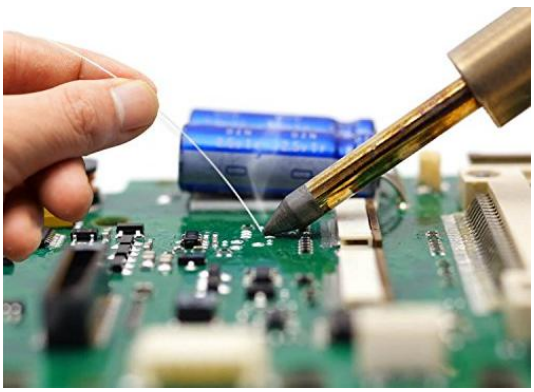
A) Mount Motors on frame and make wiring with controlling circuit.

2) Controlling system

A) Do circuit Design and make PCB (Printed circuit board)



B) Solder all components on PCB



4.3.COST ESTIATION-

Sr. No.	Description	Qty	Cost
01	Controller and electronic parts	1	3500
02	Push Button	4	100
03	Shaft	1	200
04	Motor	2	500
05	Nut + Bolt + Washer		300
06	Solar Panel	1	950
07	Battery	1	680
08	Frame	1	300
09	Miscellaneous		500
TOTAL			**6,410/-**

CHAPTER 5

Components Details and Their Working

5.1. Frame

Sheet metal is metal formed by an industrial process into thin, flat pieces. Sheet metal 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 sheets are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate steel or "structural steel".

Figure: 5.1 -Frame

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.

In most of the world, sheet metal thickness is consistently specified in millimeters. In the U.S., the thickness of sheet metal is commonly specified by a traditional, non-linear measure known as its gauge. The larger the gauge number, the thinner the metal. Commonly used steel sheet metal ranges from 30 gauge to about 7 gauge. Gauge differs between ferrous (iron-based) metals and nonferrous metals such as aluminum or copper.

5.2.DC geared motor

Working Principle

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. [1 (A)]

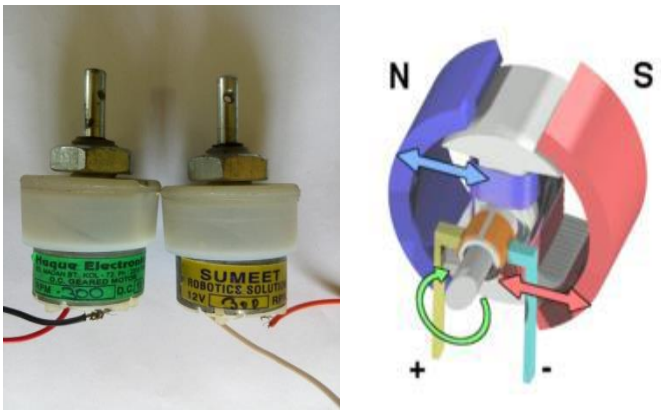


Figure: 5.2 Dc general motor

The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes. The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above.

As soon as we supply direct current in the armature, a mechanical force acts on it due to the electromagnetic effect of the magnet. Now to go into the details of the operating principle of DC motor it's important that we have a clear understanding of Fleming's left-hand rule to determine the direction of the force acting on the armature conductors of DC motor. [1(D)]

