# SOLAR ENERGY UTILIZATION AND MANAGEMENT SYSTEM USING IoT

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# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

The project aim is to design an application which is monitored over Wi-Fi technology. The advent of new high-speed technology and the growing computer capacity provided realistic opportunity for new IoT controls and realization of new methods of control theory. This technical improvement together with the need for high performance IoT created faster, more accurate and more intelligent IoT s using new IoT s control devices, new drivers and advanced control algorithms. This project describes a new economical solution of IoT control systems. The presented IoT control system can be used for different sophisticated IoT IC applications. Wi-Fi (Short for Wireless Fidelity) is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi has initial speeds of 1mbps to 2mbps. Wi-Fi transmits data in the frequency band of 2.4 GHz. It implements the concept of frequency division multiplexing technology. Range of Wi-Fi technology is 40-300 feet. The solar plate is connected to microcontroller through potentiometer. The controlling device for the IoT controlling in the project is a Microcontroller. The data sent from controlling device over Wi-Fi will be received by Wi-Fi module connected to Microcontroller. Microcontroller reads the data and decides the direction and operates the dc motors connected to it accordingly. The Microcontroller is programmed used embedded ‘C’ language.

The vision of the system is to provide an efficient internet based system to control and monitor the relay operations as well as application status. The system offers users an easy and effective means of controlling the ON/OFF condition of the developed application. This system provides information about solar plate output, battery capacity and value of soil moisture sensor. A variety of solution for connectivity is available such as SMS, Wi-Fi, Radio Frequency or Bluetooth. For the controlling there are two microcontrollers which are widely used, namely Arduino and Raspberry Pi. This project uses the Arduino microcontroller due to its simplicity and user friendly GUI.

## 1.2 INTERNET OF THINGS

The internet of things is a recent communication paradigm that envisions a near future in which objects of everyday life will be equipped with microcontrollers, transducers for digital communications and suitable protocols that will allow them to communicate with one another and with the user, making them an integral part of the internet the IOT (Internet of things) is a network of internet enable objects, together with web services that internet with the object. Underlying the internet of things are technologies such as RFID (radio frequency Identification), sensors, and smart phones.

The basic idea of the IOT is that virtually every physical thing in this world can also become a computer that is connected to the internet. To be more accurate things do not turn into computers, but they can feature tiny computers. When they do so, they are often called smart things, because they can act as smarter than things that have not been tagged. The IOT idea is not new. However it only recently became relevant to the practical world, mainly because of the progress made in hardware development in the last decade. The decline of size, cost and energy consumption, hardware dimensions that are closely linked to each other, now allows the manufacturing of extremely small and inexpensive low end computers.

## 1.3 PROBLEM DEFINATION

Design a system to produce constant supply irrespective of temperature and atmospheric variations of the solar energy for agriculture application.

## 1.4 OBJECTIVE

1) To utilize solar energy for agriculture application.

2) Control the application using IOT platform.

# CHAPTER 2

# LITERATURE SURVEY

Saroj Mondal et al. has proposed An efficient on-chip power management architecture for solar energy harvesting system is presented, which utilizes a single stage DC-DC converter when there is enough ambient energy for maintaining regulation at both the input and load. The proposed architecture utilized the stored energy to maintain regulation when there is insufficient ambient energy to supply the load requirement. The proposed architecture avoids linear regulator and utilizes simple charge pump concept in order to maintain regulation. By utilizing a switching converter instead of a linear regulator, the proposed scheme achieved higher end-to-end efficiency. Simulation, as well as experimental result, are reported to validate the proposed idea. [ 1 ]

K.R.Kashwan et al. has proposed The work that has been done shows the most effective way for power utilization and its conservation based on the activity that are detected by the camera. The sensors that had brought a dramatic change in today's environment are replaced with the camera that helps in surveillance and also in appliance control. The control of appliances is made portable. In the future work, the persons other than the residents will also be considered .This can also include a group of activities that take place in a home and may result in more energy usage Overuse of energy has caused many environmental and economic crises. Home appliances consume high energy. Energy consumption by home appliances is considered as one of the most critical areas for the attention to the researchers. Energy saving is a big challenging. Energy can be saved effectively by proper management of electricity distribution for home appliances based on the activities of the users. Recognizing human activities and providing energy supply for those appliances that are related to that activity can provide effective power utilization and conservation. The existing system uses multiple sensors and servers which monitors the human activities, causing discomfort to users. Thus a simple technique, based on Internet of Things (loT), for recognizing human activity through image processing is proposed in this paper. It is a real time approach for energy management in which a machine to machine communication takes place.[ 2 ]

