# REMOTE MONITORING AND CONTROLLING OF SOLAR PUMPING SYSTEM USING GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

A thesis

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Department of Mechanical Engineering

SONARGAON UNIVERSITY (SU)

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## Abstract

This project focuses on enhancing existing agricultural methods through the utilization of modern technologies to improve farming practices and modernize traditional agricultural systems. In remote areas, it is crucial to monitor the Solar Pumping Control System to ensure stable operation, particularly in regions with unpredictable weather patterns. This initiative aims to enable farmers at the grassroots level to adopt smart irrigation techniques for agricultural purposes. Smart irrigation offers significant advantages by providing efficient irrigation at a reduced cost and requiring minimal manpower. It is based on the concept of utilizing IoT sensors to gather data about agricultural fields and automate irrigation processes through the Internet of Things. The advancement in wireless communication technologies has facilitated the development of various engineering solutions to meet human needs. One such solution is the Remote Monitoring and Control of Solar Pumping System Using GSM, which offers a simple, versatile, and cost-effective design for controlling the on-off operation of an electric motor used for irrigation. This system allows users to activate irrigation remotely by simply giving a missed call from their mobile phones. The efficiency of a solar panel is a major concern in the field of renewable energy. This paper presents a simulation model developed in MatLab to investigate the effectiveness of various methods to increase the efficiency of solar panels.

Furthermore, the effects of different conditions on the panel's efficiency were evaluated, it also provides users with additional control to irrigate their fields from a remote location.

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# Chapter 1

# Introduction

## 1.1. Introduction

In today's rapidly growing global population, agriculture holds paramount importance in meeting the needs of humanity. Across the world, people rely on agriculture for sustenance, and it serves as a cornerstone of national economies, offering substantial employment opportunities. The agricultural sector's growth is indispensable for the economic advancement of any nation. However, many farmers continue to employ traditional farming methods, resulting in suboptimal crop yields. Conversely, automation through machinery has demonstrated significant increases in production. Thus, there is a pressing need to integrate Internet of Things (IoT) technologies into agriculture to enhance productivity. This paper proposes a system designed to monitor real-time field data and control field operations, thereby offering ease and flexibility. The primary objective of this proposal is to leverage IoT technologies to implement smart irrigation, thereby optimizing agricultural practices. [1]

Solar energy is one of the most promising renewable energy sources and is increasingly being used to power homes and businesses. Solar panels are the main component of solar energy systems, and their efficiency is critical for the success of such systems. Increasing the efficiency of solar panels is a major challenge for the renewable energy industry. This paper presents a simulation model developed in MatLab to investigate the effectiveness of various methods to increase the efficiency of solar panels. Solar energy has long been recognized as a promising alternative to traditional energy sources, and solar cells are a key component of this technology. As the demand for solar energy increases, the efficiency of solar cells must also increase. [5]

Certainly, in agriculture, irrigation is essential, especially considering the increasing water consumption compared to rainfall each year. It's imperative for growers to seek methods to conserve water while maintaining optimal crop yields. However, currently, many farmers rely on manual irrigation control techniques, which involve irrigating the land at regular intervals. This method often results in either excessive water consumption or delayed water delivery, leading to crop dehydration. [2]

## 1.2. Study Background

Wireless communication has spurred the development of various engineering solutions to meet human needs. In countries like Nepal, where agriculture plays a crucial role in development, our project focuses on leveraging mobile communication to assist farmers. The GSM Based Automatic Irrigation System offers a simple, versatile, and cost-effective design to regulate the on-off mechanism of an electric motor for field irrigation. This system utilizes the GSM network, mobile phones, and electronic circuits to create an automated system programmed to function as an intelligent device for irrigation management. In addition to autonomously monitoring soil moisture levels, the system provides users with auxiliary control, enabling remote irrigation management. Through sensor inputs, the motor operates independently, allowing farmers to monitor the system's performance and take necessary actions as required. Automating farm or nursery irrigation offers numerous benefits, allowing farmers to precisely control water application regardless of labor availability. This helps in avoiding overwatering, reducing runoff, and optimizing crop performance by ensuring water and nutrients are delivered when needed. Automatic irrigation is especially valuable for precise soil moisture management in specialized greenhouse vegetable production. In our project, soil moisture sensors continuously monitor soil moisture levels, allowing users to select the desired moisture content for different crops. Whether irrigating rice fields requiring ample water or other crops with lower moisture needs, this system caters to various crop requirements. Utilizing the GSM network enables a cost-effective irrigation system that monitors soil moisture and sends notifications to the landowner, triggering irrigation when necessary. Additionally, the system automatically switches off the motor once the desired moisture condition is achieved. [3]

Solar panel efficiency is dependent on a number of factors, such as the angle of incidence, the ambient temperature, the solar cell model and the type of material used. The angle of incidence is particularly important, as it determines how much of the solar radiation is absorbed by the solar panel. The ambient temperature is also important, as higher temperatures can reduce the efficiency of the solar panel [6]. The solar cell model is also important, as different models have different efficiency levels. Finally, the type of material used in the solar panel can affect its efficiency.

## 1.3. Objectives

- To develop effective and convenient automatic irrigation system to increase the productivity of crops.
- To minimize human labor used in irrigation.
- To provide convenience in accessing the system from anywhere at any time.
- To save the time of the owner for the large fields.
- Boosting solar panel performance by increasing efficiency of solar cell.
- Reducing cost per Watt.

## 1.4. Significance

Limitations relating to the software as well as hardware are present. Some of the majorlimitation may be grouped as follows:

1. Single moisture sensor only covers the small area of fields
2. Atmospheric moisture contents also brought some fluctuation in the measure value of soil moisture content.
3. Some chemical reaction erodes the sensitivity and physical structure of sensor
4. Lack of knowledge about the fixed moisture content require for the particular fields

## 1.5. Applications

1. In today's world, more and more people are being born, and that means there's a greater need for food. But our old-fashioned farming methods just can't keep up with the demand. That's where our agricultural technology comes in. It's all about using science to make farming better, so we can produce more food for everyone.
2. This system can make a big difference in countries that rely on farming, like Nepal and the Maldives, as well as in places with advanced farming practices, like Brazil and Europe. By using modern methods, we can grow more crops and feed more people.

Since, farmers can keep an eye on their fields right from their phones, saving time and making farming easier.

# Chapter 2

# Literature Review

## 2.1. Literature Review

Many studies in farming focus on using sensors and automatic pumps to help with issues like global warming. One big problem caused by global warming is that soil in farming areas is drying out. When the soil dries up, it's not good for growing crops because the plants don't get the nutrients they need from the soil. This is because the tiny organisms in the soil that help plants get their food don't work as well when it's too hot. So, knowing how much moisture is in the soil is really important for predicting the weather and making sure plants can grow well. Soil moisture is also important for cooling the ground down when it's too hot. It's a key part of how the environment and weather work, and it's super important for farming. Even in cities, people try to grow plants on their balconies, but sometimes they forget to water them regularly because they're busy. This can make the plants sick because they either get too much or too little water, which is bad for their growth and health. So, the idea is to make a system that helps take care of farms and gardens automatically, without needing people to do it all the time. One way is by using a special app on a phone to control a system that waters the plants when they need it, using both Wi-Fi and mobile networks. This system can keep an eye on things like temperature and moisture levels in a greenhouse and adjust them as needed to help the plants grow well. [3] Therefore, the idea behind this system is to make it easier for people to take care of their farms without spending too much time and energy. A lot of research shows that automatic irrigation systems using wireless technology are becoming really popular in farming. These systems connect to mobile phones using GSM technology, which uses cellular networks. But in some countries that are still developing, there are problems with using this kind of technology because of limitations. This paper talks about a new system that solves this issue. It uses an app called Blynk on a mobile phone to control a motor that waters the plants. This system uses both Wi-Fi and GSM technology, so it can work in different places. It's designed to keep an eye on things like temperature and moisture levels in a greenhouse and adjust them as needed to help the plants grow well. [4]

As technology improved, scientists began to explore ways to improve their efficiency. This

led to the development of multi-junction cells, which use several layers of different materials to absorb different wavelengths of light and convert it into electricity. Today, solar cells are more efficient than ever, and they are being used in a variety of applications, from powering homes to powering spacecraft. Solar cells are becoming increasingly popular as a renewable energy source due to their low cost and clean energy production. As technology continues to improve, scientists are exploring ways to make solar cells even more efficient and cost effective. [5]

### 2.2. GSM Based Irrigation Controlling System

In this setup, the connection between the two mobile phones is established through GSM technology. The GSM module and microcontroller communicate with each other using UART (universal asynchronous receiver/transmitter). When the soil moisture sensor detects low moisture levels, it sends a signal to the microcontroller. The microcontroller then signals the designated mobile phone, which is set to auto-answer mode. Once the call is received, the called mobile phone activates a buzzer. Currently, the GSM module is primarily utilized for remote control tasks such as gate control and temperature regulation. A GSM/GPRS module consists of a GSM/GPRS modem along with a power supply circuit and communication interfaces like RS-232 and USB for connection to a computer. The modem is the key component of these modules, responsible for generating, transmitting, or decoding data from the cellular network. These modules are tailored for specific cellular networks or data standards, and they use serial communication to interact with users, requiring Hayes compatible AT commands for communication with computers or microcontroller systems. [6]

Back in the day, an RS-232 port was a common sight on personal computers. It was used to connect various devices like modems, printers, mice, storage units, and more. However, RS-232 had its limitations—it wasn't particularly speedy, required relatively high voltage swings, and used large connectors. To address these shortcomings, the universal serial bus (USB) was developed, and it quickly took over many of the roles previously handled by RS-232. These days, most modern personal computers don't come equipped with RS-232 ports anymore. If we have older peripherals that still rely on RS-232, we'll need an external converter to connect them to wer computer. Despite its decline in consumer tech, RS-232

still has a presence, especially in industrial machinery and scientific instruments where it's valued for its reliability and simplicity. [7]

So, when the mobile phone receives a call, it activates a buzzer to signal that the valve needs to be opened. Pressing a button on the called mobile phone sends a signal back to the microcontroller. The microcontroller then sends a signal to open the valves, allowing water to drip onto the plant roots. Once the soil moisture reaches a sufficient level, the sensor detects this and sends a signal back to the microcontroller, turning off the buzzer. Pressing the button on the calling mobile phone again turns off the valve. The controlling system requires a power supply of +5V.