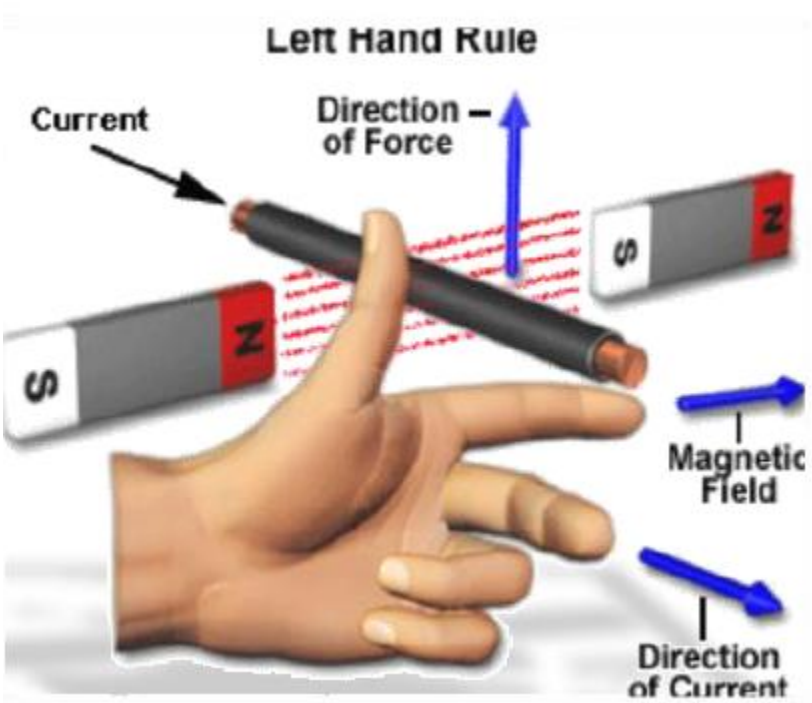


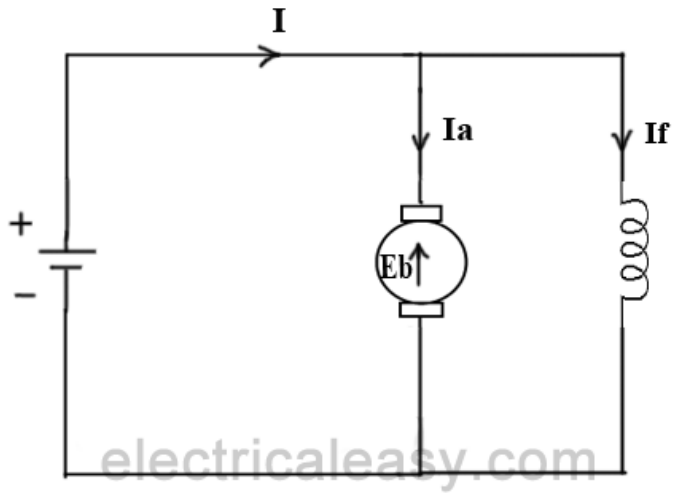
Figure: 5.3- Left hand Rule

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 magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's left-hand rule: If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other AND direction of magnetic field is represented by the first finger, direction of the current is represented by second finger then the thumb represents the direction of the force experienced by the current carrying conductor. [1(C)]

5.3. Back EMF

According to fundamental laws of nature, no energy conversion is possible until there is something to oppose the conversion. In case of generators this opposition is provided by magnetic drag, but in case of dc motors there is back emf.



Circuit:5.1 Back EMF

When the armature of the motor is rotating, the conductors are also cutting the magnetic flux lines and hence according to the Faraday's law of electromagnetic induction, an emf induces in the armature conductors. The direction of this induced emf is such that it opposes the armature current (Ia) . The circuit diagram below illustrates the direction of the back emf and armature current. Magnitude of Back emf can be given by the emf equation of DC generator. [1(B)]. Our DC motor rating is 12v, 300 rpm

5.4. Motor mounting clamp

This Mounting Bracket from Easy Mech is designed for and IG32 Planetary and DC Geared Motor to mount it on the chassis/frame firmly and securely. The Easy Mech Universal Bracket for HD and IG32 Planetary DC Geared Motor is made from high-quality Hardened Mild Steel.

figure: 5.4-motor mounting cap

The Mounting Bracket is designed by Easy Mech with one thing in mind, boosting the speed of our customer's design process by avoiding regular searches for the quality of mechanical products at an affordable price.

Use of MS in this bracket gives them good strength and makes them sturdy. Hence this Easy Mech bracket is ready to hold and take the load of your HD Planetary and IG32 Planetary DC Motor.

- **Applications:**

1 Numerically controlled machinery.
2 Factory automation robots.
3 DC motor position / velocity control.
4 In Robotics to mount a motor properly and support the motor

5.5. Battery

The lead–acid battery was invented in 1859 by French physicist Gaston Planet and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

Figure: 5.5- Battery

As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities.

