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ABSTRACT

India is mainly an agricultural country. Agriculture is the most important occupation for most of the Indian families. It plays a vital role in the development of agricultural countries. Water is the main resource for Agriculture. Irrigation is one method to supply water but in some cases there will be a lot of water wastage. Water is the main resource for farming, grazing of animals which makes it a lifeline for Agriculture. Irrigation is one of the major methods to supply water. Agriculture plays a vital role in the development of our country. In India, agriculture contributes about 19.9% of total GDP and 5% of total exports. IoT is changing the agriculture domain and empowering farmers to fight with the huge difficulties they face. Agriculture must overcome expanding water deficiencies, restricted availability of lands, while meeting the expanding consumption needs of a world population. New innovative IoT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production. In this regard to save water and time we have proposed a project titled **autonomous smart irrigation system to enhance sustainable farming**. In this system we are going to use various sensors like humidity, soil moisture sensors which senses the various parameters of the soil and based on soil moisture value land gets automatically irrigated by the action   of the actuator which is a 5V water pump. These sensed parameters and motor status will be displayed on the user android application.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1:

INTRODUCTION

1.1 Overview:

Agriculture is the backbone of the Indian Economy. In today’s world, as we see rapid growth in global population, agriculture becomes more important to meet the needs of the human race. However, agriculture requires irrigation and with every year we have more water consumption than rainfall, it becomes critical for growers to find ways to conserve water while still achieving the highest yield. However, IoT is changing the agriculture domain and empowering farmers to fight with the huge difficulties they face. The Internet of Things (IoT) is a technology where a mobile device can be used to monitor the function of a device. IOT is a type of network technology, which senses the information from different sensors and makes anything to join the Internet to exchange information.

The proposed system has been designed to overcome the unnecessary water flow into the agricultural lands. Temperature, moisture and humidity readings are continuously monitored by using temperature, moisture and humidity sensors and send these values to the assigned IP address. Android application continuously collects the data from that assigned IP address. Once the soil moisture values have exceeded the particular limit then the relay, which is connected to the ESP32 controls the motor.

1.2 Problem Statement

The traditional way of cultivation is not enough to manage the farm fields or improve the quantity of crops. According to the UN Food and Agriculture Organization, "the world will need to produce 70% more food in 2050 than it did in 2006." To meet this demand, farmers and agricultural companies will have to push the innovation limits of their current practices. This transition from agriculture to agritech is now imperative, to ensure we put food on the tables of everyone around the world. Adoption rates for IoT are accelerating across the board – reaching nearly 43% of enterprises worldwide. However, the IoT applications we presently employ in today's agricultural landscape are only just the beginning. In recent days, technology has changed tremendously. Along with improvement in Technology, humans must also cope-up with updating the environment.

1.3 Objectives

- The objective of our project is to overcome the impediments faced by the farmers in the Agriculture sector with our proposed sustainable farming with Autonomous Irrigation system.
- The scope of our project is to achieve success in each task that is planned and executed with minimum cost and time.
- The project will be scalable thereafter reaching many farmers which will be the ultimate objective and scope of our project.

1.4 Motivation

Agriculture is the backbone of the Indian Economy. In today's world, as we see rapid growth in global population, agriculture becomes more important to meet the needs of the human race, with increased water consumption because of population growth and increased demand. This is the need of the hour to create and implement strategies based on science and technology for sustainable use of water. With farming becoming a race striving towards the existence of the human race, Farmers have to grow more products in deteriorating soil, declining land availability, less water and increasing weather fluctuation. Farmers don't have to rely on the rain for their crops and with moving towards smart automation of farming the water consumption is also reduced which in turn reduces the financial burden of poor farmers.

IoT-enabled agriculture allows farmers to monitor their product and conditions in real-time. They get insights fast, can predict issues before they happen and make informed decisions on how to avoid them.

Agricultural irrigation based on IoT technology is based on crop water requirement rules. By using Internet of Things and sensors, we can control water wastage and to maximize the efficiency of irrigation methods. Hence it can greatly improve the utilization of water and can increase water productivity. Additionally, IoT solutions in agriculture introduce automation, for efficient farming SOFTWARE REQUIREMENTS

Hence, helping farmers in having a successful produce and helping the world overcome food and water crisis with the help of technology and innovation is our inspiration and motivation for our project titled "autonomous smart irrigation to enhance sustainable farming"

CHAPTER 2:

LITERATURE SURVEY

1)M. Wenz and H. Worn, "Event-based Production Rules for Data Aggregation in Wireless Sensor Networks," 2006 IEEE International Conference on Multisensory Fusion and Integration for Intelligent Systems, Heidelberg, 2006, pp. 59-64.doi: 10.1109/MFI.2006.265587 Irrigation is most important for high yield of the farm. Today, by using WSN technology it is possible to monitor and control the environmental conditions such as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity etc for irrigation. Automated irrigation performed by using solenoid valves and pumps. Solenoid valve is an electromechanical valve used with a liquid controller to control an electric current through solenoid which is a coil of wire that is used to control the state of the valve according to the need of irrigation. M.Nesa Sudha et al., 2011 [4] proposed a TDMA based MAC protocol used for collecting data such as soil moisture and temperature for optimum irrigation to save energy. MAC protocol plays an important role to reduce energy consumption. Two methods used for energy efficiency are Direct Communication method and aggregation method. Direct Communication method provides collision free transmission of data, because all the sensor nodes send data directly to the base station without the need of a header node. This method is better where the base station is near but it is not optimal where the base station is far because sensor nodes consume more energy during transmission of data and if there is much data to the sensor node, sensor nodes are quickly damaged. The data aggregation method is better to use rather than a direct communication method. The sensor node senses the data and sends it to the head node. The head node collects data from the entire sensor node, performs aggregation using various aggregation techniques, and then sends data to the base station. Thus by using aggregation methods overall energy consumption is reduced. The simulation results show that aggregation methods provide better performance rather than direct communication methods. It provides 10% increase in residual energy and 13% increase in throughput. Sensor nodes consume more energy while transmitting data.

2) K. Doddapaneni, F. A. Omondi, E. Ever, P. Shah, O. Gemikonakli and R. Gagliardi, "Deployment Challenges and Developments in Wireless Sensor Networks Clustering," Advanced Information Networking and Applications Workshops (WAINA), 2014 28th International Conference on, Victoria, BC, 2014, pp. 227-232. doi: 10.1109/WAINA.2014.46 Joaquin Gutierrez et al., 2013 [8] proposed an irrigation system that uses photovoltaic solar panels to power the system because electric power supply would be expensive. For water saving purposes, an algorithm developed with threshold values of temperature and soil moisture programmed into a micro controller gateway. The system has full duplex communication links based on internet cellular interface using GPRS based on mobile data for graphically display and stored in a database server. The automation irrigation system consists of two components: WSU and WIU. Wireless Sensor Units (WSU) components were used to minimize power consumption because the microcontroller is well suited by its lower power current in sleep mode. Wireless Information Unit (WIU) transmits soil moisture and temperature data to a web server using the GPRS module. The WIU identified, recorded and analyzed received temperature and soil moisture data collected by WSU. WIU functionality is based on a microcontroller that is programmed to perform different tasks such as downloading the date and time information from a web server and comparing the temperature and soil moisture value with maximum soil moisture and minimum temperature value so that irrigated pumps are activated.

3) I. F. Akyildiz, Weilian Su, Y. Sankarasubramaniam and E. Cayirci, "A survey on sensor networks," in IEEE Communications Magazine, vol. 40, no. 8, pp. 102-114, Aug 2002.doi: 10.1109/MCOM.2002.1024422 Sherine M.Abd El-kader et al., 2013 [26] proposed APTEEN (Periodic Threshold old sensitive Energy-Efficient sensor Network) protocol. APTEEN is a Hierarchical based routing protocol in which nodes have grouped into clusters. Each cluster has a head node and head node is responsible for broadcast data to the base station. APTEEN broadcast parameters attribute, which is a set of physical parameters, in which the user is interested to obtain info, Thresholds value as Hard Threshold and Soft Threshold, Schedule as TDMA schedule used to assign slots to save energy, which provide collision free transmission. It controls the energy consumption by changing threshold values and count time. The performance of the proposed protocol is better than LEACH on average 79% and by LEACH-C on average 112%.

4)REVIEW PAPER BASED ON AUTOMATIC IRRIGATION SYSTEM BASED ON RF MODULE, by Ma.Devashree Rane PG Scholar - VLSI, Sevagram, Wandha ladia. Published by JAICT Volume 1, Iue 9, January 2015 B. Balaji Bhan et al., 2014 proposed a system to develop WSN based soil moisture controllers that determine the water requirement by comparing soil moisture with predefined threshold value. An intelligent remote system consists of wireless sensor nodes and a computer system in which data is transmitted to a server system from where the data is accessed by individuals for decision making for automated control of irrigation for the yield productivity. Field validation tests routinely performed on different soils to measure the soil moisture, water amount in soil for an efficient irrigation system. If the stored data does not match with the soil measured data, an interrupt is sent to the pressure unit and stops irrigation automatically.

5)SENSOR BASED AUTOMATED IRRIGATION SYSTEM WITH kT: A TECHNICAL REVIEW by Karan Kanaura. Vishal Zaveri, Babu Madhav institute of Technology, Uka Tarsadia University, Bardli, Gujarat, India : SN:0975-646 Sbrine Khriji et al., 2014 [11] describe different type of sensor nodes for real monitoring and control of irrigation system. Each node consists of a TelosB mote and actuator. TelosB mote is an ultra low power wireless module for monitoring applications. Soil nodes used to measure the soil moisture, weather nodes used to measure environmental parameters and actuators used for controlling the opening of valves for irrigation. The system has cost efficient and reduce the power consumptionThe experimental result shows that the plants are well irrigate and if there is any change in threshold value the system alert to farmer about the problem to take the appropriate decision

CHAPTER 3:

REQUIREMENTS

3.1 Functional Requirement

- This project makes it easy for farmers to water their crops and to visually monitor them on a regular basis.
- If the moisture of soil reduces below a certain threshold, it alerts the farmer of the same.
- This system provides an environment where this problem can be resolved in an efficient manner.

3.2 Non-Functional Requirement

- **Usability**

The client acknowledged being typical nearly the buyer interfaces and committed to ask for ambush pressure in relocating to a unique framework with another condition.

- **Reliability**

The progressions made by the Programmer ought to be obvious both to the Project pioneer and in addition the Test design.

- **Security**

Counting bugs following the framework must give important security and must secure the entire procedure from slamming.

- **Performance**

The proposed model uses efficient sensors and technologies which enhance the various complexities of the project giving high performance measures.

- **Reusability**

Each component of this project can be used in various ways and can also have an upgrade with the provision of better performances in the future.

Software Requirements:

Blynk

- Blynk is a Platform with IOS and Android apps to control Arduino, ESP32 and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. And using Python programming language to code the project.

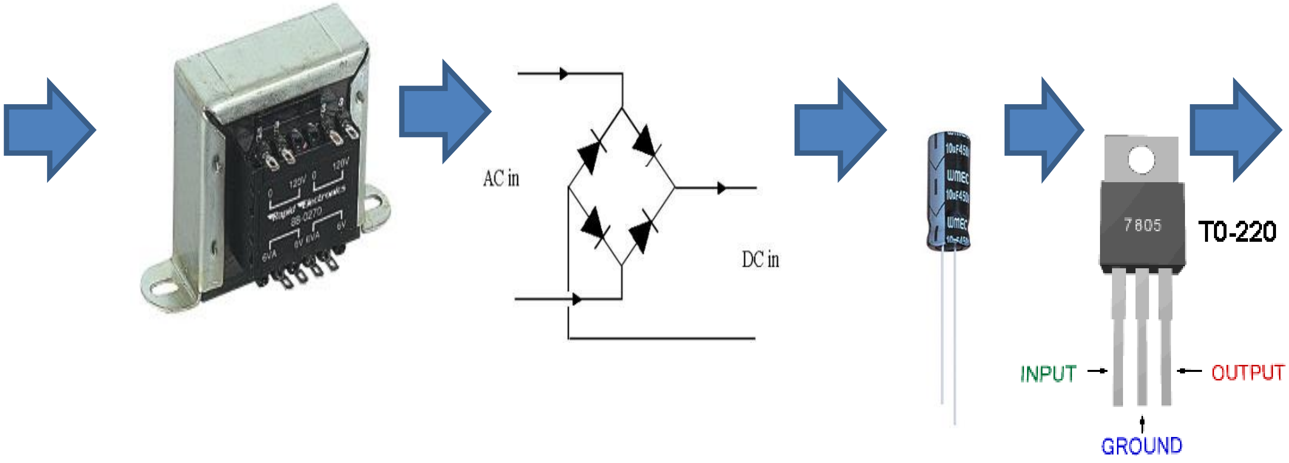
HARDWARE COMPONENTS REQUIRED:

Components	Quantity
Micro controller (ESP32)	1
Solar panel	1
Driver circuit for solar panel	1
Driver circuit (relay unit)	2
Power supply (12v)	1
MOISTURE sensor	1
water pump(5v)	2

3.3 Hardware description

3.3.1 Power Supply:

Control supply is a reference to a wellspring of electrical compel. A contraption or system that provisions electrical or diverse sorts of essentials to a yield load or assembling of weights is known as constrain supply unit or PSU. The term is most generally associated with electrical essentialness supplies, less much of the time to mechanical ones, and once in a while to others



This power supply segment is required to change over AC flag to DC flag furthermore to decrease the plenitude of the flag. The available voltage motion from the mains is 230V/50Hz which is an AC voltage, yet the required DC voltage (no repeat) with the sufficiency of +5V and +12V for various applications.