## 2.3. Project Overview

The main goal of our project is to create and implement a solar-powered water pump controller that can remotely detect the water level in a tank and pump water from a distant source, like a pond, only when needed. This ensures that plants receive the optimal amount of water for their growth, whether it's hot, cold, dry, or wet outside. To ease the burden of manual plant watering, we've implemented an automated plant watering system. This system continuously monitors the soil moisture level and determines whether watering is necessary, as well as how much water is needed for the plants' soil. Traditional manual irrigation systems often provide variable amounts of water, leading to either excess or insufficient watering for optimal crop growth. This inconsistency requires farmers to constantly monitor the soil moisture content, which can be a time-consuming task, requiring effort day and night.

## 2.4. The Photoelectric Effect of solar cell

The Photoelectric Effect of solar cells is a phenomenon in which electrons are emitted from the surface of a material when it is exposed to electromagnetic radiation like sunlight. This phenomenon is used in solar cells to convert light energy into electrical energy. When light particles (photons) hit the surface of a solar cell, they release electrons which then flow through the circuit, producing an electric current. Solar cells are able to capture a wide range of wavelengths of light, meaning they can generate electricity from a variety of sources. This makes solar cells a very efficient energy source, as they are

able to produce a great amount of electricity from a small area.

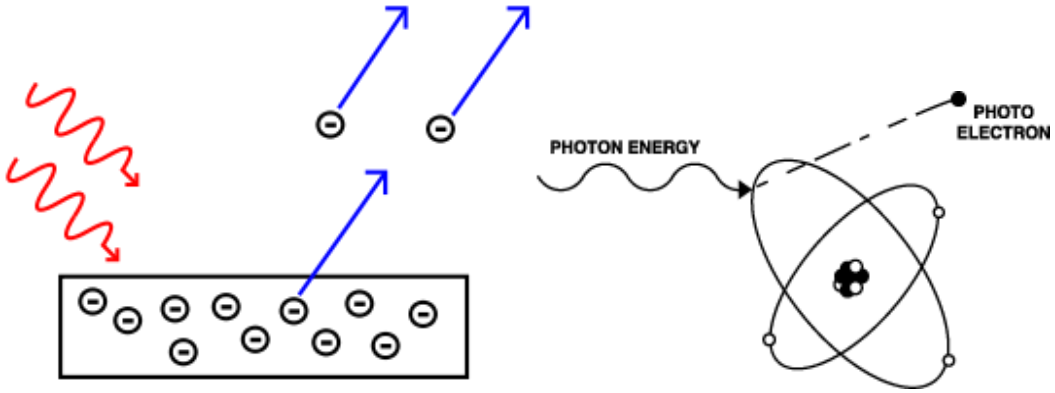



Figure-2.1: Best Research Solar Cells Efficiencies

A solar cell, or photovoltaic cell, is a type of PN junction photodiode capable of absorbing the sun's radiation. In Fig 1, the photovoltaic effect is the process through which the PV cell changes sunlight into electricity. Sunlight is made of photons, which are bundles of solar energy. When photons hit a PV cell, they can be reflected, absorbed, or pass through [2]. The absorbed photons produce electricity. The energy of the photon is passed on to an electron in the atom of the semiconductor device. A group of solar cells can transform solar energy into a usable amount of direct current (DC) electricity. [8]

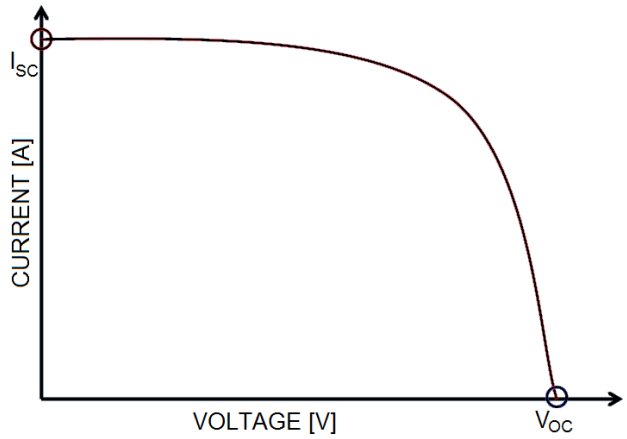



Figure-2.2: Current and Voltage Curb of Solar Cell

The amount of solar energy that a cell receives is called irradiance and is measured in Watts per meter squared (W/m2). Open Circuit Voltage ($V_{OC}$) is the highest voltage that a solar cell can generate when there is no current running through it. Short Circuit Current ($I_{SC}$) is the amount of current that runs through the solar cell when the voltage across the

cell is zero.

## 2.5. Improving the Efficiency of Solar Photovoltaic Power System

Improving the efficiency of solar photovoltaic (PV) power systems is an important research goal in the renewable energy industry. Solar PV systems convert sunlight into electricity using photovoltaic cells, which are composed of semiconductor materials such as silicon. The efficiency of a solar PV system is determined by the number of photons (light particles) that are converted into electricity. Generally, the higher the efficiency, the more electricity that can be generated from a given amount of sunlight. Research into improving the efficiency of solar PV systems focuses on developing new materials and technologies that can absorb and convert more of the sun's energy into electricity. This includes using nanotechnology to create tiny structures that can capture more photons, and using advanced materials such as grapheme to create more efficient solar cells. Additionally, research into solar cell optimization is looking at ways to improve the performance and efficiency of existing solar cells. This includes developing ways to reduce the amount of energy lost in the conversion process, as well as strategies to improve the operation of solar cells in different climates and weather conditions. Overall, improving the efficiency of solar photovoltaic power systems is an important research goal in the renewable energy industry. By increasing the efficiency of solar cells, we can generate more electricity from the same amount of sunlight, which can help reduce our reliance on non-renewable energy sources and help reduce our carbon footprint.

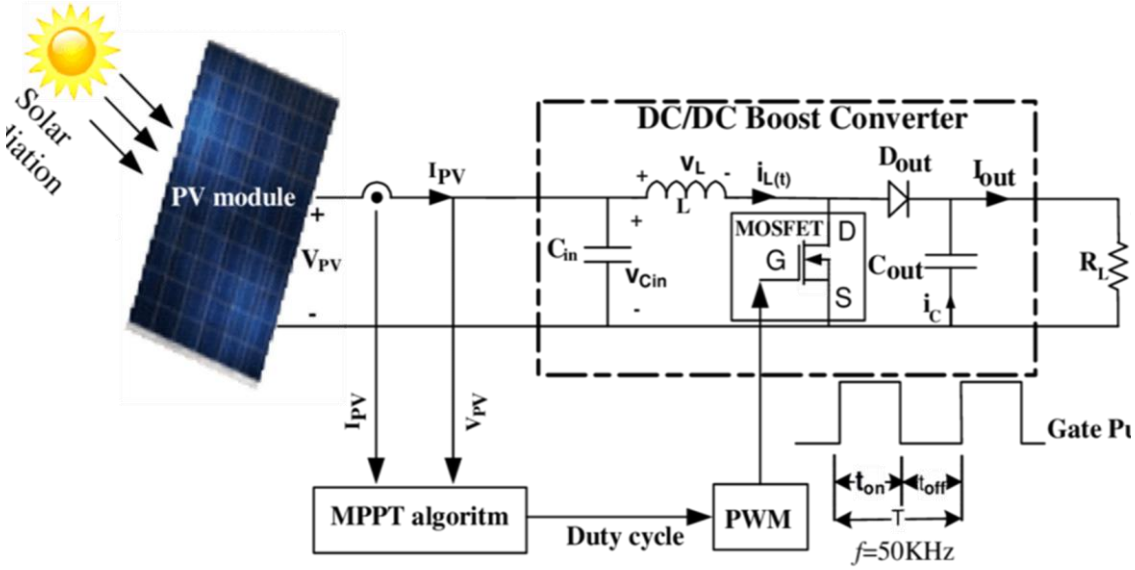



Figure-2.3: Simulation circuit of Solar System

# Chapter 3

# Methodology

## 3.1. Working Principle

The monitoring system has many sensors to measure different things, like how much electricity the solar panel makes, how the inverter works, how hot the panel and the air around it are, how much water is in the tank, how dirty the panel is, and how fast the wind is blowing to stay safe during storms. There's also a sensor to check if the soil is wet and valves to control how much water goes into the tank or onto the soil. To send data, there's a device called a GSM modem, and a small computer called a NodeMCU board manages the system and collects data from the sensors. A prototype of this Solar Powered Control System (SPCS) has been made and tested. The automatic irrigation system that uses GSM is easy to use, with just one switch to turn it on. When We choose irrigation mode, a dashboard shows the voltage from the electric line and if the motor is on or off. This system has parts like a GSM module, a dashboard screen, and a motor to pump water into the field. When We choose a specific crop mode, a sensor in the field checks how much water is in the soil. It works by turning the water level into an electric signal, kind of like how a thermometer works. The NodeMCU computer then turns this signal into numbers that it can understand, sort of like translating it into a language it knows. These numbers show up on the dashboard, like a gauge telling We how much water is there. If the soil is too dry, the motor starts pumping water into the field automatically. Once the soil has enough water, the motor stops by itself. We can see if the motor is running or stopped on the dashboard screen. And if We want to check how the field is doing when We're not there, we can call a special number. When the GSM module gets our call, the computer sends we a text message with all the details about the field's condition.