Peter Gyorke et al. has proposed The paper presented numerous real-life measurement results which have shown that a low-power sensor could operate in home or office environment powered from energy harvesting sources only. The results are summarized in Table II, where the measuring conditions are also indicated. In second part Contains the details of the measurements. Wireless sensors went through a significant evolution in the past years, however the battery based operation still not sustainable for longer periods. Energy harvesting can be the solution, if some conditions are met. In this paper solar cells and thermoelectric generators as power sources were inspected in detail, special power supply and storage units were designed for this purpose. Numerous measurements were taken to determine the average minimal energy enough to operate a wireless sensor. Predictive calculations of the harvestable energy were performed to utilize all the available energy without wasting it. This resulted in a significant improvement: the sensor was able to send 25% more messages using same amount of harvested energy.[ 3 ]

A Paventhan et al. has proposed in this paper, we were able to successfully implement an internet-based approach to monitor and control the electricity and usage on a real time basis. The prototype implementation was carried out using a 6LoWPAN enabled wireless sensor network with CoAP at the application layer. The current electricity demand in households cannot be met completely without the use of renewable sources of energy. This paper successfully demonstrates a way of managing power from both renewable and non-renewable energy sources operating in parallel. Using appliances powered by the battery can reduce the dependency on AC power thus reducing cost and saving energy. A power meter is used to measure energy consumption for the purpose of calculating the bill in real time and making it available to both the user and utility. Users can also control the loads from any location through this internet based approach. This can also be useful for the utility to shut down supply to specific individual homes, industries, etc. if they consume excess power. The automatic timing based switching of loads can be an extremely useful way of conserving energy and eliminating human intervention. For example, street lights can be turned off during the day when they are not required to be powered on. Future enhancements could include prepaid billing and possible ways of using other renewable sources of energy. The ubiquitous spread of internet in the future would only make this system even more practical and viable.[ 4 ]

Nishant Kumar Verma et al. has proposed Agriculture is an important part of Indian economy. The IoT smart device as described and discussed in the paper plays the vital role in improving farmer life as well as increase the crop production efficiency. Educating farmers with visual alerts helps them to make better and efficient decisions. Different device connected with each other help in evaluating the better data point and analysis which will help Indian government to make better policies for farmers. Indian farmers are still unfamiliar with the properties a soil processes and the best crop that can be grown in the respective fields. This IoT device will help them to easily know each detail of their soil, water level and fertilizer required for the field, thereby, providing sufficient knowledge as required for them to enhance the yields. Weather forecasting and theft protection with visual alert in their own language is added as an advantage to

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their understanding. Further, our aim is to develop an actual implementation of the product on a particular agricultural land which would be an actual case study for the progress of our project.[ 5 ]

