Automated Irrigation System

Project report submitted to
Dr. Babasaheb Ambedkar Technological University, Maharashtra
in partial fulfilment of the requirements for the award of
the degree

Bachelor of Technology
In
Computer Engineering

By

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Wardha-442 001 (India)
2022-23

BAJAJ INSTITUTE OF TECHNOLOGY, WARDHA
DEPARTMENT OF COMPUTER ENGINEERING

CERTIFICATE

This is to certify that the Project report titled

AUTOMATED IRRIGATION SYSTEM

has been successfully completed

by

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DECLARATION

We, hereby declare that the project report titled “Automatic Irrigation System” submitted by me to the Bajaj Institute of Technology, Wardha, in partial fulfilment of the requirement for the award of Degree of B. Tech. in Computer Engineering discipline is a record of bonafide project work carried out by me under the guidance of Prof. Ajay Sahu, Assistant Professor.

We, further declare that this submission by the undersigned represents my/our original work and I/We have quoted the references where others ideas/words have been included. I understand any violation of the above will levy a disciplinary action on me/us.

We, further declare that the work reported in this project report has not been submitted either in-part or in-full for the award of any other degree in any other Institute or University.

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ABSTRACT

The most difficult task in agriculture is watering the fields. The different types of watering system are drip system, nozzle type, tube method and sprinkler system . This system focuses on sprinkler irrigation. Many literature reviews stated about the automated irrigation mechanism which states the sensing of soil moisture and ON/OFF Control of motors in agriculture fields . The ideas further specify in maintaining the crops.This system focuses on the different aspect using master slave topology multiple slaves (NodeMCU ESP 8266) will work on the instruction passed by one master node . Master ESP32 is a wifi module which is used to communicate between the software and hardware. The slaves will be connected to the relays which function like a switch and then switches are connected to the motors. These motors are responsible for the working of sprinklers in the different sections of the farm. Simultaneously the rain sensor will keep the track of rain and according to that postponed the catering schedule similarly the soil moisture sensor will be responsible for checking the moisture content in the soil which will start or stop the motor for watering. This system has various phases which aims to appropriate watering to the crops according to its need in order to reduce the crop damage due to excessive or less supply of water.

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ABBREVIATIONS

MCU	*Micro-Controlling Unit*
SM	*Soil Moisture*
RTC	*Real Time Clock*

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.1 Introduction

1. Agriculture has been the most important practice from the very beginning of human civilization. It has seen many iterations of development in technology with time. A good agricultural practice is still an art.

2. Many literature reviews stated about the automated irrigation mechanism which states the sensing of soil moisture and ON/OFF Control of motors in agriculture fields . The ideas further specify in maintaining the crops.

3. A sustainable approach is required to maintain balance between these parameters and environment. Hence there is a need for an efficient monitoring and automatic controlling system. They result in a lot of wastage of water and can also promote disease such as fungus formation due to over moisture in the soil and still watering the plant.

4. So this is the system which will help farmers to avoid working at night due to electricity issues, thus this automation will take responsibility and work according to the night time which will help to reduce risk and also it will take note of moisture level in the soil and hence reduce the extra or less supply of water to avoid damaging to the plants ultimately reduces water usage.

5. This project the main work will happen in the master slave system. The master will check the status of the sensor, send one by one request to the slave system and wait for request acknowledgement and then the master will receive the data and based on that data the motor will turn on or turn off.

1.2 Motivation

The motivation behind this work was the lack of good farming facilities and technology around the world. There is an extreme shortage of an automatic irrigation system in India, which also includes the lack of technology that is being involved in the irrigation system.

Traditional farming system does not involve smart technology which makes the life of farmers very-very challenging in the fields. Irrigation needs a vital improvement in various circumstances of hot and humid regions. Efficient use of water for crops requires the understanding of smart irrigation methods. The rapid growth in population has drastically increased the demand for the development of irrigated land throughout the world.

Irrigation also needs improvement. New irrigation systems and designs are continuously in development and examination as an effort to obtain high practically attainable efficiency of water application as well as increase in crop production in the field of farming. One of our driving motivations is to provide solutions for farmers to manage their crops more efficiently by making use of various technologies.

The prime objective is to make the life of farmers much easier and user-friendly by providing them with an automated irrigation system that will not just help them to reduce their efforts but also will ensure the proper use of water which is being given to the crops to harness them.

As the world is transforming into new technologies and standards, it has become a necessary goal to bring new trends in agriculture. There are other factors that bring down the yield of crops to a great extent. Hence, automation must be implemented in agriculture to get rid of these problems.

In order to provide solutions to all such problems, it is necessary to develop an integrated system which will take care of all factors that affect productivity at each and every stage. Hence, this work deals about developing an optimal plant growth system using IOT for the farmers

1.3 Organisation of Report

The report is organized as follows: Chapter 1 is an Introduction and motivation. Chapter 2 is a literature survey and gap identification in literature, Chapter 3 explains the system requirements and specifications, use case diagram, process flow diagram, (both hardware integration and software integration diagram) and database connectivity, Chapter 4 consists of the implementation of the project, module description, planning of the project, the contribution of the team members,

screenshots of project, Chapter 5 is results and discussions, Chapter 6 holds the conclusion and future scope and finally, Chapter 7 holds references respectively.