In the methodology of this project, the operation is initiated by input commands from the Blynk App or by a missed call from a mobile phone. The NodeMCU processes data from various sensors based on predefined conditions. Initially, the water level sensor assesses the field's condition, which could range from dry to watery. This sensor is positioned near water sources. When the soil moisture level is detected to be low, indicating dryness, the pump activates automatically. This information is then saved and stored in the Altair Smart

Core server. Simultaneously, the user receives notifications regarding the pump's activation status.

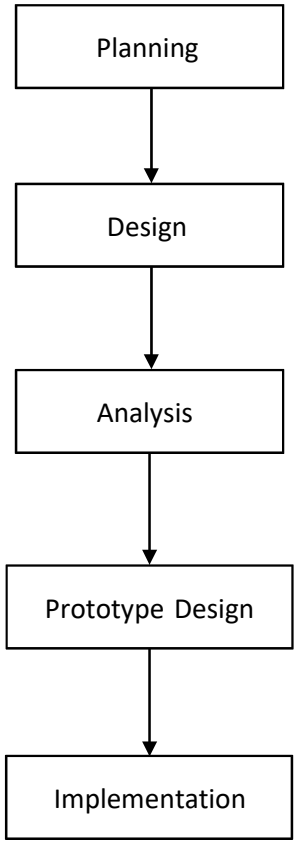



Figure-3.1: System Methodology

## 3.2. Flow Chart

The bottom shown the figure consists of the flowchart which clearly demonstrates the workflow of the project.

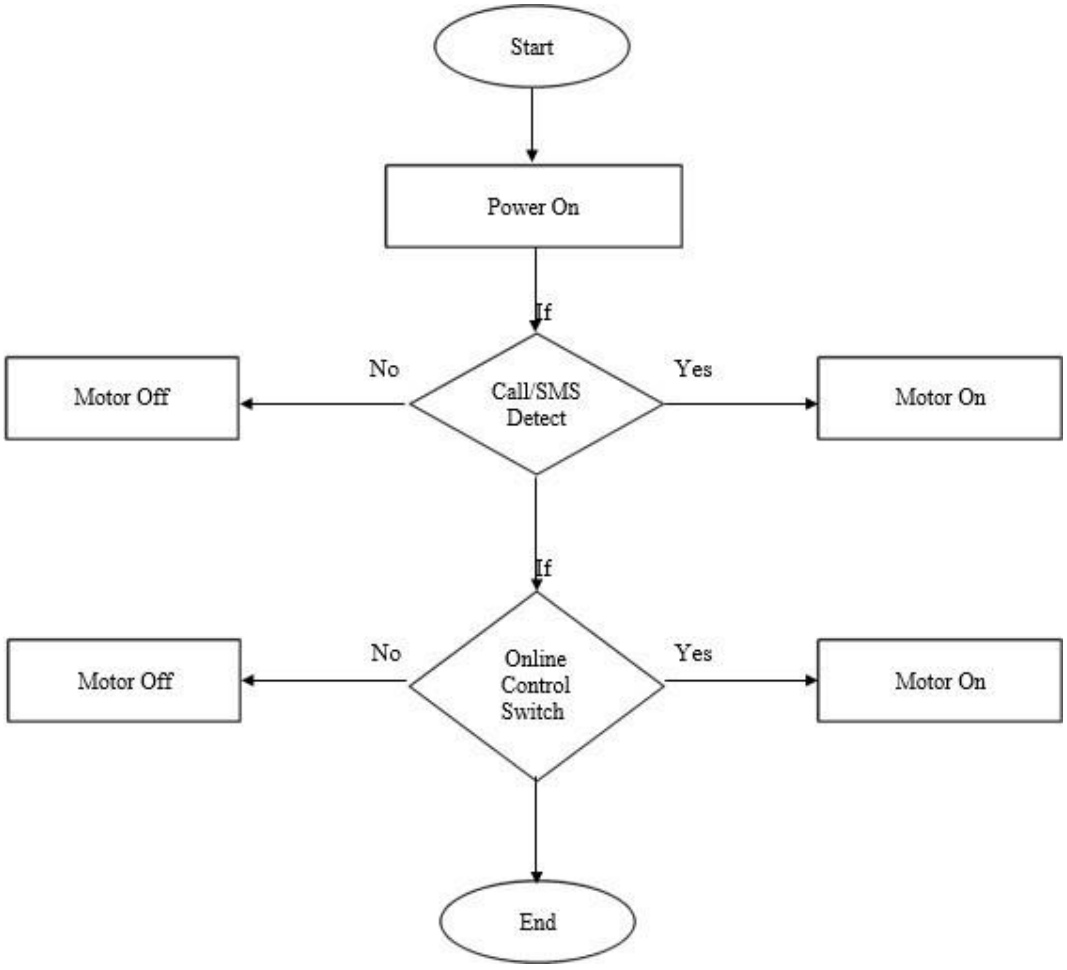



Figure-3.2: Flowchart of the System

## 3.3. Experimental Design Structure

During the testing phase of this project, a lot of effort went into fixing problems in the microcontroller code and making sure it worked well with the wired and PCB-designed hardware. To find and fix these problems, we put special messages in the code that showed us exactly what was happening when the code ran. Sometimes it was tricky to figure out if a problem was because of how the hardware was connected or because of mistakes in the

code itself. To help with this, we used a computer screen to show us the code as it ran. We also used a virtual oscilloscope, which is like a tool that helps see electrical signals, to check if there were any issues with the hardware. These ways of fixing problems were really important to make sure the project worked correctly.

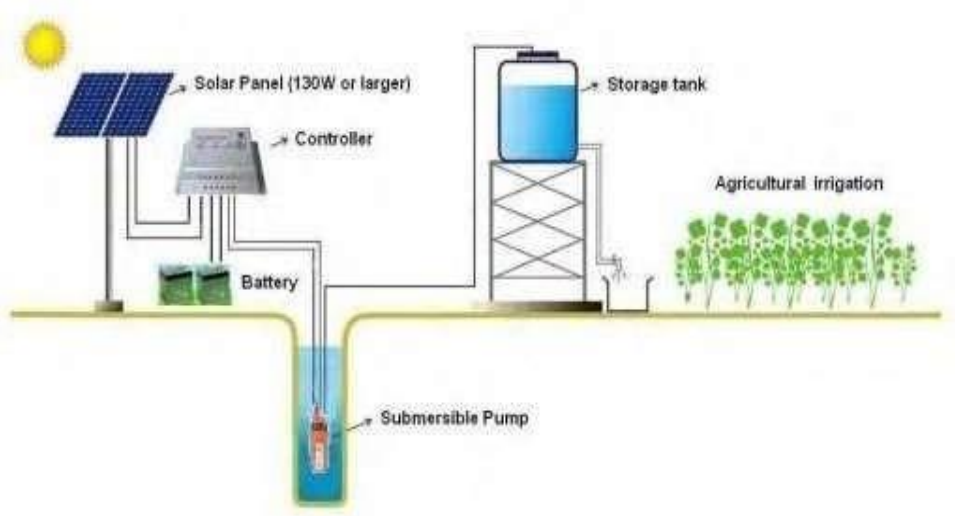



Figure-3.3: Mechanical Design Structure

Interfacing the microcontroller with the rest of our circuit proved to be a challenging and iterative process, with one of the major hurdles being ensuring that each input was correctly directed to the appropriate port of the microcontroller. To address this, we implemented numerous comparison statements within the microcontroller code. If the signals received by the microcontroller differed from what was expected, the program would enter an endless loop, outputting error statements. Only when the microcontroller recognized a valid input would it proceed to the next loop. Ensuring that the microcontroller produced the correct output signals was equally important. To verify this, we utilized test LEDs strategically placed within our circuit. If an LED was triggered erroneously, we first examined the source code to determine if any instructions misinterpreted the inputs. Then, we inspected how the specific component was wired and assessed if it behaved correctly based on the signal sent to it by the microcontroller. This process of tracing back through the code and circuitry was crucial in rectifying many of our debugging issues. Overall, interfacing the microcontroller with the rest of the circuit proved to be a lengthy and iterative trial-and-error process, requiring careful attention to detail and thorough testing.

