RAMAIAH
Institute of Technology

Project Report on
ENHANCED AGRICULTURE AND CONTROL SYSTEM

Submitted to

Ramaiah Institute of Technology, Bangalore
(Autonomous Institute Affiliated to VTU)
In partial fulfilment of the requirement for the award of degree of

BACHELOR OF ENGINEERING
IN
ELECTRONICS & TELECOMMUNICATION ENGINEERING

For the Academic Year 2022-23
Submitted by

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MAY 2023

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Department of Electronics & Telecommunication Engineering

CERTIFICATE

Certified the project work entitled "Enhanced agriculture and control system "carried out by Basavaraju H(1MS19ET017), Akhil N (1MS20ET400), Vivek Bhat (1MS19ET405), Manjunath H V (1MS20ET405) bonafide students of Ramaiah Institute of Technology, Bangalore, in partial fulfilment for the award of Bachelor of Engineering in Electronics & Telecommunication Engineering of the Visvesvaraya Technological University, Belgaum during the year 2022-2023. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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DECLARATION

We hereby declare that the project entitled “Enhanced agriculture and control system” has been carried out independently by us, under the guidance of Dr. RAMYA H R Assistant Professor, Electronics & Telecommunication Engineering, Ramaiah Institute of Technology, Bangalore. This report has been submitted in partial fulfilment for the award of degree, Bachelor of Engineering in Electronics & Telecommunication Engineering of Ramaiah Institute of Technology (Autonomous Institute, affiliated to VTU, Belgaum) during the year 2022-2023.

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ABSTRACT

The farming of agriculture has started past 12000 years back, Neolithic age gave birth of civilization, Farming and later being continued as traditional farming practices. India being an agrarian's country, Mostly Indian farming are dependent on rains, soil, dampness and environment challenges. Our farmers upgraded to modern state of art technology in cultivation. Globally the IoT systems has contributed its application in many fields and proven to be successful. It is the time that Indian farmer need to introduce the Smart Agricultural systems for higher crop yield. The productivity with compilation of data from sensors, actuators and modern electronic gadgets the farmer can monitor agricultural fields. Smart Agriculture can forecast weather data, switching ON the pump motor acknowledging the dampness of soil terms of moisture levels with help of sensors which are interfaced to Raspberry pi module. The Smart agriculture system can be operated from anywhere with help of networking technology. On joining process in research and development in Smart Agriculture& Artificial Intelligence can be cutting edge technology in data compiling and resource optimization.

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LIST OF ABBREVIATIONS

IOT: Internet of Things

RPI: Raspberry Pi

MQTT: Message Queuing Telemetry Transport

GPIO: General-Purpose Input/output

I2C: Inter-Integrated Circuit

USB: Universal Serial Bus

HDMI: High-Definition Multimedia Interface

RAM: Random Access Memory

OS: Operating System

IDE: Integrated Development Environment

VCC: Voltage Common Collector

URL: Uniform Resource Locator

LIST OF TABLES

RAMAIAH INSTITUTE OF TECHNOLOGY BANGALORE

(Autonomous institute affiliated to VTU) Department of Electronics & Telecommunication Engineering

Project work – ETP (2019-2023 batch)

Course outcomes

CO1	Review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications
CO2	Identify the clear objectives & methodology for implementing the project by visualizing the Hardware and Software
CO3	Design and Implementation of identified Problem using appropriate modern tools and Techniques in the area of telecommunication/ multidisciplinary areas
CO4	Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual
CO5	Ability to write the thesis following ethical values and publish the work in quality conferences/journals supporting lifelong learning abilities