1 Discharge

Fully discharged: two identical lead sulfate plates

In the discharged state both the positive and negative plates become lead (II) sulfate (PbSO 4), and the electrolyte loses much of its dissolved sulfuric acid and becomes primarily water. The discharge process is driven by the conduction of electrons from the negative plate back into the cell at the positive plate in the external circuit.

Negative plate reaction

Pb(s) + HSO− 4(aq) → PbSO 4(s) + H+ (aq) + 2e− Release of two conducting electrons gives lead electrode a net negative charge

As electrons accumulate they create an electric field which attracts hydrogen ions and repels sulfate ions, leading to a double-layer near the surface. The hydrogen ions screen the charged electrode from the solution which limits further reactions unless charge is allowed to flow out of electrode.

Positive plate reaction

PbO 2(s) + HSO− 4(aq) + 3H+ (aq) + 2e− → PbSO 4(s) + 2H 2O(l)

The total reaction can be written as

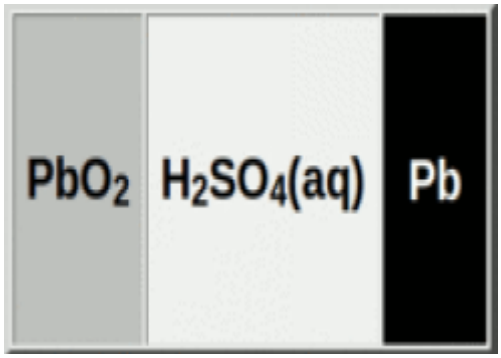
Pb(s) + PbO 2(s) + 2H 2SO 4(aq) → 2PbSO 4(s) + 2H 2O(l)

The sum of the molecular masses of the reactants is 642.6 g/mol, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere-hours per kilogram (or 13.9 ampere-hours per kilogram for a 12-volt battery). For a 2 volts cell, this comes to 167 watt-hours per kilogram of reactants, but a lead–acid cell in practice gives only 30–40 watt-hours per kilogram of battery, due to the mass of the water and other constituent parts.

2 CHARGING

Fully recharged: Lead negative plate, Lead dioxide positive plate and sulfuric acid electrolyte

In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide, with the electrolyte of concentrated sulfuric acid.



Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-acid battery allows the electrolyte level to be inspected and topped up with any water that has been lost.

5.6 SOLAR PANEL

Photovoltaics (PV) is a term which covers the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon studied in physics, photochemistry, and electrochemistry.

PV systems have the major disadvantage that the power output is dependent on direct sunlight, so about 10-25% is lost if a tracking system is not used, since the cell will not be directly facing the sun at all times. [2(B)]