CHAPTER 2

LITERATURE SURVEY

2.1 Literature review

2.1.1 H. M. Yasin, S. R. M. Zeebaree (2019). Arduino Based Automatic Irrigation System: Monitoring and SMS Controlling

Nowadays, there is speed and diversity in scientific innovations that enter into the way of an individual's life and make the life easier. There are many inventors of irrigation systems that rely on the control system which facilitates the way towards a solid system of irrigation. In this research, a new system is designed to monitor and operate the irrigation system. The system uses the Arduino mega 2560 enhanced with Global System for Mobile communication (GSM) technology so that Arduino platform allows to receive/send SMS to/from the mobile of farms/homeowner according to soil needed for water or the instructions sent by the user. The system is equipped with moisture sensors that are inserted in the soil to irrigate the plants automatically if the ground is dry or controlled by mobile using SMS messaging. The mobile of farms/homeowner can inform him if soil needs watering and in turn the farmer/householder sends an SMS message to the controller to start irrigation, and then send another SMS message to stop the irrigation after receiving an SMS message from the microcontroller that the soil saturated with water. There are probabilities to take into consideration, one of them is if the water tank is empty, which in this situation the moisture sensor inserted in the tank to inform the homeowner there is no water if empty and in turn the homeowner has sent the SMS message to microcontroller to turn ON the water pump to provide the tank with water. Another probability is rain fall; in this state, the rain drop sensor module is added to the system to stop the irrigation via SMS sent by homeowner.

2.1.2 P.B. Wakhare, S. Neduncheliyan (2020) Automatic irrigation system based on internet of things for crop yield production:

For century's agriculture has been based on traditional methods, and when modern technology was introduced, it was only in modernizing the traditional equipment. But the scope for monitoring, automation and data analysis based on real time data acquisition from farms has not been much explored. When we explore this field it will also open up the scope for Internet of Things based automation in agriculture field. The main aim of this research paper will be designing and implementing smart automation system for farms alongside constantly analyzing and reporting real time data from the field. In this paper explain about the prototype design of microcontroller based intelligent irrigation system controller which will allow irrigation to take place from remote places where manual inspection is not needed. According to pH value of soil, a list of best suited crop is selected from all crops. Values of monitoring parameters are adjusted according to optimal condition required for particular crop.

2.1.3 Lita, D. A. Vasan, A. Ghergita (2020) Automation module for precision irrigation system

In this paper is presented an improved design for an automation module which is dedicated for applications in irrigation systems used in precision agriculture. The architecture of the automation module relies on Arduino Uno development board containing the microcontroller ATmega328P which performs the majority of the control tasks required in the operation of the proposed system. The long-distance data transmission and remote monitoring of the important parameters of the system is realized with the connectivity ensured by SIM800L quad-band GSM/GPRS module. Also, the local connection between the automation module and a PC running a software control application is realized with the CH340G USB to USART converter which is integrated on the Arduino board. The automation module controls a precision irrigation system containing a set of sprinklers, a humidity sensor, a flow meter and a variable speed pump. By using a modern implementation approach, based on versatile ATmega328P microcontroller, together with the communication capabilities offered by the GSM/GPRS module SIM800L, the proposed design represents an efficient and cost-effective solution for implementing smart irrigation systems for modern agriculture industry.

2.1.4 S. Peraka, R. Sudheer, B. N. Rao (2020). Smart Irrigation based on Crops using IoT:

In this paper, we proposed a new irrigation system, which works based on the latest IoT technology to reduce the wastage of water and it reduces manual labor to irrigate the crops. The main objective of the proposed irrigation system is to supply the required amount of water to the crop based on the type and stage of the crop. The proposed irrigation system pumps the water to the crop based on the type, area, and date of the plantation of the crop, and these parameters are registered by the farmer through the IoT-based Android App. The designed irrigation system uses ESP8266 Controller, Moisture, and Water Level sensors for irrigating the crops. The problem with the moisture sensor-based irrigation system is supplying water to the crop only based on the sensor reading, but different crops require different amounts of water at different stages. Hence, in this paper, we divided the total crop duration into five different stages. Based on the type and stage, the crop gets irrigated automatically using the motor incorporated in the circuit and the motor action can be controlled using the algorithm designed for ESP8266. Another problem with the moisture sensor is it shows maximum reading even when the water level is low. This problem can be resolved by using a water level sensor and hence, the proposed smart irrigation system is superior to the existing moisture sensor-based irrigation system.

2.1.5 S, Velmurugan & Balaji, V. (2020). An IOT based Smart Irrigation System using Soil Moisture and Weather Prediction :

The scarcity of clean water resources around the globe has generated a need for their optimum utilization. Internet of Things (IoT) solutions, based on the application specific sensors' data acquisition and intelligent processing, are bridging the gaps between the cyber and physical worlds. IoT based smart irrigation systems can help in achieving optimum water-resource utilization in the precision farming landscape. This paper presents an open-source technology based smart system to predict the irrigation requirements of a field using the sensing of ground parameters like soil moisture, soil temperature, and environmental conditions along with the weather forecast data from the Internet. The intelligence of the proposed system is based on a smart algorithm, which considers sensed data along with the weather forecast parameters like precipitation, air temperature, humidity, and UV for the near future. The complete system has been developed and deployed on a pilot scale, where the sensor node data

is wirelessly collected over the cloud using web-services and a web-based information visualization and decision support system provides real-time information insights based on the analysis of sensor data and weather forecast data. The paper describes the system and discusses in detail the information processing results of three weeks data based on the proposed algorithm. The system is fully functional and the prediction results are very encouraging.