Mapping of Course outcome to Program outcome

ETP : Project work															
CO	**Statement**	**Program Outcomes (POs)**												**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
ETP.1	Review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications	3	3		3		2	2		3	2		2	3	2	1
ETP.2	Identify the clear objectives & methodology for implementing the project by visualizing the Hardware and Software	3	3	3	3		2	2		3	2	3	2	3	2	2
ETP.3	Design and Implementation of identified Problem using appropriate modern tools and Techniques in the area of telecommunication/ multidisciplinary areas	3	3	3	3	3	2	2		3		3	2	3	2	2
ETP.4	Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual	3	3						3	3	3	3	1	2	-	3
ETP.5	Ability to write the thesis following ethical values and publish the work in quality conferences/journals supporting lifelong learning abilities								3	3	3		3	-	-	3
Course Articulation		3	3	3	3	3	2	2	3	3	3	3	2	2.75	2	2.2

Justification:

1. CO1 mapped to PO1, 2, 4, 6, 7, 9, 10, 12 – The project requires knowledge of engineering domains like raspberry pi, Arduino and Web Design. Literature review is required to understand current research work. These complex problems must be analyzed and interpreted from the data. This project can be applied to various agriculture field and is necessary for increasing yield of a crops and also for irrigation purpose. For successful completion of the project, teamwork and communication is required and there are various future scopes which validates life-long learning
2. CO2 mapped to PO1, 2, 3, 4, 6, 7, 9, 10, 11, 12 – Objectives and methodology are derived from the literature review and domain knowledge. This project can be applied to various agriculture field and is necessary for increasing yield of a crops. The modules should be studied individually and team work is required for integration. For successful completion of the project, teamwork and communication is required.
3. CO3 mapped to PO1, 2, 3, 4, 5, 6, 7, 9, 11, 12 – Design and implementation requires knowledge derived from literature review and subjects. Interpretation is required to understand the results and for proper functioning of the modules. Solutions must be designed and investigations must be performed. Modern tools must be used like python, thinkspeak and Website. Project management is required for all members to work in the given time and there are various future scopes which validates life-long learning.
4. CO4 mapped to PO1, 2, 8, 9, 10, 11, 12 – Validation of results requires knowledge about agriculture system and problem analysis skills for its development. Ethics of research must be followed and team work and coordination are necessary with project management skills.
5. CO5 mapped to PO8, 9, 10, 12 – Ethics and teamwork is necessary during research through communication between the team members. This research can be continued for future scope of the project by implementing the database values for the control system.

Chapter 1

INTRODUCTION

Internet of Things (IOT) is a new telecommunication field that is currently growing extraordinarily fast. Its practical purpose is to have control of input devices so that output devices show a reaction, which may happen automatically. For instance, when a presence sensor is activated an IOT system may be able to lock some door or send a notification to a very far place in seconds.

1.1 Need of smart farming:

Smart farming is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology – including big data, the cloud and the internet of things (IoT) – for tracking, monitoring, automating and analyzing operations. Also known as precision agriculture, smart farming is software-managed and sensor-monitored.

Smart farming is growing in importance due to the combination of the expanding global population, the increasing demand for higher crop yield, the need to use natural resources efficiently, the rising use and sophistication of information and communication technology and the increasing need for climate-smart agriculture.

It enables growers and farmers to reduce waste and enhance productivity ranging from the quantity of fertilizer utilized to the number of journeys the farm vehicles have made, and enabling efficient utilization of resources such as water, electricity, etc.

IoT smart farming solutions is a system that is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, crop health, etc.) and automating the irrigation system. The farmers can monitor the field conditions from anywhere.

1.2Introduction to the Smart Farming:

Internet of Things (IoT) is a global structure in connecting society through information and communication technologies. It enables services to connect both physical and virtual things. The connection allows both things to communicate through real-time data. According to [2], the IoT solutions are increasingly extending to virtually all areas of everyday life. For an example, users can easily switch on and off the fan at home by using

smartphone anywhere and anytime. Application of IoT is not just an in-home automation, but also has been implemented in agriculture. The IoT can monitor the crop or make irrigation a lot easier.