3.3.1.2 Battery:

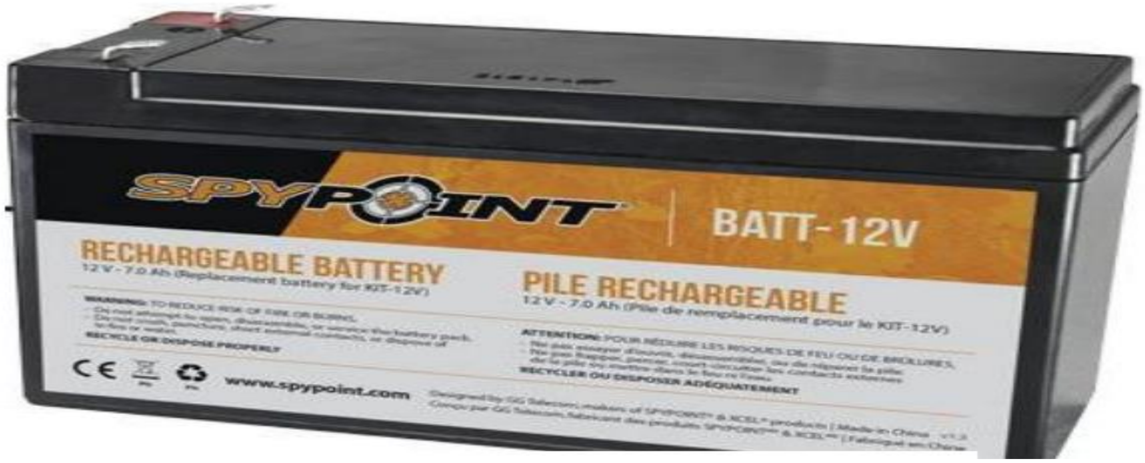

SPYPOINT
BATT-12V
RECHARGEABLE BATTERY
12 V - 7.0 Ah (Replacement battery for KIT-12V)
PILE RECHARGEABLE
12 V - 7.0 Ah (Pile de remplacement pour le KIT-12V)
www.spypoint.com

Fig 3.3.1.2: 12V rechargeable battery

Specification:

- Voltage: 12V
- Power: 7 Ah
- Number of cells: 6
- Maximum charging current: 1.75 AMPS

Description:

Dry cell batteries are batteries that use an extremely low-moisture electrolyte. They are contrasted by wet cell batteries such as lead-acid batteries, which use a liquid electrolyte.

The electrolyte that is used in most dry cell batteries is a sort of paste which, though containing moisture, is still relatively dry. Dry cell batteries create electrical energy by converting chemical energy into electricity. The exact means of doing so depends on the type of dry cell battery in question, but the materials that are used are generally zinc and carbon or zinc and manganese dioxide. These materials are placed within the electrolyte paste within the battery. They react with each other through a chemical process in which the electrolyte (carbon or manganese dioxide) reacts with the zinc, creating electricity. This is transmitted out of the battery using positive and negative electrodes. The inner view of a battery is as shown:

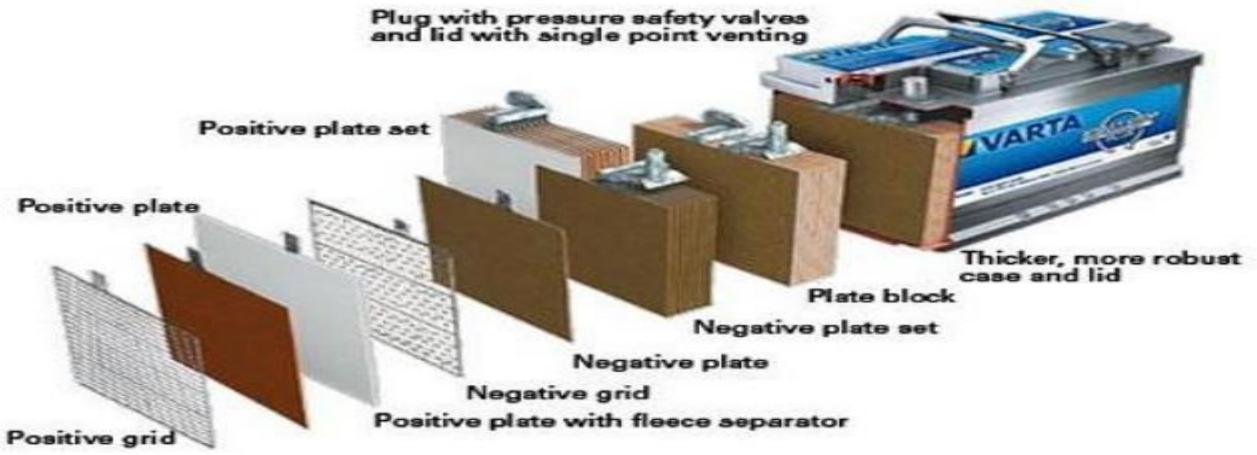

Plug with pressure safety valves and lid with single point venting
Positive plate set
Positive plate
Thicker, more robust case and lid
Plate block
Negative plate set
Negative plate
Negative grid
Positive plate with fleece separator
Positive grid
VARTA

Fig 3.3.1.3: Inner view of a battery

The various parts of the lead acid battery are shown below. The container and the plates are the main part of the lead acid battery. The container stores chemical energy which is converted into electrical energy by the help of the plates.

1. Container – The container of the lead acid battery is made of glass, lead lined wood, ebonite, the hard rubber of bituminous compound, ceramic materials or molded plastics and are seated at the top to avoid the discharge of electrolyte. At the bottom of the container, there are four ribs, on two of them resting the positive plate and the others supporting the negative plates. The prism serves as the support for the plates and at the same time protects them from a short circuit. The material of which the battery containers are made should be resistant to sulphuric acid, should not deform or porous, or contain impurities which damage the electrolyte.

2. Plate – The plate of the lead-acid cell is of diverse design and they all consist of some form of a grid which is made up of lead and the active material. The grid is essential for conducting the electric current and for distributing the current equally on the active material. If the current is not uniformly distributed, then the active

material will loosen and fall out.

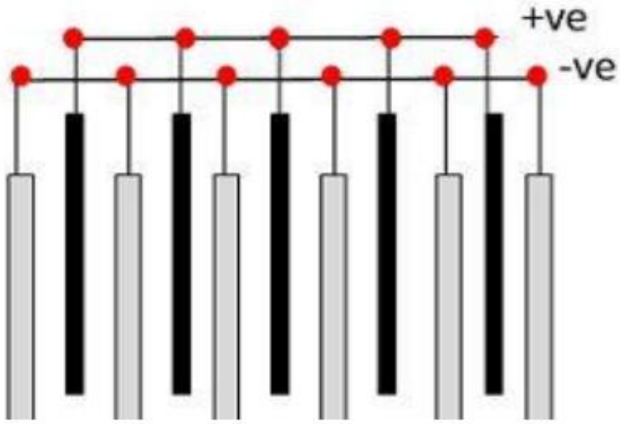


Fig 3.3.1.3: Arrangements of plates in Lead-acid battery

The grids are made up of an alloy of lead and antimony. These are usually made with the transverse rib that crosses the places at a right angle or diagonally. The grid for the positive and negative plates are of the same design, but the grids for the negative plates are made lighter because they are not as essential for the uniform conduction of the current. The plates of the battery are of two types. They are the formed plates and pasted plates.

Plante's plates: They are used largely for stationary batteries as these are heavier in weight and more costly than the pasted plates. But the plates are more durable and less liable to lose active material by rapid charging and discharging. The plante's plate has a low-capacity weight-ratio. Faure process: It is much suitable for manufacturing of negative plates rather than positive plates. The negative active material is quite tough, and it undergoes a comparatively low change from charging and discharging.

3. Active Material – The material in a cell which takes active participation in a chemical reaction (absorption or evolution of electrical energy) during charging or discharging is called the active material of the cell. The active elements of the lead acid are

a. Lead peroxide ($PbO2$) – It forms the positive active material. The $PbO2$are dark chocolate broom in color.

sponge lead – It forms the negative active material. It is grey in color.

c. Dilute Sulphuric Acid ($H2SO4$) – It is used as an electrolyte. It contains 31% of
sulphuric acid.

The lead peroxide and sponge lead, which form the negative and positive active materials have little mechanical strength and therefore can be used alone.

4. Separators – The separators are thin sheets of non-conducting material which are made up of chemically treated lead wood, porous rubbers, or mats of glass fiber and are placed between the positive and negative to insulate them from each other. Separators are grooved vertically on one side and are smooth on the other side.

5. Battery Terminals – A battery has two terminals: the positive and the negative. The positive terminal with a diameter of 17.5 mm at the top is slightly larger than the negative terminal which is 16 mm in diameter.

Working principle:

Smart Irrigation system is developed by using the Microcontroller i.e., Nodemcu esp32 and it plays a main role in this automated system. The sensors like soil moisture sensor, humidity sensor and the temperature sensor are connected to the microcontroller. Thus, the output of these sensors are fed into the Nodemcu esp32. On receiving the signal from these sensors, the Microcontroller gives the appropriate output that turns on the relay according to the soil moisture and the atmospheric conditions and operates the water pump. This soil moisture sensor determines the soil condition and it is expressed in terms of Resistance. Then it compares the output Resistance with the reference resistance.

If the reference resistance is higher than the soil condition expressed in resistance, then the pump gets turned ON and the agricultural land is irrigated automatically by the signal which has been provided by the relay. In the reverse condition, the relay does not operate, the pump remains in the OFF condition. On receiving the signal from the soil moisture sensor, the Microcontroller gets an analog signal which is converted into digital signal. The program is already done in the Microcontroller and the signal is given to the relay circuit. Based on the signal given to the relay circuit the motor actuated ON or OFF. Once the temperature is low the soil becomes wet, the resistance is higher than that of the reference resistance then low signal goes to the Microcontroller [“logic 0”] which makes the motor turn OFF and it stops pumping the water.

The voltage is obtained from the comparator which is present inside the sensor. When the sensor is placed in the field there will be conductivity. When there is good conduction that implies the presence of moisture content, as water is the good conductor of electricity. Then, the signal is passed and the motor is turned OFF and when there is no conduction, this indicates the absence of water content hence the motor is turned ON by necessary signals generated by the Nodemcu. When the control signal is sent to turn on the motor, the relay switch is closed and the motor is connected to the circuit and the water is pumped to the plants. Similarly, if the control signal is to turn OFF the motor, then the relay switch is opened and the motor is not given supply so the motor is turned OFF. Thus, the necessary water is provided to the plants when they are in need, this is done according to the program burned in the NodeMCU ESP32. Here frequent monitoring is not required.

3.3.1.4: Working principle during discharging:

When the cell is full discharge, then the anode is of lead peroxide (PbO2) and a cathode is of metallic sponge lead (Pb). When the electrodes are connected through a resistance the cell discharges and electrons flow in a direction opposite to that during charging. The hydrogen ions move to the anode and reaching the anodes receive one electron from the anode and become a hydrogen atom. The hydrogen atom comes in contact with a PbO2, so it attacks and forms lead sulphate (PbSO4), whitish in colour and water according to the chemical equation.

Each sulphate ion (SO4—) moves towards the cathode and reaching there gives up two electrons, becomes radical SO4, attacks the metallic lead cathode and forms lead sulphate whitish in colour according to the chemical equation.

3.3.1.5: Working principle during recharging:

For recharging, the anode and cathode are connected to the positive and the negative terminal of the DC supply mains. The molecules of the sulphuric acid break up into ions of 2H+ and SO4—. The hydrogen ions being positively charged move towards the cathodes and receive two electrons from there and form a hydrogen atom. The hydrogen atom reacts with lead sulphate cathode forming lead and sulphuric acid according to the chemical equation

$$\begin{array}{c} PbSO_4 + 2H = PbO + H_2O \\ PbO + H_2SO_4 = PbSO_4 + 2H_2O \\ \hline PbO_2 + H_2SO_4 + 2H = PbSO_4 + 2H_2O \end{array}$$

SO4— ion moves to the anode, gives up its two additional electrons becomes radical SO4, react with the lead sulphate anode and form leads peroxide and lead sulphuric acid according to the chemical equation

The following figure shows the recharging of a Lead-oxide cell

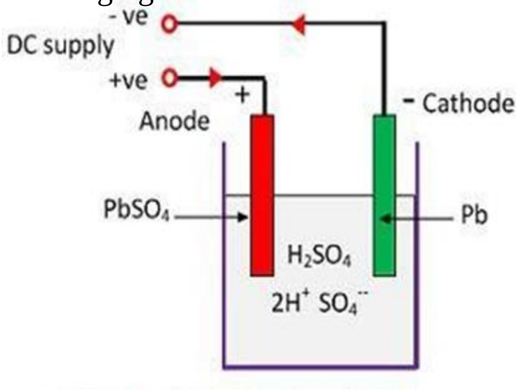


Fig 3.3.1.5: Recharging of a battery

The charging and discharging are represented by a single reversible equation given below

