“SOLAR POWER AUTOMATIC IRRIGATION SYSTEM USING IOT”

A MINOR PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OFBACHELOR OF TECHNOLOGY

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CERTIFICATE OF RECOMMENDATION

This is to certify that the minor project report entitled **"**SOLAR POWER AUTOMATIC IRRIGATION SYSTEM USING IOT**"**, that project prepared under my supervision by: Rahul Roshan Padhi Reg No:2101367003, Ratiranjan Tarai Reg No: 2101367033, Madhusmita Mallick Reg No:2221367009,Anil Sethi Reg No: 2101367007, Aliva Behera Reg No:2101367005, Subham Kumar Dutta Reg No : 2221367020, Udit Kumar Routray Reg No:2221367140, Somanath Malik Regd No: 2101367040, Abhijit Maity Reg No: 2101367053, Asutosh Behera reg No: 2221367059, is accepted in partial fulfillment of the requirements for the degree of Bachelor of Technology and this work has not been submitted elsewhere before for any academic degree.

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CERTIFICATE OF APPROVAL

The foregoing minor project is hereby approved as a credible study of an Engineering subject carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite to the degree for which it is submitted. It is understood that by this approval, the undersigned do notnecessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the project only for the purpose for which it is submitted.

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Examiner/Supervisor

for Evaluation of the Minor Project

ABSTRACT

By this project we will be able to automate agricultural monitoring & actions using IoT. In this project we will develop a monitoring system and automation for agricultural uses. There will be a sensor to know moisture parameters in field. If moisture is less than required, system will switch ON the pump automatically and update it in an IoT server. There will be a LCD which will show connected IP address and other data can be displayed in this LCD. We will monitor all data like moisture or Pump Switching in the IP from mobile or Laptop connected to the said Wi-Fi. We will use Wi-Fi controller, Temperature & Moisture Sensor, Relay, LCD, Power Supply and other required components. We will harvest complete power from solar Energy. Solar Panel will be there by which solar energy will be converted into electrical energy and get stored in battery. Whole power will be supplied by the battery connected to the circuit. In this way we will develop a project which will be very useful for the farmers of our country.

Keywords: Agricultural, IOT, Automation, Sensor, Wi-Fi controller

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CHAPTER-1

1 INTRODUCTION

In today's fast-paced world, where time is a precious commodity, human beings increasingly seek automation to simplify their daily lives. Our lifestyle now demands that everything be remote-controlled, instantaneously accessible, and self-operating. From household appliances to entire industrial processes, automation has become a fundamental part of how we function. Beyond just a few areas, nearly every aspect of modern life has been made more efficient and automated. With the rapid advancements in electronics, it is only logical that technology should make our lives easier, more convenient, and less labor-intensive.

One such example of this technological evolution is the "Automatic Irrigation System using IoT". This system, designed to optimize water usage in agriculture, demonstrates the power of innovation in addressing real-world challenges. By leveraging the Internet of Things (IoT) and sensor technology, we have created a model that offers a smart, efficient way to control irrigation facilities. The goal is not just to automate watering processes but to help millions of people—particularly farmers—who struggle with inefficient or manual irrigation systems.

The core of this model lies in its use of sensor technology and a microcontroller, which work together to form a "smart switching device." The system includes soil moisture sensors that detect the level of moisture in the soil, ensuring that irrigation occurs only when necessary. This intelligent, automated mechanism ensures that crops receive the optimal amount of water, reducing waste and promoting healthier, more sustainable farming practices.

1.1 SENSOR TECHNOLOGY

Sensor technology plays a crucial role in the development of modern automated systems, including the Automatic Irrigation System using IoT. Sensors are devices that detect and respond to physical stimuli from the environment, converting them into measurable signals or data. These stimuli can include light, heat, motion, moisture, pressure, and other variables, depending on the type of sensor. In the context of IoT (Internet of Things) applications, sensors provide the critical data needed to make real-time, data-driven decisions.

For example, in the case of an automatic irrigation system, sensors are used to measure the soil moisture levels, which informs the system when and how much water needs to be distributed to crops.

1.1.1 Types of Sensors in Irrigation Systems

Several types of sensors can be used in an automated irrigation system, each serving a specific function. Below are the most common sensors used in irrigation systems:

Soil Moisture Sensors

Function: These sensors measure the moisture content in the soil, which is critical for determining whether irrigation is needed. The system can automatically activate the irrigation system when the soil moisture drops below a certain threshold. Types:

Capacitive Sensors: Measure soil moisture based on changes in capacitance.

Resistive Sensors: Measure soil resistance, which changes with varying moisture levels.

Tensiometer: Measure the tension or suction of water in the soil, giving an indication of the moisture available to plants.

Temperature Sensors

These sensors measure the ambient temperature of the soil or air. Temperature is an important factor in plant growth and irrigation, as extreme heat can increase evaporation rates and change water requirements.

Common Types: Thermistors, thermocouples, and digital temperature sensors like the DHT11 or DHT22.

Rainfall Sensors (Rain Gauges)

These sensors detect rainfall in real-time. By incorporating rain sensors, the irrigation system can be designed to stop watering when it detects that it is raining, preventing over-watering and water waste.

Types: Tipping bucket rain gauges and optical rain sensors.

Flow Sensors

These sensors monitor the flow of water through pipes, allowing the system to detect water usage, ensure that the water pump is functioning correctly, and track the amount of water delivered to the field.

Common Types: Turbine-based or electromagnetic flow meters.

Light Sensors (Photoresistors or Photodiodes)

These sensors measure the intensity of light. In some advanced irrigation systems, light levels can influence irrigation schedules, particularly in greenhouse or controlled environments, where sunlight intensity might dictate the need for additional irrigation.

1.1.2 Working procedure of sensor technology in an irrigation system:

1. Data Collection: Sensors placed in the field or near crops continuously monitor environmental parameters like soil moisture, temperature, and light levels.

2. Data Transmission: The collected data is transmitted to the microcontroller, which processes the data. In IoT systems, this communication might take place over a local network (Wi-Fi, Zigbee) or even over cellular networks if the field is in a remote location.

3. Decision Making: The microcontroller processes the incoming data and compares it to preset thresholds. For example, if the soil moisture is below the threshold level, the system will trigger the irrigation process. If the moisture level is sufficient, the system will delay or stop watering.

4. Action: Based on the microcontroller's decision, the system activates the irrigation mechanisms (e.g., water pumps or valves). This action could be manual or fully automated, depending on the system design.

5. Feedback and Monitoring: Continuous feedback from the sensors ensures that the irrigation system remains efficient. The data can be displayed on a user interface, allowing farmers or operators to monitor the system remotely, adjust parameters, or troubleshoot if necessary.

1.2 MICROCONTROLLER:

A microcontroller is a compact, programmable electronic device that serves as the brain of many embedded systems, including IoT applications like an automatic irrigation system. It processes data from sensors, makes decisions based on pre-set logic or algorithms, and controls actuators (such as motors, pumps, and valves) to perform specific tasks. In simple terms, a microcontroller is the component that "makes things happen" in an automated system.

In the case of an IoT-based automatic irrigation system, the microcontroller plays a critical role in monitoring soil moisture levels, processing sensor data, and controlling the irrigation mechanism to ensure optimal water usage. By automating irrigation processes based on environmental data, the microcontroller helps conserve water and optimize crop growth.

1.2.1 Key Functions of a Microcontroller in an Automatic Irrigation System

Data Collection

The microcontroller receives data from various sensors (e.g., soil moisture, temperature, rainfall, etc.). It interprets this data and stores it in memory for processing. In an IoT system, the microcontroller also handles communication with other devices like smartphones, computers, or cloud servers to transmit or receive data.

Decision Making

Based on the sensor inputs, the microcontroller compares the data to pre-programmed thresholds or algorithms. For instance, if the soil moisture is below a set value (indicating that irrigation is needed), the microcontroller will trigger an action to start the water pump or activate a valve.

Control and Actuation

After processing the data, the microcontroller sends control signals to actuators such as water pumps, solenoid valves, or motorized systems. These actuators perform physical actions like starting or stopping the water flow, ensuring that irrigation occurs only when needed and with the right amount of water.

Communication

In an IoT system, microcontrollers enable communication between different components. The microcontroller may communicate with a cloud server to upload sensor data, receive remote commands, or monitor system performance. It could also use Wi-Fi, Bluetooth, or other wireless technologies to allow users to control the irrigation system remotely via smartphones or computers.

User Interface

Some microcontrollers have the capability to display system information on local user interfaces, such as LCD screens, or send notifications and alerts via apps or web dashboards. These interfaces may show current soil moisture levels, irrigation status, system health, and other relevant data.

1.2.2 Common Microcontrollers Used in IoT-Based Irrigation Systems

Several microcontroller platforms are popular in building automatic irrigation systems due to their versatility, ease of use, and support for IoT applications. Here are a few widely used microcontrollers:

Arduino

Arduino is one of the most popular open-source hardware platforms for building DIY electronics and IoT projects. Arduino microcontrollers, such as the Arduino Uno or Arduino Nano, are widely used in agricultural applications.

Use Case: In an irrigation system, an Arduino can read moisture sensor data, make decisions based on predefined thresholds, and control a water pump or solenoid valve.

Raspberry Pi

Raspberry Pi is a small, powerful single-board computer that can run full operating systems like Linux. While it's more powerful than most microcontrollers, it can still function as the central controller in an IoT-based irrigation system, especially when more processing power or complex features are needed.

Use Case: Raspberry Pi could be used for a more sophisticated irrigation system that integrates multiple sensors, weather data, and real-time control via a web or mobile interface.

ESP8266/ESP32

The ESP8266 and its more powerful successor, the ESP32, are low-cost microcontrollers with built-in Wi-Fi (and Bluetooth in the case of the ESP32). These microcontrollers are perfect for IoT applications where wireless communication is essential.

Use Case: An ESP32-based irrigation system can connect to a cloud server, allowing for real-time monitoring and control through an app or website.

STM32

STM32 microcontrollers are high-performance chips used in more advanced or professional-grade systems. These chips are often used in industrial or commercial-grade IoT applications due to their reliability and performance.

Use Case: STM32 can be used in complex agricultural settings, where large areas need to be managed or when higher precision and durability are required.

1.2.3 Working procedure of Microcontroller in the Automatic Irrigation System

Sensor Data Acquisition: The microcontroller reads data from various connected sensors (e.g., soil moisture, temperature, or humidity sensors).

Processing and Analysis: Based on the input data, the microcontroller compares the sensor values with programmed threshold values. For instance, if the soil moisture level falls below a certain point, the microcontroller triggers the irrigation system.

Control Output: The microcontroller sends output signals to actuators like pumps, valves, or motors. For example, it can turn on a pump to irrigate the crops or close the valve to stop the irrigation once the soil moisture is at an acceptable level.

Remote Monitoring and Control: In an IoT system, the microcontroller can send data to a cloud platform or a remote server. This allows farmers to monitor the irrigation system from anywhere using a mobile app or web portal. Users can also adjust settings like moisture thresholds or irrigation schedules remotely.

Alerts and Notifications: The microcontroller can also send alerts or notifications to the user if there are issues (e.g., low battery, pump failure, or abnormal moisture levels). This makes the system more reliable and easier to maintain.

1.3 BASIC MODEL

The basic model of the automatic irrigation system is relatively simple: it uses sensors to detect soil moisture and, based on the data, automatically triggers the water motor or pump to start or stop irrigation. This allows farmers to monitor and control irrigation from virtually any part of the field or even remotely, ensuring that water is used efficiently and without constant manual intervention.