# CHAPTER 3

# BLOCK DIAGRAM

## 3.1 BLOCK DIAGRAM

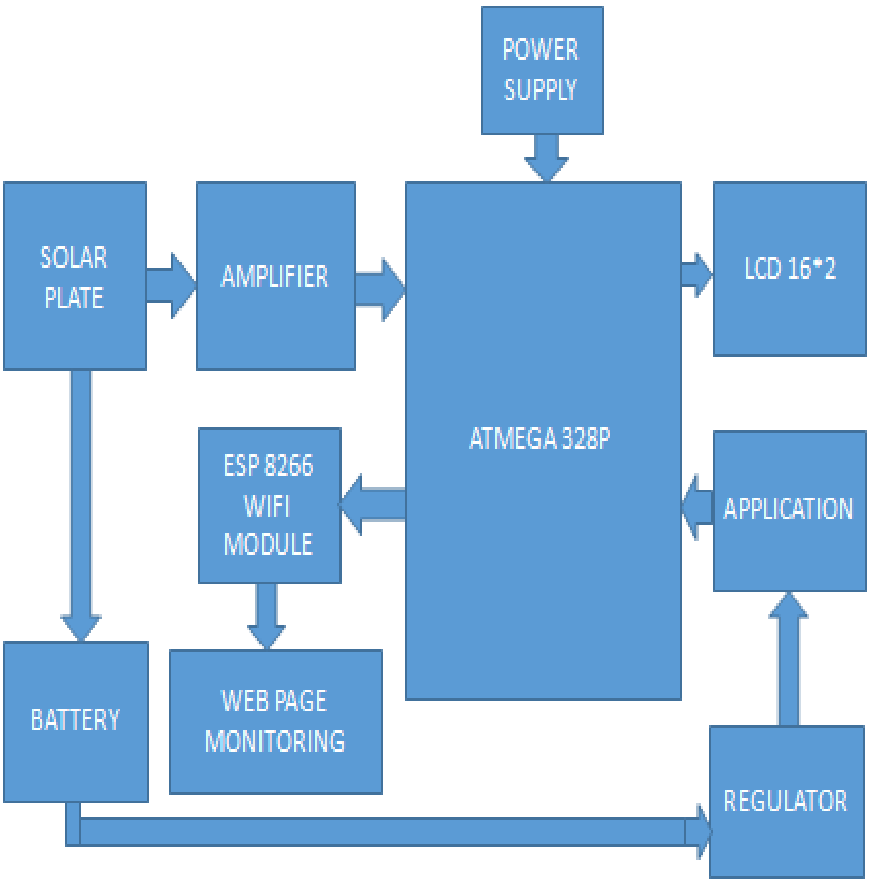


Fig 3.1 Block Diagram

## 3.2 DESCRIPTION

The solar plate which is used as our main energy source is connected to microcontroller through potentiometer. The main aim of solar plate is to generate required power by using sun rays. Microcontroller reads the signal which is coming from solar plate and the resulting voltage of solar plate is displayed on LCD. Simultaneously solar plate is also connected to battery to charge the battery. Solar plate gives us unregulated DC power supply but battery can give us regulated DC power supply. DC motor need regulated power supply to drive itself. So output of battery gives to motor directly.

The basic use of our project is in agricultural area, where load shedding is main concern. Farmers didn't get sufficient amount of electricity to provide water to their farms. So we designed the system which works on solar energy. When value of soil sensor decreases below from standard predefined level then system realises our farm needs water and it displays on webpage as well as on LCD. We have to ON or OFF motor manually.