2.2 Gaps Identification in Literature

Numerous studies on the subject of automated irrigation systems have revealed that, in accordance with it, soil moisture sensors are used to sense soil moisture. The irrigation system in agricultural areas is only operated on the basis of motor control (ON/OFF). However, there are many factors that need to be taken into account. For example, since the farm is a hectare-sized area and the soil moisture sensor is quite small and can only detect changes in a few centimetres of space, this notion cannot be implemented effectively. The farmers might not be able to afford it if soil moisture are applied at that time because it won't be cost-effective.

Likewise, the watering cycles for various plants vary. Consequently, we cannot solely rely on the results of the soil moisture sensor while watering.

2.3 Problem statement

Everyone is aware of how crucial irrigation is to all forms of agriculture. Irrigation is used for plant growth, lawn maintenance, and the production of landscaping plants. The issue is that irrigation requires sprinklers that are connected to extremely powerful batteries, which calls for three phase of power supply. Additionally, the majority of villages in India have three-phase electricity available at night, which is an issue. As a result, the farmers must travel at night to start the motor and return later to turn it off. It could result in a number of troublesome circumstances, including animal or thief attacks, among others.

In addition, manual irrigation may result in crop damage due to inadequate or excessive water supply to the crops.

2.4 Objectives

Main aim of our systems is to help farmers by making their work easy, with automated irrigation.

Accurate irrigation scheduling could reduce the amount of irrigation applied by utilizing rainfall and shallow groundwater as supplementary water sources, minimize irrigation-induced drainage, leaching and salt additions, and manage plant available water

Some general objectives are

- ➢ To supply water to the crops according to their needs.
- ➢ To avoid all the time-consuming process by assigning the tasks automatically.
- ➢ To keep the track of tasks with timely reminders & notifications.
- ➢ To reduce extra effort.

2.5 Scope of Work

Automated irrigation is the use of a device to operate irrigation structures so the change of flow of water from bays can occur in the absence of the irrigator. Automation can be used in a number of ways: to start and stop irrigation through supply channel outlets, to start and stop pumps.

This project shifts from manual irrigation to automatic irrigation. Sensors are used to monitor humidity level in the soil and the water level in the tank which are processed by the microcontroller indicating ON or OFF condition of the system.

By using sensors like moisture, rain, etc. water supply for irrigation can be managed Soil moisture sensors smartly measure the soil moisture and detect that whether the area is properly gets satisfied by its water requirements.

Saves your water and time. Sprinkler irrigation systems can be set to daily or weekly watering, as well as timed for specific hours during day or night.

CHAPTER 3

SYSTEM REQUIREMENTS AND SPECIFICATIONS

3.1 Hardware requirements

3.1.1 Node MCU ESP 8266

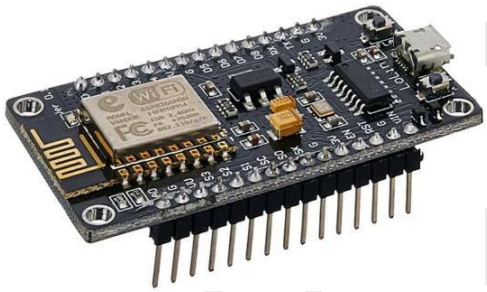

Figure 3.1: Node MCU ESP8266

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.

3.1.2 Relay

Figure 3.2: Relay

Relay modules use low-level data signals to switch relays capable of handling loads up to 10 Amps. Ideal for devices like PIR detectors and other sensors that output low level signals that need to turn another device on or off. A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a microcontroller. When activated, the electromagnet pulls to either open or close an electrical circuit.

3.1.3 Soil Moisture Sensor

Figure 3.3: Soil Moisture Sensor

Soil moisture sensors measure the water content in the soil and can be used to estimate the amount of stored water in the soil horizon. Soil moisture sensors do not measure water in the soil directly. Instead, they measure changes in some other soil property that is related to water content in a predictable way.

The soil moisture sensor consists of two probes that measure the volume of water in the soil. The two probes allow the electric current to pass through the soil and, according to its resistance, measure the moisture level of the soil.

3.1.4 Jumper Wires

Figure 3.4: Jumper wire

Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering. You can use jumper wires to modify a circuit or diagnose problems in a circuit.

Jumper wires come in three versions: Male-to-male jumper, Male-to-female jumper and Female-to-female jumper. And two types of head shapes: square head and round head.

The difference between each is in the endpoint of the wire. Male ends have a pin protruding and can plug into things, while female ends do not but are also used for plugging. Moreover, a male connector is referred to as a plug and has a solid pin for centre conduction. Meanwhile, a female connector is referred to as a jack and has a centre conductor with a hole in it to accept the male pin. Male-to-male jumper wires are the most common and what you will likely use most often. For instance, when connecting two ports on a breadboard, a male-to-male wire is what you will need.

3.1.5 Rain Sensor

Figure 3.5: Rain Sensor

Rain Sensor sends out a beam of infrared light that, when water droplets are on the windshield, is reflected back at different angles. This tells the system to activate the wipers, as well as adjust wiper speed and frequency based on the intensity of the precipitation combined with the vehicle's speed.