While this initial model offers a straightforward switching mechanism, the system is highly scalable. It can be extended to accommodate more advanced features, such as scheduling, weather integration, or multi-zone irrigation. Additionally, by utilizing two conducting wires, the system can be expanded to control multiple motors or pumps simultaneously, giving users greater flexibility and control over their irrigation setup.

Ultimately, the Automatic Irrigation System using IoT is not just a technological innovation; it represents a step forward in making farming more efficient, reducing water wastage, and supporting sustainable agricultural practices. This system is a testament to the growing need for automation in all aspects of life,

making it easier for individuals, especially in agricultural sectors, to manage complex processes with minimal effort and maximum efficiency.

CHAPTER-2

LITRATURE REVIEWE

The theme of a literature review is the main idea or pattern that emerges from a collection of works on a specific topic. A thematic literature review organizes and analyzes a body of literature by identifying, analyzing, and reporting on these themes.

Leah C. Kelley, Eric Gilbertson, Anwar Sheikh, Steven D. Eppinger and Steven Dubowsky mentioned that Solar-powered agricultural irrigation is an attractive application of renewable energy. However, to be practical it must be both technically and economically feasible. Here, a method is presented for calculating the feasibility of photovoltaic-powered (PVP) irrigation. The feasibility is expressed as a function of location, which includes climate data, aquifer depth and cost, including local political policies such as carbon taxes. A discounted cash flow analysis is used to compare the lifecycle costs of photovoltaic-, diesel engine- and electrical grid-powered irrigation systems. Five examples illustrate the method's application. These results suggest that PVP irrigation is technically and economically feasible, provided that there is enough land available for the solar array.[1]

García-Carmona, A., & Criado, A.M. presented that a didactic proposal oriented to teaching notions of semiconductor physics in secondary education. The methods and the results of a pilot study designed to analysis the effectiveness of a teaching sequence on the topic are also described. The subjects were 60 students, aged 14–15 years, of a secondary school in Seville, Spain. The levels of knowledge acquired by the students were evaluated by means of a test and personal interviews, which we also used to detect the most frequent obstacles they encountered against learning. Also, we employed personal interviews and analysis of the students' notebooks to evaluate their attitudes towards semiconductor physics and its learning, and to evaluate the degree to which the teaching sequence fosters cooperative learning and the self-regulation of learning. The results indicated that the students in general acquired ideas and reasoning in the appropriate line, although with some mistakes or inaccuracies with respect to scientific conceptions, and acquired positive attitudes towards the learning of semiconductor physics, with a high degree of motivation during the teaching–learning process.[2]

E. F. Christensen, C. H. Willis and C. C. Herskind explained that the general principles employed in the analysis of rectifier circuits have been quite fully covered in the literature and are now well understood. However, there is not available a complete analysis giving the essential formulas in a systematic and unified form readily usable by the engineer. It is the purpose of this paper to present such a treatment.[3]

Yong Chai Tan, Montaser Mahmoud, Hadi Jaber and Mohamad Ramadan described that Countries are working into making agriculture more sustainable by integrating different technologies to enhance its operation. Implementing improvements in irrigation systems is crucial for the water-use efficiency and works as a contributor to Sustainable Development Goals (SDGs) under the United Nations specifically Goal 6 and Target 6.4. This paper aims to highlight the contribution of SMART irrigation using Internet of Things (IoT) and sensory systems in relation to the SDGs. The study is based on a qualitative design along with focusing on secondary data collection method. Automated irrigation systems are essential for conservation of water, this improvement could have a vital role in minimizing water usage. Agriculture and farming techniques is also linked with IoT and automation, to make the whole processes much more effective and efficient. Sensory systems helped farmers better understand their crops and reduced the environmental impacts and conserve resources.[4]

Jalalu Guntur, S Srinivasulu Raju and K Jayadeepthi derived the objectives of this paper is to design a Low-Cost Automatic Irrigation System that will help disadvantaged farmers save time and money. Agriculture is India's and many other countries' lifeblood. Agriculture in India is heavily reliant on

rainwater, however rain alone is insufficient, thus underground water is used for irrigation in the agricultural area. The level of underground water is decreasing day by day. Poor management of water can happen due to over-irrigation in the field. Many areas are suffering from draughts. In several places, people have to travel many kilometers to get drinking water. Moreover, the electricity supply timings are very odd in fields. Because of this, farmers have to suffer so many sleepless nights. To effectively resolve these problems and to reduce human resources, modern technology can be used. One of the IoT applications is an innovative irrigation system.[5]

Sagnick Biswas, Labhvam Kumar Sharma, Ravi Ranjan and Sayak Saha proposed and developed the solution that we have deployed an array of sensors to measure temperature, soil moisture, humidity, and water usage to automate a traditional agricultural system more smartly, as agriculture is one of the most important factors contributing to India's GDP. The chapter's significant contribution is to identify the predicted amount of water required for a particular field for a particular time duration, as well as the water consumption details of the field being stored in the cloud. Hence, it is possible to find out using an artificial intelligence-machine learning tool and can be accessed through the web and mobile applications for daily, monthly, or seasonal water consumption requirements. The moisture content of the soil is measured by a soil moisture sensor, which triggers a pump via a microcontroller when the moisture content in the soil goes below a set threshold.[6]

M. Wang, W.Shi and W. Zheng explained that water saving irrigation is an important way to solve the shortage of water resources in arid areas. The design of water saving irrigation system based on water balance theory can effectively solve the problem of uneven distribution of soil moisture and system decision lag. This paper introduces the theoretical realization of water balance method, and then introduces the calculation method of water supplement and crop transpiration. On the basis of the theoretical research, this paper introduces the intelligent water saving irrigation control system designed by the method of the Agricultural Internet of things, and gives the detailed design method of the system hardware and software of. The system is applied in Xiaotangshan, Beijing. The application results show that intelligent water saving irrigation based on water balance can effectively implement irrigation.[7]

CHAPTER-3

THEORITICAL ANALYSIS

3.1 COMPONENTS USED

3.1.1 TRANSFORMER

Transformer is the electrical device that converts one voltage to another with little loss of power. Transformers work only with AC. There are two types of transformers as Step-up and Step-down transformer. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage.

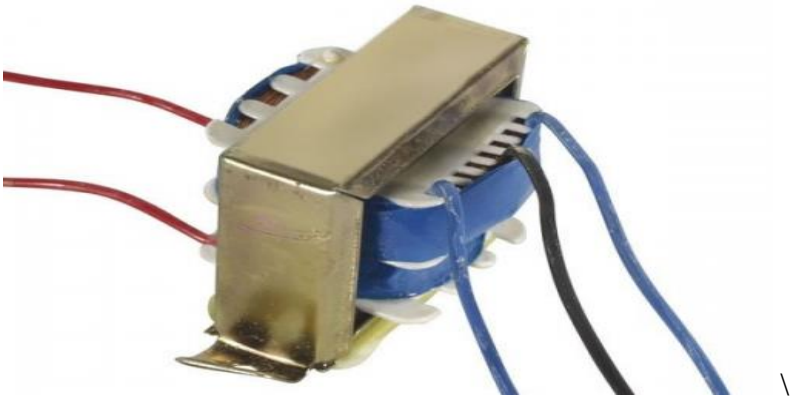


Figure 1. Transformer

Here a step down transformer is used as shown in figure 1 to get 5V AC from the supply i.e.230V AC. Step down transformers are designed to reduce electrical voltage. Their primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it. For instance, a step down transformer is needed to use a 110v product in a country with a 220v supply. Step down transformers convert electrical voltage from one level or phase configuration usually down to a lower level. They can include features for electrical isolation, power distribution, and control and instrumentation applications. Step down transformers typically rely on the principle of magnetic induction between coils to convert voltage and/or current levels. Step down transformers are made from two or more coils of insulated wire wound around a core made of iron. When voltage is applied to one coil (frequently called the primary or input) it magnetizes the iron core, which induces a voltage in the other coil, (frequently called the secondary or output). The turn's ratio of the two sets of windings determines the amount of voltage transformation.

3.1.1.1 OPERATING PRINCIPLE

The transformer is based on two principles: first, that an electric current can produce a magnetic field (electromagnetism) and second that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). Changing the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil.

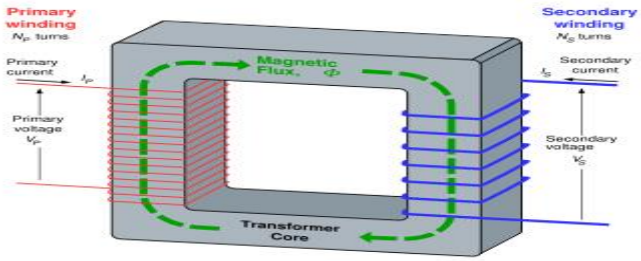


Figure 2. Ideal transformer

An ideal transformer is shown in figure 2. Current passing through the primary coil creates a magnetic field. The primary and secondary coils are wrapped around a core of very high magnetic permeability, such as iron, so that most of the magnetic flux passes through both the primary and secondary coils. If a load is connected to the secondary winding, the load current and voltage will be in the directions indicated, given the primary current and voltage in the directions indicated.

3.2 TRANSISTORS

A transistor shown in figure 3 is a semiconductor device commonly used to amplify or switch electronic signals. A transistor is made of a solid piece of a semiconductor material, with at least three terminals for connection to an external circuit.

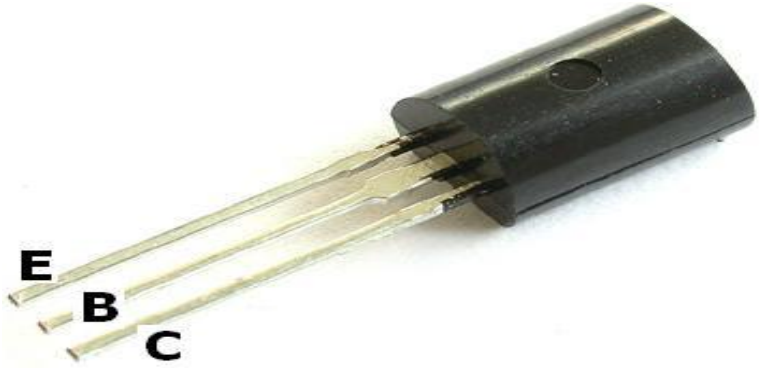


Figure 3. Transistor

A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals is shown in figure 3. Because the controlled (output) power can be much more than the controlling (input) power, the transistor provides of a signal. Transistor can be regarded as a type of switch, as can many electronic component. There are two main types NPN and PNP .In this fire alarm circuit we are used the NPN type transistor. A transistor have three leads mainly base, emitter, collector. The base lead mainly used to activate the transistor. The collector is the positive lead and the emitter is the negative lead. The below fig. shows a NPN transistor.

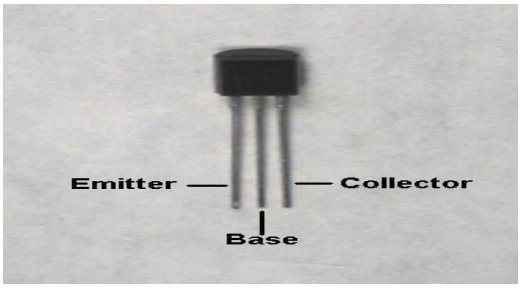


Figure 4. NPN Transistor

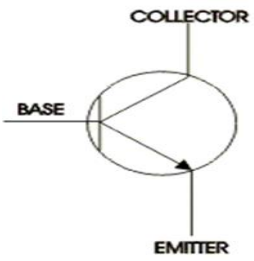


Figure 5. PNP Transistor

Some transistors are packaged individually but most are found in circuits. The transistor is the fundamental building block of modern electronic devices, and its presence is ubiquitous in modern electronic systems. In this fire alarm circuit we are used three transistors BC548, BC558, SL100B. SL100B is a special type transistor.