CIRCUIT DIAGRAM

## 3.3 CIRCUIT DIAGRAM

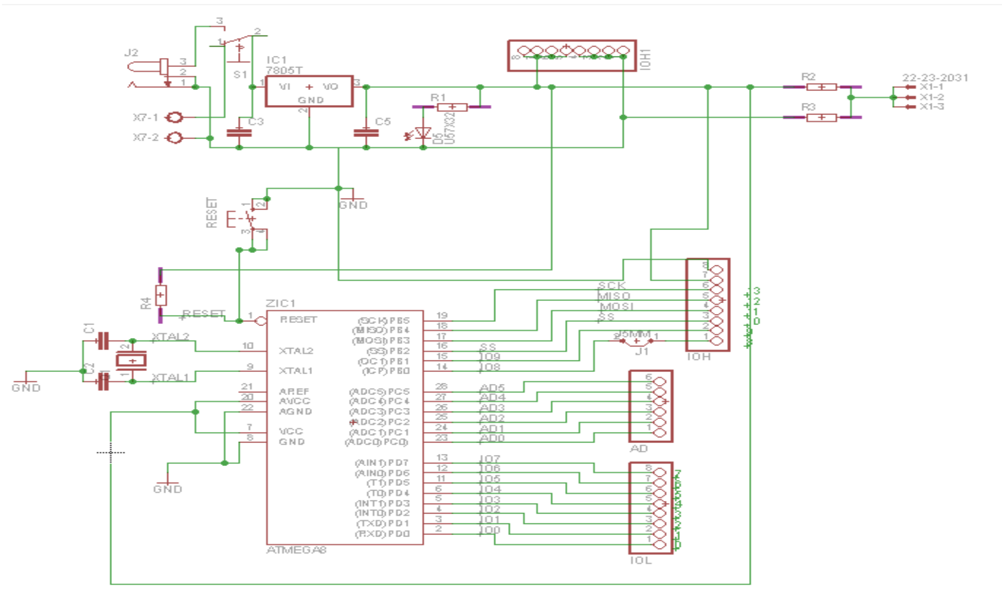


Fig 3.2 Circuit Diagram

# CHAPTER 4

# METHODOLOGY

## 4.1 METHODOLOGY

Our Project is based on IoT which is implemented with Wi-Fi

Module ESP 8266. For designing the circuit diagram we used Eagle software. After completing circuit diagram we got layout of circuit diagram from same software.

We used AVR ATMEGA 328 microcontroller and for programming of microcontroller Arduino software is used. Proteus 8 professionals and proteus 7 software are used for the simulation.

## 4.2 HARDWARE DESCRIPTION

### 4.2.1 Microcontroller (AT328):-

A microcontroller (also microcomputer, MCU or µC) is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. Microcontrollers are designed for small or dedicated applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys .The ATmega8A is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8A achieves throughputs approaching 1 MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed. It is a High-performance, Low-power AVR® 8-bit Microcontroller having Advanced RISC Architecture.

Fig. 4.2.1 ATMEGA (328) Microcontroller.

## Features Of Atmel 8 bit AVR Series:

1. 28-pin AVR Microcontroller
2. Flash Program Memory: 32 k bytes
3. EEPROM Data Memory: 1 k bytes
4. SRAM Data Memory: 2 k bytes