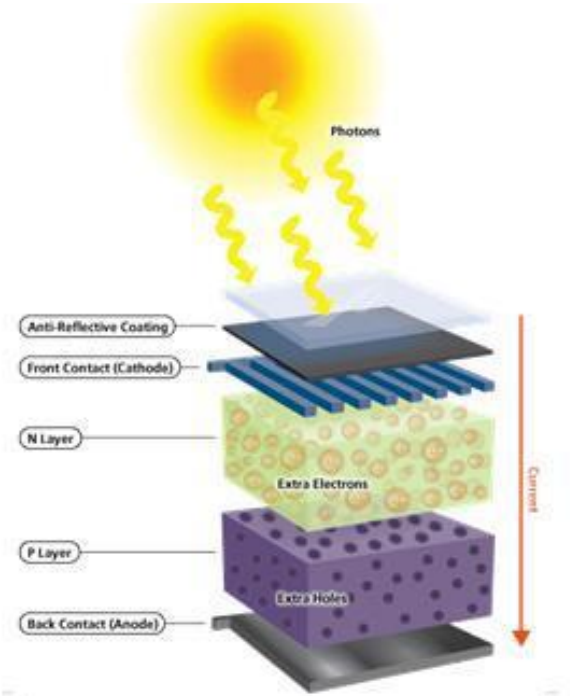
Figure: 5.6 Solar panel

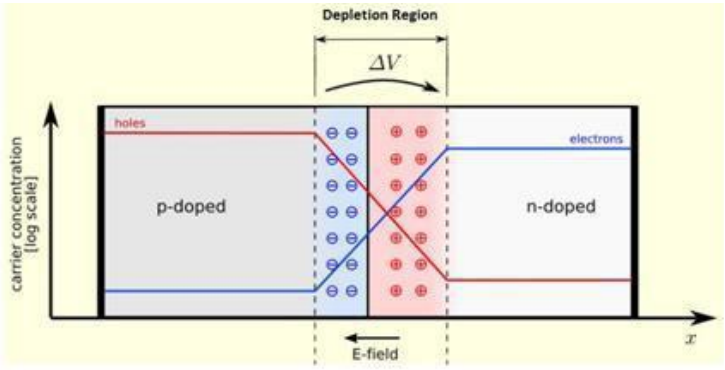
P-type and n-type materials-

Intrinsic crystal Solar cells are running on junction effect principle. To understand junction effect, we should understand n-type and p-type material. Doping process is needed to obtain n-type or p-type material. Doping means inserting another atom into the bulk crystal. Consider silicon crystal: each silicon atom has four electrons in its valance band and these electrons make bonds with other Silicon atom. You can see the silicon crystal in the left side with valance electrons of each Si atom. Note that we call that structure as crystal since all Si atoms are perfectly aligned. We can convert this structure in to n-type or p-type by doping different atoms. For example, let's dope it by boron. Boron atom has 3 electrons in its valance band. When we insert B atom instead of a Si atom, one bond between B atom and a Si atom will be very weak. To complete the perfect symmetry in this stricter, crystal will be aimed to catch an external electron. As you can see an electron is missing since B atom has 3 electrons in its PVImage6valence band. This missing bond can be treated a positively charged particle called 'hole'. This material is called p-type material. What if we dope Phosphorous atom instead of Boron atom? Phosphorous atom has 5 electrons in its valance band. [2(C)]

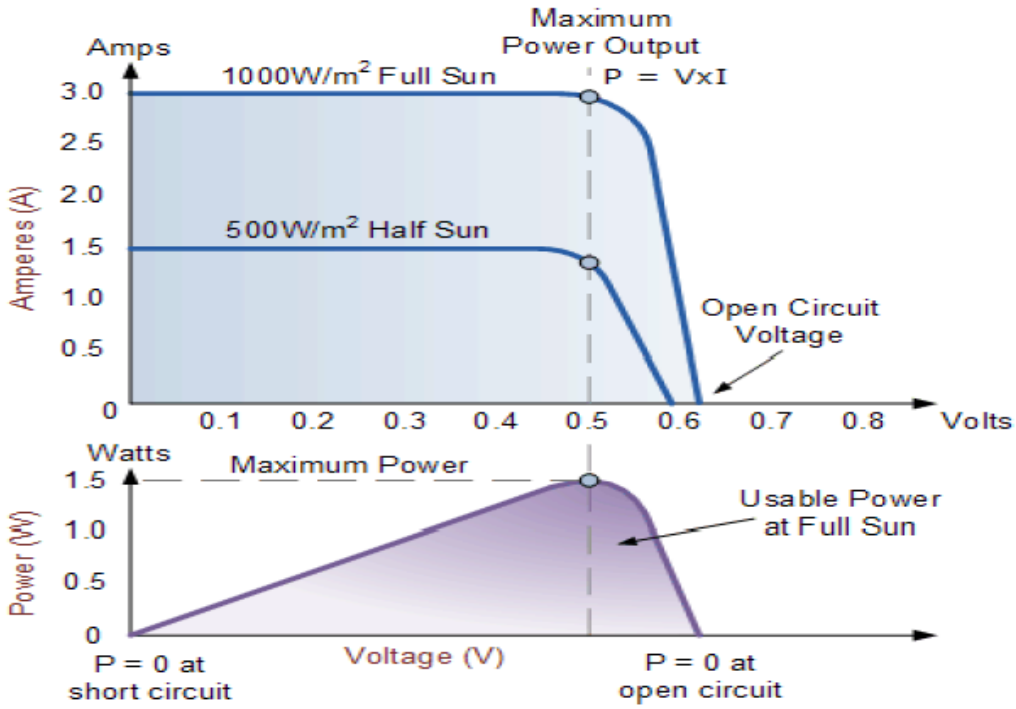
When P atom is inserted into the Si lattice, 4 electrons will be able make bond with neighbor Si atoms. However, 5th electron will be hanged on. So, it will be in an energy level that very close to conduction band since it will be nearly free. This nearly free electron can easily leave P atom with a small thermal energy. Note that there is