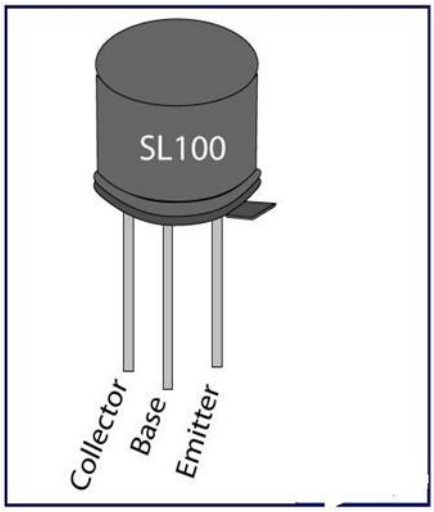


Figure 6. SL100B Transistor

SL100B shown in figure 6 is a general purpose medium power NPN transistor. It is mostly used as a switch in common emitter configuration. For switching application SL100 is biased in such a way that it remains fully on if there is a signal at its base .In the absence of base signal it gets turned off completely. The emitter leg of SL100 is indicated by protruding edge in the transistor case. The base is nearest to emitter while collector lies at other extreme of the casing.

3.2.1 TRANSISTOR WORKING

Figure 7. NPN and PNP Transistor

3.2.2 NPN TRANSISTOR OPERATION

Just as shown in figure 7, in the PN junction diode, the N material comprising the two end sections of the NPN transistor contains a number of free electrons, while the center P section contains an excess number of holes. The action at each junction between these sections is the same as that previously described for the diode; that is, depletion regions develop and the junction barrier appears. To use the transistor as an amplifier, each of these junctions must be modified by some external bias voltage. For the transistor to function in this capacity, the first PN junction (emitter-base junction) is biased in the forward, or low-resistance, direction. At the same time the second PN junction (base-collector junction) is biased in the reverse, or high-resistance, direction. A simple way to remember how to properly bias a transistor is to observe the NPN or PNP elements that make up the transistor.

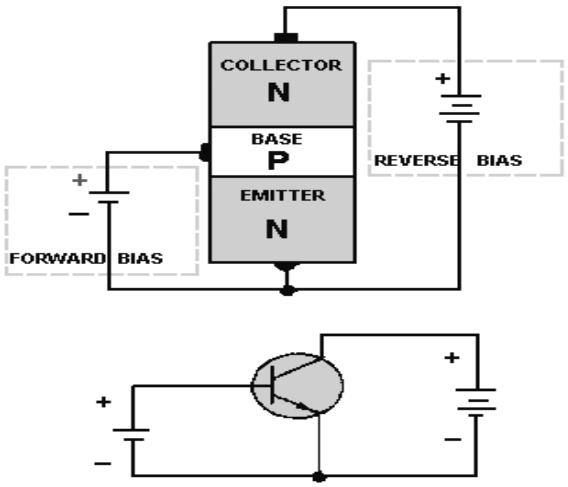


Figure 8. semiconductors, diodes, NPN transistors

3.2.3 PNP TRANSISTOR OPERATION

The PNP transistor works essentially the same as the NPN transistor as shown in figure 8. However, since the emitter, base, and collector in the PNP transistor are made of materials that are different from those used in the NPN transistor, different current carriers flow in the PNP unit. The majority current carriers in the PNP transistor are holes. This is in contrast to the NPN transistor where the majority current carriers are electrons. To support this different type of current (hole flow), the bias batteries are reversed for the PNP transistor. A typical bias setup for the PNP transistor is shown in figure 9. Notice that the procedure used earlier to properly bias the NPN transistor also applies here to the PNP transistor. The first letter (P) in the PNP sequence indicates the polarity of the voltage required for the emitter (positive), and the second letter (N) indicates the polarity of the base voltage (negative). Since the base-collector junction is always reverse biased, then the opposite polarity voltage (negative) must be used for the collector. Thus, the base of the PNP transistor must be negative with respect to the emitter, and the collector must be more negative than the base. Remember, just as in the case of the NPN transistor, this difference in supply voltage is necessary to have current flow (hole flow in the case of the PNP transistor) from the emitter to the collector. Although hole flow is the predominant type of current flow in the PNP transistor, hole flow only takes place within the transistor itself, while electrons flow in the external circuit. However, it is the internal hole flow that leads to electron flow in the external wires connected to the transistor.

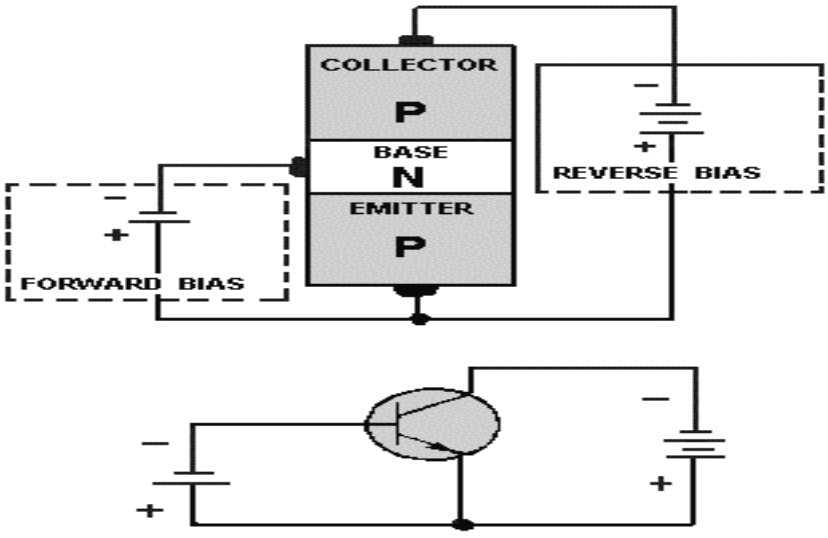


Figure 9. semiconductors, diodes, PNP transistors

The basic requirements for a biasing circuit as shown in figure 9, are

(a) Establish the operating point in the center of the active region of the characteristics, so that applying input signal the instantaneous Q point does not move.
(b) Stabilize the collector current against temperature variations.
(c) Make the operating point independent of the transistor parameters so that it does not shift when the transistor is replaced by another of the same type in the circuit.

3.2.4 APPLICATIONS OF TRANSISTOR

These are used in communications, control systems, consumer applications (like TV, mobile phones, audio), transport applications, aerospace, military, switching, industrial systems, security, digital systems, computer equipment, power supplies, inverters etc.

3.3 RESISTORS

Resister as shown in figure 10 is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resisters can also be used to provide a specific voltage for an active device such as transistor. It is a two terminal component that produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law:

$$V = IR$$

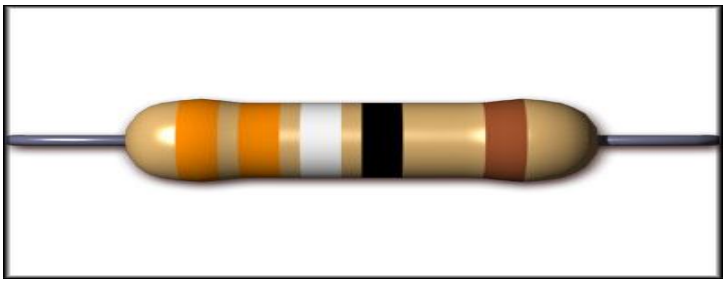
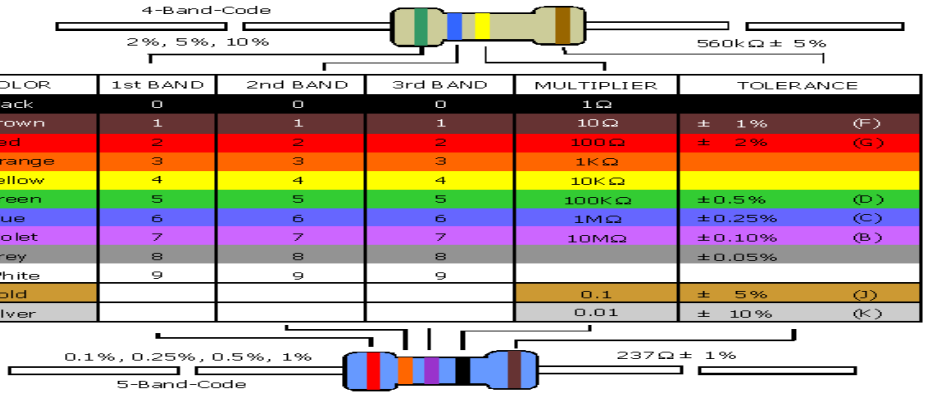


Figure 10. Resistor

Resistors are elements of electrical networks and electronic circuits and are ubiquitous in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy ,such as nickel/chrome).The primary characteristics of a resistor are the resistance, the tolerance, maximum working voltage and the power rating. Resistors can be integrated into hybrid and printed circuits. , as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

There are eight resisters R1 to R8 are used in this circuit of different value. The resistance value can differ from one another by means of colzor coding technique. Colour coding technique can be described as follows;

TABLE 1: Resistor color code



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

Then a potential difference is required between the two terminals of a resistor for current to flow. This potential difference balances out the energy lost. When used in DC circuits the potential difference, also known as a resistors voltage drop, is measured across the terminals as the circuit current flows through the resistor. Most resistors are linear devices that produce a voltage drop across themselves when an electrical current flow through them because they obey Ohm's Law and different values of resistance produces different values of current or voltage. This can be very useful in Electronic circuits by controlling or reducing either the current flow or voltage produced across them.

There are many thousands of different types of Resistors and are produced in a variety of forms because their particular characteristics and accuracy suit certain areas of application, such as High Stability, High Voltage, High Current etc., or are used as general purpose resistors where their characteristics are less of a problem. Some of the common characteristics associated with the humble resistor are; Temperature Coefficient, Voltage Coefficient, Noise, Frequency Response, Power as well as Temperature Rating, Physical Size and Reliability.

Resistors are broadly classified into 3 types based on composition. These are described below.

3.3.1 Carbon Resistor

Carbon Resistors are the most common type of Composition Resistors. Carbon resistors are a cheap general purpose resistor used in electrical and electronic circuits. Their resistive element is manufactured from a mixture of finely ground carbon dust or graphite (similar to pencil lead) and a non-conducting ceramic (clay) powder to bind it all together.

3.3.2 Film Resistor

The generic term "Film Resistor" consist of Metal Film, Carbon Film and Metal Oxide Film resistor types, which are generally made by depositing pure metals, such as nickel, or an oxide film, such as tin-oxide, onto an insulating ceramic rod or substrate

3.3.3 Wire wound Resistor

Another type of resistor, called a Wire wound Resistor, is made by winding a thin metal alloy wire (Nichrome) or similar wire onto an insulating ceramic former in the form of a spiral helix similar to the film resistor above. These types of resistors are generally only available in very low ohmic high precision values due to the gauge of the wire and number of turns possible on the former making them ideal for use in measuring circuits and Whetstone bridge type applications.