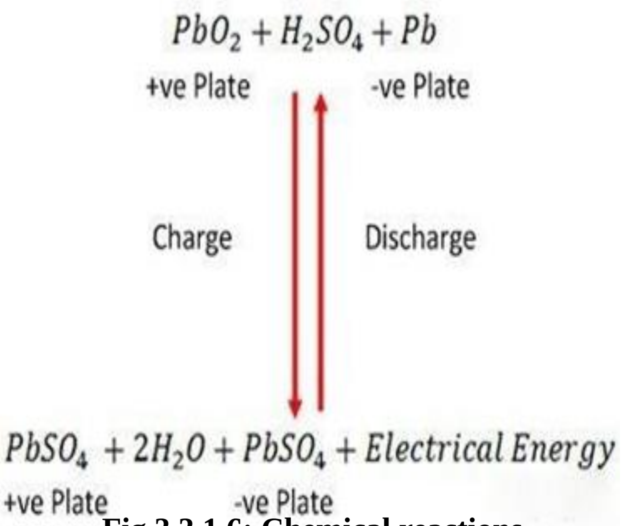
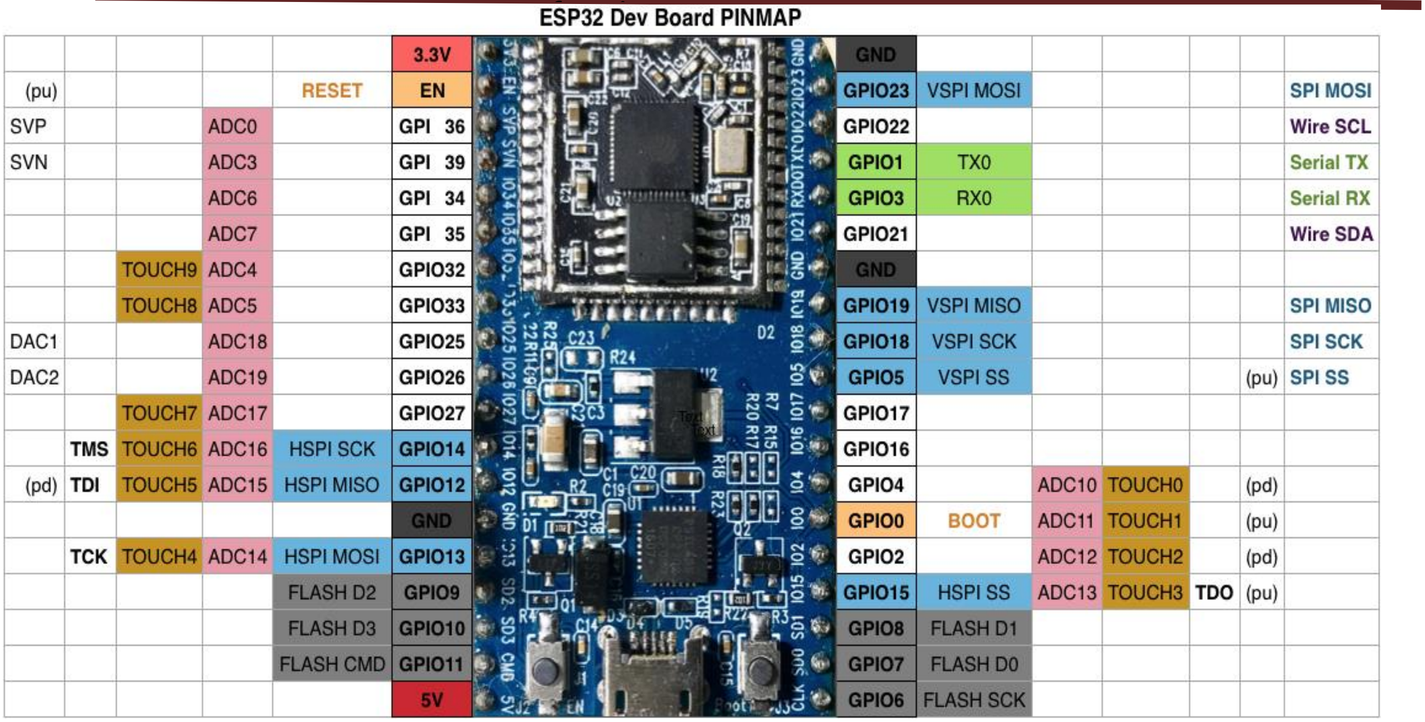


Fig 3.3.1.6: Chemical reactions

3.3.2 Node MCU ESP32 concepts:

- This key studio ESP32 core board is a Mini development board based on the ESP-WROOM-32 module. The board has brought out most I/O ports to pin headers of 2.54mm pitch. These provide an easy way of connecting peripherals according to your own needs. When it comes to developing and debugging with the development board, the both side standard pin headers can make your operation more simple and handy. The ESP-WROOM-32 module is the industry's leading integrated WiFi + Bluetooth solution with less than 10 external components. It integrates antenna switch, RF balun, power amplifiers, low noise amplifiers, filters and power management modules. At the same time, it also integrates with TSMC's low-power 40nm technology, so that power performance and RF performance are safe and reliable, easy to expand to a variety of applications.

- The Pin Map below shows the functions that can be used on each pin.



					3.3V	GND						
(pu)				RESET	EN	GPIO23	VSPI MOSI					SPI MOSI
SVP			ADC0		GPI 36	GPIO22						Wire SCL
SVN			ADC3		GPI 39	GPIO1	TX0					Serial TX
			ADC6		GPI 34	GPIO3	RX0					Serial RX
			ADC7		GPI 35	GPIO21						Wire SDA
		TOUCH9	ADC4		GPIO32	GND						
		TOUCH8	ADC5		GPIO33	GPIO19	VSPI MISO					SPI MISO
DAC1			ADC18		GPIO25	GPIO18	VSPI SCK					SPI SCK
DAC2			ADC19		GPIO26	GPIO5	VSPI SS				(pu)	SPI SS
		TOUCH7	ADC17		GPIO27	GPIO17						
	TMS	TOUCH6	ADC16	HSPI SCK	GPIO14	GPIO16						
(pd)	TDI	TOUCH5	ADC15	HSPI MISO	GPIO12	GPIO4		ADC10	TOUCH0		(pd)	
					GND	GPIO0	BOOT	ADC11	TOUCH1		(pu)	
	TCK	TOUCH4	ADC14	HSPI MOSI	GPIO13	GPIO2		ADC12	TOUCH2		(pd)	
				FLASH D2	GPIO9	GPIO15	HSPI SS	ADC13	TOUCH3	TDO	(pu)	
				FLASH D3	GPIO10	GPIO8	FLASH D1					
				FLASH CMD	GPIO11	GPIO7	FLASH D0					
					5V	GPIO6	FLASH SCK					

Fig 3.3.2:ESP32 NODE MCU PIN DIAGRAM

3.3.3 Soil moisture sensor

A Soil Moisture Sensor is one kind of low-cost electronic sensor that is used to detect the moisture of the soil. This sensor can measure the volumetric content of water inside the soil. This sensor consists of mainly two parts, one is Sensing Probes and another one is the Sensor Module. The probes allow the current to pass through the soil and then it gets the resistance value according to moisture value in soil. The Sensor Module reads data from the sensor probes and processes the data and converts it into a digital/analog output. So, the Soil Moisture Sensor can provide both types of output Digital output (DO) and Analog output(AO).

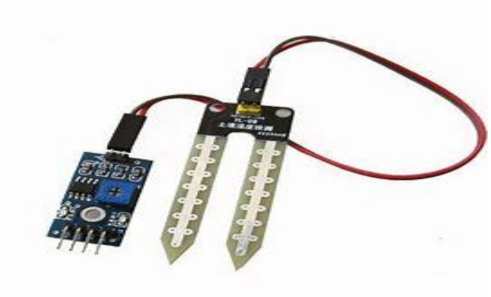
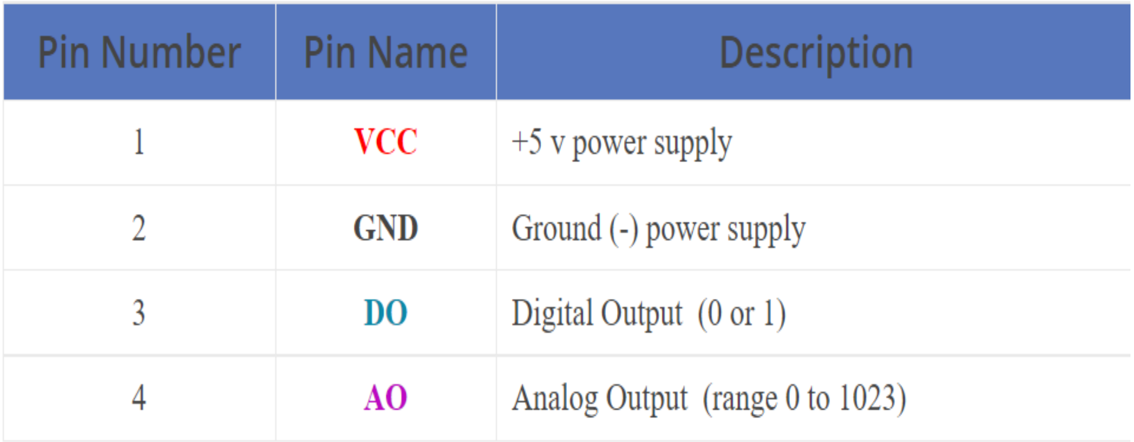


Fig 3.3.3: Soil moisture Sensor

Features:



Pin Number	Pin Name	Description
1	VCC	+5 v power supply
2	GND	Ground (-) power supply
3	DO	Digital Output (0 or 1)
4	AO	Analog Output (range 0 to 1023)

Advantages:

- Soil Moisture detection
- It’s used in an irrigation system when soil is dry it starts the watering system automatically

3.3.4:Solar panel

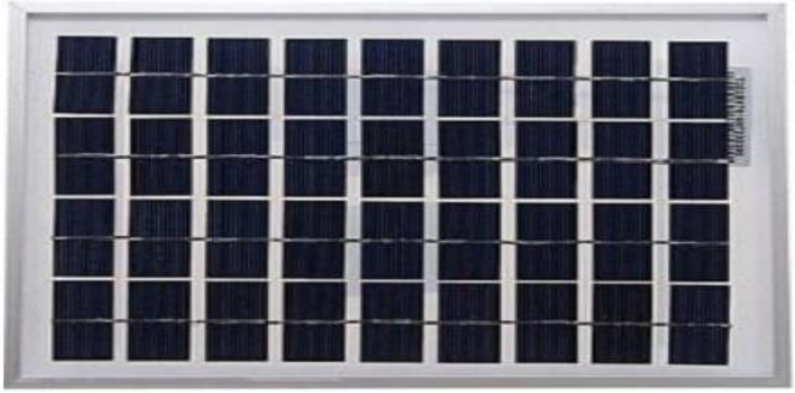


Fig 3.3.4:12V solar panel

Features and Benefits:

1. Best service for: High Efficiency, low light working, Water-proof, 20 years Life time, proper solution for 12v solar power panel or 12 Volt DC load directly. Maximum Output Voltage: 17.9 to 22.41 volt. For AC Load Please use Inverter.
2. Portable Facility: Light weight. 0.59 kg (1.28 lbp)
3. Best Fit: Camping, cars, snowmobiles, tractors, motorcycles or another application can be charged by this 12v Output Solar Panel.
4. Multi usages: This *ECO-WORTHY* Polycrystalline can charge *12 Volt rechargeable batteries* in case of emergency, best fit for outdoor use such as vehicles working, traveling, camping and training.
5. Packing Details: 1PC 12V 5W Solar battery Charger
6. Installation: Easy to install and completely maintenance-free. Shockproof, rust and dustproof. Can be used for trickle charger.

Overall, this *Solar Panel With 12v Output* is portable, durable and easy to install, High efficiency powerful modules. No matter where you go, the *ECO-WORTHY* 5w solar panel to charge 12v battery is the perfect match for you.

How it works: Portable 12v solar panel

Top Advantages:

- Small size for portability, Easy to use, long life
- A pretty reliable performance for small scale needs
- Lightweight
- Water-Resistant
- Easy to install
- High Modulus Conversion Efficiency
- Be confirm that your Battery Voltage higher then 10.8 Volt
- Individually not fit for large scale application

3.3.5: 5V water pump:

These pumps are cheap and useful for prototyping but they won't last very long under intensive workload, so they are good for prototyping and projects that require watering from time to time and not a continuous water flow. If you plan to have a continuous water flow, go for a better one.

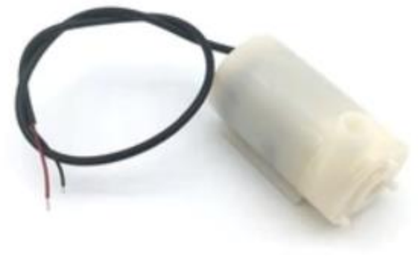


Fig 3.3.5:5V water pump

Specification:

- **Voltage: CC 3-5 V**
- **Operating current: 100-200mA**
- **Load power: 0,4-1,5 W**
- **Max height: 40-110 cm/15,75 “-43,4”**
- **Water flow: 80-120L/H**
- **Continuous working life: 500 hours**

Description

Water pumps are the positive displacement pump which moves gases, liquids via a reciprocating diaphragm. They are highly reliable because they do not include inner parts that rub against each other. They also contain no sealing or lubricating oils within the pumping head which means that there is no chance of oil vapour leakage or contamination of the handled media.

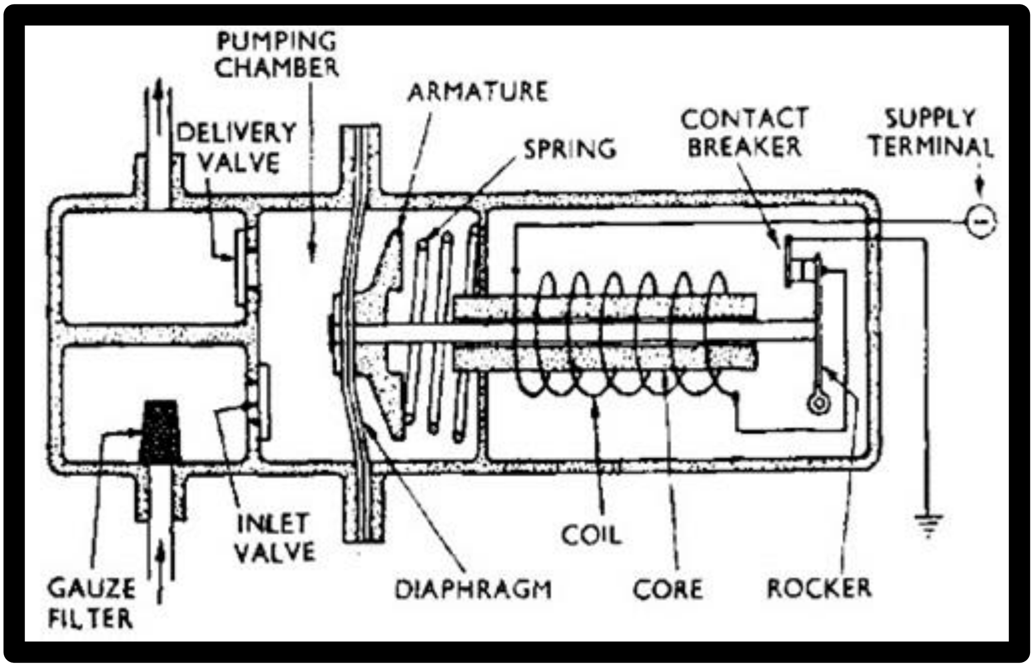


Fig 3.3.5.1: Inner view of diaphragm motor

Simple water pumps consist of a diaphragm, displacement chamber, two valves, and a driving mechanism. The diaphragm is made of a flexible material companionable with the pumped media. It is sealed in place between the side of the displacement chamber and an attached flange. The chamber volume is slightly greater than what the diaphragm can displace. The valves are typically spring-loaded ball valves or flapper valves made of the same material as the diaphragm, and they function to admit the fluid in and out of the chamber. The driving mechanism is what flexes the diaphragm.