3.1.6 Sprinkler

Figure 3.6: Sprinkler

Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops

which fall to the ground. The pump supply system, sprinklers and operating conditions must be designed to enable a uniform application of water.

3.1.7 ESP32

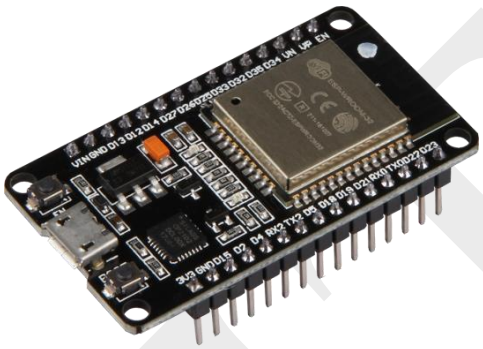

Figure 3.7: ESP32

ESP32 is the SOC (System on Chip) microcontroller which has gained massive popularity recently. Whether the popularity of ESP32 grew because of the growth of IoT or whether IoT grew because of the introduction of ESP32 is debatable.

The ESP32 can easily connect to a Wi-Fi network to connect to the internet (station mode), or create its own Wi-Fi wireless network.

3.1.8 Laptop/ PC

A Laptop/PC is an electronic device that can store, process, and retrieve data. Usually, it can perform a variety of tasks which makes life more comfortable.

3.2 Technology Used

3.2.1 Flutter

Figure 3.8: Flutter

Flutter is an open-source software development kit which enables smooth and easy cross-platform mobile app development. You can build high quality natively compiled apps for ios and Android quickly, without having to write the code for the two apps separately. All you need is one codebase for both platforms.

Flutter is Google's UI toolkit for building beautiful, natively compiled applications for mobile, web, and desktop from a single codebase. Flutter works with existing code, is used by developers and organizations around the world, and is free and open source.

3.2.1 Firebase

Figure 3.9: Firebase

Firebase is a mobile app platform with integrated, unified client libraries in various mobile programming languages. Firebase's different backend-as-a-service features help you develop high-quality apps, grow your user base, and earn more money.

Google Firebase is a google-backed application development software that enables developers to develop ios, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiments.

The Firebase realtime database lets you build rich, collaborative applications by allowing secure access to the database directly from client-side code. Data is persisted locally, and even while offline, realtime events continue to fire, giving the end user a responsive experience.