The soil moisture sensor continuously measures the moisture content of the soil. This information, along with the status of the motor (whether it's on or off), is sent via SMS, while the supply voltage is displayed continuously on the Dashboard screen. Users are given the option to select the type of field they want to irrigate using the Blynk App. They can choose between fields that require a lot of water, like rice fields, or those that need moderate or less water. If the user is away from the cultivated area, they can simply give a missed call to check the moisture content remotely. If the soil has sufficient moisture, indicating that irrigation isn't needed, the motor remains off. However, if the soil moisture is insufficient, signaling the need for irrigation, the motor switches on automatically. Once the field reaches the required moisture level, the motor shuts off automatically. This automated process ensures efficient irrigation management without constant manual intervention.

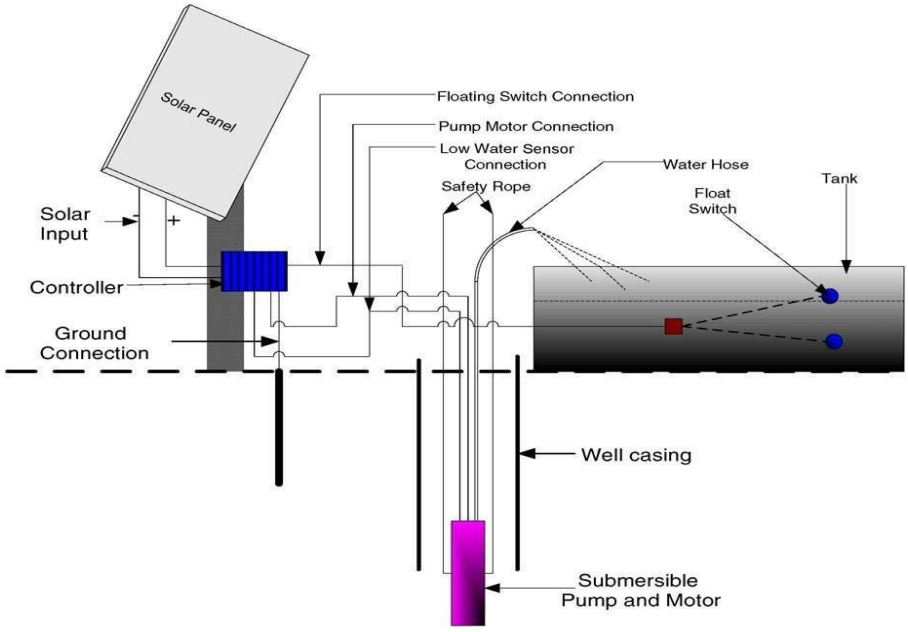



Figure-3.4: Electrical Design Structure

### 3.4. Requirements Component & Software

To begin with the project, let’s get the idea of all the components that we used for the project. Itis very important to know all the information about both hardware and software specifications.The components we are using are as follows:

**3.4.1.** Software Requirements:

- Arduino IDE
- Proteus simulation software

**3.4.2.** Hardware Components:

| SL/NO | Instrument | Quantity |
|---|---|---|
| 1 | Node MCU Micro-controller (Built in Wi-Fi) | 1 |
| 2 | Solar Panel (6v DC) | 1 |
| 3 | Pizzo Speaker | 1 |
| 4 | DC Water Pump | 1 |
| 5 | Voltage Converter (LM2596) | 1 |
| 6 | L293D Charging Module | 1 |
| 7 | PCB Board with Black Line | 2 |
| 8 | Relay Module (5 volt) | 1 |
| 9 | Transistor (BC547) | 5 |
| 10 | Resistor (100ohm, 1k, 10k) | 4 |
| 11 | Led (white) | 2 |
| 12 | Jumper Wire (Male to Female) | 1 |
| 13 | Lithium Battery Pack (Cell) | 6 |
| 14 | Glue Stick | 1 |
| 15 | Card Board | 20 |
| 16 | Glue Gun | 4 |
| 17 | Card Board | 2 |

Table 1: Hardware Components

## 3.5. Description of the Components

The component details are described sequentially in below that we used in our project.

### 3.5.1. NodeMCU (ESP8266)

The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT)

projects of all kinds.

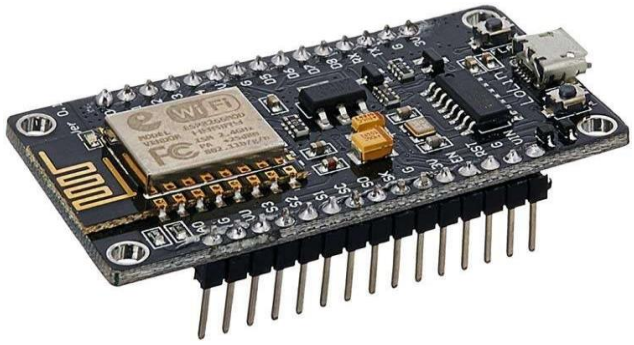


Figure-3.5: NodeMCU Micro-controller

However, as a chip, the ESP8266 is also hard to access and use. We must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. We also have to program it in low-level machine instructions that can be interpreted by the chip hardware.

This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

### 3.5.2. 10W Solar Panel (12V)

Small, compact, all weather this 12v 10w Solar Panel is built to high standards. An ideal panel for steady battery charging and maintenance or our small off grid lighting project. This high quality 12v 10w Solar Panel works in both sunny and overcast conditions and is fully weatherproof. Comessupplied with 2 meters of cable, a blocking diode to prevent reverse charging and crocodile clips for easy battery connection.



Figure-3.6: 10w Solar Panel

12v 10w Solar Panel Specification

- Dimensions: 355mm x 252mm x 25mm
- Weight: 1.3kg
- Open Circuit Voltage: 21.6V
- Short Circuit Current: 0.66A
- Power Allowance Range: 5%
- Max Power Voltage: 16.96V
- Max System Current: 0.5A
- Max System Voltage: 300VDC
- Number of Cells: 36
- Year electronic component warranty
- 25 year efficiency guarantee @ >80%

### 3.5.3. GSM Module (SIM800L)

It is a breakout board with minimum system of SIM800L Dual-band GSM/GPRS module. It cancommunicate with controllers via AT commands.




Figure-3.7: GSM SIM800A.

Features:

a) Quad-Band 850/ 900/ 1800/ 1900 MHz

b) Dual-Band 900/ 1900 MHz

c) GPRS multi-slot class 10/8GPRS mobile station class B

d) Compliant to GSM phase 2/2+Class 4 (2 W @850/ 900 MHz)

e) Class 1 (1 W @ 1800/1900MHz)

f) Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced ATCommands)

g) Low power consumption: 1.5mA (sleep mode)

h) Operation temperature: -40°C to +85 °C

The GSM plays a very important role wireless communication. It has to follow different protocols toperform secure wireless communication. They are:

a. **Specifications for data:** Maximum 85.6 Kbps with GPRS class 10. USSD and PPPstackspecified. Coding scheme CS 1,2,3,4
b. **Specifications for SMS:** Point-to-point MO and MT, SMS cell broadcast, text andPDUmode.
c. **Software Features:** 0710 MUX protocol with embedded TCP/UDP protocol andFTP/HTTP.

### 3.5.4. Transistor

The BC548 is a general-purpose NPN bipolar junction transistor commonly used in Europeanand American electronic equipment. It is notably often the first type of bipolar transistor hobbyist's encounter and is often featured in designs in hobby electronics magazines where a general-purpose transistor is required. The BC548 is low in cost and widely available. The BC548 is a part of a family of NPN and PNP epitaxial silicon transistors that originated withthe metal-cased BC108 family of transistors. The BC548 is the modern plastic-packaged BC108 the BC548 article at the Radio Museum website describes the BC548 as a successor to the BC238 and differing from the BC108 in only the shape of the package. Datasheets for the BC548 give specifications that are identical to, or exceed, those of the BC108, BC148 and BC238 predecessors. Thus, the BC548 (or BC546 to 550) is a valid substitute in any circuit designed for the older BC108 (or BC148), which includes many Mallards and Philips published designs.

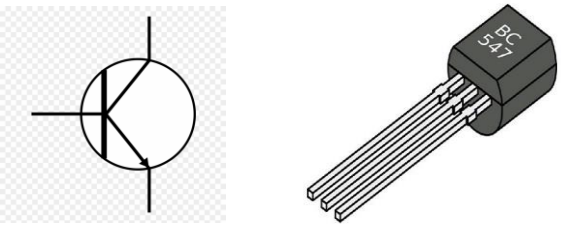



Figure-3.8.: NPN Transistor with Symbol

The BC548 is supplied in a standard TO-92 3-pin package. The assignment of transistor elements (b,c,e) to leads, i.e. the "pin-out", uses the same convention used by some - but not all

- other TO-92 devices. As viewed in the top-right image, going from left to right, the pin-out isas follows:

- lead **1** (left in diagram) is the **c**ollector,
- lead **2** is the **b**ase, and
- lead **3** is the **e**mitter

### 3.5.5. Power Supply

We have used a sealed 3.7V Lithium Battery which has nominal capacity of 2mAh. The 18650C1-2600 is 1200mAh version 18650C1 (1pcs cell inside) battery. It is made of single 18650 li ion rechargeable battery cell with Protection PCB/PCM inside and Pointed Head. The 18650 batteries could be in danger if use unprotected due to possible frequent over discharge,over charge or short circuit. It is very important to have the 18650 battery protected by proper PCM with specifications matching cell manufacturer's guide. Depending the cell inside used in 18650C1, the capacity can be from 1200mAh as lowest option to 1500mAh as the highest option. 1200mAh is already the highest capacity achieved so far in 2018, the claimed 4000mah/5000mah/6000mAh 18650 battery is total fake ones.