3.4 VOLTAGE REGULATOR

Voltage regulators produce fixed DC output voltage from variable DC (a small amount of AC on it). Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC. It can also used in circuits to get a low DC voltage from a high DC voltage (for example we use 7805 to get 5V from 12V). There are two types of voltage regulators

1. fixed voltage regulators (78xx, 79xx)

2. Variable voltage regulators (LM317)

In fixed voltage regulators there is another classification

1. Positive voltage regulators

2. Negative voltage regulators

3.4.1 Fixed voltage regulators (78xx, 79xx)

3.4.1.1 Positive voltage regulators

This includes 78xx voltage regulators. The most commonly used ones are 7805 and 7812. 7805 gives fixed 5V DC voltage if input voltage is in (7.5V-20). You may sometimes have questions like, what happens if input voltage is <7.5 V or some 3V, the answer is that regulation won't be proper. Suppose if input is 6V then output may be 5V or 4.8V, but there are some parameters for the voltage regulators like maximum output current capability, line regulation etc. won't be proper. Remember that electronics components should be used in the proper voltage and current ratings as specified in datasheet. You can work without following it, but you won't be able to get some parameters of the component.

3.4.1.2 Negative voltage regulators

Mostly available negative voltage regulators are of 79xx family. The mainly available 79xx IC's are 7905,7912 1.5A output current, short circuit protection, ripple rejection are the other features of 79xx IC's.

Figure 11. Regulator

Many of the fixed voltage regulators have 3 leads and look like power transistors, such as the 7805 (+5V 1A) regulator shown in figure 11. If adequate heat sinking is provided then it can deliver up to maximum 1A current. For 7805 IC, for an input of 10v the minimum output voltage is 4.8V and the maximum output voltage is 5.2V. The typical dropout voltage is 2V. . These ICs have internal thermal shutdown and short circuit current limiting.

3.5 CAPACITORS

A device used to store an electric charge consisting of one or more pairs of conductor separated by an insulator. The capacitance is the amount of electric charge stored in the capacitor at a voltage of 1volt.The capacitance is measured in the unit of farad. The capacitor disconnects current in dc circuit and short circuits current in ac circuit. In fire alarm circuit polarized and ceramic capacitor is used. There are three capacitors are used in this circuit.one is 10microfarad 16volt, means its capacitance is 10 microfarad at 16 volt. similarly other two are. 04microfarad and .01microfarad at 63volt.as shown in figure 12.

Figure 12. Capacitors

A capacitor is a passive component consisting of a pair of conductor separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors. An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practices; the dielectric material which placed in place between the plates passes a small amount of leakage current. Capacitors are widely used in electronic circuits to block the flow of direct current while allowing alternating current to pass, to filter out interference, to smooth the output of power supplies, and for many other purposes.

3.5.1 Working of capacitor

A capacitor consists of two metal plates as shown in figure 13 which are separated by a non-conducting substance or dielectric. Take a look at the figure given below to know about dielectric in a capacitor.

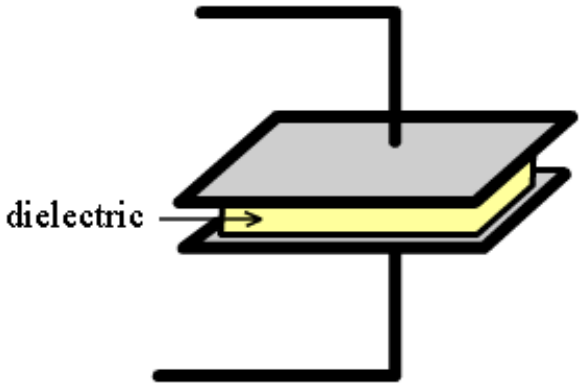


Figure 13. Dielectric material increases the capacitance of capacitor

Though any non-conducting substance can be used as a dielectric, practically some special materials like porcelain, mylar, teflon, mica, cellulose and so on. A capacitor is defined by the type of di-electric selected. It also defines the application of the capacitor.

According to the size and type of dielectric used, the capacitor can be used for high-voltage as well as low-voltage applications.

For applications in radio tuning circuits air is commonly used as the dielectric. for applications in timer circuits mylar is used as the dielectric. For high voltage applications glass is normally used. For application in X-ray and MRI machines, ceramic is mostly preferred.

The metal plates are separated by a distance "d", and a dielectric material is separately placed in between the plates.

The dielectric constant of the dielectric material is equal to the dielectric of air. The dielectric material is the main substance that helps in storing the electrical energy.

3.5.2 Advantages

- Since the capacitor can discharge in a fraction of a second, it has a very large advantage. Capacitors are used for appliances which require high speed use like in camera flash and laser techniques.
- Capacitors are used to remove ripples by removing the peaks and filling in the valleys.
- A capacitor allows ac voltage to pass through and blocks dc voltage. This has been used in many electronic applications.
-

3.6 DIODE

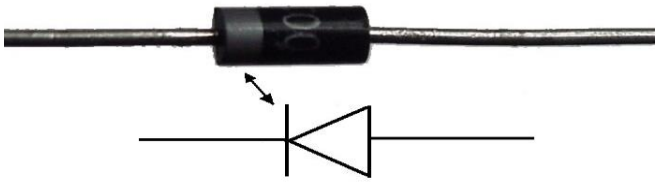


Figure 14. Diode

The most common function of a diode (figure 14) is to allow an electric current in one direction (called the forward direction) while blocking current in the opposite direction (the reverse direction). Thus, the diode can be thought of as an electronic version of a check valve. This unidirectional behaviour is called rectification, and is used to convert alternating current to direct current, and remove modulation from radio signals in radio receivers.

3.6.1 DIODE Working principle

A p–n junction diode is made of a crystal of semiconductor. Impurities are added to it to create a region on one side that contains negative charge carriers (electrons), called n-type semiconductor, and a region on the other side that contains positive charge carriers (holes), called p-type semiconductor. When two materials i.e. n-type and p-type are attached together, a momentary flow of electrons occur from n to p side resulting in a third region where no charge carriers are present. It is called Depletion region due to the absence of charger carrier (electrons and holes in this case). The diode's terminals are attached to each of these regions. The boundary between these two regions, called a p–n junction, is where the action of the diode takes place. The crystal allows electrons to flow from the N-type side (called the cathode) to the P-type side (called the anode), but not in the opposite direction.

A semiconductor diode's behavior in a circuit is given by its current–voltage characteristic, or I–V graph (see graph below). The shape of the curve is determined by the transport of charge carriers through the so-called *depletion layer* or *depletion region* that exists at the p–n junction between differing semiconductors. When a p–n junction is first created, conduction-band (mobile) electrons from the N-

doped region diffuse into the P-doped region where there is a large population of holes (vacant places for electrons) with which the electrons "recombine". When a mobile electron recombines with a hole, both hole and electron vanish, leaving behind an immobile positively charged donor (dopant) on the N side and negatively charged acceptor (dopant) on the P side. The region around the p–n junction becomes depleted of charge carriers and thus behaves as an insulator.

However, the width of the depletion region (called the depletion width) cannot grow without limit. For each electron–hole pair that recombines, a positively charged dopant ion is left behind in the N-doped region, and a negatively charged dopant ion is left behind in the P-doped region as shown in figure 15. The recombination proceeds more ions are created, an increasing electric field develops through the depletion zone that acts to slow and then finally stop recombination. At this point, there is a "built-in" potential across the depletion zone.

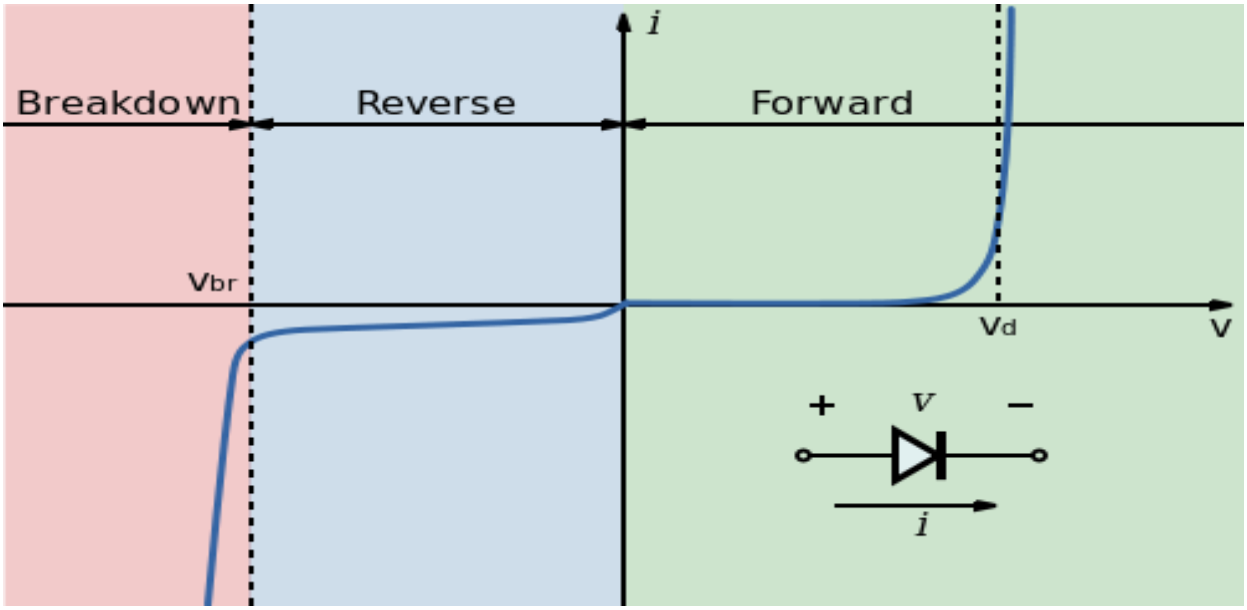


Figure 15. characteristics of a PN- Junction diode

If an external voltage is placed across the diode with the same polarity as the built-in potential, the depletion zone continues to act as an insulator, preventing any significant electric current flow (unless electron/hole pairs are actively being created in the junction by, for instance, light. see photodiode). This is the *reverse bias* phenomenon. However, if the polarity of the external voltage opposes the built-in potential, recombination can once again proceed, resulting in substantial electric current through the p–n junction (i.e. substantial numbers of electrons and holes recombine at the junction). For silicon diodes, the built-in potential is approximately 0.7 V (0.3 V for Germanium and 0.2 V for Scottky). Thus, if an external current is passed through the diode, about 0.7 V will be developed across the diode such that the P-doped region is positive with respect to the N-doped region and the diode is said to be "turned on" as it has a forward bias.

3.7 RECTIFIERS

A rectifier is a circuit that converts AC signals to DC. A rectifier circuit is made using diodes. There are two types of rectifier circuits as Half-wave rectifier and Full-wave rectifier depending upon the DC signal generated.

3.7.1 Half-wave Rectifier

It is the rectifier circuit that rectifies only half part of the AC signal. It uses only a single diode. It only uses only positive part of the AC signal to produce half-wave varying DC and produce gaps when the AC is negative.