5. I/O Pins: 23

6. Timers: Two 8-bit / One 16-bit

7. A/D Converter: 10-bit Six Channel

8. PWM: Six Channels

9. RTC: Yes with Separate Oscillator

10. MSSP: SPI and I^2C Mater and Slave Support

11. USART: Yes

12. External Oscillator: up to 20MHz

# Pin description of ATMEGA328 Microcontroller:

**VCC:** Digital supply voltage. Magnitude of the voltage range between 4.5V to 5.5V for the ATmega328.

**GND:** Ground reference digital voltage.

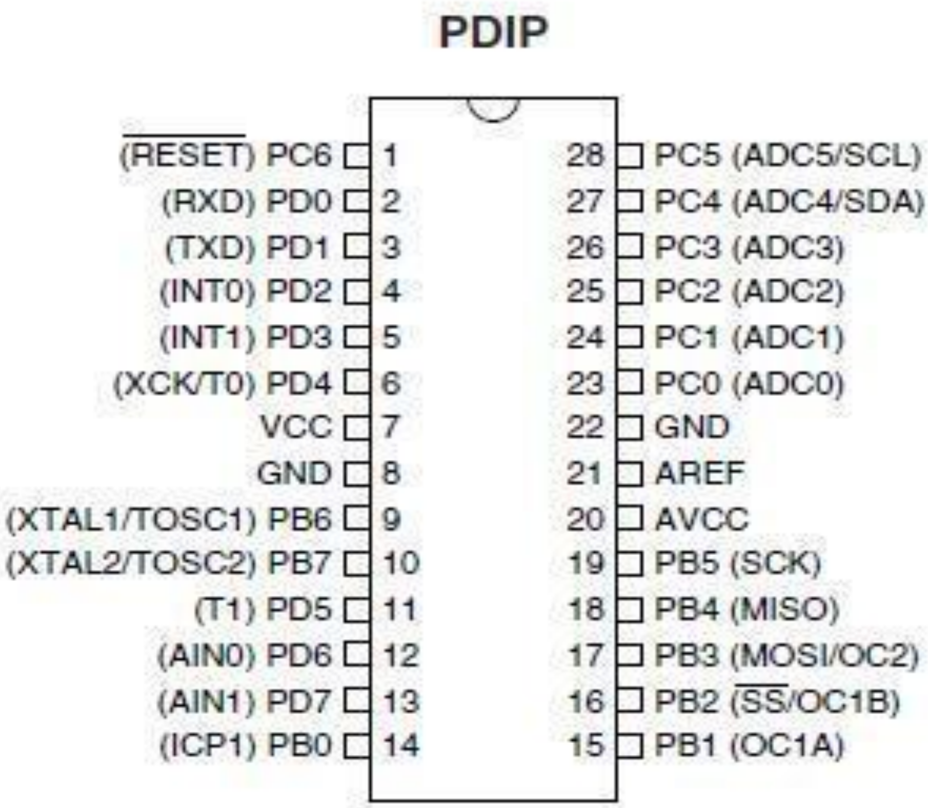


Fig. 4.2.2 Pin Diagram

## 4.2.2:- Voltage Regulator IC:-

Usually, we start with an unregulated power supply ranging from 9volt to 12volt DC. To make a 5volt power supply, IC 7805 voltage regulator as shown in figure has been used.

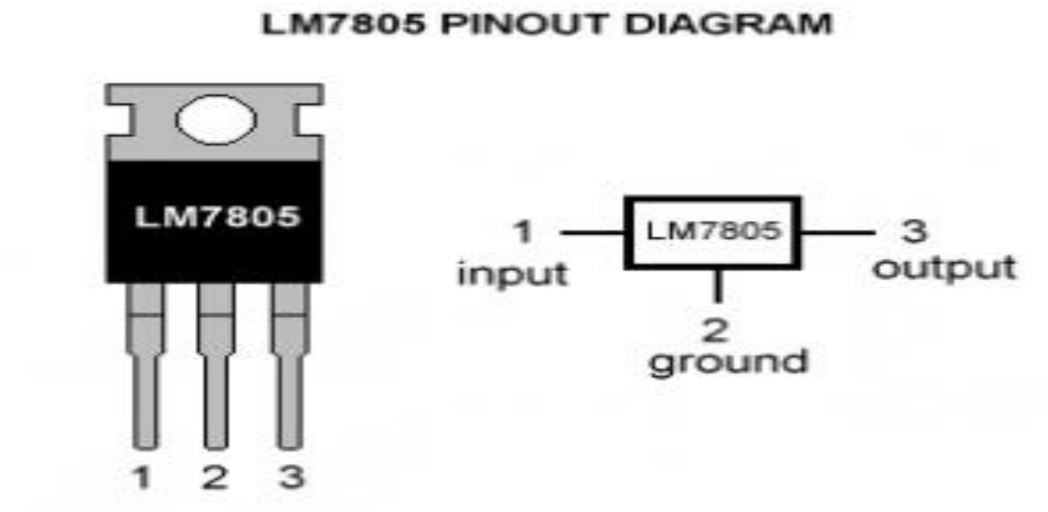


Fig 4.2.3 IC 7805 Voltage Regulator

## 4.2.3 ESP 8266 (Wi-Fi module) :-

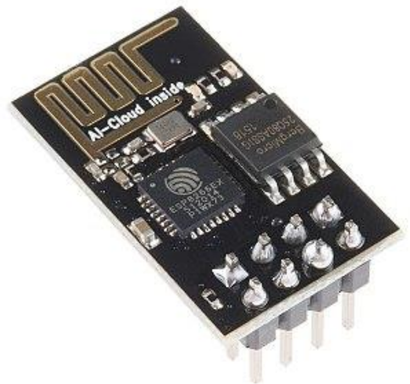


Fig. 4.2.4 ESP 8266(Wi-Fi Module)

ESP8266 is an impressive, low cost WiFi module suitable for adding WiFi functionality to an existing microcontroller project via a UART serial connection. The module can even be reprogrammed to act as a standalone WiFi connected device-just ass power.

The Features list is impressive and includes:

- 802.11 b/g/n protocol
- WiFi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack

## 4.2.4 Aurdino Board

Aurdino is a tool for making computers sense and control more of the physical world than desktop computer. It's an open-source computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Aurdino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Aurdino projects can be stand-alone, or communicate with software running on your computer. There are many other microcontrollers and microcontroller plateforms availables for

Physical computing. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Aurdino is also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems.