Figure-3.9: 6 Volt DC Power Supply

This power supply can be used to power multiple devices by adding a 3.7V Splitter to the barrel connector.

### 3.5.6. Resistor

Electricity flows through a material carried by electrons, tiny charged particles inside atoms. Broadly speaking, materials that conduct electricity well are ones that allow electrons to flow freely through them In metals, for example, the atoms are locked into a solid, crystalline structure (a bit like a metal climbing frame in a playground). Although most of the electrons inside these atoms are fixed in place, some can swarm through the structure carrying electricity with them. That's why metals are good conductors a metal put superlatively little resistance to electrons flowing through it. Plastics are entirely different. Although often solid, they don't have the same crystalline structure.

Their molecules (which are typically very long, repetitive chains called polymers) are bonded together in such a way that the electrons inside the atoms are fully occupied. There are, in short, no free electrons that can move about in plastics to carry an electric current. Plastics are good insulators: they put up a high resistance to electrons flowing through them. This is all alittle vague for a subject like electronics, which requires precise control of electric currents. That's why we define resistance more precisely as the voltage in volts required to make a current of 1-amp flow through a circuit. If it takes 500 volts to make 1-amp flow, the resistanceis 500 ohms (written 500 Ω). We might see this relationship written out as a mathematical equation: $V = I \times R$ this is known as Ohm's Law for German physicist Georg Simon Ohm (1789–1854).

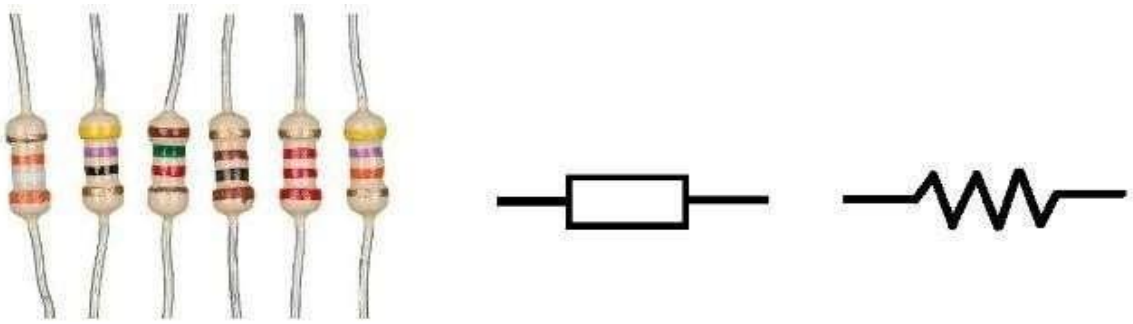


Figure-3.10: Picture of Resistor with Symbol

### 3.5.7. Connecting Wires

A wire is a single, usually cylindrical, flexible strand. Wires are used to bear carry electricityand telecommunications signals. Standard sizes are determined by various wire gauges. The term wire is also used more loosely to refer to a bundle of such strands, as in multi stranded wire', which is more correctly termed a wire rope in mechanics, or a cable in electricity.

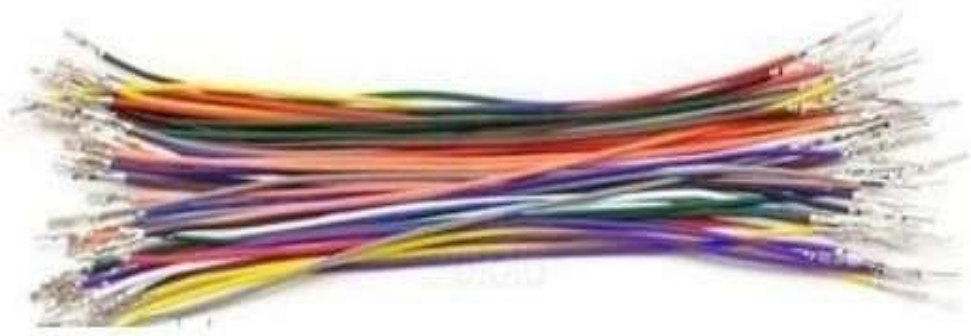


Figure-3.11: Picture of Connecting Wire

### 3.5.8. Relay Module

Here we use a single Channel 5V Relay Module to switch the 9V and use the NodeMCU to control the relay. This is a 5V 1-channel relay interface board, and each channel needs a 15- 20mA driver current. It can be used to control various appliances and equipment with large current. From the picture below, we can see that when the signal port is at low level, the signal light will light up and the opt coupler 817c (it transforms electrical signals by light and can isolate input and output electrical signals) will conduct, and then

the transistor will conduct, the relay coil will be electrified, and the normally open contact of the relay will be closed. When the signal port is at high level, the normally closed contact of the relay will be closed. So, we can connect and disconnect the load by controlling the level of the control signal port. The SRD-05 VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which connect to the device we want to control.

1. NC: Normally closed 120-240V terminal
2. NO: Normally open 120-240V terminal
3. C: Common terminal
4. Ground: Connects to the ground pin on the Arduino
5. 5V Vcc: Connects the Arduino
6. Signal: Carries the trigger signal from the Arduino that

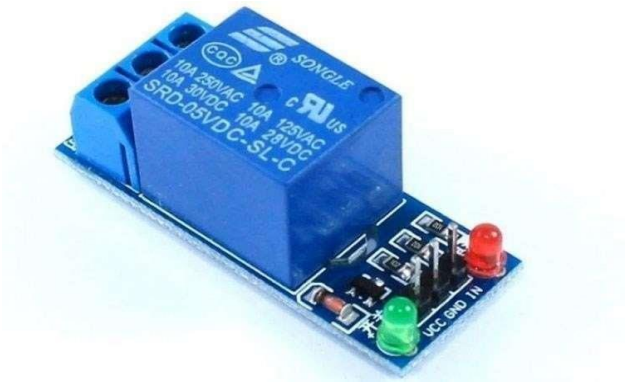



Figure-3.12: 5V Relay Module

Inside the relay is a 120-240V switch that's connected to an electromagnet. When the relay receives a HIGH signal at the signal pin, the electromagnet becomes charged and moves the contacts of the switch open or closed.

**a. Pin Description**

| INPUT | OUTPUT |
|---|---|
| VCC: Positive supply voltageGND: Ground IN1--IN4: Relay control port | Connect a load, DC 30V/10A , AC 250V/10A |

**b. Features**:

- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Weight: 61g
- PCB Color: Blue
- There are four fixed screw holes at each corner of the board, easy for installand fix. The diameter of the hole is 3.1mm
- High quality Single relay is used with single pole double throw, a common terminal, anormally open terminal, and a normally closed terminal