an extra electron in this new structure. So we call this new material n-type material. In contrast to p-type material, n-type material has a tendency to give electrons. Consequently, we have two types of materials. One wants to give electrons and the other wants to receive electrons. We can create a p-n junction by bringing them together. [2(A)]





$$P_{MAX} = V_{OUT} \times I_{MAX}$$



Graph: 5.1 Power/Vs Voltage

The type of solar power produced by a photovoltaic solar cell is called direct current or DC the same as from a battery. Most photovoltaic solar cells produce a "no load" open circuit voltage (nothing connected to it) of about 0.5 to 0.6 volts when there is no external circuit connected. This output voltage (VOUT) depends very much on the load current (I) demands of the PV cell. For example on very cloudy or dull day the current demand would be low and so the cell could provide the full output voltage, VOUT but at a reduced output current. But as the current demand of the load increases a brighter light (solar radiation) is needed at the junction to maintain a full output voltage, Vout.

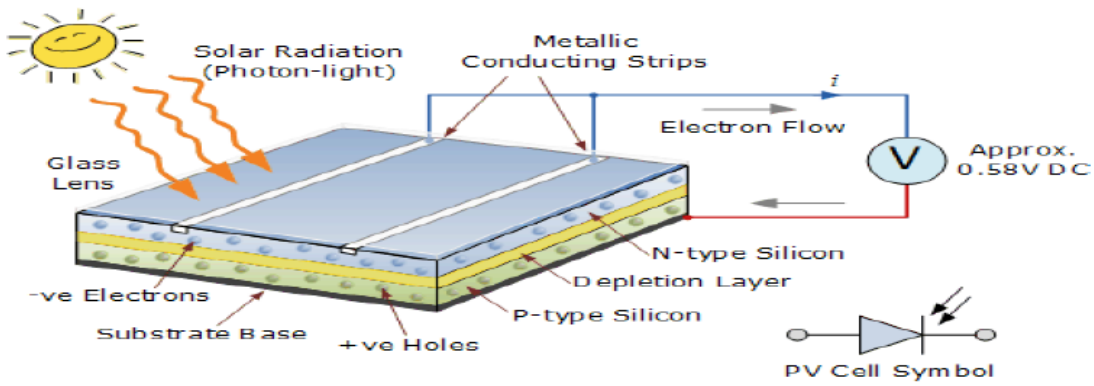


Figure: 5.7 -Working Diagram

5.7LED-

Figure: 5.8- LED

LEDs are semiconductor devices are made out of silicon. When current passes through the LED, it emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until its white hot. LEDs present many advantages over traditional light sources including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching

LM7805 (3 TERMINAL VOLTAGE REGULATER)-

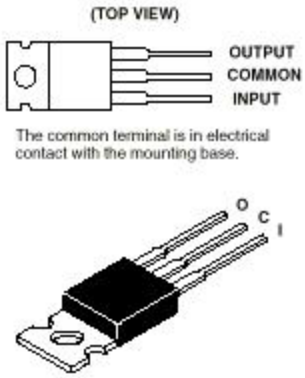


Figure: 5.9- Pin description of LM7805

Figure: 5.10-View of LM7805

This is used to make the stable voltage of +5V for circuits. The LM7805 is three terminal positive regulators are available in the TO-220 - package and with several fixed output voltages, making 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, more information please refer Data sheet 0f LM7805

CIRCUIT

RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm or monitoring systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infrared communication designs as they have the advantage of not requiring line-of-sight operation.