In late decades, there is a quick advancement in Smart Agricultural Systems. Show that agriculture has great importance worldwide. Indeed, in India for example, about 70 % of the people relies upon the vital sector of agriculture. In the past, irrigation systems used to be dependent on the mills to irrigate the farm by conventional methods without knowing the appropriate quantities of these crops. These old systems are a major cause of the waste of large quantities of water and thus destroy some crops because of the lack of adequate quantities of water. However, with the recent technological developments, there have been innovative systems for irrigation without the farmer interfering in the irrigation process. Because the Sultanate of Oman is in a region suffering from lack of rain throughout the year and lack of groundwater, modern irrigation systems will reduce this issue of lack of water.

Indeed, smart systems have proven their capability to regulate the irrigation of crops. It also works to stop the waste of water in irrigation. Furthermore, it will work to minimize number of employees which lead to saving money. Agriculture is developing from mechanized by simple methods in the twentieth century to being automated in the 21st century. There is evolving in field operation in agriculture section, which request a high accuracy in processes to optimize output and quality of the crops, in addition, limiting the production cost. To reach these prerequisites, automation systems must be introduced. In this project, we try to solve the problems of irrigation such as errors caused by farmers and the consumption of large quantities of water. These errors affect trees as their fungi may also affect the overall stock of water.

It is necessary to make effective effort and contribution to achieving the desired objectives of this system. Therefore, the effort should not be limited to individual effort. In addition, farmers must be very important to achieve the high efficiency of modern irrigation systems. With the increase of world population, the need for farming yields is increasing instantaneously. Further, the farmer’s potential and abilities in the agriculture filed are reducing, the income in agriculture needs to continue development regarding the prediction of world population increases from 6.8 billion in 2013 to over 10 billion by 2050.

Efficiencies become an essential demand with the declining of farmer's potential. Expected objectives of this project are facilitated and simplify the irrigation system by installing and designing the whole automatic irrigation system, increase crop performance by reducing overwatering from saturated soil. It can prevent irrigation happening on the day at the wrong time, to switch engine ON or OFF by utilizing the irrigation system, the controller will work to switch the engine, so no need for employers, to reduce mistakes of operation due to employees as much as possible and to preserve water from waste.

1.3Application

Weather Monitoring

Weather plays a very significant role when it comes to the agriculture sector. In agriculture, there is almost everything dependable upon the climate condition. In smart Farming, temperature humidity, light intensity, and soil moisture can be monitored through various sensors. These are again used by the reactive system to trigger alerts or automate the process such as water and air control.

Smart Irrigation on Agriculture Land

In smart irrigation, automated sprinkler systems or smart pumps are used. Soil moistures sensors are used in different areas to get the moisture of the soil in agricultural land. Based on the results from the soil moisture sensors, the smart pumps or smart sprinklers are turned on/Off.

Monitoring Soil Quality

Farmers usually use a sampling method to calculate soil fertility, moisture content. Fortunately, this sampling doesn't give accurate results as chemical decomposition varies from location to location. Meanwhile, this not much helpful. To resolve this thing, IoT plays an essential role in Farming. Sensors can be installed at a uniform distance across the length and breadth of the farmland to collect the accurate soil data, which can be further used in the dashboard or mobile application for the farm monitoring.

1.4 Limitations of Smart Farming:

Smart farming system requires an unlimited or continuous internet connection to be successful. This means that in rural communities, especially in the developing countries where we have mass crop production, it is completely impossible to operate this farming method. In places where internet connections are frustratingly slow, smart farming will be an impossibility.

Smart farming makes use of high techs that require technical skill and precision to make it a success. It requires an understanding of robotics and ICT. However, many farmers do not have these skills. Even finding someone with this technical ability is difficult or even expensive to come by, at most. And, this can be a discouraging factor hindering a lot of promising farmers from adopting it.

1.5 Motivation Behind Project:

In short, Smart Farming refers to several procedures and techniques that check the field's state and environmental characteristics, in order to ensure they grow and are kept in the best possible conditions -usually, also in the fewer time by means of sensors and automated processes.

The present work is, therefore, inspired under the conviction that industrial processes could get benefit of using more refined control systems and, particularly, that there is an upward tendency of growing plants under an enclosed climate where organic matter, chemical products and electrical resources needs to be optimized, all which requires a specific tracing based on indicators throughout the whole life of a plant.