3.3 Circuit diagram

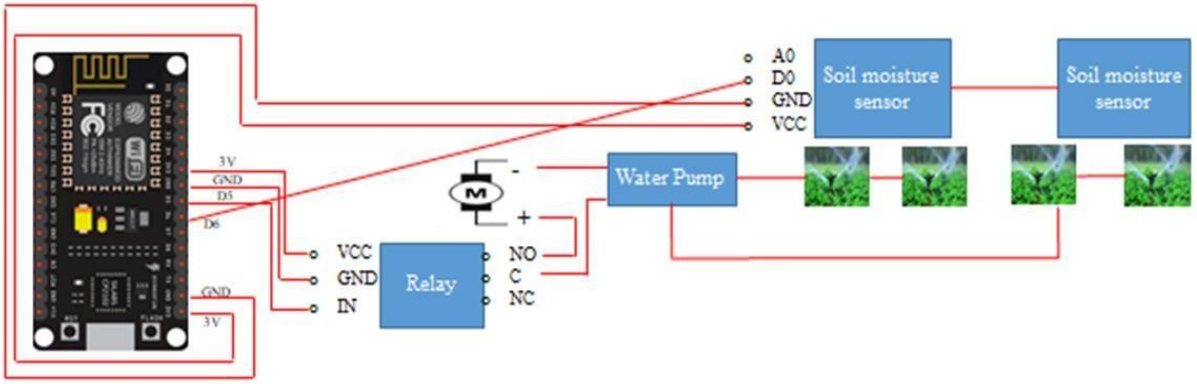

Figure 3.10: Circuit Diagram

3.4 Process Flow

3.4.1 Hardware Implementation Diagram

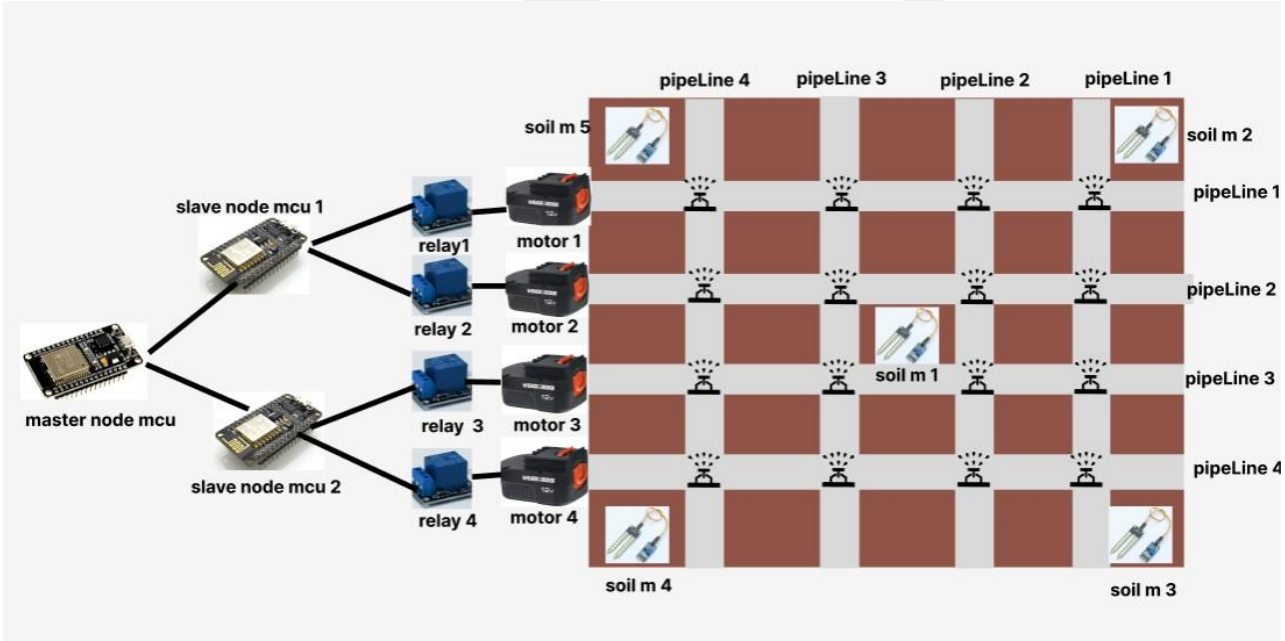

Figure 3.11: Hardware implementation diagram

3.4.2 Hardware and software integration

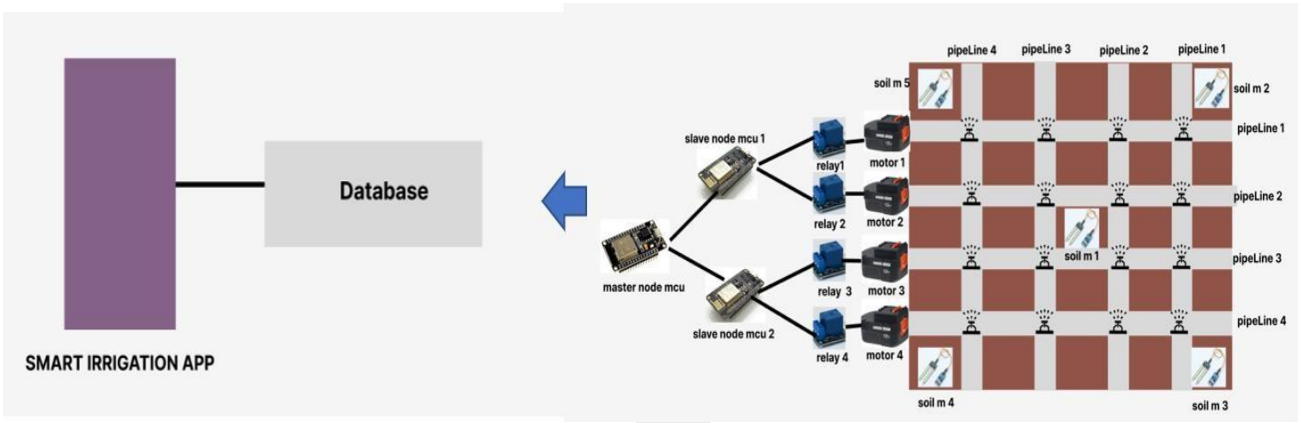

Figure 3.12: Hardware and Software Integration

CHAPTER 4
IMPLEMENTATION OF PROJECT

4.1 Modules Description

- Here, we have established a master-slave topology. The first step is to set up the hardware components in the farm, such as the pipeline, sprinklers, rain sensor, and soil moisture sensor. There are one master and two slave. The master is esp32, and the slave is nodemcu esp 8266. We took into account a four-by-four grid in our model, with four pipelines embedded in the soil and sprinklers positioned on top of those pipelines. The soil moisture sensor occupies the grid's corners and center.
- Motor 1 will be connected to Pipeline 1. Correspondingly other pipeline 2, 3, 4 is associated with engine 2, 3, 4 at the same time.
- After that, the motors are connected to the switch-acting relay. Four relays are connected to four motors.
- The first two relays are linked to the first slave node mcu, and the last two relays are linked to the second slave node mcu.
- One master ESP32 is connected to these two slave nodes mcu esp 8266.
- The system operates in this manner. The client has an application (mechanized water system framework) which will request that the client select a yield that he/she needs to water, then the client needs to set its timetable after how long clients need to set water system. Wheat, for example: Wheat needs to be watered every 21 days. In this scenario, the user will select wheat as the crop name and enter 21 days, which indicates that irrigation will begin every 21 days. Now, in addition to choosing irrigation for each 21st day, the user must also choose the time in hours, minutes, or seconds. This indicates that on the 21st day, irrigation should take place for one hour or two hours, depending on the time the user enters into the app.
- The irrigation process will begin automatically as soon as the user enters these three fields and sets the timings.

- At that point, soil moisture is constantly assessing the soil's moisture content. The pipeline will stop working if the soil moisture in a section indicates that the land has received all of the water it needs at that point.
- The rain track is now being detected by the rain sensor. Soil moisture will check the land's water requirements once more if it rains a day earlier than expected, determining which areas of the land require water and which areas have enough water.
- All readings will be displayed on the screen of the mobile application at this time when both the rain and soil moisture sensors are functioning.
- Which sensor has detected moisture in the soil and which has not, which pipeline sprinklers and motors are operating, and whether or not the rain sensor has detected rain will all be displayed.