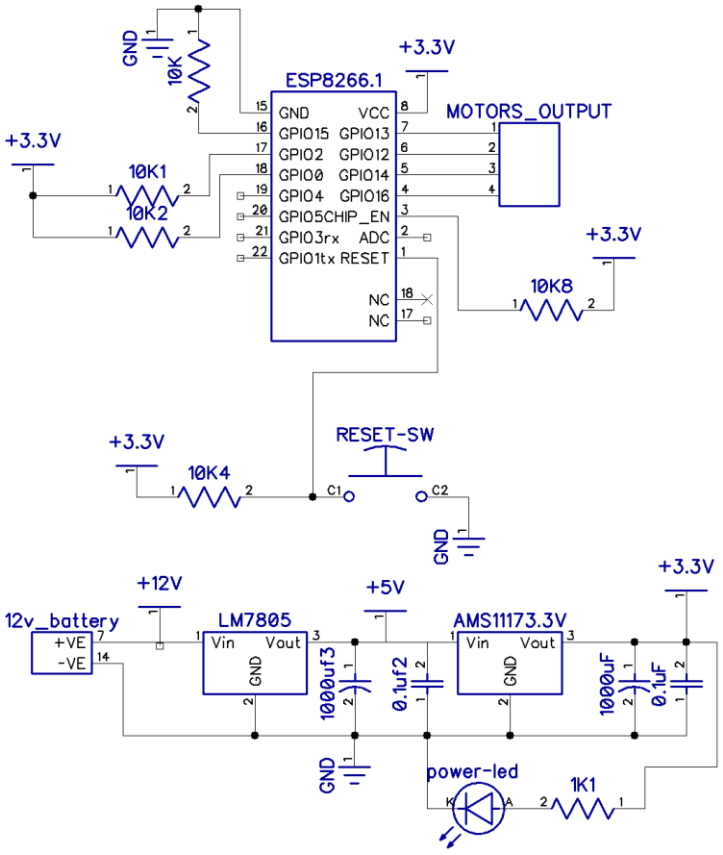


Figure: 5.11-Circuit Diagram

Several carrier frequencies are commonly used in commercially available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz these frequencies are used because of national and international regulations governing the use of radio for communication. Short Range Devices may also use frequencies available for unlicensed such as 315 MHz and 868 MHz

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required achieving operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. Finally, radio circuits are usually subject to limits on radiated emissions, and require Conformance testing and certification by a standardization organization such as ETSI or the U.S. Federal Communications Commission (FCC). For these reasons, design engineers will often design a circuit for an application which requires radio communication and then "drop in" a pre-made radio module rather than attempt a discrete design, saving time. [4(D)]

5.8.ESP-12E: -

ESP-12E is a low power consumption of the UART-Wi-Fi module, with very competitive prices in the industry and ultra-low power consumption technology, designed specifically for mobile devices and IOT applications, user's physical device can be connected to a Wi-Fi wireless network, Internet or intranet communication and networking capabilities. ESP-07 the use of small ceramic antenna package can support IPEX interface. Users have a variety of installation options.

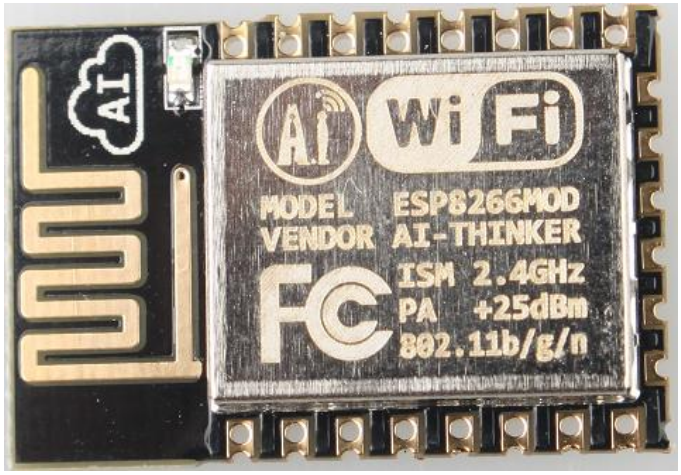
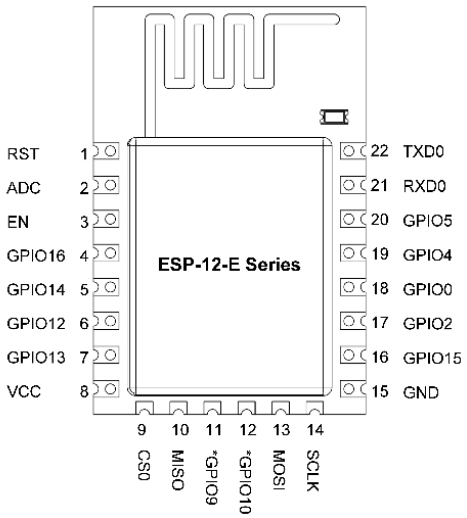