In this project, we try to solve the problems of irrigation such as consumption of large quantities of water. These errors affect trees as their fungi may also affect the overall stock of water. It is necessary to make effective effort and contribution to achieving the desired objectives of this system. Therefore, the effort should not be limited to individual effort. In addition, farmers must be very important to achieve the high efficiency of modern irrigation systems.

Chapter 2

BACKGROUND THEORY

In the beginning, we should have enough knowledge on how irrigation systems work and how it can be built in an efficient way. This chapter focuses on similar concepts.

The majority of rural people, agricultural activities continue to be one of their main livelihood strategies. Production of food crops is not dependent on any formally acquired knowledge of farming but is solely based on indigenous agricultural knowledge passed from generation to generation through experience and careful observations. Resource-poor farmers, especially in rural areas, follow traditional farming methods to produce their food crops and these are specifically tailored to suit their environments. Household members are the main source of farm labour with men mainly responsible for ploughing activities while the bulk of planting, weeding and harvesting activities is the responsibility of women. Crop protection against pests is done through traditional methods where farmers mix some combinations of pest control made from locally available resource in order to minimise losses. However, there are no weather monitoring, moisture dampness and water management, they depend on rains and flow of water upstream to downstream and canal watering system. As the agriculture has turned to more labour intensive, and skilled people have migrated to urban community for livelihood and comfort living, left the traditional agriculture farmers much more expensive and riskier. We heard yield versus suicidal of farmer. To convert loss making traditional farming into high crop yielding and profit making proposed smart agriculture system is brought out.

2.1 Exploration of background working of System

Sensor Based Automatic Irrigation Management System

The aim of this study is to build a system that helps the process of regulating water by measuring the humidity ratio. The grounded sensors all around the land area will give notice about the need for water and likewise, it will be provided. At the same time arranged a mechanized approach for the water tanker to be filled when it is empty

Automatic plant watering system

This system considered to sense dryness of the soil and in the end switch on the electric pump to begin the supply of water and switch off the pump on every occasion enough water is provided.

The Materials used are: Transistor 548, Resistor 1k, Variable resistor 47kΩ, Diode1N4007, Relay 5v, LED, DC converter, Circuit board, Probes, AC water pump, Water reservoir. In this study, there is no real implementation it is only on circuit and information about how the system should work and I think no need to use LED system can work full automated without using LED

Automatic Plant irrigation system

This gadget works with two probes insert within the soil. When the soil is dry then the probes will now not behaviour and while the soil is wet then the probes will behaviour. Thy used HEX inverter and this offers the complement output for its input, i.e., whilst the enter is high it offers low output. the running of the 2 probes in the soil relies upon on the resistance for instance if the resistance is high manner the soil is dry and whilst the soil is wet then the resistance is low and the voltage given to the two probes is given from the battery linked to the circuit.

Automatic Watering and Irrigation

Agricultural irrigation water is becoming scared not only in arid and semi-arid regions but also in the high rainfall regions. Because of the uneven distribution of rainfall pattern not successfully used by most of the crops. In this modern age, subsurface drip irrigation (SDI) plays a vital role for judicious use of water as per the requirement of the crop. But this system still needs to maintain by the operators. In order to improve its efficiency and ensuring water demand of the crop, efforts for SDI assembling with moisture level detectors are helpful in better crop germination and yield.

IoT-Enabled Sensors for Moisture Determination

In order to acquire more precision in water utilization (IoT) solution, involves special ground-based sensors for data recording and processing, are narrowing the gaps between the computer application and applied science. IoT based smart irrigation system helpful to simulate the irrigation needs of the crop and field with sensing of edaphic factors like soil temperature, moisture and evaporation rate, and temperature air humidity and also can predict future water requirement of the crop linking with the weather forecast from the Internet in specific a region. The structure of this system relies on an algorithm, which detects sensors data and integrating with weather elements e.g., rainfall, humidity, temperature, and UV for future prediction. This improved technology has the potential to increase judicious water application and use according to crop stage and requirement. Additionally, SDI can be linked with fertigation (irrigation water plus fertilizer), that not only increase irrigation efficiency (20–305) but also decrease fertilizer especially nitrogen losses (20–40%) as well as increase crop yield (10–20%) depending upon soil, crop and environmental conditions.