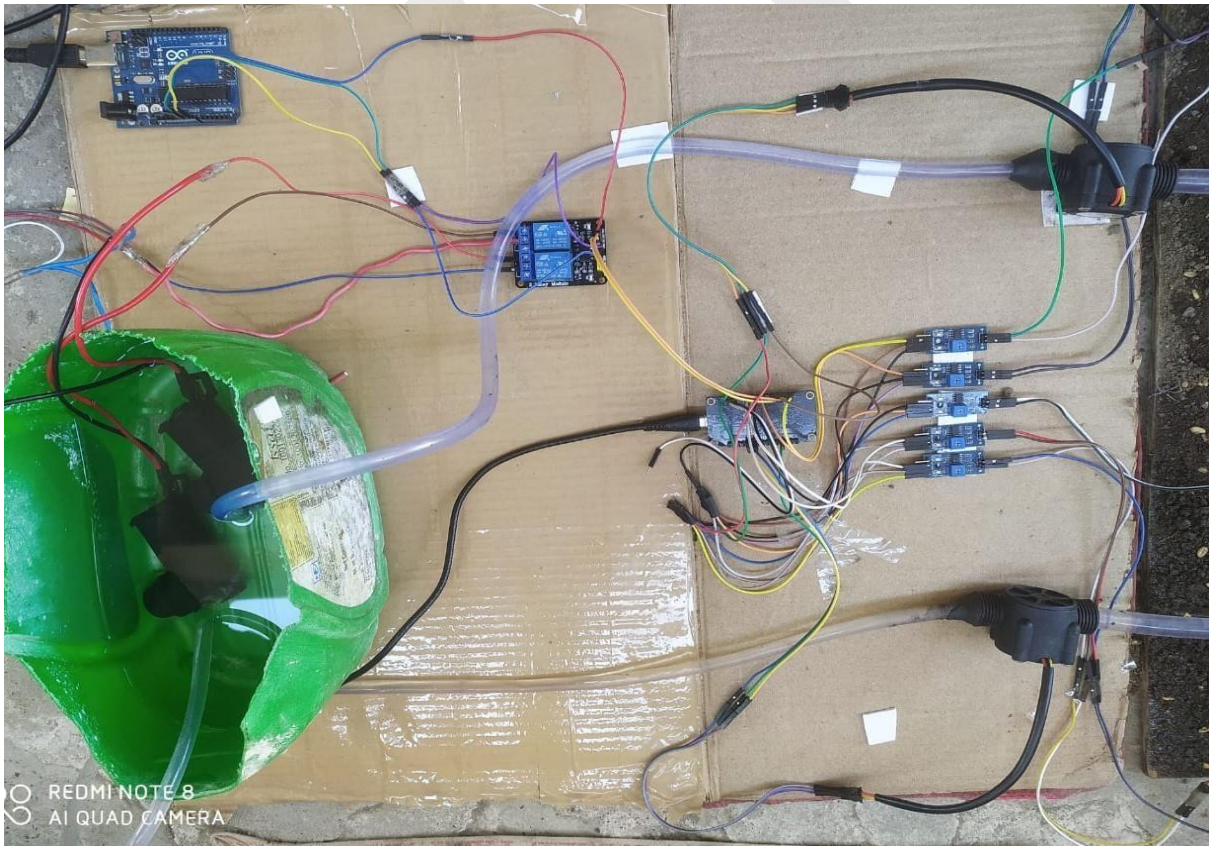

Figure 4.1: Hardware Components

Figure 4.2: Sprinkler Implementation

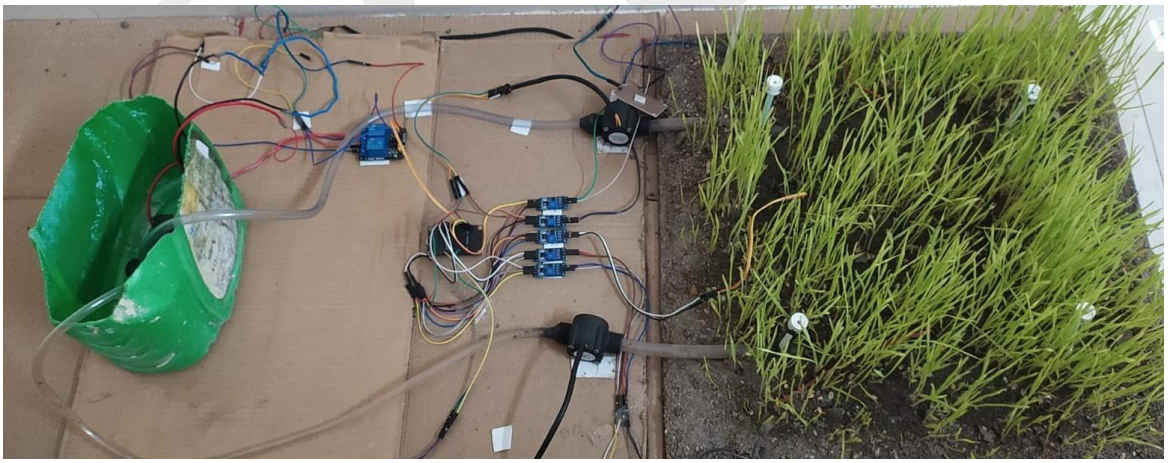

Figure 4.3: Hardware and Software Implementation

4.2 Planning of Project

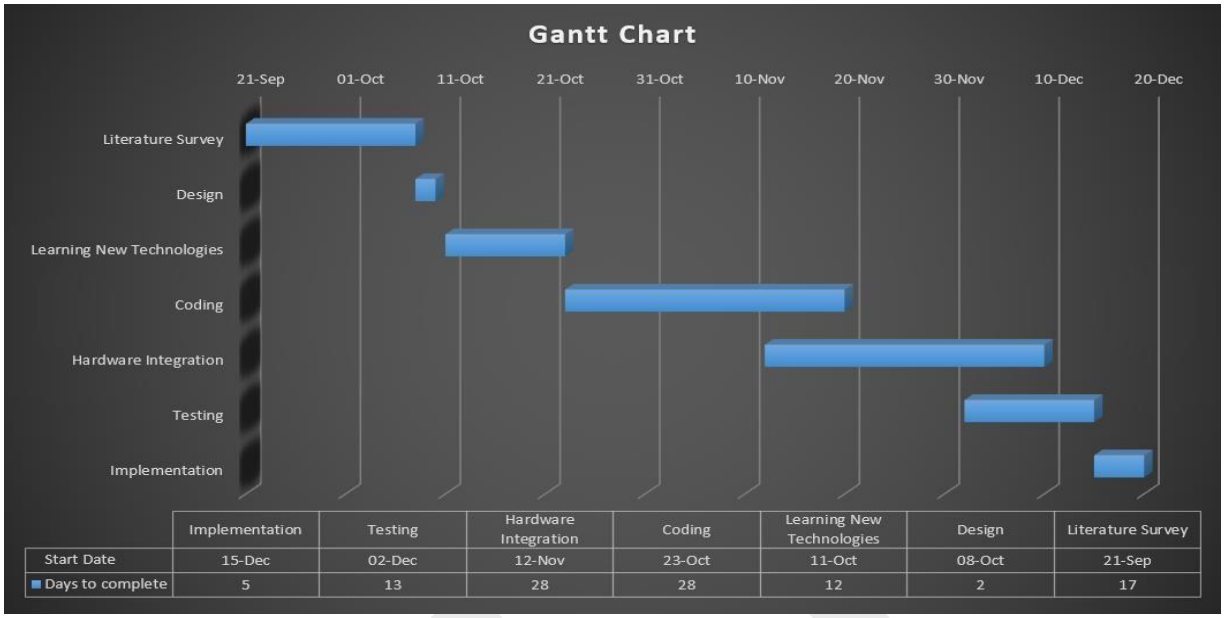

Figure 4.4: Gantt Chart

4.3 Contribution by team members

Sr. No.	Team Member Names	Contributions