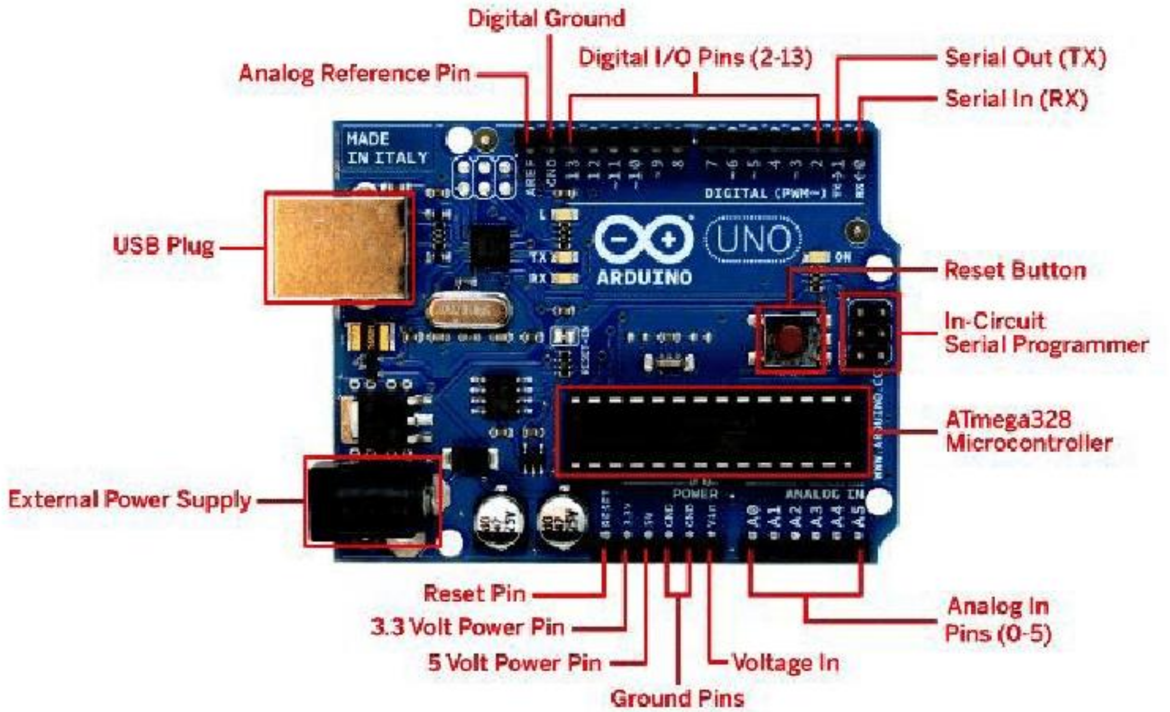


Fig. 4.2.5 Aurdino UNO

## 4.2.5 Solar Plate:-

Fig. 4.2.6 Solar plate

The amount of power that a PV solar panel provides is indicated by the wattage (W). The higher the wattage, the more powerful the panel. Wattage can be calculated from the Amps (current) and Volts and vice versa:

Watts = Amps x Volts
Amps = Watts / Volts
Volts = Watts / Amps

There are two main types of solar panel: amorphous and crystalline. In general, amorphous perform better than crystalline under low light conditions and don’t suffer as much power loss in hot temperatures. However, in good conditions, the efficiency of amorphous panels is lower, and they are physically larger than crystalline panels of the same wattage. Rollable, folding and flexible panels are generally amorphous, whereas crystalline panels tend to be aluminium framed and glass fronted, and therefore heavy and difficult to transport