Chapter 3

LITERATURE REVIEW

1) **Smart Agriculture Monitoring System using IoT with Data Analysis K. Lova Raju[*1], V. Vijayaraghavan[2]**

The proposed system comprises of smart agriculture includes different hardware components such as temperature and humidity sensor (DHT11), moisture sensor, raspberry pi with Wi-Fi module, android mobile, and thing Speak cloud. These IoT sensors are interfaced to raspberry pi with the help of MCP3008 (analog to digital converter) and the data will be transmitted to cloud. It provides the collected data and analysed data to the farmer or end-user. They can access the data from cloud or database like thing Speak. From this paper we have studied how different sensors interfaced with raspberry pi and displayed a sensor data over IoT web application

2) **Smart Irrigation System Using IOT And Raspberry Pi Ms. Swapnali B.Pawar1, Prof. Priti Rajput2, Prof. Asif Shaikh3**

They proposed the system which detects the moistures level and accordingly motor is switched on. Here Sensor output signal is applied to the comparator and signal conditioning circuit which has potentiometer to decide the moisture level above which the output of comparator goes high. This output signal is given to the Raspberry Pi board. If the soil moisture value is above the moisture level, then the 3-phase induction motor will be OFF, whereas if the moisture level is low motor will be ON through the relay. LDR (Light Dependent Resistor) is used to control the light automatically and by using this we can monitor the farm at night also. From this paper we have studied interfacing of ultrasonic sensor with motor and controlling the water level of tank.

3) **Smart Agriculture System using IoT Technology Adithya Vadapalli1, Swapna Peravali2& Venkata Rao Andhra University College of Engineering**

They proposed an irrigation process by analyzing the moisture of soil and the climate condition (like raining). They have displayed environmental parameters like atmosphere, temperature and productivity of soil, harvest web watching engages area of weed, level of water, bug acknowledgment, animal interference in to the field, alter improvement, cultivation. From this paper we have studied how exactly wastage of water is controlled and interfacing of soil moisture with raspberry pi.

4) **Jesús Gento Ribas "IOT Technologies Research and Smart Agriculture Prototype"**

IOT technologies may in essence share the main purpose of control systems' technologies, but change drastically on the user experience, offering new command ways such as remote or voice control and also an elegant information presentation. Therefore, providing an easy user interaction and clear output results are indispensable requirements for IOT future systems

5) **Ms. Swapnali B.Pawar1, Prof. Priti Rajput2, Prof. Asif Shaikh3 Smart Irrigation System Using IOT And Raspberry Pi**

They proposed that sensors are the device which converts the physical parameter into the electric signal. A sensor's sensitivity indicates how much the sensor's output changes when the input quantity being measured changes.

One of the most obvious advantages is the time savings afforded by an automatic sprinkler or drip irrigation system.

Another advantage is that irrigation systems, particularly the drip type, can be positioned so that water is more effectively targeted where it is needed.

The primary disadvantage associated with a sprinkler system is the expense. These systems can be quite costly depending on the size of the property. A remote-control system can help in working irrigation system valves dependent on schedule. Irrigating remote farm properties can be exceptionally troublesome and labor-intensive. It gets hard to comprehend when the valves were started and whether the ideal measure of water was distributed. It has disadvantages like Cost, Reliability and Increased channel maintenance

Chapter 4

PROBLEM STATEMENTS

The economy of many countries depends on agriculture. To achieve the best quality from this research, it is important to focus on some vital characteristics such as the appropriate amount of electricity as well as water supply and a suitable schedule for irrigation of crops.