1.	Shruti Kakhe	Writing code for Arduino software, Distribution of task, Hardware Integration
2.	Tejaswini Dhage	Hardware Connections, Documentation
3.	Shreya Agnihotri	Hardware Connections, Documentation
4.	Nikhil Dhage	Frontend Implementation, Backend

4.4 Screenshots of Project

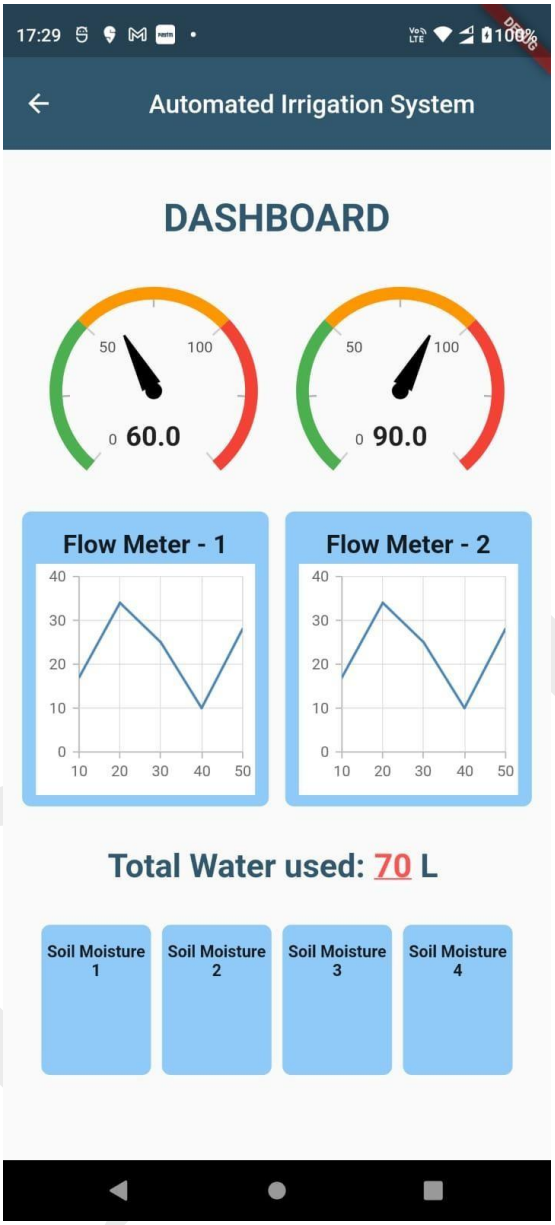

Figure 4.5: Dashboard(App)