## 4.2.6 16*2 LCD display:-

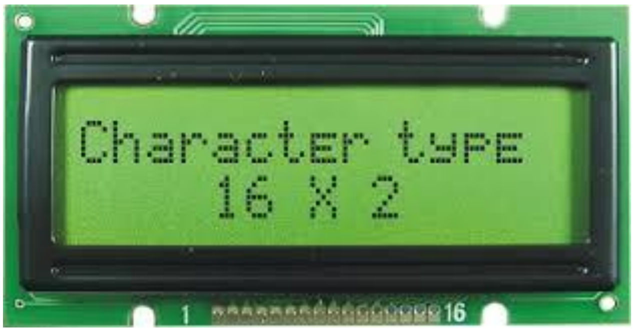


Fig. 4.2.7 LCD Display

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

4.2.7 Boost convertor:

Fig 4.2.8 Boost Converter

Step up DC-DC converter is based on LM2577-ADJ IC, this project provides 12V output using 5V input, maximum output load 800mA. The LM2577 are monolithic integrated circuits that provide all of the power and control functions for step-up (boost), fly back, and forward converter switching regulators. The device is available in three different output voltage versions: 12V, 15V, and adjustable. Requiring a minimum number of external components, these regulators and fly back transformers designed to work with these switching regulators. Included on the chip is a 3.0A NPN switch and its associated protection circuitry, consisting of current and thermal limiting, and under voltage lockout. Other features include a 52 kHz fixed-frequency oscillator that requires no external components, a soft start mode to reduce in-rush current during start-up, and current mode control for improved rejection of input voltage and output load transients.

## 4.2.8 Buck Converter:

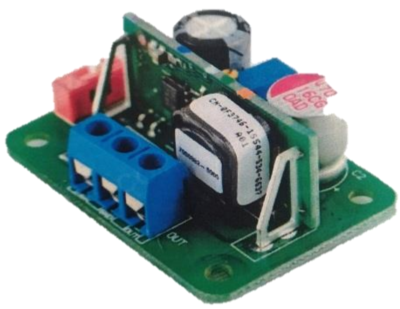

Fig 4.2.9 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter)

## 4.2.9 Relay :

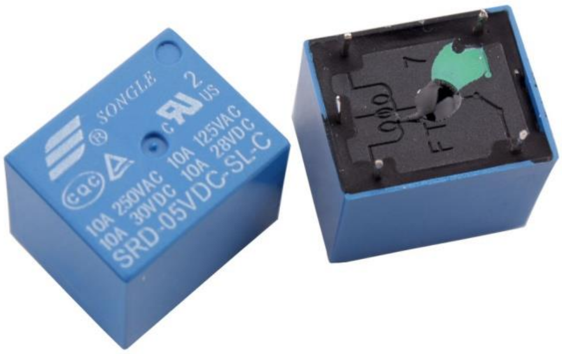


Fig 4.2.10 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

# CHAPTER 5

# PLANNING AND TENTATIVE COST IN INR

## 5.1 PLANNING

While preparing our projects, we divided our project in three different parts which is use of solar energy, recent studies on IOT, and the finalisation of application of our project.

1) We studied about what type of projects are implemented on solar energy and where we can use solar energy.
2) By using IOT which type of projects are implemented and where we can use IOT for our projects.
3) The main thing for us that where we can use our projects. So after discussion with our guide we deided to use our project in rural areas where shortage of electricity occurs And 80% of our population depends on agriculture.

So after thing in mind these points we started working on our project's block diagram and circuit diagram. We designed simulated of our project and currently we are working on exact implementation of our project.

Table 5.1 Planning of Project

| Sr. No. | Month | Work to be done |
|---|---|---|
| 1 | November | Component purchasing and PCB designing |
| 2 | Secember | Component Mounting |
| 3 | January | Develop Program |

| | | |
|---|---|---|
| 4 | February | Testing |
| 5 | March | Finalization of Project |

# 5.2 COMPONENTS LIST

Table 5.2 List of Components Required

| Component name | Quantity | Cost (rupees) |
|---|---|---|
| AVR ATMEGA 328 Microcontroller | 1 | 250.00 |
| AVR ATMEGA 328 Development board | 1 | 600.00 |
| ESP 8266( wifi module) | 1 | 200.00 |
| Solar panel | 1 | 1000-1500 |
| 4N35 Optocoupler IC | 1 | 170.00 |
| Soil Moisture Sensor | 1 | 250.00 |
| Battery 12v | 1 | 300-500 |
| Relay | 4 | 150.00 |
| 16*2 LCD Display | 1 | 150-200 |

| | | |
|---|---|---|
| | | |
| DC Motor (12 v) | 1 | 200-300 |

## CHAPTER 6

## CONCLUSION

### 6.1 CONCLUSION:-

After designing and modifying block diagram correctly, we designed the circuits diagram using microcontroller IC ATMEGA 328 and WiFi module ESP 8266. After designing circuit diagram the simulation work has been carried out with proteus software. With this analysis we can say that the implemented project could give a good solution in modern agriculture field.

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