3.3.6 RELAY:

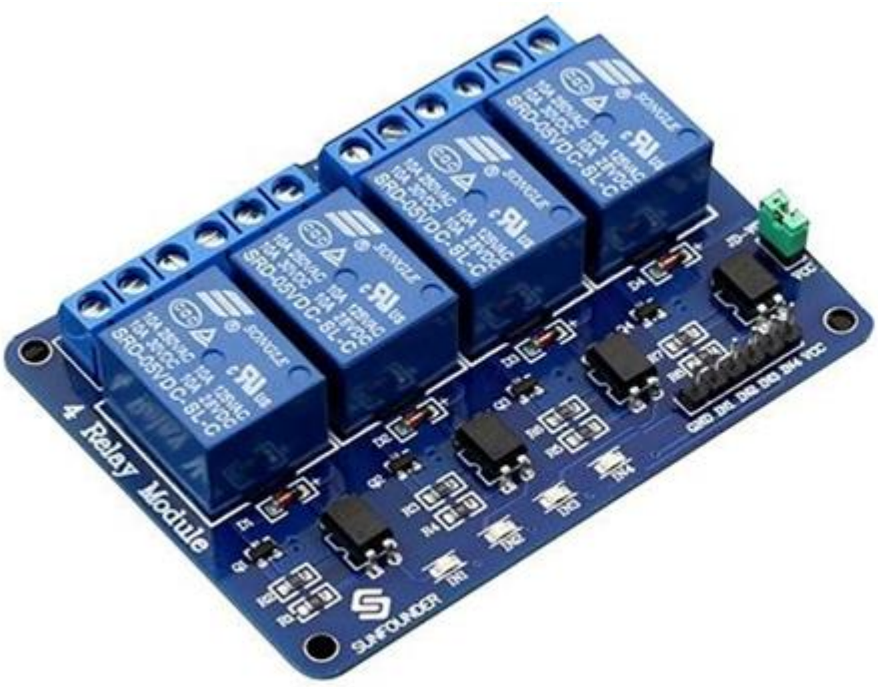


Fig 3.3.6: 4-Channel Relay

Specification:

- Drive current: 20mA
- Control signal: 5V/12V/24V TTL level
- Relay Maximum output: DC 30V/10A, AC 250V/10A.
- State: Active low

Description:

A relay is an electrically operated switch. Relays use an electromagnet to mechanically operate a switch. 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. A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core (a solenoid), an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts. The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. The armature is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open.

A LOW Level 5V 4-channel relay interface board requires a 15-20mA driver current for each channel. It can be used to control various appliances and equipment with large currents. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by a microcontroller. This module is optically isolated from the high voltage side for safety requirements and also prevents ground loop when interface to microcontroller. A schematic of a 4 channel relay is shown

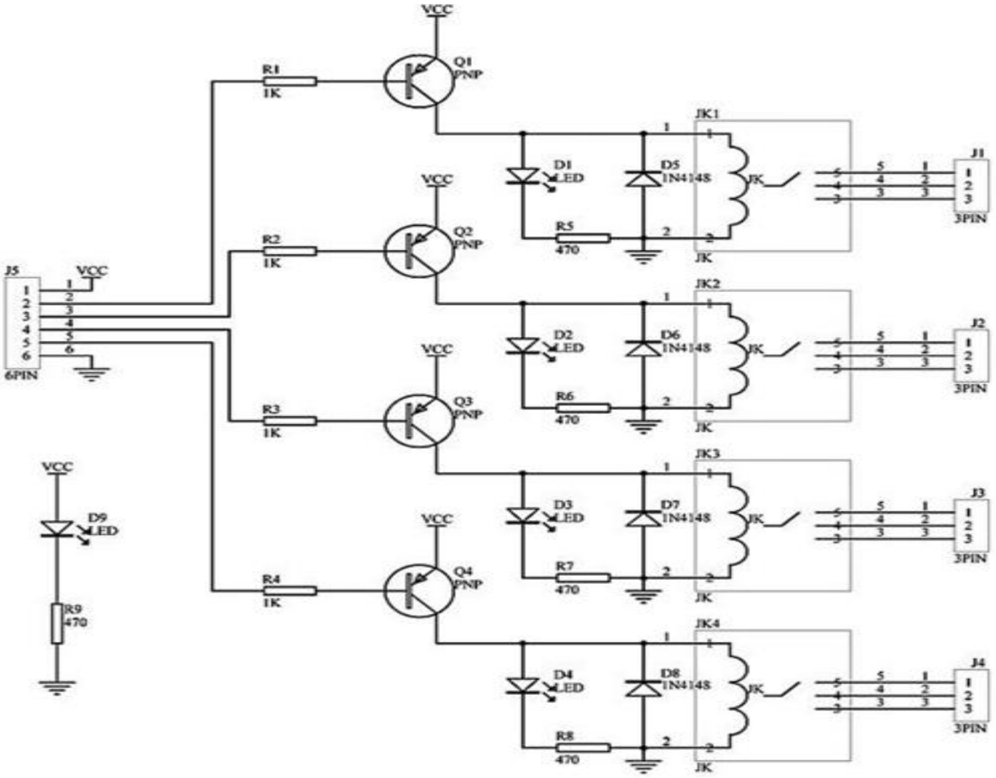


Fig 3.3.6.1: 4 channel relay module schematics

The module layout of a 4-channel relay is as shown

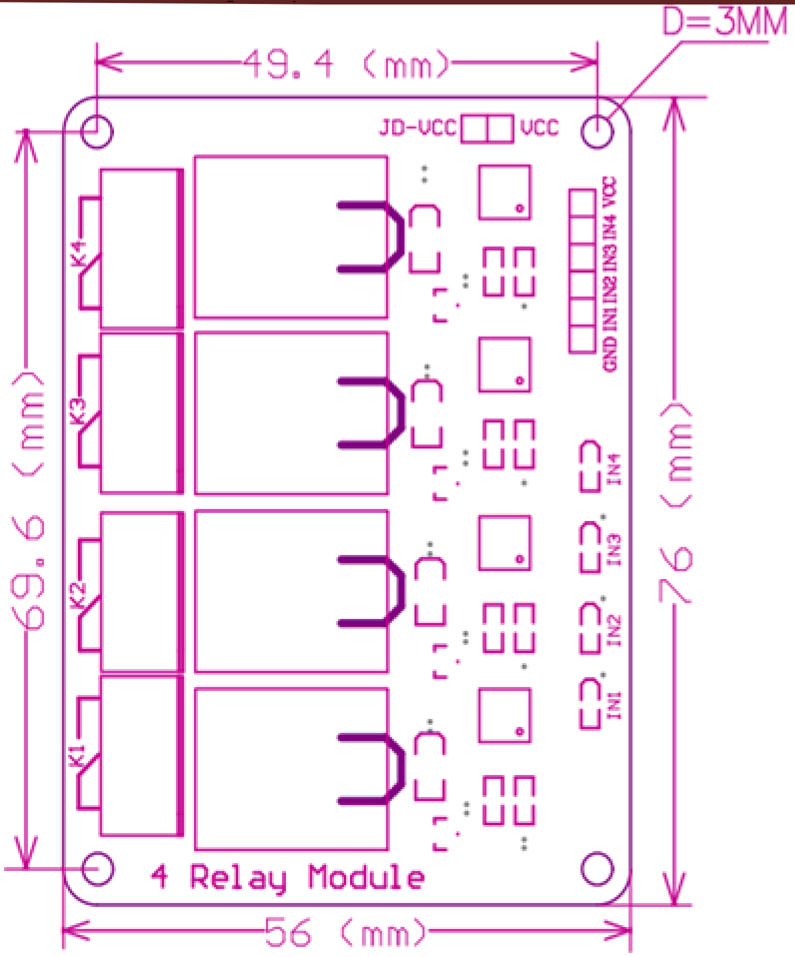
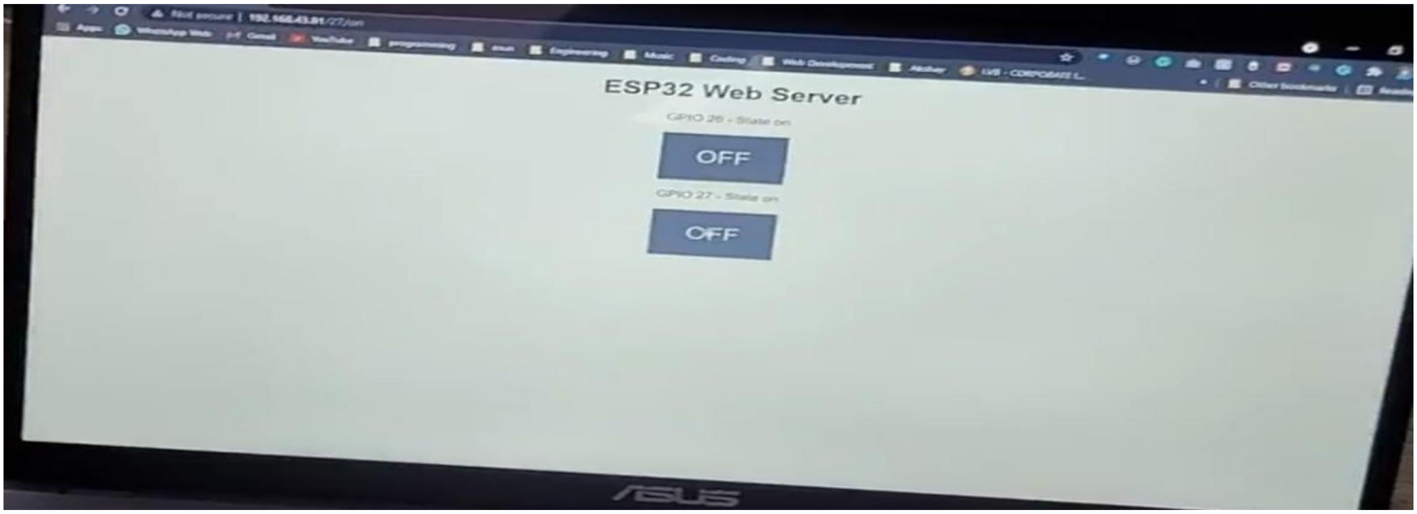