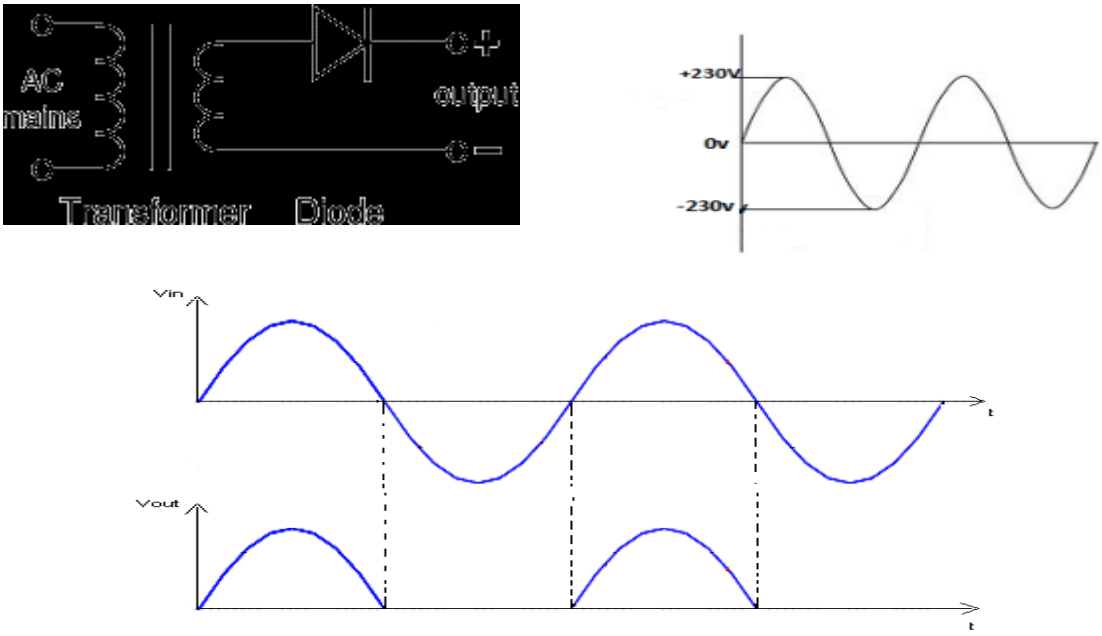


Figure 16. Half Wave controlled converter

3.7.2 Full-wave Rectifier

It is also called as Bridge Rectifier. A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses the total AC wave (both positive and negative sections) shown in figure 17.

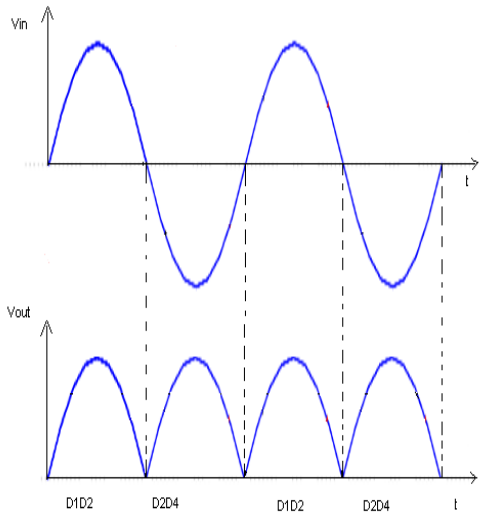


Figure 17. full wave bridge rectifier

3.8 SMOOTHING

Smoothing shown in figure 18 is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output. Here a capacitor of 330uF is used as a smoothing circuit.

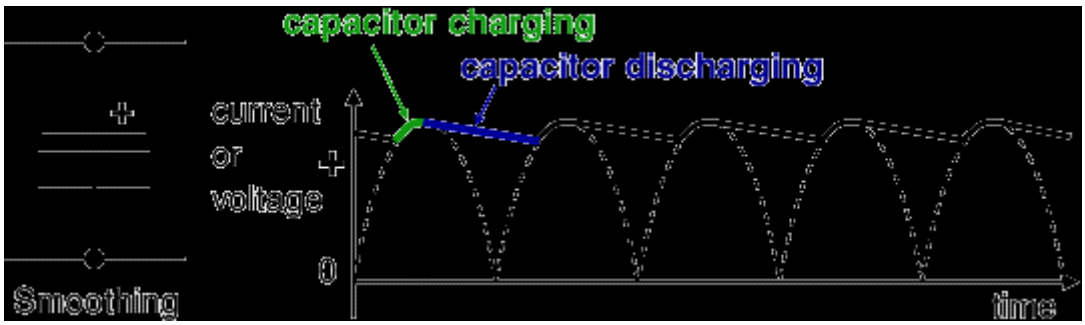


Figure 18. smoothing

3.9 LIGHT EMITTING DIODE

One red led is used in fire alarm circuit .A led shown in figure 19 is a semiconductor light source. LEDs are used as indicator lampsin many devices .LED's emitted low intensity red light ,but modern versions are available across the visible ,ultraviolet and infrared wavelength with very brightness.When a led is forward biased,electrones are able to recombine with electron holes within the device ,releasing energy in form of photons.The fig of one LED is shown below.

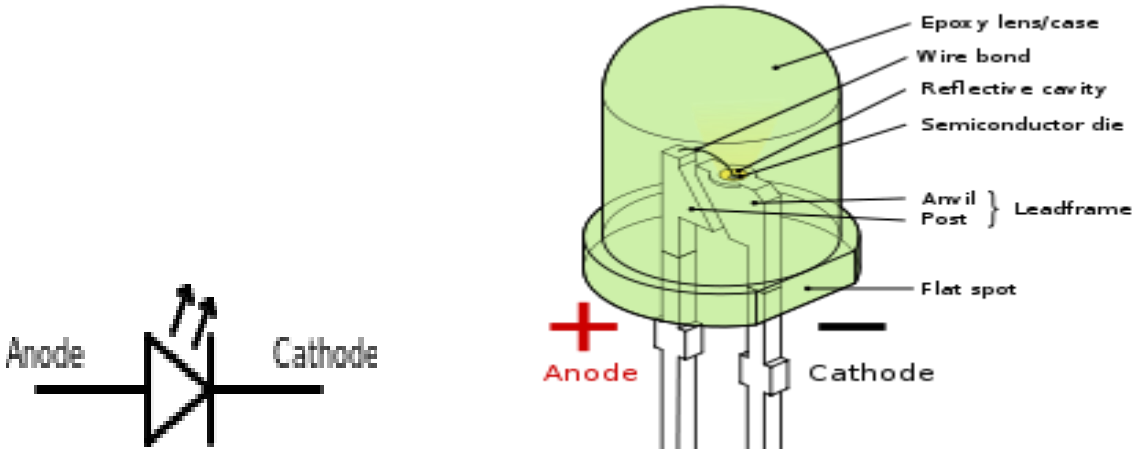


Figure 19. Light emitting diode

3.10 NodeMCU Fast IoT Application Development

The best way to develop quickly an IoT application with less Integrated circuits to add is to choose this circuit "NodeMCU". shown in figure 20 Today, we will give a detailed Introduction on NodeMCU V3. It is an open-sour
firmware and development kit that plays a vital role in designing a proper IoT product using a few script lines

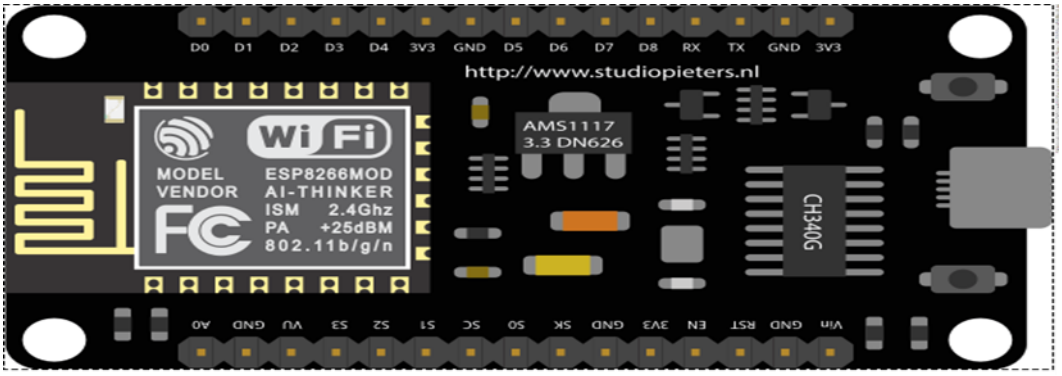


Figure 20. NodeMCU

The best way to develop quickly an IoT application with less Integrated circuits to add is to choose this circuit "NodeMCU". Today, we will give a detailed Introduction on NodeMCU V3. It is an open-source firmware and development kit that plays a vital role in designing a proper IoT product using a few script lines.

The module is mainly based on ESP8266 that is a low-cost Wi-Fi microchip incorporating both a full TCP/IP stack and microcontroller capability. It is introduced by manufacturer Espressif Systems. The ESP8266 NodeMcu is acomplex device, which combines some features of the ordinary Arduino board with thepossibility of connecting to the internet.

Arduino Modules and Microcontrollers have always been a great choice to incorporate automation into the relevant project. But these modules come with a little drawback as they don't feature a built-in WiFi capability, subsequently, we need to add external Wi Fi protocol into these devices to make them compatiblewith the internet channel.

This is the famous NodeMCU which is based on ESP8266 Wi Fi SoC. This is version 3and it is based on ESP-12E (An ESP8266 based Wi Fi module). NodeMCU is also an open-source firmware and

development kit that helps you to prototype your IOT product within a few LUA script lines, and of course you can always program it with Arduino IDE.

In this article, We will try present useful details related to this Wi Fi DevelopmentKit, its main features, pinout and everything we need to know about this moduleand the application domain.

3.10.1 Introduction NodeMCU V3

NodeMCU V3 shown in figure 21 is an open-source firmware and development kit that plays a vital role in designing an IoT product using a few script lines.
Multiple GPIO pins on the board allow us to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.

- The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module.

The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects you with a well-known developer community.

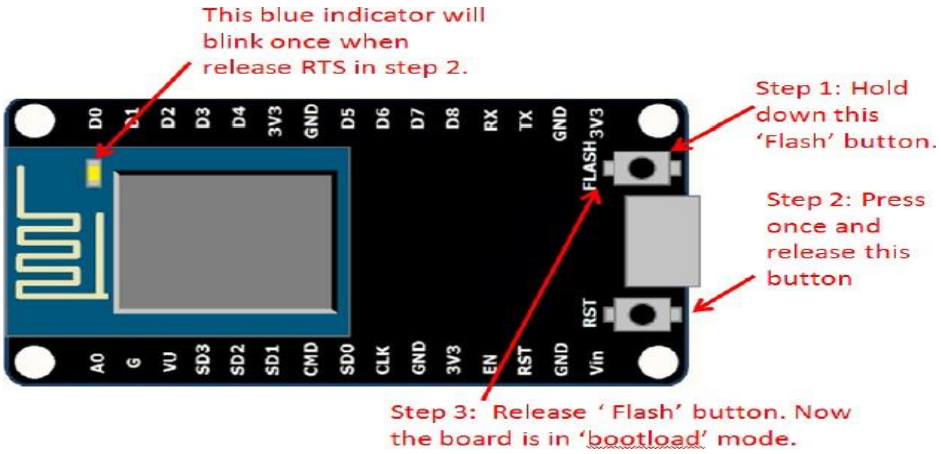


Figure 21. NodeMCU V3

Open source firmware gives you the flexibility to edit, modify and rebuilt the existing module and keep changing the entire interface until you succeedin optimizing the module as per your requirements.

- USB to UART converter is added on the module that helps in converting USBdata to UART data which mainly understands the language of serial communication.

Instead of the regular USB port, Micro
USB port is included in the module that
connects it with the computer for dual purposes: programming and powering upthe board.

- The board incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer.

The ability of module to establish a flawless Wi-Fi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry.

3.10.2 NodeMCU V3 Pinout

NodeMCU V3 comes with a number of GPIO Pins. As shown in figure 22 the Pinout of the board.