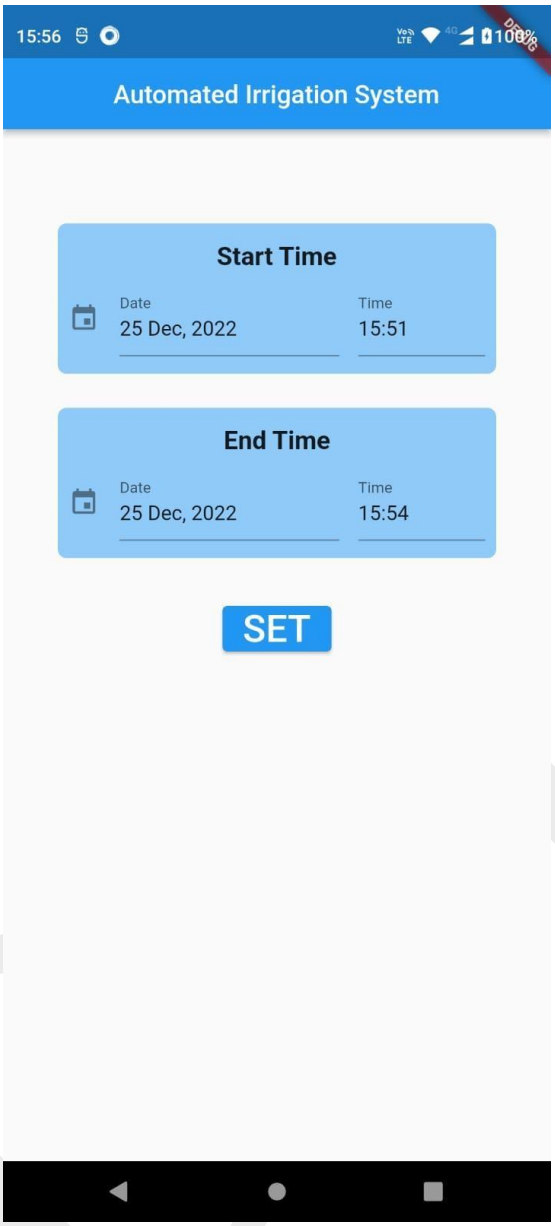

Figure 4.6: Home Page(app)

CHAPTER 5

RESULTS AND DISCUSSIONS

- The master ESP32 will control the overall operation.

- It is responsible for showing real time data using RTC sensors or the sensors real time readings on the application.

- Additionally, whenever a user sets a scheduled event in the application, master ESP32 is responsible for sending it to slaves and automating the system in response.

- The results are also shown in graphs on the dashboard of the app.

CHAPTER 6
CONCLUSIONS AND FUTURE SCOPE

6.1 Conclusion

An efficient system is proposed, designed and implemented that remotely controls and monitors the irrigation process.

By using modern technology, irrigation has become easier, through the use of soil moisture sensors and the measurement of their value through the microcontroller and automatic ordering of irrigation without the need to use workers to do so. And,helping farmers especially reduced the work and risk which farmers used to take at the night time for irrigation and saving their time and effort has become one of the things to be considered by the. The use of automatic irrigation leads to improving the growth of the plant and reducing the wilting of leaves, by giving water to meet the requirements of growth.

The proposed system shows the superiority of the irrigation system based on the soil moisture sensor on the traditional irrigation system, in terms of the amount of water used in each irrigation process, where it is worthwhile to note how the two methods differ.

As water supplies become scarce and polluted, there is a need to irrigate more efficiently in order to minimize water use and chemical leaching. Recent advances in soil water sensing make the commercial use of this technology possible to automate irrigation management for vegetable production. However, research indicates that different sensor types perform under all conditions with no negative impact on crop yields with reductions in water use range as high as 70% compared to traditional practices.

6.2 Future Scope

Right now, as efficient as our proposed model is, it can be enhanced to improve its capabilities and features greatly. Some of the adjustments or modifications that can be implemented into it can transform it into automated systems that can be used in

various environments and can also be used on a large scale. Such as, multiple sprinklers can be connected to the device and necessary coding can be done to use it on a widespread area with multiple crops of the same species.

If the proposed model is required to be used for an area with different crops, the model can be designed and coded in a way that it has the suitable humidity level and the necessary moisture level for the crop to grow in. With this in effect, one device can execute different processes based on the crops.

If the model is to be used on a large-scale farming area, it can be collaborated with Machine learning to identify the crops by itself and access the required data from a centralized database with the addition of any visual recognition sensor powered by python based scripts. The model can be mass produced and further used in multiple acres of farmlands that belong to the same farmer to deduce the statistics of every change in humidity and soil moisture levels along with an event log of every instruction executed by the NodeMCU, along with the usage of Big Data Analytics, the collected data from hundreds of acres can be all sorted and organized in a simpler and easier representation to evaluate the specific land and its output based on the comparison between its yield and the amount of nurturing done by the model with the amount of instructions executed as the variable.

This form of analyzing the growth and yield of farmlands can further be used to grade lands in terms of efficiency and the lower yielding lands can be dealt with properly or even be put to use for a different crop altogether based on its conditions. There are multiple evolutions this model could take based on what it is set to be used for. As time progresses and when automation enhances farming and agricultural practices worldwide, this system would be a strong base to build up on.

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