Fig 3.3.6.2: 4 channel relay module layout

3.4 SOFTWARE DESCRIPTION

1.Browser for website access

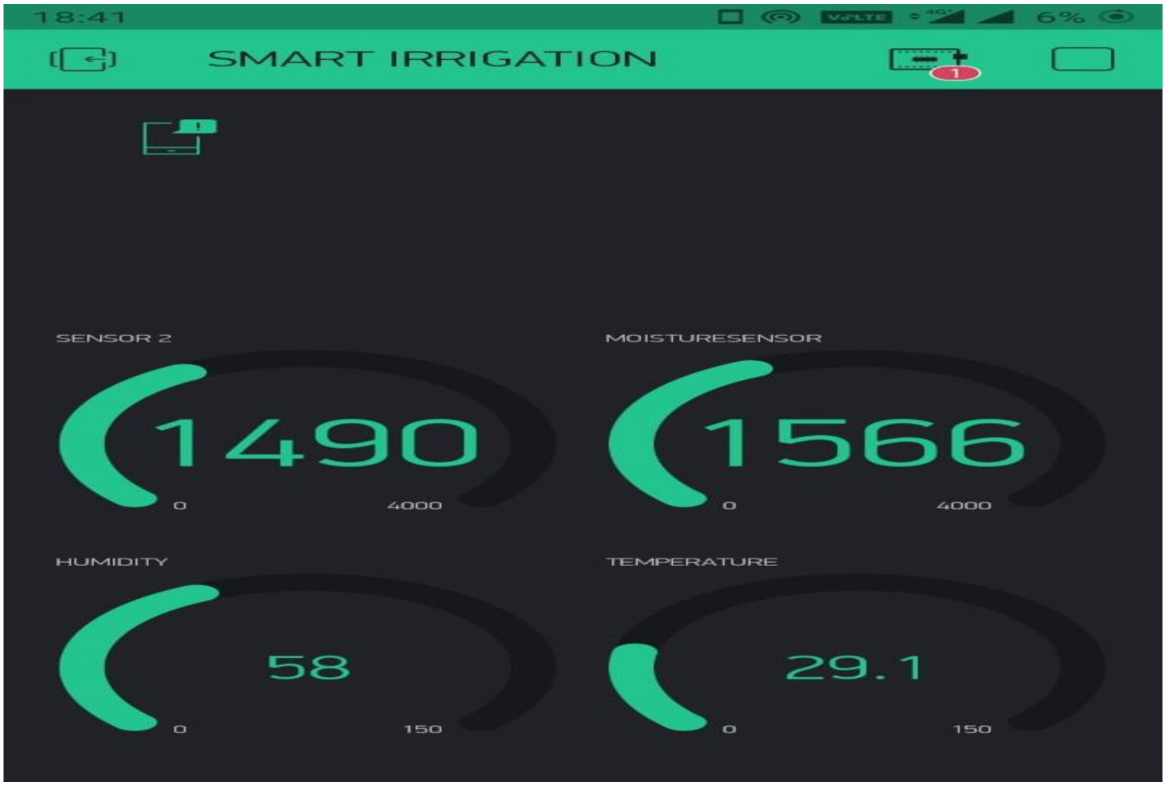


ESP32 Web Server

GPIO 26 - State on

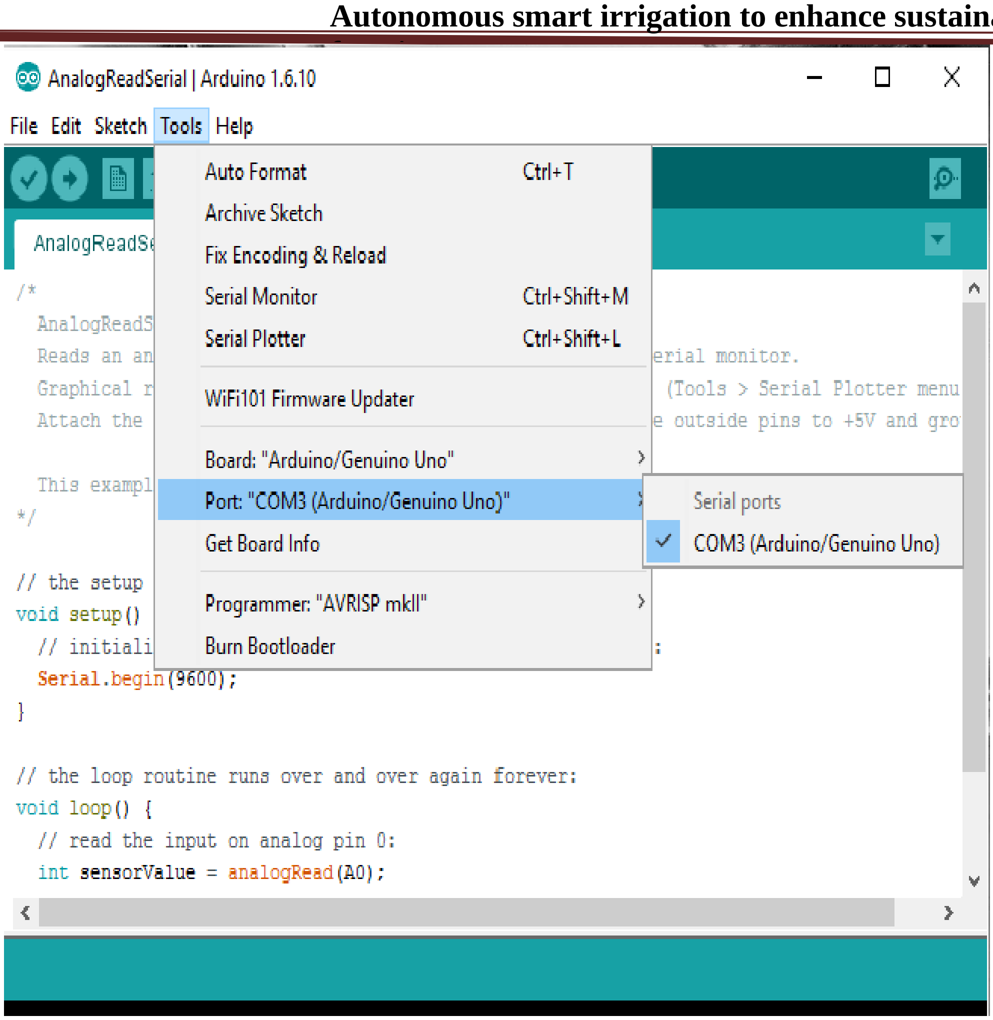
GPIO 27 - State on

2. BLYNK APP



3. Arduino IDE for Embedded C programming

The **Arduino Integrated Development Environment (IDE)** is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.


AnalogReadSerial | Arduino 1.6.10
File
Edit
Sketch
Tools
Help
AnalogReadSe
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 Firmware Updater
Board: "Arduino/Genuino Uno"
Port: "COM3 (Arduino/Genuino Uno)"
Get Board Info
Programmer: "AVRISP mkII"
Burn Bootloader
Serial ports
✓ COM3 (Arduino/Genuino Uno)

```
/*
  AnalogReadS
  Reads an an                      erial monitor.
  Graphical r                       (Tools > Serial Plotter menu
  Attach the                       e outside pins to +5V and gro

  This exampl
*/

// the setup
void setup()
  // initiali                      ;
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
```

CHAPTER 4:

SYSTEM ANALYSIS & DESIGN

Introduction

Here we introduce a wearable ring which normally works as an ordinary watch. It also incorporates a Bluetooth unit that will help the victim to communicate with their family or police at the first sign of trouble. It also activates an alarm from the phone which is connected via Bluetooth. This enables them to gain the attention of others to the scenario. This demands the need of additional hardware which results in increased size and weight.

4.1 Existing System

REVIEW PAPER BASED ON AUTOMATIC IRRIGATION SYSTEM BASED ON RF MODULE, by Ma. Devashree Rane PG Scholar - VLSI, Sevagram, Wandha ladia, Published by JAICT Volume 1, Issue 9, January 2015 B. Balaji Bhan et al., 2014

SENSOR BASED AUTOMATED IRRIGATION SYSTEM WITH IoT: A TECHNICAL REVIEW by Karan Kanaura. Vishal Zaveri, Babu Madhav institute of Technology, Uka Tarsadia University, Bardli, Gujarat, India : SN:0975-646 Sbrine Khriji et al., 2014

Agriculture robotic vehicle based pesticide sprayer with efficiency optimization: Aishwarya B.V, Archana. G, C. Umayal, In Technological Innovation in ICT for Agricultural and Rural Development (TIAR), 2015 IEEE 2015 Jul 10 (pp. 59-65)

4.2 Proposed System/Solution

Smart Irrigation system is developed by using the Microcontroller i.e., Nodemcu esp32 and it plays a main role in this automated system. The sensors like soil moisture sensor,humidity sensor and the temperature sensor are connected to the microcontroller. Thus the output of these sensors are fed into the Nodemcu esp32. On receiving the signal from these sensors, the Microcontroller gives the appropriate output that turns on the relay according to the soil moisture and the atmospheric conditions and operates the water pump. This soil moisture sensor determines the soil condition and it is expressed in terms of Resistance.Then it compares the output Resistance with the reference resistance.

If the reference resistance is higher than the soil condition expressed in resistance, then the pump gets turned ON and the agricultural land is irrigated automatically by the signal which has been provided by the relay. In the reverse condition, the relay does not operate, the pump remains in the OFF condition. On receiving the signal from the soil moisture sensor the Microcontroller gets an analog signal which is converted into digital signal. The program is already done in the Microcontroller and the signal is given to the relay circuit. Based on the signal given to the relay circuit the motor actuated ON or OFF. Once the temperature is low the soil becomes wet, the resistance is higher than that of the reference resistance then low signal goes to the Microcontroller [“logic 0”] which makes the motor turn OFF and it stops pumping the water.

The voltage is obtained from the comparator which is present inside the sensor. When the sensor is placed in the field there will be conductivity. When there is good conduction that implies the presence of moisture content, as water is the good conductor of electricity. Then, the signal is passed and the motor is turned OFF and when there is no conduction, this indicates the absence of water content hence the motor is turned ON by necessary signals generated by the Nodemcu. When the control signal is sent to turn on the motor,the relay switch is closed and the motor is connected to the circuit and the water is pumped to the plants. Similarly, if the control signal is to turn OFF the motor, then the relay switch is opened and the motor is not given supply so the motor is turned OFF. Thus, the necessary water is provided to the plants when they are in need, this is done according to the program burned in the NodeMCU ESP32. Here frequent monitoring is not required.

Advantages:

- The farmer can sit anywhere in this world and connect it through the internet.
- Effective utilization of Internet of Things (IOT).
- High performance.
- Low power consumption and reduced man power.
- It uses IOT technology.

CHAPTER 5:

SYSTEM DESIGN

5.1 Introduction

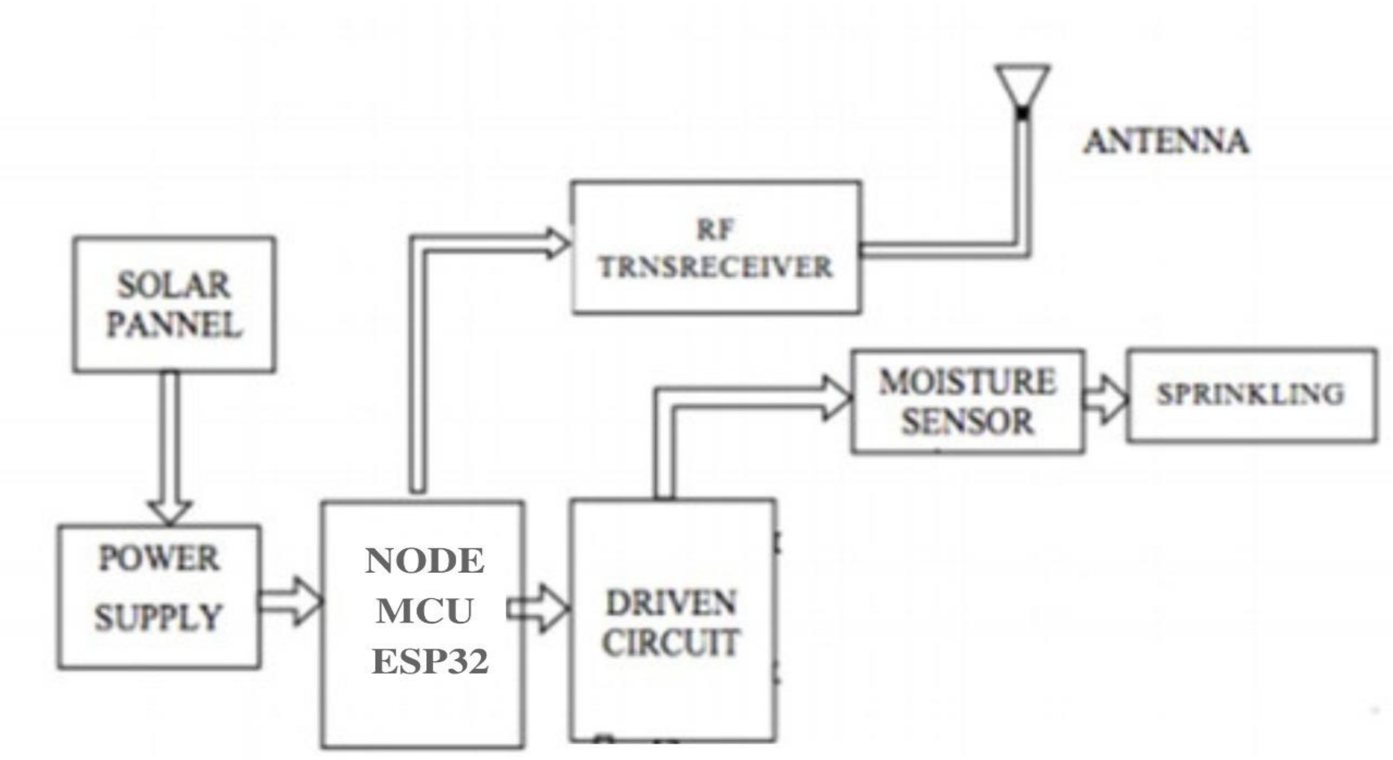
The framework configuration develops a general structure building outline. Programming diagrams incorporate addressing the item system in a shape that might be changed into at least one anticipated. The essential demonstrated by the end customer must be placed in a systematic way. Diagram is a creative system; an extraordinary design is the best approach to reasonable structure. The structure "Layout" is portrayed as "The methodology of applying distinctive frameworks and guidelines with the ultimate objective of describing a strategy or a system in sufficient purpose important to permit its physical affirmation". Diverse design segments are taken after to add to the system. The design detail depicts the segments of the system, the sections or segments of the structure and their appearance to end-customers.

5.2 Design Consideration

The explanation behind the plan is to orchestrate the course of action of the issue dictated by the necessities report. This stage is the underlying stage in moving from issue to the game plan space. All things considered, start with what is obliged; diagram takes us to work towards how to satisfy those necessities. The design of the system is perhaps the most essential segment affecting the way of the item and note-worthily affects the later stages, particularly testing and upkeep. System diagram delineates all the huge data structure, report game plan, yield and genuine modules in the system and their Specification is picked.

5.3 SYSTEM ARCHITECTURE

The architectural configuration procedure is concerned with building up a fundamental basic system for a framework. It includes recognizing the real parts of the framework and interchanges between these segments. The beginning configuration procedure of recognizing these subsystems and building up a structure for subsystem control and correspondence is called construction modeling outline and the yield of this outline procedure is a portrayal of the product structural planning. The proposed architecture for this system is given below.

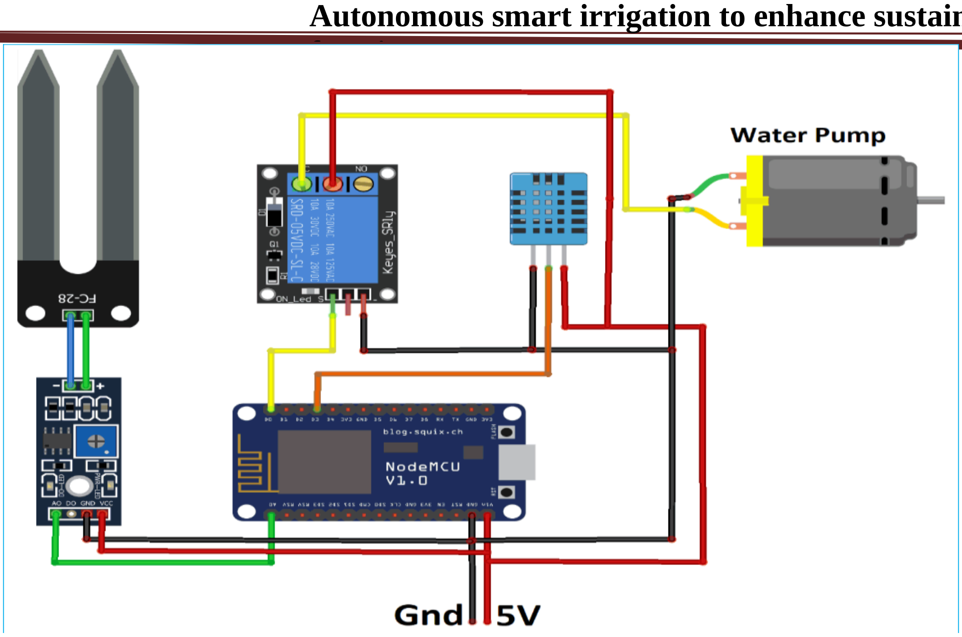


Data Flow diagram:

The DFD is straightforward graphical formalism that can be utilized to speak to a framework as far as the info information to the framework, different preparation did on this information and the yield information created by the framework. A DFD model uses an exceptionally predetermined number of primitive images to speak to the capacities performed by a framework and the information stream among the capacities.