4.1 Problem Statement Objectives:

- Farmers are facing problems in meeting these standards, especially those living in poverty. This project looks into developing an automated irrigation system that could be controlled through mobile application.
- This system will work to minimize the number of workers in a crop field, control and save water and electricity, increase agricultural production using small quantities of water, minimize manual intervention in watering operations with increasing watering speed and preserving plants from fungi.
- All these features make these research sustainable option to be considered to improve the agriculture and irrigation efficiency.
- Expected objectives of this project are facilitated and simplify the irrigation system by installing and designing the whole automatic irrigation system, increase crop performance by reducing overwatering from saturated soil. It can prevent irrigation happening on the day at the wrong time, to switch engine ON or OFF by utilizing the irrigation system, the controller will work to switch the engine, so no need for employers, to reduce mistakes of operation due to employees as much as possible and to preserve water from waste.

4.2 Methodology:

We are designing an IOT based Smart Farming based on Raspberry Pi that operate automatically by sensing the moisture content and humidity of the soil. It will also study the rainfall pattern in the particular region by using the Rain Sensor and will switch ON/OFF the pump using relay without human intervention and hence result in saving of water. Soil quality will be maintained with the help of soil moisture sensor which will result in proper enrichment of crops. Although there are several security issues related to the smart farming, such as compatibility, heterogeneity, constrained devices, processing.

Use of Wireless Sensor Networking System:

Wireless Sensor network in the process of development in smart and precision agriculture can be used to monitor regularly the changes in environmental conditions such as climate, hydrology, plant physiology, humidity, temperature, rains dampness of soil and others. As a process input, it can also demonstrate as a controller in the providing the inputs for seeds, fertilizers, pesticides etc. The WSN application shall aid the data collection process to for information needed by the farmers for cultivation and also as Input feeder control system on agricultural machinery. The failures and breakdown issues such as malfunction of sensor and power supply related issues and also the information security may be an area of concern in the Wireless Sensor networking systems.

We maintain water level and flow it as required by relay switch on /off the Pump. Soil moisture sensors are fixed under the ground in field. Initially the water level reading is taken and decisions are made according to it. The temperature sensor (DTH11) is fixed at the center of the field to get the overall reading of temperature of the soil. These sensors are connected to Raspberry pi where we will get the readings. All sensors will send data to RPi and data will be forwarded to WSN systems. The threshold value will be set according to the crop. The threshold value will be marked based on the requirement of the crop specified and predefined in the raspberry pi for every sensor. Whenever any sensor reaches a threshold value, message alert is sent to the user and action is taken according to it.

4.3BlockDiagram:

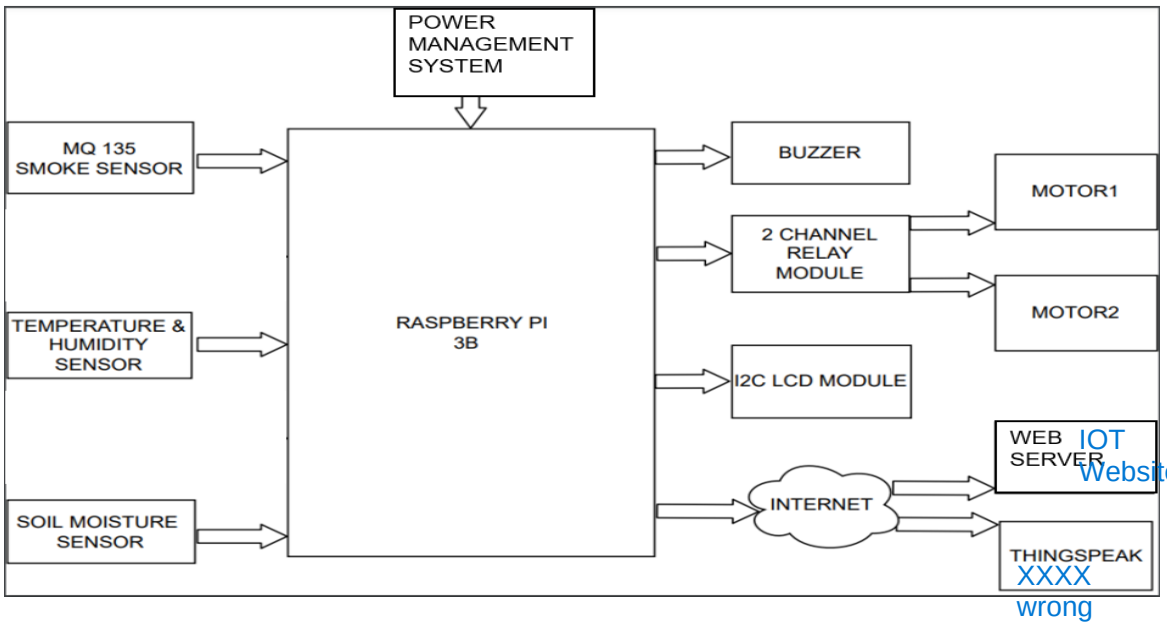


Fig 1.1 Enhanced agriculutre and control system block diagram

4.4 Description of Block diagram

As shown in the fig (1.1) the Raspberry Pi is the heart of the system. The Raspberry Pi incorporates a number of enhancements and new features. These features of raspberry pi are improved power consumption, increased connectivity and greater IO which made this powerful, small and lightweight ARM based computer.

Sensors:

We use the soil moisture sensor to measure the moisture. Moisture level above which the output of comparator goes high. This output signal is given to the Raspberry Pi board. If the soil moisture value is above the moisture level, then the motor1 will be OFF, whereas if the moisture level is low motor1 will be ON through the relay.

A Rain Sensor will be used which will turn off the motor1 pump in case of rainfall. A relay will control the pump. So, whenever a low amount of moisture is detected in the soil, the motor1 automatically starts working, and hence the irrigation is completed automatically. When the soil becomes wet, automatically motor1 turns OFF. Remember when the low moisture level as well as rain detects the motor1 will OFF and if not raining motor1 will be ON as usual.

DHT-11 Humidity Temperature Sensor to measure Air Temperature and Humidity respectively. This sensor's value temperature and humidity is monitoring continuously on LCD display.

We will interface Ultrasonic sensor with Raspberry Pi. The Ultrasonic sensor is used to measure the distance in Centimeters, thus the sensor is placed in the top of the container (Tank) to measure the presence of a substance which presents inside the container, as water increases, ultrasound gets reflected back to the echo phase, which triggered from Trigger phase. We set a specific distance value for turn ON/OFF the motor2 automatically.

The air quality sensor detects ammonia, nitrogen oxide, smoke, CO2, and other harmful gases. The air quality sensor has a small potentiometer that permits the adjustment of the load resistance of the sensor circuit. The 5V power supply is used for air quality sensor. When it identifies the smoke from fire or gas, we get as alert alarm through buzzer.

Actuator:

The dual channel relay module is used to control the two motors. Basically, relay works as a switch. So, we coded the program for each motor separately. Motor1 for irrigation and motor2 for refill water to tank. Hence both motors are controlled by the relay.

LCD display always displays the temperature and humidity values and showing the status of motors either ON/OFF. We can monitor all these operation through internet. Sensed data is published to website and MQTT dashboard. MQTT dashboard is a mobile application, parameters are updated by the internet. Here we can see the temperature and humidity and also know the status of the both motors as well. These all process can be monitored remotely through Thing speak Server online from everywhere. Here temperature, humidity and water level of tank represent graphically.

Chapter 5

HARDWARE AND SOFTWARE REQUIREMENTS

Smart farming system uses basic sensors and IoT technologies to provide live information about a particular farm the next era of Smart Agriculture can be definitely based on Internet of Things (IoT).