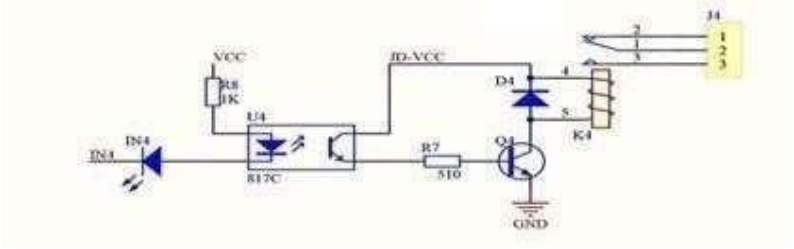



Figure-3.13: Relay Module circuit diagram

## 3.6. Block Diagram

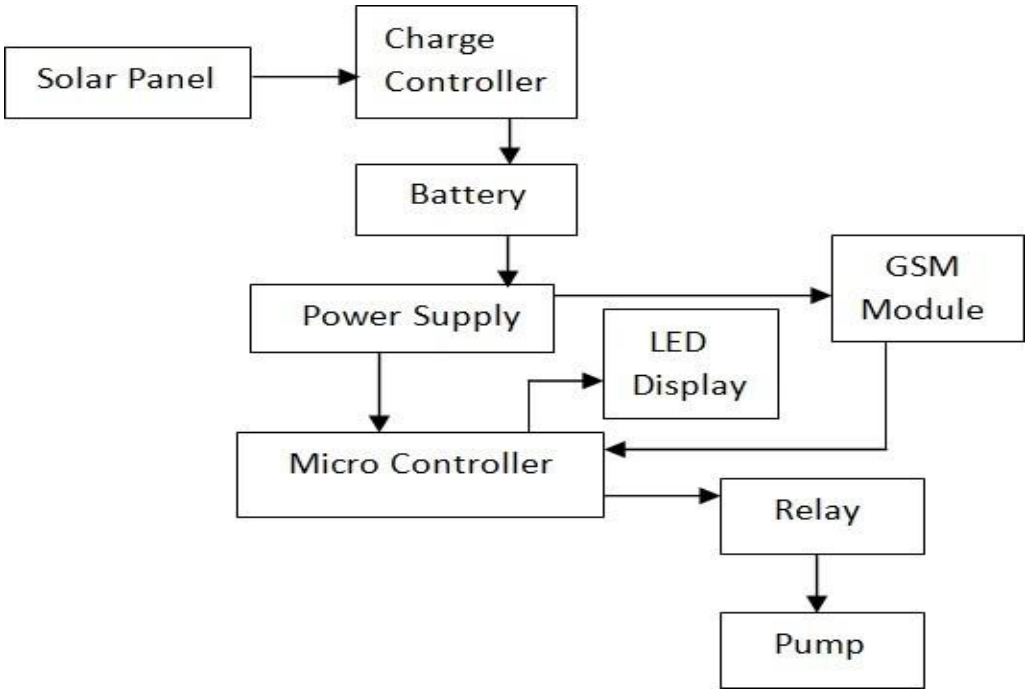



Figure-3.14: Block Diagram of the Project

## 3.7. Circuit Diagram

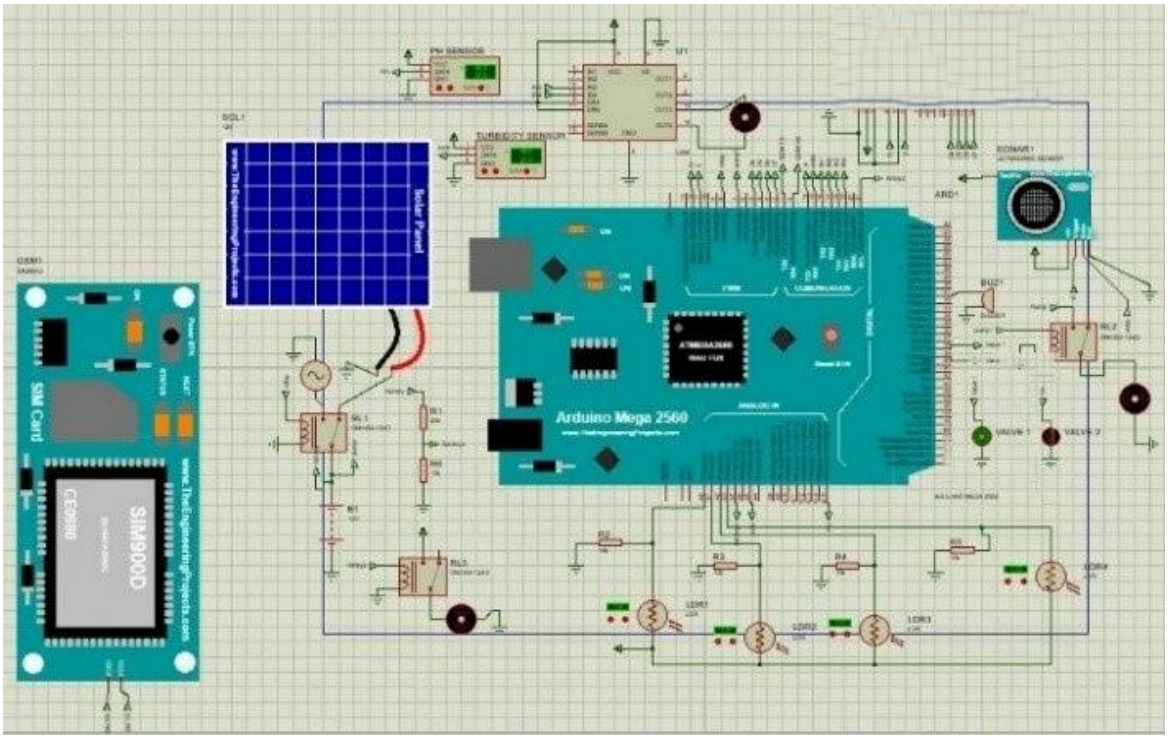



Figure-3.15: Circuit Diagram of the Project

## 3.8. IoT Device Dashboard

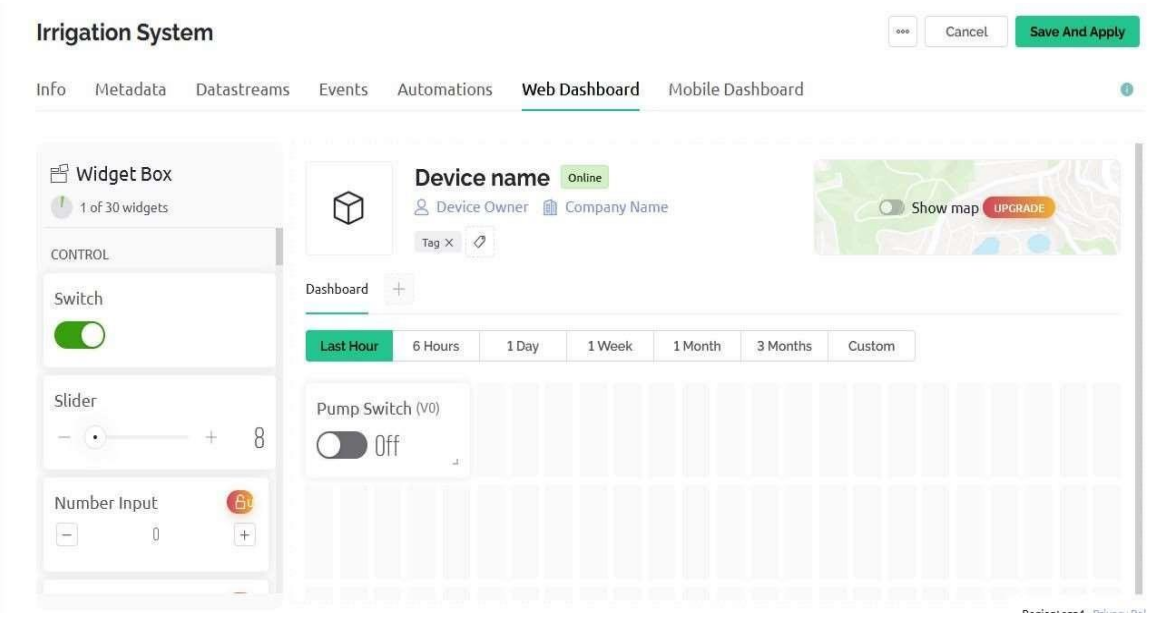


Figure-3.16: Device Dashboard

## 3.9. Device Info

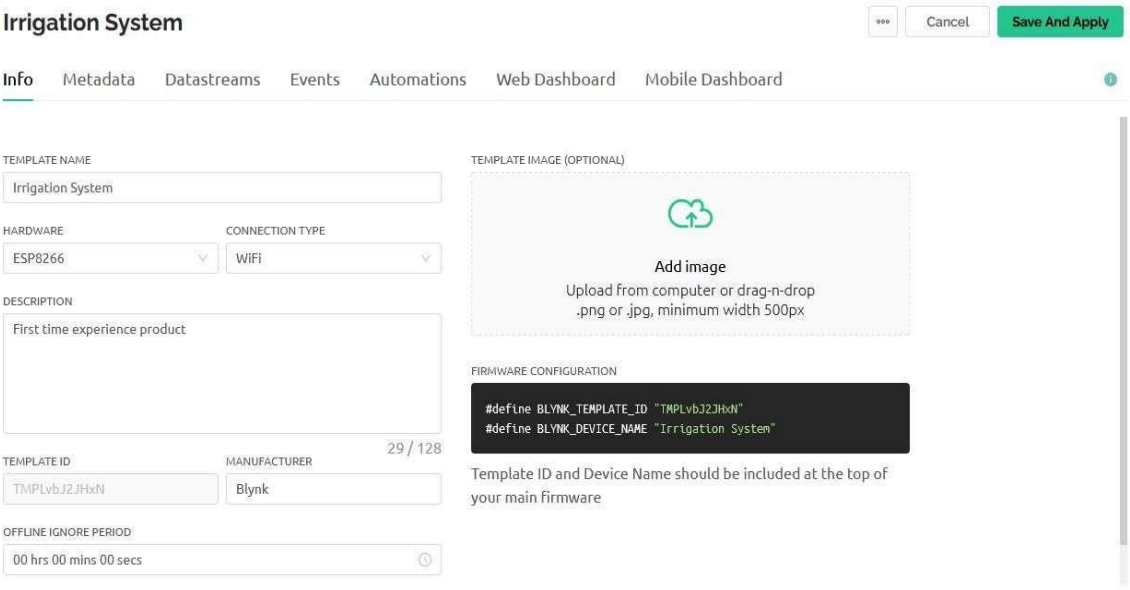



Figure-3.17: Device Info

## 3.10. IoT Switch

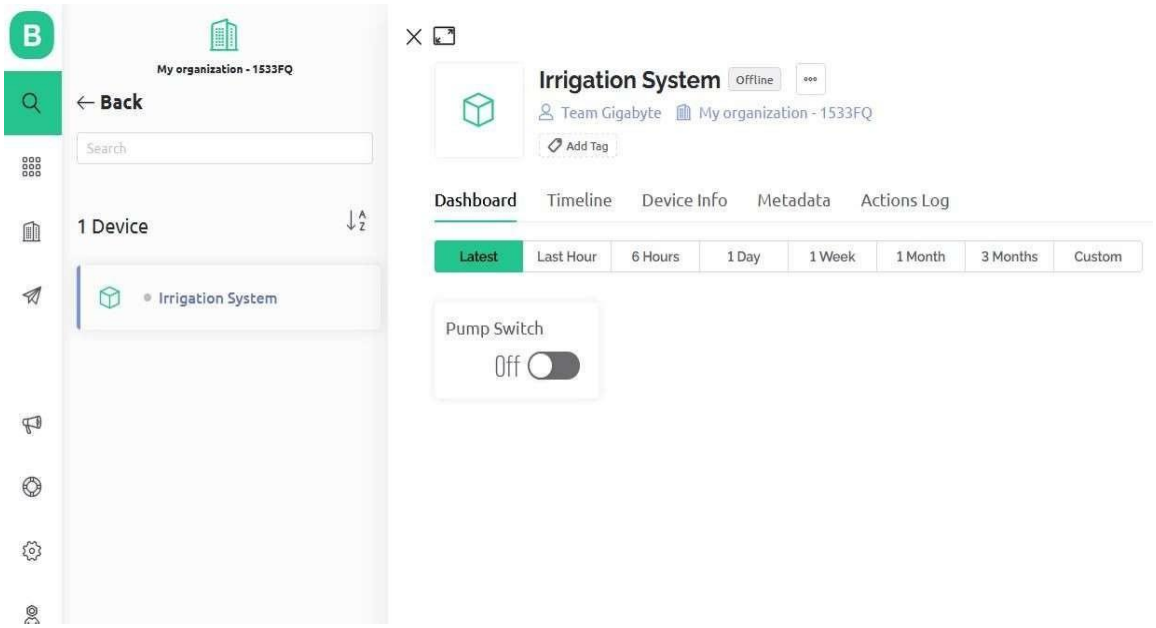



Figure-3.18: IoT Switch

### 3.11. Components Installation

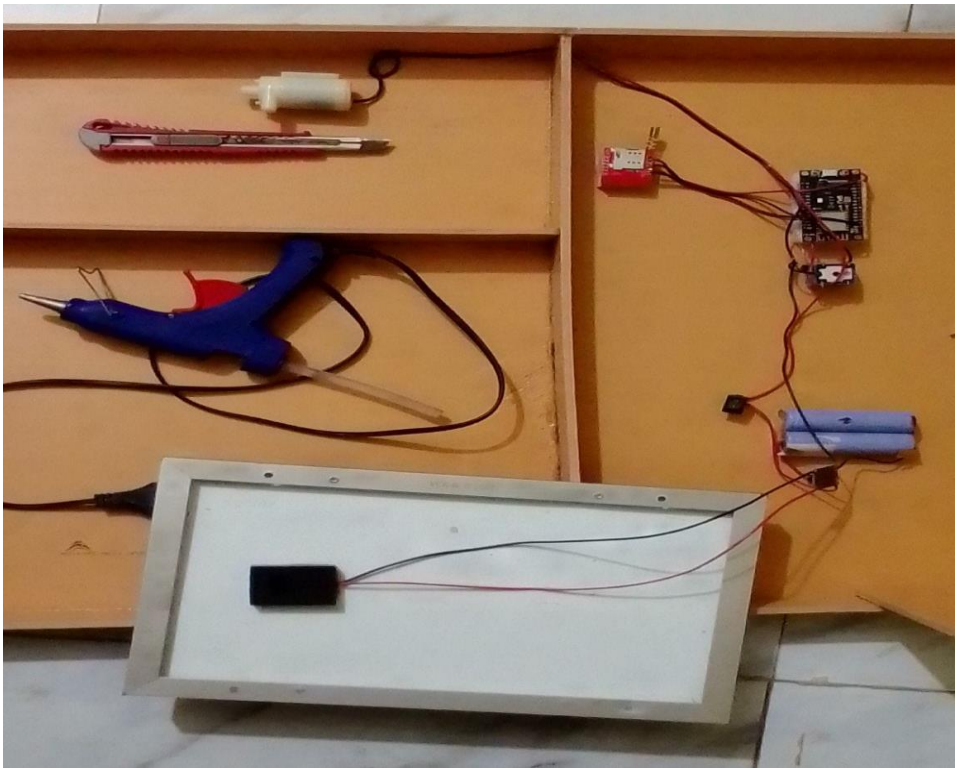


Figure-3.19: Component Setup

### 3.12. Project Picture

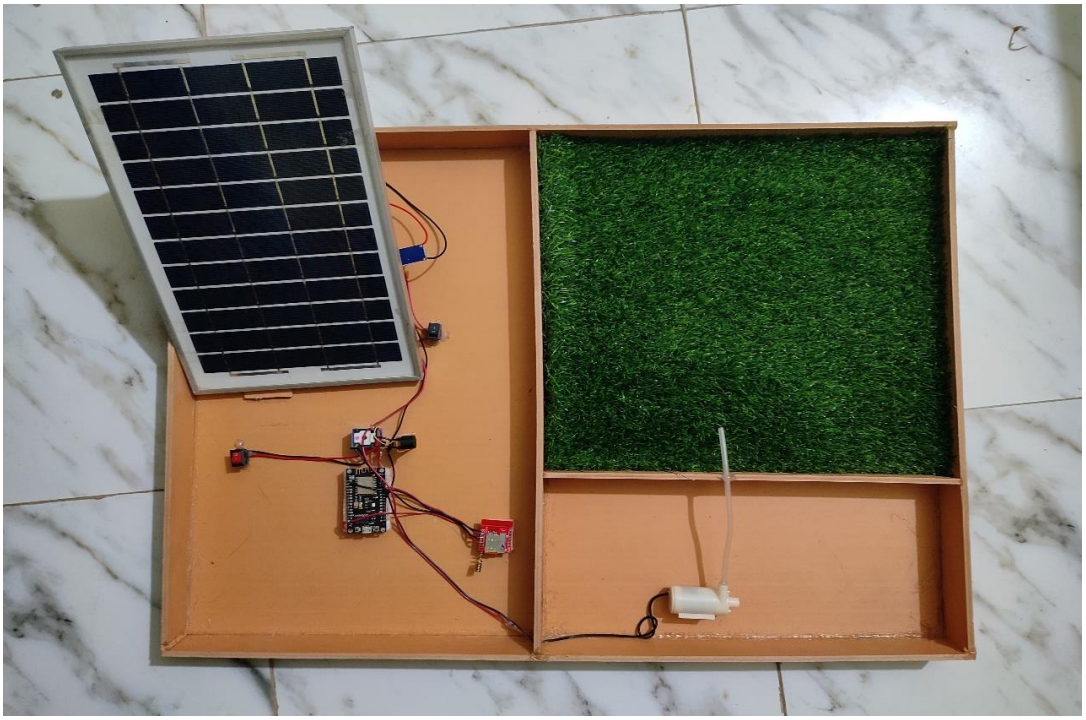


Figure-3.20: Remote Monitoring and Control of Solar Pumping System Using GSM

# Chapter 4

# Experimental Testing

## 4.1. Implementation Issues & Test Plan

When we were putting the system into action, we faced some tough challenges. This is because we needed real people to try out the finished system in different situations. Here are some of the problems we thought we might run into:

### 4.1.1. Test Plan

After the system is built, it goes into the testing phase. This means putting it onto the right devices to see if it works. Then, people with different jobs, like managers and staff, try it out to see if everything runs smoothly. Once the system is finished being developed, it enters the system testing phase. Here, it's installed on the right devices for testing. Once that's done, people with different roles, like managers and staff, will try it out to see how well it works. The purpose of system testing is to identify and determine the degree of system stability. At the same time, it is given an opportunity for developer to figure out error or bug that has not been raise and encounter during the system development phase. Those error or bug that has been found during the system testing activities will be solved before the system release. Each and every testing before system testing phases is actually tested by the system developer itself. Therefore, it might cause some biases toward the testing due to the system developer have knowledge about the system software logics and lead the result to be inappropriate. There are four types of testing that willbe used to test the developed system which includes unit testing, integration testing, system testing and acceptance testing.

### 4.1.2. Unit Testing

The first testing method used is unit testing. This involves testing each part of the system separately, without integrating them all together. Unit testing helps developers find errors and bugs more easily because they're looking at smaller parts of the system instead of the whole thing. They also check if the data values are correct by testing different types of inputs, both valid and invalid, to make sure the system responds as expected.

### 4.1.3. Functional Testing

Once unit testing is done, the next step is functional testing. This type of testing checks if the system's features work as they should base on the design specifications. It focuses on testing the main functions of the system using different test cases to ensure that the whole system works together properly and completes tasks with the expected results.

### 4.1.4. System Testing

System testing of the Arduino program and hardware is a testing conducted on a system which is complete, integrated system that works as a whole. System testing is a critical testing procedure that must be conducted by project developer before the system released. During system testing it can evaluate the system's compliance with its specified requirements according to the system design. Furthermore, several testing activities in system testing test not only the design of the system, but also the behavior and the believed expectations result fromthe customer. In addition, various complex test cases that used to test the system are accordingto the business process requirements which are collected from the user. Meanwhile, errors or bugs that detected during the testing is required software developer look into it from the initial step of the business process to the end of the process to ensure it have expected result in orderto solve the errors or bugs to determine the degree of system stability.