The principal motivation behind why the DFD method is so famous is most likely in light of the way that DFD is an exceptionally basic formalism- It is easy to comprehend and utilization. Beginning with the arrangement of abnormal state works that a framework performs, a DFD display progressively speaks to different sub capacities. Actually, any various leveled models are easy to get.

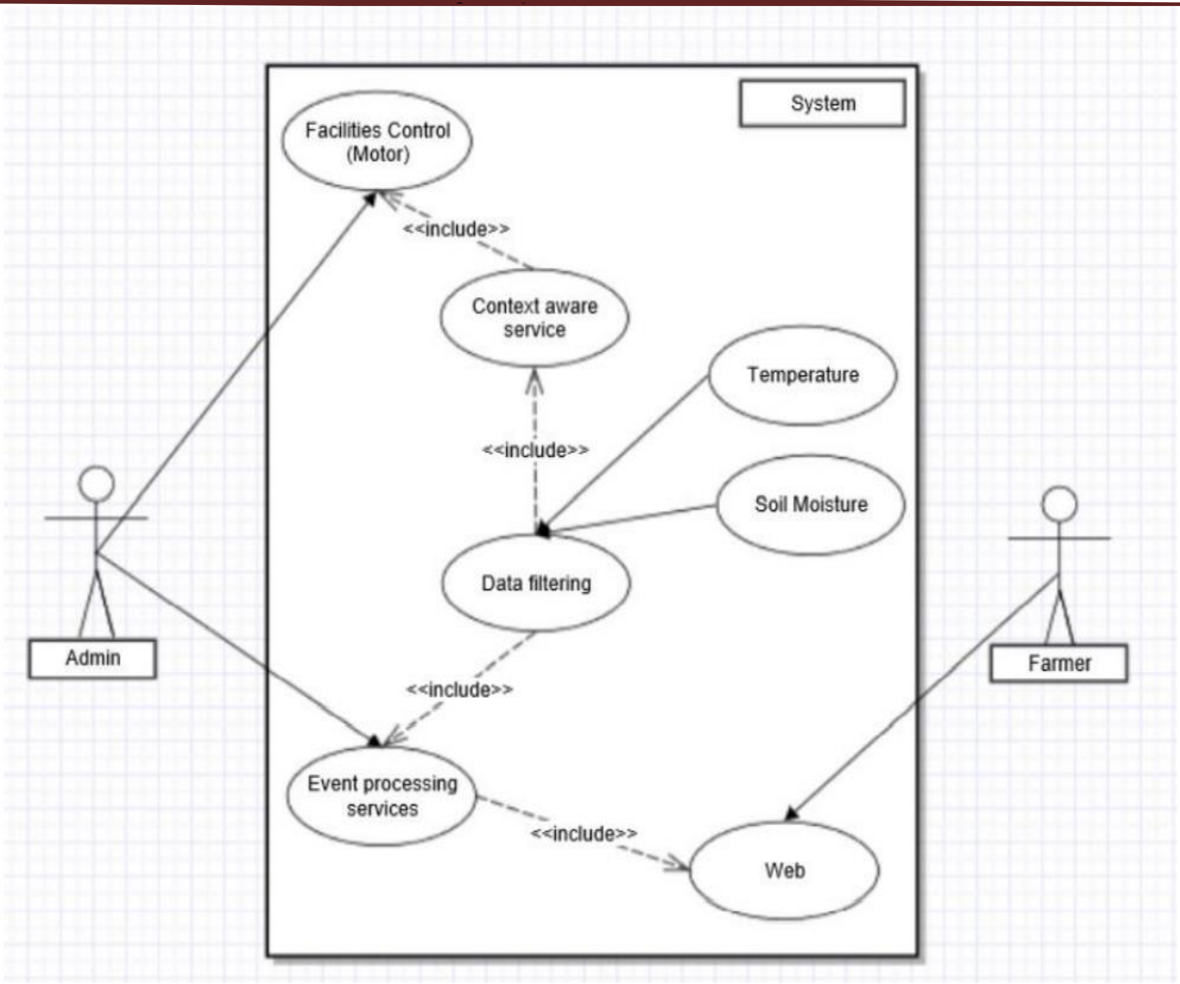
The human personality is such that it can without much of a stretch see any progressive model of a framework in light of the fact that in a various leveled model, beginning with an extremely straightforward and unique model of framework, distinctive points of interest of a framework are gradually presented through the diverse orders. A data-flow diagram (DFD) is a graphical representation of the "stream" of information through a data framework. DFDs can likewise be utilized for the perception of information handling.



Use Case Diagram

A use case chart is a kind of behavioral graph made from a Use-case examination. Its object is to present a graphical diagram of the usefulness given by a framework regarding performers, their objectives (spoken to as utilization cases), and any conditions between those utilization cases. Use case charts give us the data about how clients and utilization cases are connected with the framework. Use cases are used amid prerequisites elicitation and examination to speak to the usefulness of the framework. Use cases concentrate on the conduct of the framework from an outside perspective.

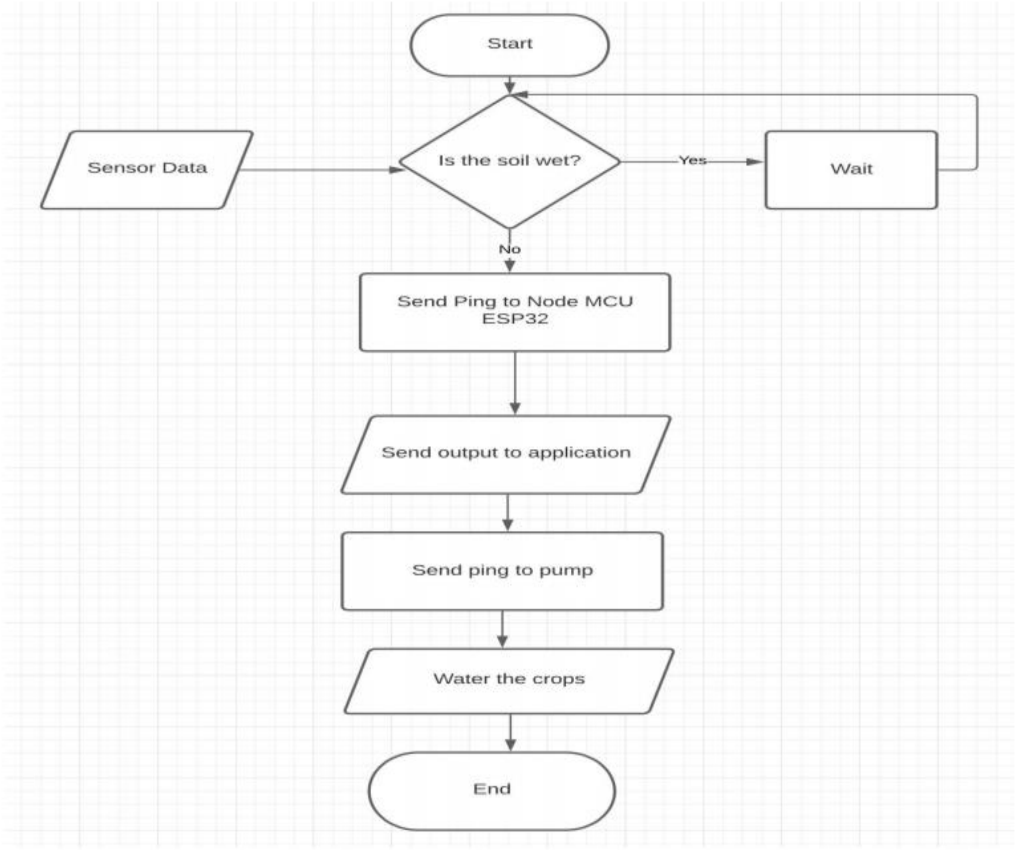
A use case depicts a capacity given by a framework that yields an obvious result for a performer. A performing artist portrays any element that collaborates with the system. The performers are outside the limit of the framework, while the use cases are inside the limit of the framework. On-screen characters are spoken to with stick figures, use cases with ovals, and the limit of the framework with a container encasing the use cases.


System
Facilities Control (Motor)
<<include>>
Context aware service
<<include>>
Temperature
Soil Moisture
Data filtering
<<include>>
Event processing services
<<include>>
Web
Admin
Farmer

Flow chart diagram:

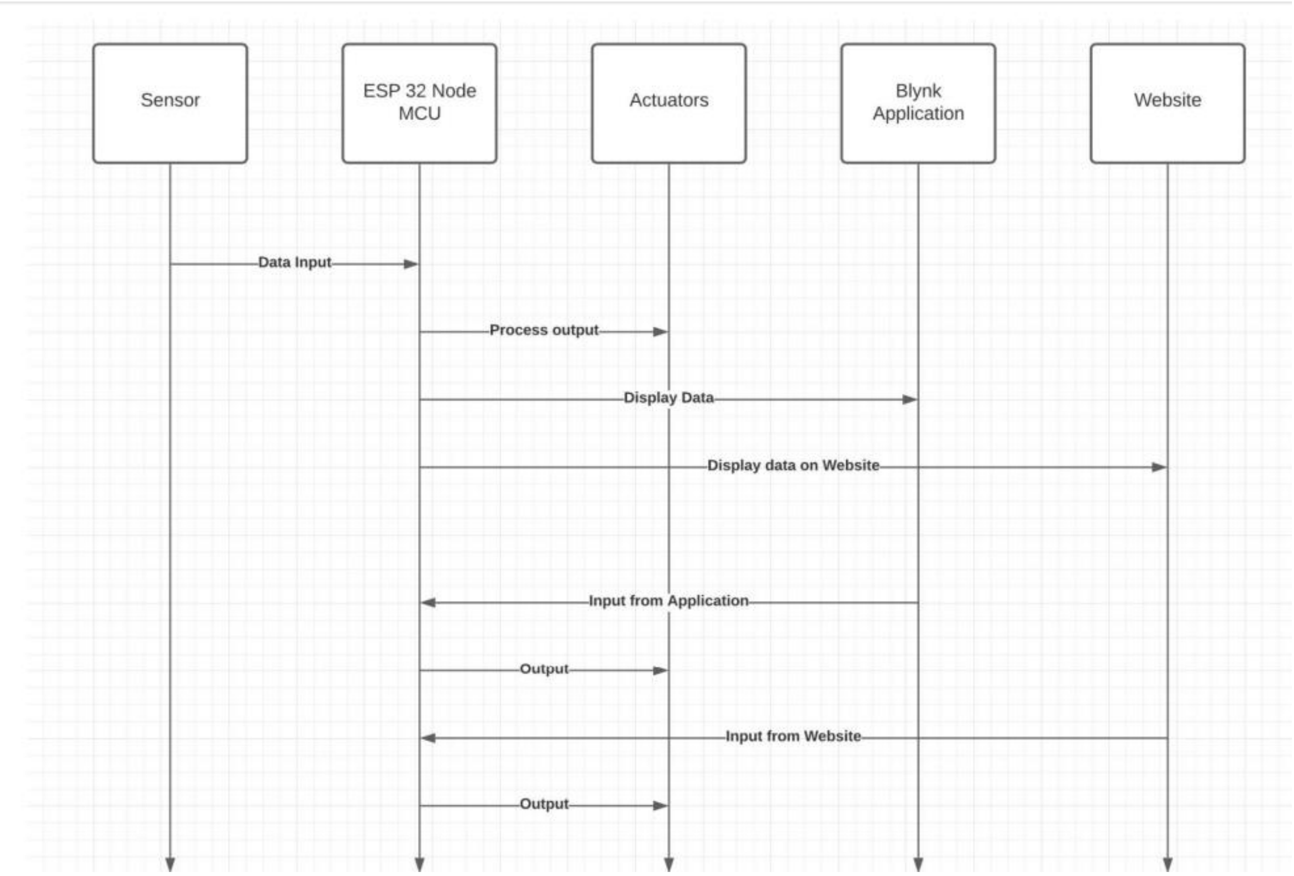
A flowchart is a type of diagram that represents a workflow or process. A flowchart can also be defined as a diagrammatic representation of an algorithm, a step-by-step approach to solving a task.

The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model to a given problem. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields



Sequence diagram:

A sequence diagram is a system is an interaction diagram that shows how processes operate with one and other and in what order. It’s a construct of a message sequence chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are sometimes called event diagrams or event scenarios.



CHAPTER 6:

IMPLEMENTATION

Introduction

This stage is the underlying stage in moving from issue to the course of action space. Accordingly, starting with what is obliged; the diagram takes us to work towards how to fully fill those requirements. System plot portrays all the critical data structure, record course of action, yield and genuine modules in the structure and their Specification is picked. This assumes an essential part on the grounds that it will give the last yield on which it was being worked.

Implementation:

Smart Irrigation system is developed by using the Microcontroller i.e., Nodemcu esp32 and it plays a main role in this automated system. The sensors like soil moisture sensor,humidity sensor and the temperature sensor are connected to the microcontroller. Thus the output of these sensors are fed into the Nodemcu esp32. On receiving the signal from these sensors, the Microcontroller gives the appropriate output that turns on the relay according to the soil moisture and the atmospheric conditions and operates the water pump. This soil moisture sensor determines the soil condition and it is expressed in terms of Resistance.Then it compares the output Resistance with the reference resistance.