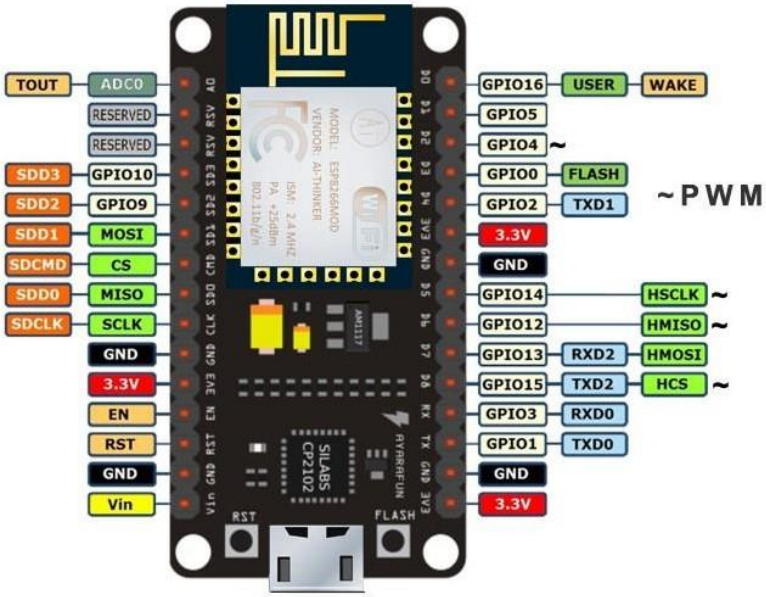


Figure 22. Node MCU V3 & GIPO pins

- There is a candid difference between Vin and VU where former is the regulated voltage that may stand somewhere between 7 to 12 V while later isthe power voltage for USB that must be kept around 5 V.

3.10.3 Features

1. Open-source
2. Arduino-like hardware
3. Status LED
4. Micro USB port
5. Reset/Flash buttons
6. Interactive and Programmable
7. Low cost
8. ESP8266 with inbuilt wi-fi
9. USB to UART converter
10. GPIO pins
11. Arduino-like hardware IO
12. Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware.
13. Code like Arduino, but interactively in Lua script.
14. Nodejs style network API
15. Event-driven API for network applications, which facilities developers writing code running on a 5mm*5mm sized MCU in Nodejs style.
16. Greatly speed up your IOT application developing process.
17. Lowest cost WI-FI
18. Less than $2 WI-FI MCU ESP8266 integrated and easy to prototyping development kit.
19. We provide the best platform for IOT application development at the lowest cost.

As mentioned above, a cable supporting micro USB port is used to connect theboard. As you connect the board with a computer, LED will flash. You may needsome drivers to be installed on your computer if it fails to detect the NodeMCU board. You can download the driver from this page.

Note: We use Arduino IDE software for programming this module. It is important to note that the pin configuration appearing on the board is different from the configuration we use to program the board on the software i.e. when we write code for targeting pin 16 on the Arduino IDE, it will actually help is laying out thecommunication with the D0 pin on the module.

As shown in figure 23 the pin configuration to use in Arduino IDE.

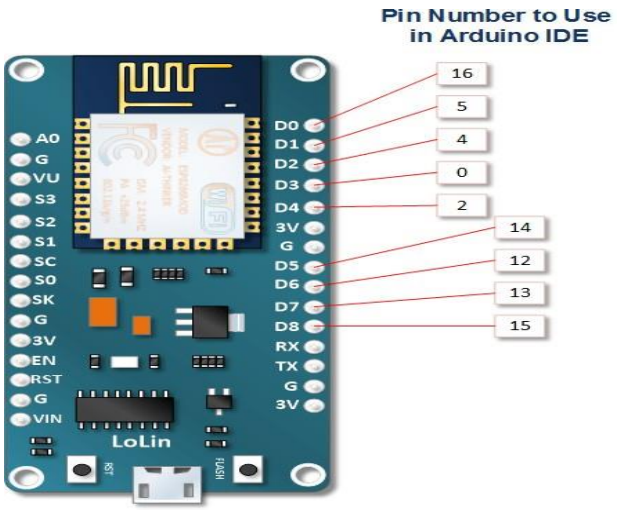


Figure 23. Arduino IDE

3.10.4 How to Power NodeMCU V3

We can see from the pinout image above, there are five ground pins and three3V3 pins on the board. The board can be powered up using the following threeways.

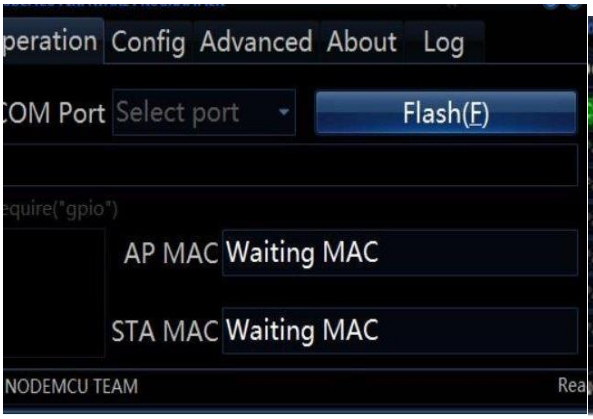
USB Power. It proves to an ideal choice for loading programs unless the projectyou aim to design requires separate interface i.e. disconnected from the computer.

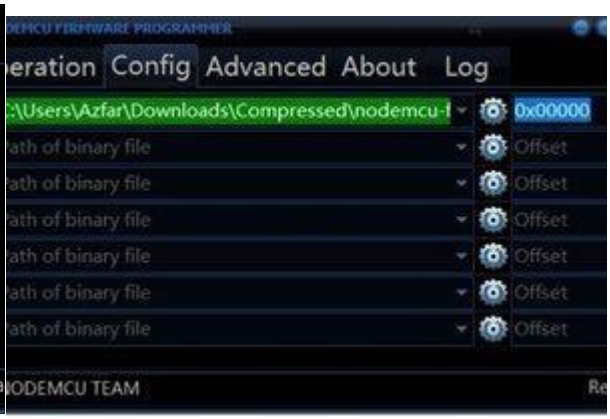
Provide 3.3V. This is another great option to power up the module. If you haveyour own off-board regulator, you can generate an instant power source for yourdevelopment kit.

Power Vin. This is a voltage regulator that comes with the ability to support upto 800 mA. It can handle somewhere between 7 to 12 V. You cannot power thedevices operating at 3.3 V, as this regulator unable to generate as low as 3.3V.

Programming

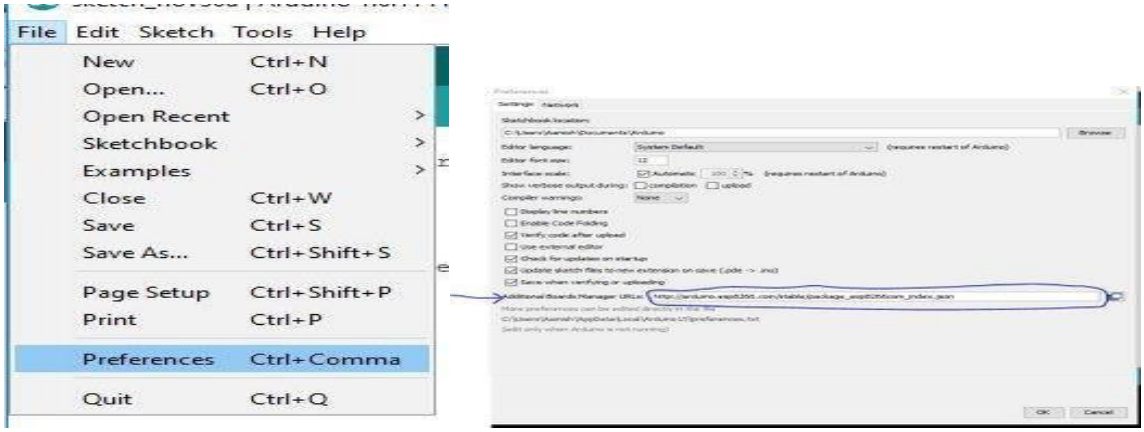
Step 1: Installing the Firmware





In NodeMCU Boards the first thing you need is to install the Firmware to the boardthe following method works for all NodeMCU Boards

1. Open the NodeMCU flasher master folder than open the win32/win64 folder as yourcomputer. now open the folder Release than double click ESP8266Flasher.
2. Select the COM Port.
3. Goto config tab
4. click on the small gear and open up the firmware which you have downloaded
5. go to the advanced tab and select the desired Baudrate
6. Goto the Operation tab and click on Flash Button.



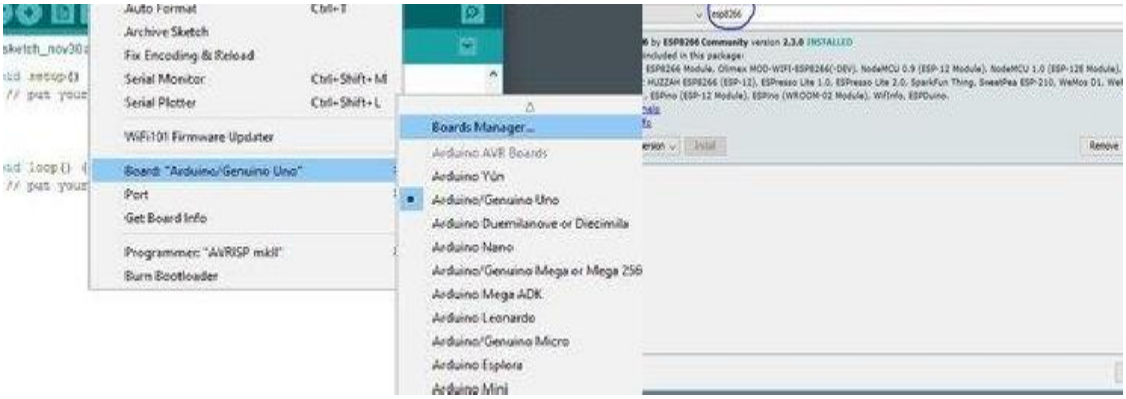
Step 2: Preparing the Arduino IDE
After Installing the firmware you are ready to do the programming with the ESP8266

1. Install the Arduino IDE
2. open the Arduino IDE from the desktop icon
3. Click on File tab and than open preferences
4. In the additional Boards Manager URLs add the following link (http://arduino.esp8266.com/stable/package_esp8266com_index.json) and click OK
5. Goto Tools>Boards>Boards Manager
6. In the search field type esp8266 click the esp8266 by ESP8266 Community option andclick Install

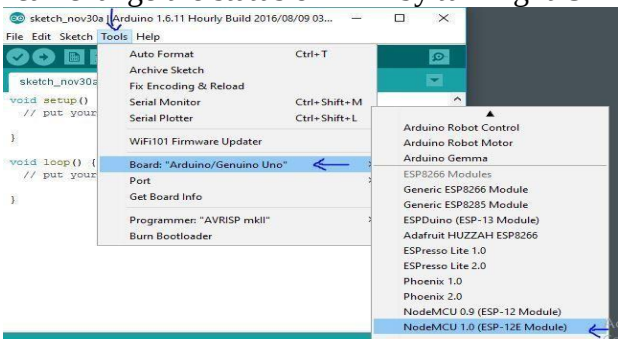
Step 3: Code...

Now we can do whatever you want with your NodeMCU board Following is an example for led blinking with NodeMCU board via webserver

- In Arduino IDE go to tools>Boards>select NODEMCU 1.0 (ESP - 12E Module)
- again go to tools and select port.
- Change the Wi fi name and password from the following code.
- Now click on Upload button to upload the following code.
- Connect the lead's positive leg on D9 pin of board and negative to the ground of thecode.
- Power up the board and open the serial monitor from Arduino IDE
- after connecting to the wi-fi it will show you the IP address.



- type that IP address on the web browser(Edge, Chrome, Firefox etc..)
- A webpage will open you can change the status of LED by turning it ON or OFF.