Fig 5.12- ESP-12E

- **Features: -**

- 802.11 b/g/n protocol
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- +19.5dBm output power in 802.11b mode
- Power down leakage current of < 10uA
- Integrated low power 32-bit MCU
- SDIO 2.0, SPI, UART
- STBC, 1x1 MIMO, 2x1 MIMO
- A-MPDU & A-MSDU aggregation & 0.4µs guard interval
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)



➢ **Applications: -**

- Smart power plugs
- Home automation
- Mesh network
- Industrial wireless control
- Baby monitors
- IP Cameras
- Sensor networks
- Wi-Fi location-aware devices
- Security ID tags
- Wi-Fi position system beacons

5.9. Micro Switch -

A miniature snap-action switch, also trademarked and frequently known as a micro switch, is an electric switch that is actuated by very little physical force, through the use of a tipping-point mechanism, sometimes called an "over-center" mechanism.

Switching happens reliably at specific and repeatable positions of the actuator, which is not necessarily true of other mechanisms. They are very common due to their low cost but high durability, greater than 1 million cycles and up to 10 million cycles for heavy duty models. This durability is a natural consequence of the design.

Fig 5.13- micro switch

The defining feature of micro switches is that a relatively small movement at the actuator button produces a relatively large movement at the electrical contacts, which occurs at high speed (regardless of the speed of actuation). Most successful designs also exhibit hysteresis, meaning that a small reversal of the actuator is insufficient to reverse the contacts; there must be a significant movement in the opposite direction. Both of these characteristics help to achieve a clean and reliable interruption to the switched circuit.

5.10.L293d Motor Driver Module

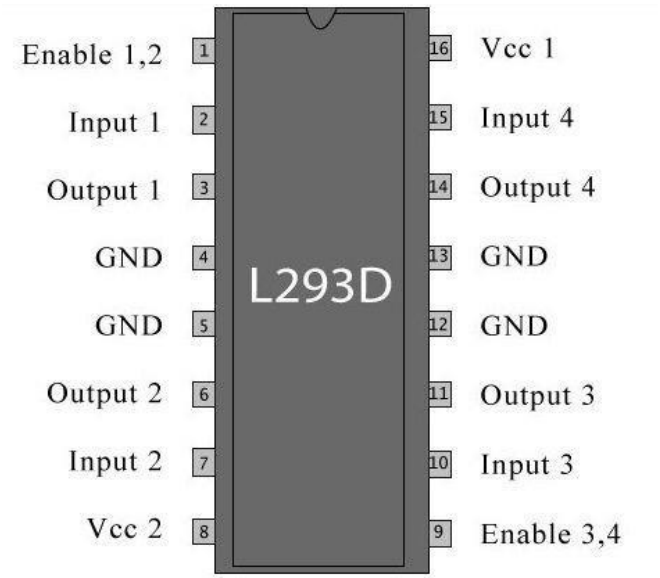


Fig 5.14- L293D MOTOR DRIVER MODULE

A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for

controlling a low current rated motor. We will be referring the motor driver IC as L293D only. L293D has 16 pins. [4(C)]

5.11.Resistor

A resistor is a passive two-terminal electrical-component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Fig 5.14- Resistor

5.12. Wire Connectors

Connectors are used to join subsections of circuits together. Usually, a connector is used where it may be desirable to disconnect the subsections at some future time: power inputs, peripheral connections, or boards which may need to be replaced.