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The voltage is obtained from the comparator which is present inside the sensor. When the sensor is placed in the field there will be conductivity. When there is good conduction that implies the presence of moisture content, as water is the good conductor of electricity. Then, the signal is passed and the motor is turned OFF and when there is no conduction, this indicates the absence of water content hence the motor is turned ON by necessary signals generated by the Nodemcu. When the control signal is sent to turn on the motor, the relay switch is closed and the motor is connected to the circuit and the water is pumped to the plants. Similarly, if the control signal is to turn OFF the motor, then the relay switch is opened and the motor is not given supply so the motor is turned OFF. Thus, the necessary water is provided to the plants when they are in need, this is done according to the program burned in the NodeMCU ESP32. Here frequent monitoring is not required.

CHAPTER 7:

PSEUDO CODE

Pseudo Code uses the structural conventions of a normal programming language but the intention is for human reading rather than machine reading. Omission of details that are essential for machine understanding of the algorithm such as variable declarations, specific system code and some sub-routines is pseudocode. Augmentation of programming language is done with natural language description details where convenient or with compact mathematical notation. The purpose of using pseudocode is that it is easier for people to understand than conventional programming language code and that the key principles of an algorithm are efficiently and the environment independently described. Pseudocode is commonly used in textbooks and scientific publications that are documenting various algorithms and also in the plan of computer program development, for sketching the structure of the program before the actual coding takes place.

Steps:

1. Firstly, we imported ESP32 libraries.
2. Booting the ESP32 was done.
3. Next, connect all the sensors.
4. Finally, we linked website and BLYNK app to ESP32

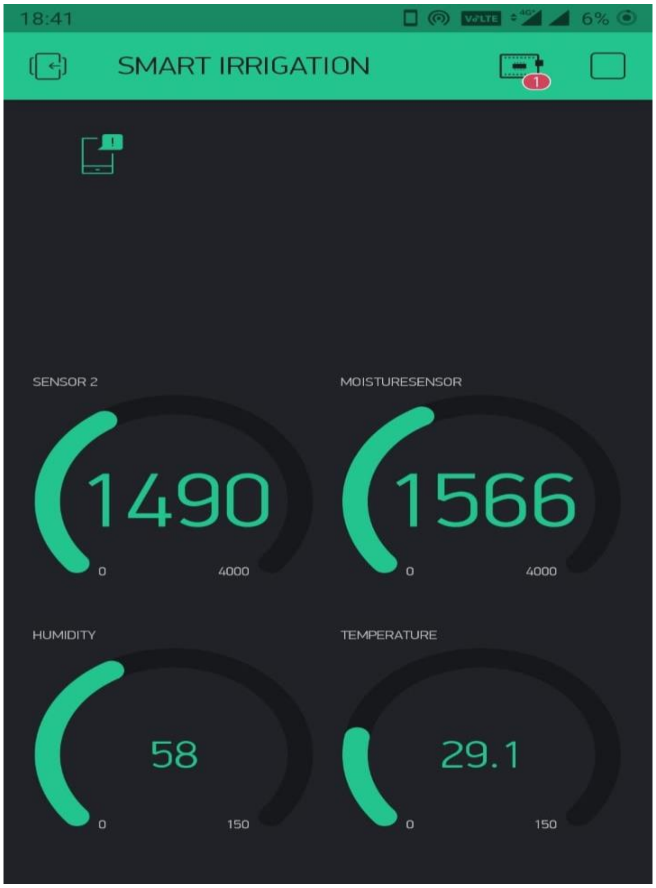
7.1 AUTONOMOUS SMART IRRIGATION TO ENHANCE SUSTAINABLE FARMING:-

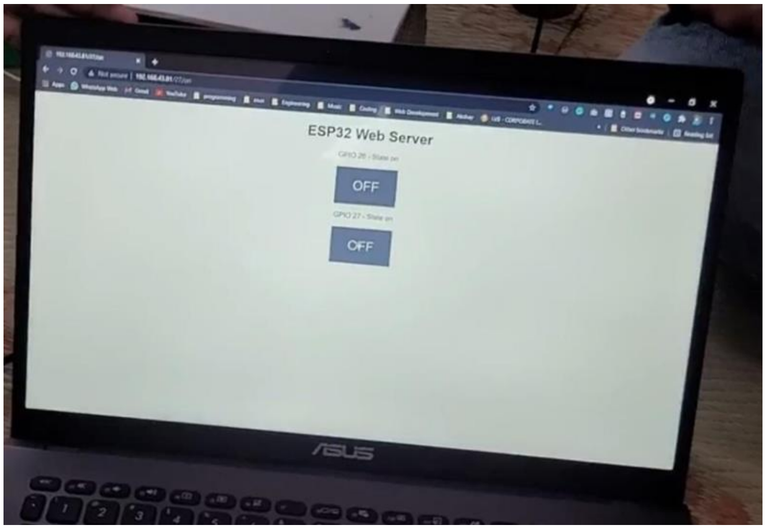
- **Blynk code**

```
# define ledPin1 15
# define ledPin2 19
# define sensorPin1 34
# define sensorPin2 35
#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <WiFiClient.h>
#include<DHT.h>
#include <BlynkSimpleEsp32.h>
int trigger = 2000; // set the level
char auth[] = " XzG-sTxcRsY0demPr23hJ90L_LyW7fYS";
// Your WiFi credentials.
char ssid[] = "Cheetha";
char pass[] = "vrsk9153";
#define DHTPIN 4         // What digital pin we're connected to

// Uncomment whatever type you're using!
#define DHTTYPE DHT11     // DHT 11
//#define DHTTYPE DHT22   // DHT 22, AM2302, AM2321
//#define DHTTYPE DHT21   // DHT 21, AM2301
// Load Wi-Fi library
#include <WiFi.h>

// Replace with your network credentials
const char* ssid = "Surya_room";
const char* password = "Studytable241321";

// Set web server port number to 80
WiFiServer server(80);

// Variable to store the HTTP request
String header;

// Auxiliary variables to store the current output state
String output26State = "off";
String output27State = "off";

// Assign output variables to GPIO pins
const int output26 = 26;
const int output27 = 27;

// Current time
unsigned long currentTime = millis();
// Previous time
unsigned long previousTime = 0;
// Define timeout time in milliseconds (example: 2000ms = 2s)
```

```
const long timeoutTime = 2000;

DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;
void sendSensor()
{
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
  // You can send any value at any time.
  // Please don't send more that 10 values per second.
  Blynk.virtualWrite(V8, h);
  Blynk.virtualWrite(V9, t);
}
void setup()
{
Serial.begin(115200);
  // Initialize the output variables as outputs
  pinMode(output26, OUTPUT);
  pinMode(output27, OUTPUT);
  // Set outputs to LOW
  digitalWrite(output26, LOW);
  digitalWrite(output27, LOW);

  // Connect to Wi-Fi network with SSID and password
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  // Print local IP address and start web server
  Serial.println("");
  Serial.println("WiFi connected.");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  server.begin()
    pinMode(2, INPUT_PULLUP);
  // Attach pin 2 interrupt to our handler
  attachInterrupt(digitalPinToInterrupt(2), loop, CHANGE);
    Serial.begin(9600);
    pinMode(ledPin1, OUTPUT);
    digitalWrite(ledPin1, LOW);
    pinMode(ledPin2, OUTPUT);
    digitalWrite(ledPin2, LOW);
    // turn off LED
    Blynk.begin(auth, ssid, pass); // connect to blynk
    dht.begin();

  // Setup a function to be called every second
  timer.setInterval(1000L, sendSensor);
}


void loop()
{
  Blynk.run(); // Run blynk
  timer.run();
 Serial.print("Moisture Sensor1 Value:");
 Serial.println(analogRead(sensorPin1));
  Serial.print("Moisture Sensor2 Value:");
  Serial.println(analogRead(sensorPin2));
 Serial.println(sensorPin1);// read the value from the sensor
 Serial.println(sensorPin2);
 Blynk.virtualWrite(V5,analogRead(sensorPin1));
  Blynk.virtualWrite(V6,analogRead(sensorPin2));
if (analogRead(sensorPin1)<=trigger)
{
    Blynk.notify("soil in region1 is low ill turn on motor");
    digitalWrite(ledPin1, HIGH); // turn on the motor

}
else
{
      Blynk.notify("soil in region1 is high i'll turn off motor");
    digitalWrite(ledPin1, LOW); // turn off motor
}
delay(500);
if (analogRead(sensorPin2)<=trigger)
{
      Blynk.notify("soil in region2 is low ill turn on motor");
    digitalWrite(ledPin2, HIGH); // turn on the LED

}
else
{
     Blynk.notify("soil in region2 is high i'll turn off motor");
    digitalWrite(ledPin2, LOW); // turn off LED
}
delay(500);
WiFiClient client = server.available();   // Listen for incoming clients

  if (client) {                             // If a new client connects,
    currentTime = millis();
    previousTime = currentTime;
    Serial.println("New Client.");          // print a message out in the serial port
    String currentLine = "";                // make a String to hold incoming data from the client
    while (client.connected() && currentTime - previousTime <= timeoutTime) {  // loop while the client's
connected
      currentTime = millis();
      if (client.available()) {             // if there's bytes to read from the client,
        char c = client.read();             // read a byte, then
        Serial.write(c);                    // print it out the serial monitor
        header += c;
        if (c == '\n') {                    // if the byte is a newline character
          // if the current line is blank, you got two newline characters in a row.
          // that's the end of the client HTTP request, so send a response:
          if (currentLine.length() == 0) {
            // HTTP headers always start with a response code (e.g. HTTP/1.1 200 OK)
            // and a content-type so the client knows what's coming, then a blank line:
            client.println("HTTP/1.1 200 OK");
            client.println("Content-type:text/html");
            client.println("Connection: close");
            client.println();
            // turns the GPIOs on and off
            if (header.indexOf("GET /26/on") >= 0) {
              Serial.println("GPIO 26 on");
              output26State = "on";
              digitalWrite(output26, HIGH);
            } else if (header.indexOf("GET /26/off") >= 0) {
              Serial.println("GPIO 26 off");
              output26State = "off";
              digitalWrite(output26, LOW);
            } else if (header.indexOf("GET /27/on") >= 0) {
              Serial.println("GPIO 27 on");
              output27State = "on";
              digitalWrite(output27, HIGH);
            } else if (header.indexOf("GET /27/off") >= 0) {
              Serial.println("GPIO 27 off");
              output27State = "off";
              digitalWrite(output27, LOW);
            }
            // Display the HTML web page
            client.println("<!DOCTYPE html><html>");
            client.println("<head><meta name=\"viewport\" content=\"width=device-width, initial-
scale=1\">");
            client.println("<link rel=\"icon\" href=\"data:,\">");
            // CSS to style the on/off buttons
            // Feel free to change the background-color and font-size attributes to fit your preferences
            client.println("<style>html { font-family: Helvetica; display: inline-block; margin: 0px auto; text-
align: center;}");
            client.println(".button { background-color: #4CAF50; border: none; color: white; padding: 16px
40px;");
            client.println("text-decoration: none; font-size: 30px; margin: 2px; cursor: pointer;}");
            client.println(".button2 {background-color: #555555;}</style></head>");
            // Web Page Heading
            client.println("<body><h1>ESP32 Web Server</h1>");

            // Display current state, and ON/OFF buttons for GPIO 26
            client.println("<p>GPIO 26 - State " + output26State + "</p>");
            // If the output26State is off, it displays the ON button
            if (output26State=="off") {
              client.println("<p><a href=\"/26/on\"><button class=\"button\">ON</button></a></p>");
            } else {
              client.println("<p><a href=\"/26/off\"><button class=\"button
button2\">OFF</button></a></p>");
            }

            // Display current state, and ON/OFF buttons for GPIO 27
            client.println("<p>GPIO 27 - State " + output27State + "</p>");
            // If the output27State is off, it displays the ON button
            if (output27State=="off") {
              client.println("<p><a href=\"/27/on\"><button class=\"button\">ON</button></a></p>");
            } else {
              client.println("<p><a href=\"/27/off\"><button class=\"button
button2\">OFF</button></a></p>");
            }
            client.println("</body></html>");

            // The HTTP response ends with another blank line
            client.println();
            // Break out of the while loop
            break;
          } else { // if you got a newline, then clear currentLine
            currentLine = "";
          }
        } else if (c != '\r') {  // if you got anything else but a carriage return character,
          currentLine += c;      // add it to the end of the currentLine
        }
      }
    }
    // Clear the header variable
    header = "";
    // Close the connection
    client.stop();
    Serial.println("Client disconnected.");
    Serial.println("");
  }

}
```

Output:


18:41
6%
SMART IRRIGATION
1
SENSOR 2
1490
0
4000
MOISTURESENSOR
1566
0
4000
HUMIDITY
58
0
150
TEMPERATURE
29.1
0
150


ESP32 Web Server
GPIO 26 - State on
OFF
GPIO 27 - State on
OFF
ASUS

CHAPTER 8

TESTING

Testing of any product consists of giving the product an arrangement of test information and watching if the product carries on, not surprisingly, if the product neglects to carry on obviously ,then the conditions under which disappointment happens are noted for investigation and amendment. At last the framework in general is tried to guarantee that blunders in past countenances are revealed and the venture acts as determined.

8.1 Basics of software testing:

8.1.1 Black Box testing

Black box testing is done to find the following

- Incorrect or missing functions
- Interface errors
- Errors on external database access
- Performance error
- Initialization and termination error

8.1.2 White Box Testing

This allows the tests to

- Check whether all independent paths within a module have been exercised at least once
- Exercise all logical decisions on their false sides
- Execute all loops and their boundaries and within their boundaries
- Exercise the internal data structure to ensure their validity
- Ensure whether all possible validity checks and validity lookups have been provided to validate data entry.

8.2 Types of Testing

- Following are the different types of testing
- Unit Testing
- Integration Testing
- System Testing
- Performance Testing
- Validation Testing
- Acceptance Testing

Let us consider each testing and discuss it in detail. Firstly we move to the first testing and give its detailed description.

8.2.1 Unit Testing

Singular parts are tried to guarantee that they work accurately. Every part is tried freely, without another framework segment. This framework was tried with the arrangement of legitimate test information for every module and the outcomes were checked with the normal yield. Unit testing centers around confirmation exertion on the littlest unit of the product outline module. This is otherwise called MODULE TESTING. This testing is done amid stages, every module is observed to work agreeable as respects to the normal yield from the module.