3.10.5 Copy, Paste and Upload the Tutorial Sketch

The sketch is one that comes as an example from ESP8266.COM

```
#include "ESP8266WiFi.h"

void setup() {

  Serial.begin(115200);

  // Set WiFi to station mode and disconnect from an AP if it was
previously connected

      WiFi.mode(WIFI_STA);
       WiFi.disconnect();
          delay(2000);
  Serial.println("Setup done");

}

void loop() {

  Serial.println("scan start");



  int n = WiFi.scanNetworks();// WiFi.scanNetworks will return the
number of networks found

  Serial.println("scan done");
  if (n == 0)

    Serial.println("no networks found");
```

```
      Serial.print(i + 1);
      Serial.print(": ");
      Serial.print(WiFi.SSID(i));
      Serial.print(" (");
      Serial.print(WiFi.RSSI(i));
      Serial.print(")");

       Serial.println((WiFi.encryptionType(i) == ENC_TYPE_NONE)?" ":
"*");

      delay(10);

    }

  }

  Serial.println("");
```

3.10.6 Serial Communication Between NodeMCU and Arduino

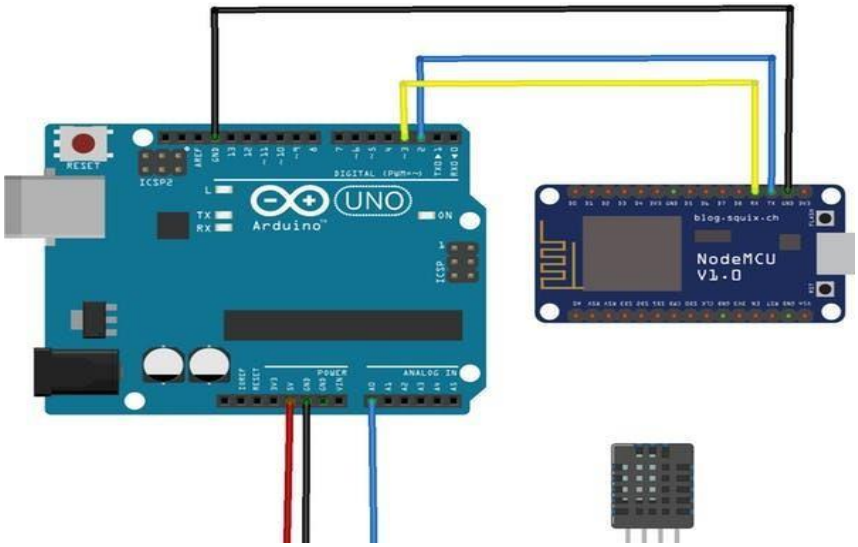
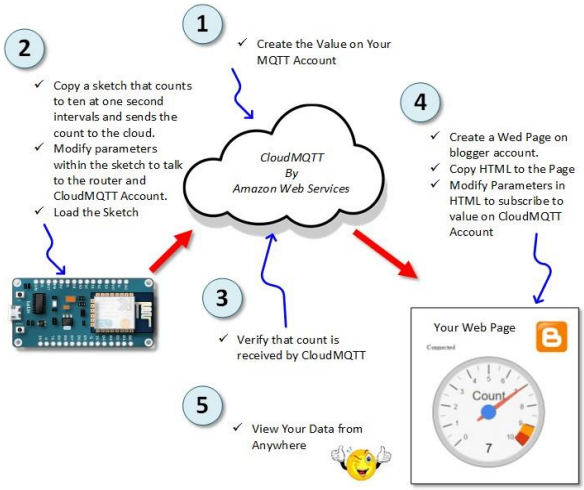


Figure 24. NODEMCU&AURDINO COMMUNICATION

3.10.7 Projects and Applications

NodeMCU V3 is mainly used in the Wi-Fi Applications which most of the other embedded modules fail to process unless incorporated with some external Wi-Fiprotocol. Following are some major applications used for NodeMCU V3.



- Internet Smoked Alarm
- VR Tracker
- Octopod
- Serial Port Monitor
- ESP Lamp
- Incubator Controller
- IoT home automation
- Security Alarms

3.10.8 NodeMCU ESP-12E Arduino IDE Digital Input Tutorial

Connect the Circuit

You may wish to power your NodeMCU another way. You can read about it HERE.

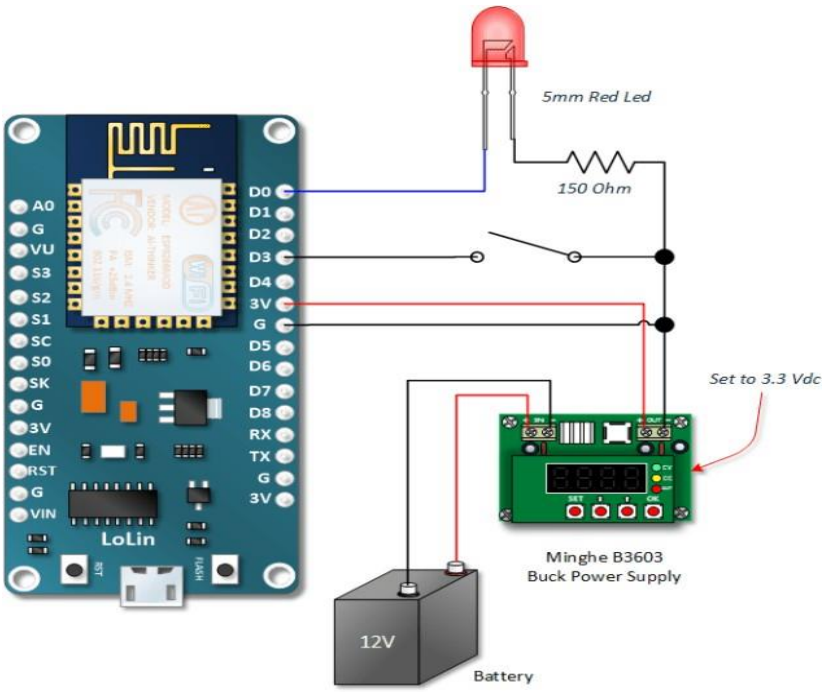


Figure 25. CIRCUIT

Copy, Paste and Upload the Code

The code is real simple works as follows:

- The input is read from switch pin If switch is closed, it will read a low.
- The LED output pin is set to the opposite of the switch pin. If the switch is closed, the output pin willbe set to a high. A high will turn on.

3.11 RELAY

A relay shown in figure 25 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.

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 ICs 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.

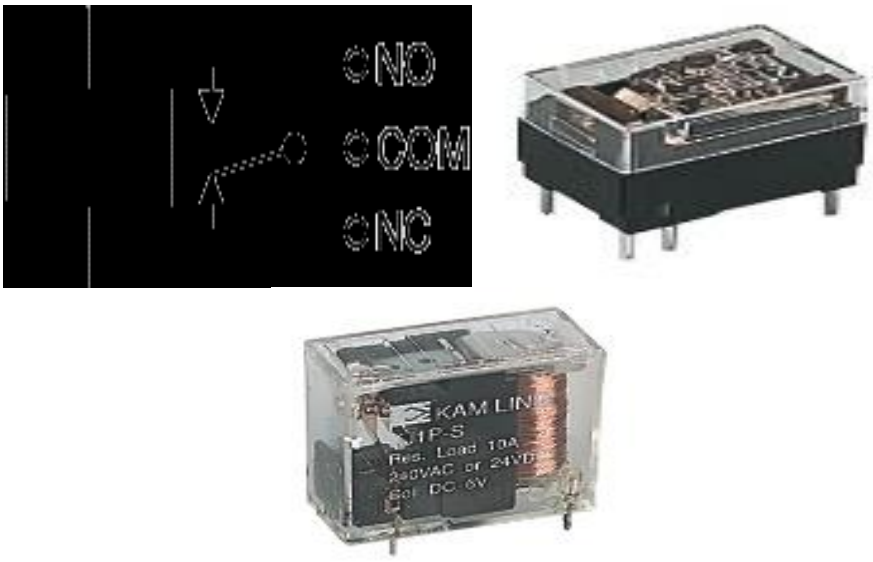


Figure 26. RELAY

3.11.1 Protection diodes for relays

Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram FIGURE NO. 26 shows how a signal diode (e.g. 1N4148) is connected 'backwards' across the relay coil to provide this protection.
Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.

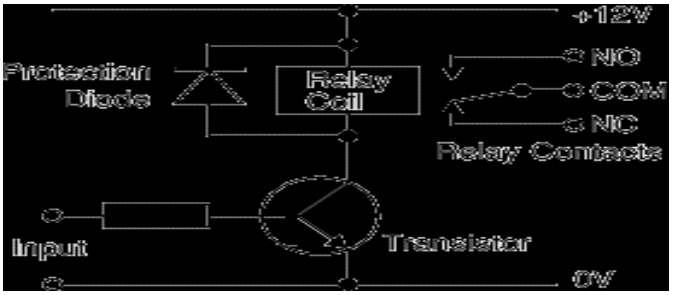


figure 27. protection diode diagram

3.11.2 Relays and transistors compared

Like relays, transistors can be used as an electrically operated switch. For switching small DC currents (< 1A) at low voltage they are usually a better choice than a relay. However transistors cannot switch AC or high voltages (such as mains electricity) and they are not usually a good choice for switching large currents (> 5A). In these cases a relay will be needed, but note that a low power transistor may still be needed to switch the current for the relay's coil! The main advantages and disadvantages of relays are listed below:

3.11.3 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.

3.11.4 Disadvantages of relays:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many ICs can provide, so a low power transistor may be needed to switch the current for the relay's coil.

3.12 CENTRIFUGAL PUMP

Centrifugal pumps as shown in figure 27 are the most preferred hydraulic pumps used in domestic and industrial world. In this video we will have a conceptual overview of the working of centrifugal pumps.

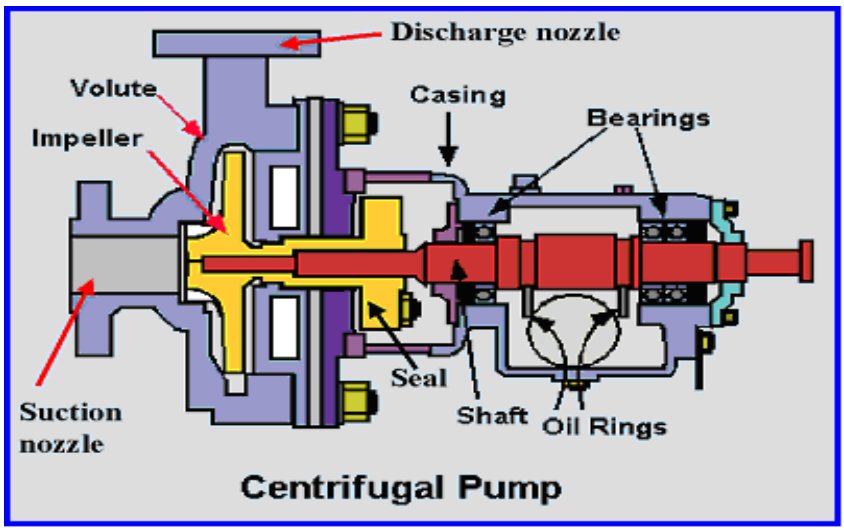


Figure 28. CENTRIFUGAL PUMP

Centrifugal pumps are used to induce flow or raise pressure of a liquid. Its working is simple. At the heart of the system lies impeller. It has a series of curved vanes fitted inside the shroud plates. The impeller is always immersed in the water. When the impeller is made to rotate, it makes the fluid surrounding it also rotate. This imparts centrifugal force to the water particles, and water moves radially out.