# Chapter 5

# Results and Discussions

## 5.1. Proposed System Completion

The proposed system is designed and developed to solve all the problem statements which are stated in chapter one of this report. First of all, the developed system provides a feature that isable to solve the problem of difficulties in our achievement. The project objective is the prevention of fire security is not in sequence. It also eliminates all the manual processes that involve in the traditional method. In addition, the developed system allows to update the fire security system with robotic system. In a nutshell, the system has fulfilled all significant outcomes that according to all the problem statements and project objectives that are stated.

## 5.2. Results

With this project we became successful to demonstrate with regarding the objectives of the project. The moisture content of the three different types of fields were measured successfully. Motor automatically turns on or off with the different level of moisture level content in the soil. Farmer successfully got the status of his fields whether dry or wet by just giving miss call from his master mobile. We became successful to meet the moisture content of the crops with their specific level of moisture content.

## 5.3. Calculation

- The charging time of a 10-watt solar panel depends on several factors, including:
  - Sunlight Intensity: The amount of sunlight hitting the solar panel.
  - Efficiency of the Panel: How efficiently the solar panel converts sunlight into electricity.
  - Battery Capacity: The capacity of the battery being charged.
  - Charging Controller Efficiency: Efficiency losses in the charging controller.

    Let's make some assumptions for a sample calculation:

    **Sunlight Intensity:** 1000 watts per square meter (standard test condition).

**Efficiency of the Panel:** Let's assume it's 15%. Battery Capacity:

Let's say we have a 12-volt, 10 Ah battery.

❖ First, calculate the energy output of the solar panel per hour:

- *Energy Output (in watt-hours) = Solar Panel Wattage × Sunlight Intensity × Panel Efficiency*
- *Energy Output = 10 Watts × 1000 W/m² × 0.15 = 1500 Watt-hours per day Now,*

*Let's consider the charging efficiency. Assuming an 80% charging efficiency (20% loss):*

- *Effective Energy for Charging = Energy Output × Charging Efficiency*
- *Effective Energy for Charging = 1500 Watt-hours × 0.80 = 1200 Watt-hours per day*

Now, let's calculate the charging time required for a full charge:

- *Charging Time = Battery Capacity / Effective Energy for Charging*
- *Charging Time = (10 Ah × 12 V) / 1200 watt-hours*
- *Charging Time = 0.1 kWh / 1.2 kWh/day*
- *Charging Time ≈ 0.0833 days*

If we want the charging time in hours, we can multiply 0.0833 days by 24 hours/day:

Charging Time ≈ 2 hours

So, under these assumptions, it would take approximately 2 hours to charge a 10 Ah, 12-volt battery fully using a 10-watt solar panel. Keep in mind that these calculations are simplified and actual charging times may vary based on real-world conditions.

❖ To calculate energy consumption, we need to know the power rating of the device/appliance and the duration for which it operates.

Here's the formula:

- *Energy Consumption (in kWh) = Power (in kW) × Time (in hours)*

Let's say we have a device rated at 500 watts (0.5 kW), and we use it for 5 hours:

- *Energy Consumption = 0.5 kW × 5 hours = 2.5 kWh*

So, the energy consumption would be 2.5 kilowatt-hours (kWh). If we have multiple devices with different power ratings and usage times, we can sum up their individual

energy consumptions to find the total energy consumed.

- To calculate the power consumption of a water pump rated at 6 Watts, we'll need to know the duration for which the pump operates.

  Let's say the water pump runs for 4 hours:

  - *Energy Consumption (in kWh) = Power (in kW) × Time (in hours)*

  Given:

  - *Power of the water pump = 6 Watts = 0.006 kW (since 1 watt = 0.001 kW)*
  - *Time the water pump operates = 4 hours*
  - *Energy Consumption = 0.006 kW × 4 hours = 0.024 kWh*

  So, the energy consumption of the 6-watt water pump, running for 4 hours, would be 0.024 kilowatt-hours (kWh).

- We have to run 5W, 6V a dc pump for irrigation and also have a 10W solar panel. Consideringthese variables, the output (Watt-hours / day) of a solar generator unit maybe 60-70% of the theoretical value.

  For that the energy required is:

  Solar generator output

  = wattage of solar cells x Sunlight hour (average) x 60%

  = 10 x 6 x 60 /100

  = 36 Watt-hours /day

  The energy consumption of motor is (5 x 6) = 30w/day.

  Energy save for a day is = (36-30) Watt /day

  = 6W/day.

## 5.4. Discussion

From the project carried out, we find the system effectively low cost and user friendly. Thewhole University remains under the user's control all the time. In future we may find some devices that are more reliable, faster and cheaper. We have tried to make a good controlling system. The components that we have used can be changed with the latest device but it should have the proposed goal of this project.

All the tasks of this project are done successfully. We were able to fulfill our goals as proposed in this system. We had our limitations in time and expenses but we hope that it will serve as basis of other latest AI systems as that of western countries.

Almost all scientific and latest technologies have both good and bad sides. That doesn't mean we should avoid technology. This type of work inspires us to do better for our country. Smart Technology is a blessing for our country. We should try to avoid the bad consequences and use it for our betterment.

## 5.5. Errors

Problems related to Irrigation are as follows:

1. Delays in Project completion
2. Water disputes
3. Regional discrepancies in irrigation development
4. Salinity & Water logging
5. Increasing costs of irrigation
6. Losses in working irrigation projects
7. Increased siltation & ageing of infrastructure
8. Tail - ender scarcity: Farmers who possess land at the end of canal system are known as tail-enders.

# Chapter 6

# Conclusion

## 6.1. Conclusion

Everyone know that Bangladesh is middle income country with a large population. According to this huge population country's food production is not enough. Bangladesh is an Asiaticcountry and our main food is based on paddy and wheat. For producing different crops and vegetables, we have to use different renewable and non-renewable energy. Here, in our experiment, we use renewable solar energy directly by the solar panel instead of diesel. In the irrigation process, mainly farmers are directly involved to grow in the field, though they have limited knowledge about solar water pump. They normally use diesel to run the motor for watering, which is not much expensive like solar pump. But in our research, we can observe that for a long term investment, like almost 20 or 25 years' cultivation, solar water pump ismuch better than the diesel pump. In solar pump, there is no maintaining cost. We have to invest money only one time and then can be use it more than 20 years. Moreover, Bangladesh has a suitable climate because almost more than half of the year, it has fully hot sunny days. So, we can easily use the solar energy for irrigation for producing more food. As our countryhas the potential to give us solar energy, that's why we are interested to do research on it. After 11 months of researching, we have found so many important things with some difficulties. We have done with the designing process, the technological analysis, economic analysis and select solar panel ratings, motor ratings and pump ratings according to our analysis and their calculations for showing power and flow rate and so on. After observing all these things, wecan say that solar water pump is the most suitable and essential for technological and economic development of our country.

## 6.2. Future Work

The scope of our project “GSM Based Automatic Irrigation System” is immense. The future implications of the project are very great considering the amount of time, money and resources it saves. The project we have undertaken can be used as a reference or as a base for realizing a scheme to be implemented in other projects of greater level such as GSM pump controller, weather updates using mobile phones, pest control, control farming vehicles using mobiles, etc. The project itself can be modified to achieve a complete Automatic Irrigation system whichwill then create a platform for the user to interface between him and the agricultural field.

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## APPENDIX

### Programming Language (Motor On/Off Arduino Code):

```
#include <SoftwareSerial.h>
const String phone="+8801798771927"; // white list phone include +88 or
our country codeSoftwareSerial gsmSerial(D4,D2);

String responseData;
String senderNumber;
void setup() {
 Serial.begin(9600);
 responseData.reserve(200);
 Serial.begin(9600);
 gsmSerial.begin(9600);
 delay(100);
 gsmSerial.write("AT\r");// because of SIM800L
 autobounding modedelay(100);
 gsmSerial.write("AT+IPR=9600\r"
 ); delay(100);
 gsmSerial.write("AT+CMGF=1\r"
 ); delay(500);
 gsmSerial.write("AT+CNMI=2,2,0,0
 ,0\r"); delay(100);
 Serial.print(gsmSerial.readString()
 );
 gsmSerial.write("AT+CLIP=1\r\n"
 ); delay(100);
 }
void loop() {
```

```
 Blynk.run();
if (gsmSerial.available()>0) {
   responseData = gsmSerial.readStringUntil('\n');
   Serial.println(responseData);
   parse();
   delay(1000);
 }
}
void parse(){
 if (responseData.indexOf("CLIP:")>0){
 senderNumber=responseData.substring(responseData.indexOf("+CLIP:")
    +8,responseData.indexOf("+CLIP: ") +22); //PARSE CALLER ID
 Serial.println("Caller
 number :");
 Serial.println(senderNumb
 er);
  if (senderNumber == phone){
   Serial.println("Sender number White
   list : ok");relayStatus =! relayStatus;
   digitalWrite(relayPin,relayStatus);
   gsmSerial.write("ATH\r"); // disconnect call & then
   send SMS
   gsmSerial.print("AT+CMGS=\""+phone+"\"\r");
   delay(1000);
   gsmSerial.print("Motor status:off
   0:on ");
   gsmSerial.print(relayStatus);
```

```
delay(200);
gsmSerial.write(0x1A); // ctrl+z to send
messagedelay(100);
}
gsmSerial.write("ATH\r");
delay(500);
}
```