8.2.2 Integration Testing

Mix testing is another part of testing that is for the most part done keeping in mind the end goal to reveal mistakes related to the stream of information crosswise over interfaces. The unit-tried modules are assembled together and tried in little sections, which make it less demanding to seclude and revise mistakes. This approach proceeded with unit I have coordinated all modules to frame the framework all in all.

8.2.3 System Testing

Framework testing is really a progression of various tests whose basic role is to completely practice the PC based framework. Framework testing guarantees that the whole incorporated programming framework meets prerequisites. It tests a design to guarantee known and unsurprising outcomes. A case of framework testing is the setup arranged framework mix testing. Framework testing depends on process depiction and streams, underscoring pre-driver process and incorporation focuses.

8.2.4 Performance Testing

The execution testing guarantees that the yield being delivered inside as far as possible and time taken for the framework aggregating, offering reaction to the clients and demand being sent to the framework so as to recover the outcomes.

8.2.5 Validation Testing

The approval testing can be characterized from multiple points of view, however a straightforward definition is that. Approval succeeds when the product capacities in a way that can be sensibly expected by the end client.

8.2.6 Acceptance Testing

This is the last phase of testing procedure before the framework is acknowledged for operational utilization. The framework is tried inside the information provided from the framework procurer instead of recreated information.

Table 1 Unit Test Case 1

S1 Test Case	UTC-*1
Name of Test	Embedded c language
Expected Result	We are using embedded c language for microcontrollers. We can upload the code in Arduino.
Actual output	Same as expected.
Remarks	Successful

Table 2 Unit Test Case 2

S2 Test Case	UTC-*2
Name of Test	Sensing moisture
Expected Result	Measure real time moisture value of the soil
Actual output	Same as expected.
Remarks	Successful

Table 3 Unit Test Case 3

S3 Test Case	UTC-*3
Name of Test	Sensing humidity and temperature
Expected Result	measure real time humidity and room temperature
Actual output	Same as expected.
Remarks	Successful

Table 4 Unit Test Case 4

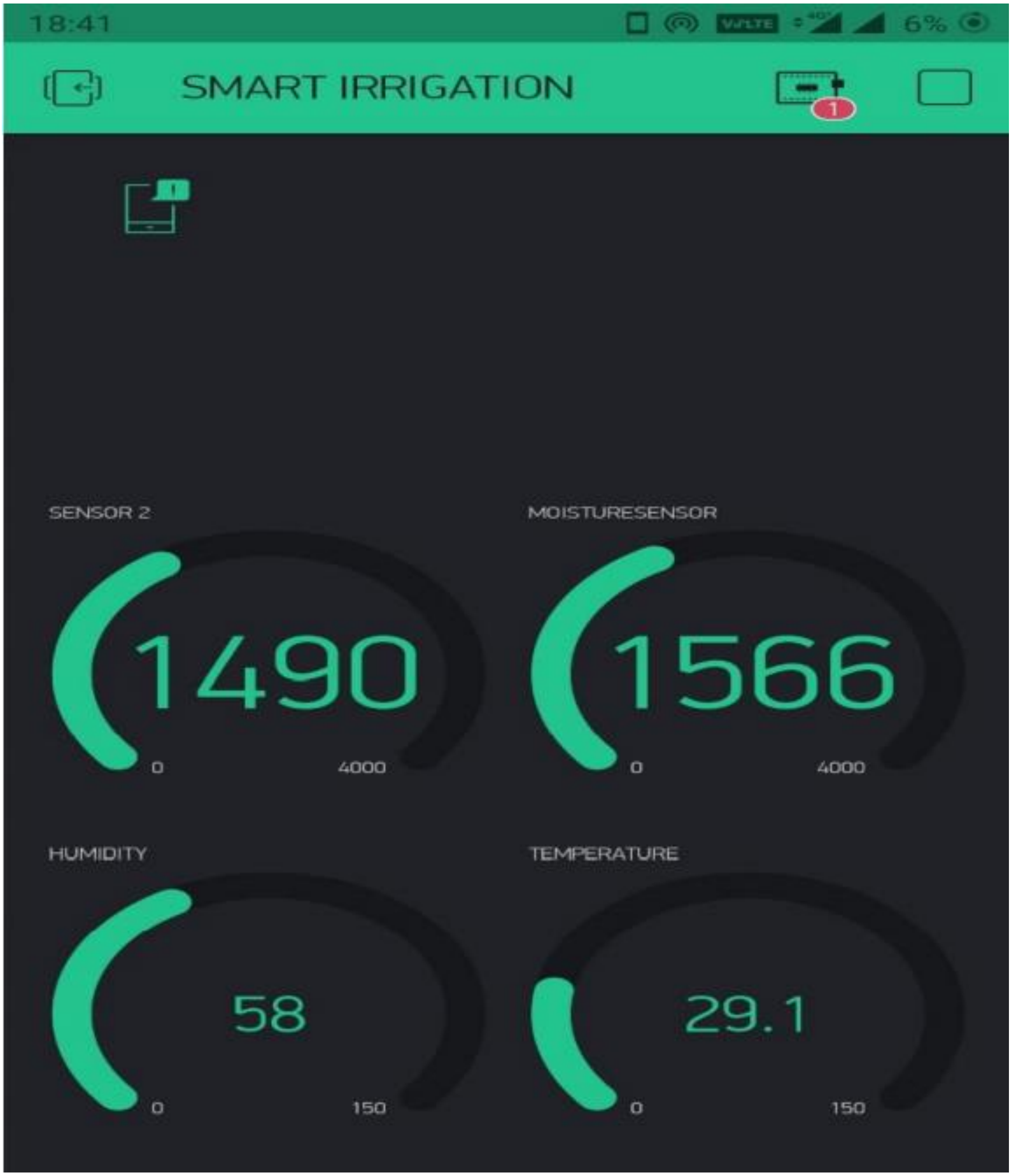
S4 Test Case	UTC-*4
Name of Test	Sending notification to Blynk app
Expected Result	Sending notification to BLYNK app when moisture value reaches threshold or when moisture value diminish below threshold
Actual output	Same as expected.
Remarks	Successful

Table 5 Unit Test Case 5

S5 Test Case	UTC-*5
Name of Test	Turning the motor on and off
Expected Result	motor should turn on when the moisture value is low in soil and motor should turn off when soil moisture value reaches threshold
Actual output	Same as expected.
Remarks	Successful

CHAPTER 9:

RESULTS

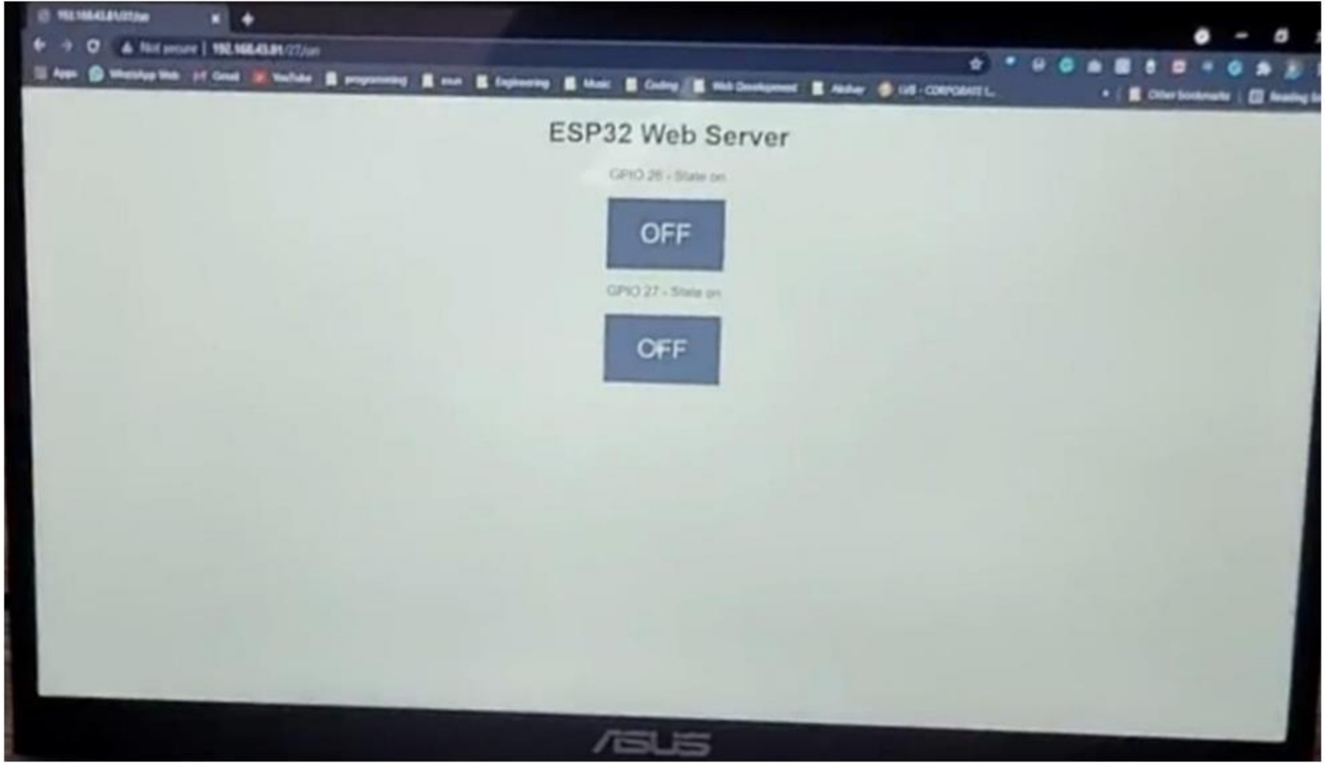


SENSOR 2
1490
0 4000

MOISTURESENSOR
1566
0 4000

HUMIDITY
58
0 150

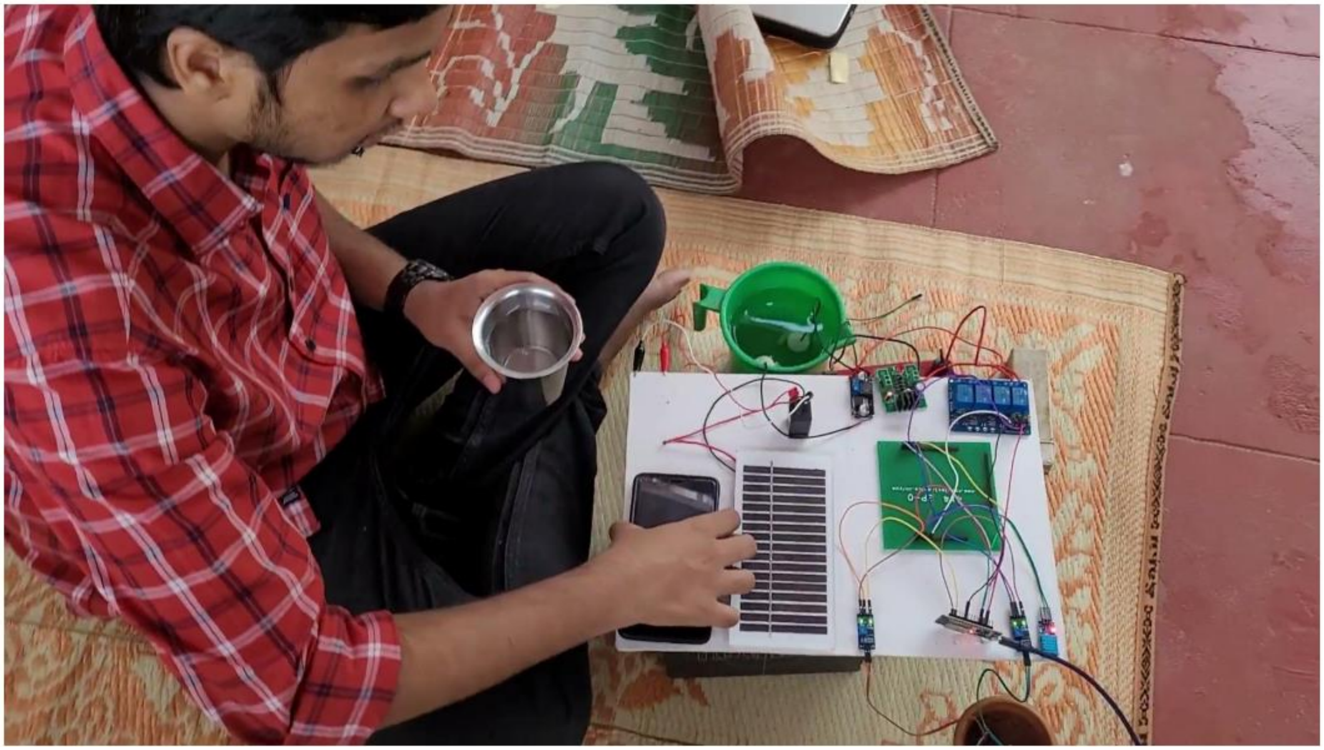
TEMPERATURE
29.1
0 150



ESP32 Web Server

GPIO 26 - State on

GPIO 27 - State on



CHAPTER 10

CONCLUSION AND FUTURE SCOPE

The Use of the sensors keeps the farmer well informed about the ongoing things in the field with respect to the crop.

● Effective utilization of automation which eases the load off the farmers both physically and economically.

● The performance and the precision have been increased to a greater extent as the human errors are reduced and substantial increase in the yield is witnessed.

● Low power consumption and reduced man power. Overall, our project helps to overcome the impediments faced by the farmer in Agriculture. This Project certainly sets a trend in the future of agriculture in our country as there is an improved yield.

Future enhancement:

- The objective of our project is to overcome the impediments faced by the farmers in the agriculture sector with our proposed sustainable farming with Autonomous Irrigation system. The scope of our project is to achieve success in each task that is planned and executed with minimum cost and time.
- The project will be scalable thereafter reaching many farmers which will be the ultimate objective and scope of our project. Addition of weather prediction data.
- pH level monitoring
- Crop disease prediction

CHAPTER 11

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