Since the rotational mechanical energy is transferred to the fluid, at the discharge side of the impeller, both the pressure and kinetic energy of the water will rise. At the suction side, water is getting displaced, so a negative pressure will be induced at the eye. Such a low pressure helps to suck fresh water stream into the system again, and this process continues.

The negative pressure at the eye of the impeller helps to maintain the flow in the system. If no water is present initially, the negative pressure developed by the rotating air, at the eye will be negligibly small to suck fresh stream of water. As a result the impeller will rotate without sucking and discharging any water content. So the pump should be initially filled with water before starting it. This process is known as priming.

3.13 BLOCK DIAGRAM

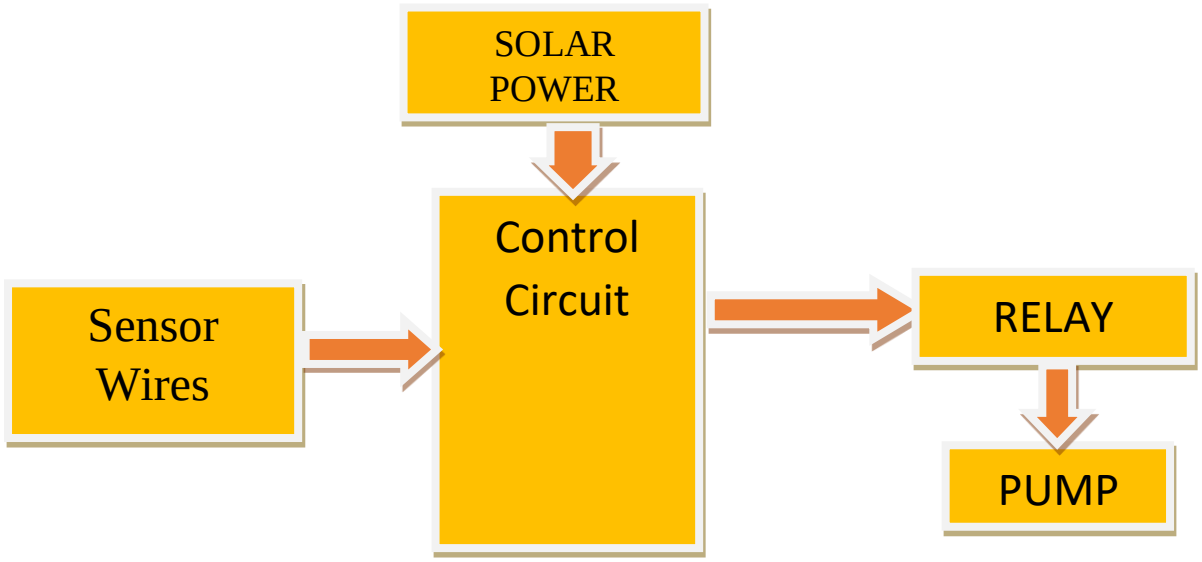


Figure 29. Block diagram

Limitation

Grid Connection is required for this system to be in work mode which is difficult in agricultural fields.

CHAPTER: 4

EXPERIMENTAL SETUP

4.1 COMPONENT SPECIFICATION

- Solar panel
  - Maximum power 20 wp
  - Maximum power voltage 19.25 v
  - Maximum power current 1.04 A
  - Short circuit current 1.11 A
  - Open circuit voltage 22.5 V
  - Maximum system voltage 600 V
- Battery :

(Number of battery =3, each battery contains 4 volt of powers.)

  - Max charge current 3.6 A
  - Nominal voltage 12 V
  - Capacity 12 AH
  - Terminal T2 FASTON 250
- LED Display
  - Module size 32*16 mm
  - Pixel pitch 10 mm
  - Module pixel 3.2*1.6 mm
  - Pixel density 1000 pcs/mm*mm
  - Drive IC qty. 12 pcs
- Relay
  - Working voltage 12 V
  - Static circuit 5 mA
  - Maximum current 80 mA
  - Trigger current 2-4 mA
  - Maximum load AC 250 V/10 A, DC 30V/10 A
- Node MCU
  - Micro controller ESP 8266-12F
  - Operating voltage 3.3 V
  - Digital I/O pins 12
  - Analog input pins 1
  - Clock speed 80 MHz/160MHz
- Pump specification
  - Voltage rating 12 VDC
  - Operating current 0.13-0.22
  - Flow rate 80 ≈ 120
  - Cable length 25 cm

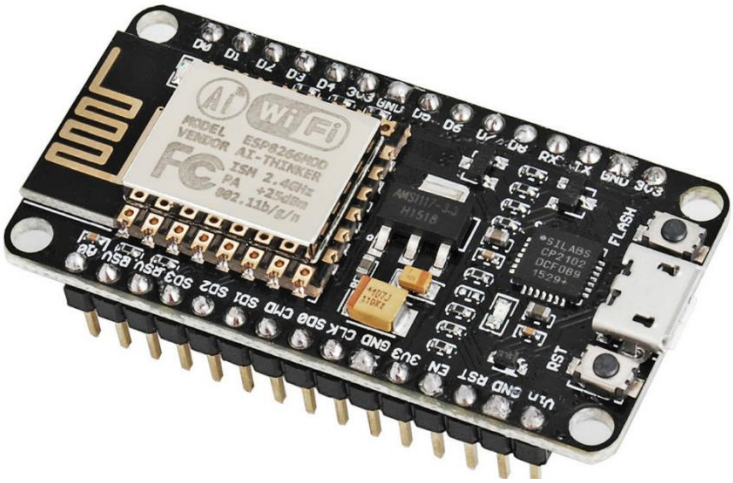
Figure30. solar panel

figure 31. Battery

Figure 32. pump

Figure 33. relay circuit

Figure 34. LCD



ss Figure 35. NodeMCU

4.2 EXPERIMENTAL SUPPORT

The system works by using a solar panel to charge a battery that is connected to the charging circuit, which then powers the micro-controllers, sensors and pump. A switching circuit is used to vary connections to the Dc water pump. The micro-controller contains the code which helps to control the sensing unit and send signals to the switching circuit. The sensing unit consists of two soil moisture sensors which were used to detect the soil moisture content and transmit the received data to the micro-controller for processing. An ultrasonic sensor is used to measure the water level in a storage tank and then send the signal to the micro-controller from which it can be controlled.

A mobile device or any internet-enabled device is used to monitor and control the pump via the web inter face. A Node Micro-controller Unit was configured on the Arduino IDE to connect to a Wi-Fi network with a pre-defined SSID and key. After the Wi-Fi module receives power, it takes between2 to 10s to connect to the network while it is within range. Also, the pump's discharge supplies water from a water reservoir on which is mounted an ultrasonic sensor which detects water level. It is then connected to the soil where soil moisture sensors are used to determine the water content of the soil. In this project, two soil moisture sensors were used to increase the accuracy of the system.

A buzzer was also used to notify the farmer when there is low water available in the water reservoir so that it could be refilled. The IOT platform makes use of graphical and mathematical representations to show real-time status of the soil moisture, water level and motor status.

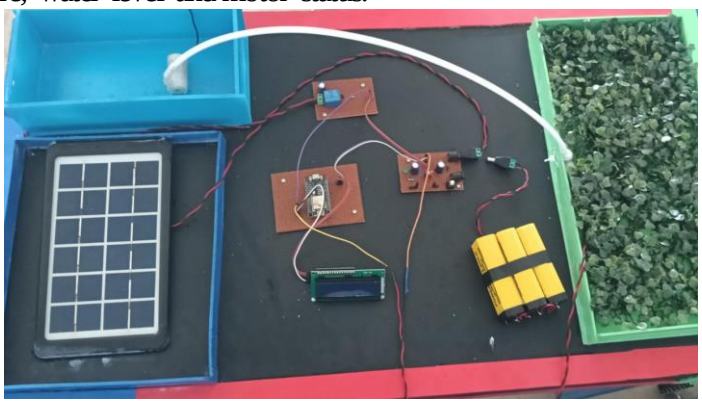


Figure 36. Schemetic diagram

4.3 WORKING PRINCIPLE:

If the water is at the low level, then microcontroller senses the ADC value and turns on the motor to pump water into the tank and once it exceeds the high level, microcontroller turns on the motor. A solenoid valve is an electromechanically operated valve.

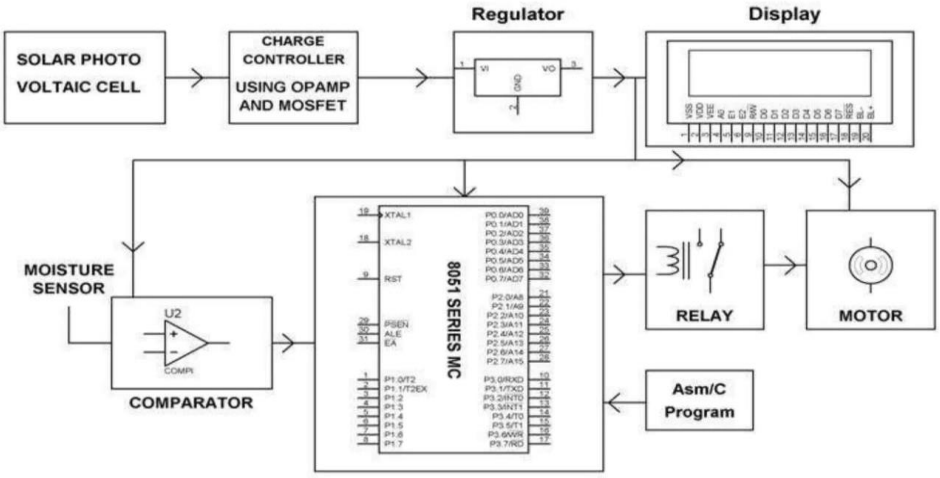


Figure 37. working diagram

CHAPTER :5

RESULT AND DISCUSSION

5.1 RESULT

Finally, we have found a fabricated model of solar powered irrigation system using IOT, which is used in agriculture.

5.2 DISCUSSION

Results and Discussion The proposed design is directly connected with the ADAFRUIT IO server through the IoT Wi-Fi Module which is situated in the system to transmit the field values from the design to the server. With the help of data sensed from the field using the following sensors {Temperature sensor, Level Sensor, Moisture sensor, Voltage Sensor}, the data is arranged in the webpage designed. The temperature sensors detects the temperature in the field and displays in the webpage in the unit of Degree Celsius. The Moisture Sensor Analyzes the water content present in the field in a continuous manner and it is connected to the IoT and displays the value of moisture in the measured value in the ADC value. The other sensor system that acts in the system is Voltage Sensor, it detects the voltage that is stored in the external battery circuit where the solar panel is connected , the voltage sensor measured value is represented in the unit of Volts. The Designed and the IoT Webpage that is created using ADAFRUIT IO is displayed with the sensed values and the working status of motors.

CHAPTER :6

CONCLUSION AND FUTURE PROSPECTIVE

6.1 CONCLUSION

- This is a very efficient and economical system.
- It operates wirelessly.
- The control commands can be given easily .
- We can save our valuable time here.

Embedded system is a latest technology in now days which we used in our project for controlling our system with conducting wires. Sensor is an overwhelming technology launched which is working very efficiently in our project to control all the working of the circuit. So no doubt that, in future this project will help in many functions of leading organization.

6.2 FUTURE PROSPECTIVE

By doing this project we have been acquainted with the controller working and their programming to make the system working.

- Error is reduced by human by a controller.
- Automatic method is more reliable as compared to manual method, it is more stable also.
- It is costly comparatively but accuracy and stability provided by this method can cover the cost.

CHAPTER 7

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