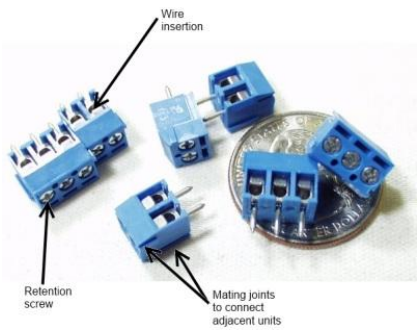


Fig 5.15- Wire connectors

5.13. ARDUINO IDE

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on our computer, used to write and upload computer code to the physical board.

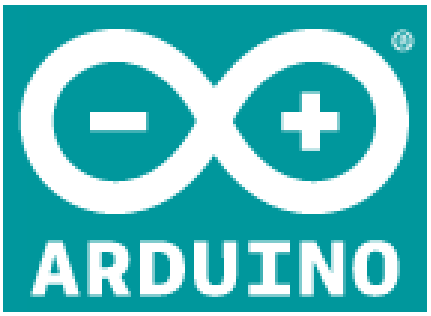


Fig.5.16- ARDUINO IDE

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board we can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even our smart-phone or our TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects.

Recently, arduino is compatible for almost all AVR microcontrollers.

4.13.1Android App: -

An Android app is a software application running on the Android platform. Because the Android platform is built for mobile devices, a typical Android app is designed for a smartphone or a tablet PC running on the Android OS.

Although an Android app can be made available by developers through their websites, most Android apps are uploaded and published on the Android Market, an online store dedicated to these applications. The Android Market features both free and priced apps. Android apps are written in the Java programming language and use Java core libraries. They are first compiled to Dalvik executables to run on the Dalvik virtual machine, which is a virtual machine specially designed for mobile devices. Developers may download the Android software development kit (SDK) from the Android website. The SDK includes tools, sample code and relevant documents for creating Android apps. Novice developers who simply want to play around with Android programming can make use of the App Inventor. Using this online application, a user can construct an Android app as if putting together pieces of a puzzle.

Chapter 6

CONCLUSION

From the project we could achieve our motto of – "How the actual communication between an Electronic parts and Mechanical Linkages takes place through the Microcontroller." Also, from 'this' project we got enriched in actual wiring to Microcontroller and various electronic parts, various machining processes, various measuring processes, various type of jig and fixtures, etc. through-out the fabrication of project.

Also, we got enriched in design calculations for various parts, in purchasing various materials through proper place and through proper channel. And very much important part of life is that- How to deal with humanized behavior to complete our requirements!

Due to the project, we got some-what familiar with an Industrial Culture & Environment as we have visited frequently to some industries for getting an expert advice. THIS project has given much more of both- The educational knowledge and various critical situations which have to handle you on behalf of own.

Chapter 7

References

) DC Motor:(A) Ashfaq Hussain, Haroon Ashfaq ‘ Electric machines’ Dhanpat Rai & CO, 2016 (B) Electric Machinery P.S Bhimra ,6th Edition Khanna Publishers (C) Electric machine Desine A.K Sawhney Dhanpat Rai & CO. (D) Electrical Machine, Nagthrath & Kothari, TMH

2) PV CELL: (A) Non Conventional Energy Sources ,GD Rai, Khanna Publishers (B) Renwable Energy Sources and Conversion Technology ,Bhansal Publishers,Tata Mc Graw Hill, (C) Nonconventional Energy, Ashok v Desai,New Age International Publishers Ltd

3) RADIO FREQUENCY , (A)Microwave Engineering 3rd Edition David M.pozar, Willy & Sons (B) Microwaves, KC Gupta , New Age Publishers (C) Microwave Engineering , A das & S Das TMH (D) Microwave Devices and Circuit, Sy Liao , Pearson education

4) DIGITAL ELECTRONICS

(A)Digital Principal & Application,5th Edition, Leach & Malvino, Mc Graw Hill Company.

(B)Modern Digital Electronics, 2nd Edition, R.P. Jain, Tata Mc Graw Hill Company.

(C)Fundamental of Digital Circuits, A, Anand Kumar, PHI.

(D)Digital Logic Design, Morries Mano,PHI.