5.1 Hardware Requirements:

RASPBERRY PI

As shown in the fig (1.2) the main element in this prototype is the Raspberry Pi, which is the head that processes all the information, connects to the Internet and controls motors. Its operating system has been chosen to be Raspbian, a free operating system very popular and optimized for the Raspberry Pi, which is based on Debian. The main code was written in Python and executes the system's actions automatically. This script is able to run automatically on the Raspberry Pi boot. Raspberry Pi 3 Model B, first of the third-generation Raspberry Pi with Bluetooth 4.1 and Wi-Fi. Packed with high processing power in a petite body, it's capable to process documents, control robots, run large games, and even watching HD videos.

Figure 1.2 Raspberry Pi Module

The features raspberry pi 3 model B:

- Quad Core 1.2GHz Broadcom BCM2837 64bit CPU

- 1GB RAM
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
- 100 Base Ethernet
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- 4 USB 2 ports / 40-pin extended GPIO

DHT 11

As shown in the fig (1.3) the DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data.

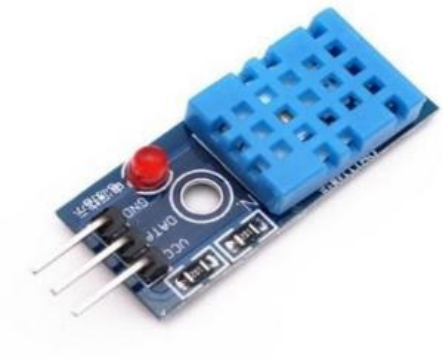


Figure 1.3 Temperature and humidity sensor

MQ135 Gas Sensor

As shown in the fig (1.4) MQ135 gas sensor has high sensitivity to ammonia gas, sulfide, benzene series steam, also can monitor smoke and other toxic gases well. It can detect kinds of toxic gases and is a kind of low-cost sensor for kinds of applications

Figure 1.4 Smoke sensor

SOIL MOISTURE SENSORS

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. Instead, they measure changes in some other soil property that is related to water content in a predictable way. This device is usually sold with a probe (right element in the Figure 1.6), which is the sensor itself, and a small circuit (left element in Figure 1.5) that feeds the probe with current and provides an analog output as well as a digital one, whose value is compared to a threshold controlled by the blue potentiometer which, in detail, could be seen.

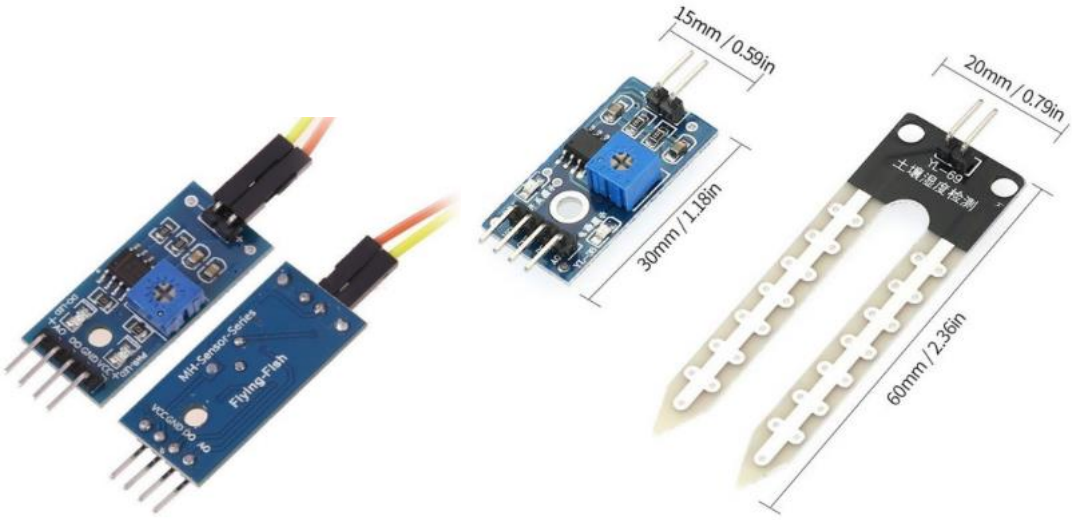


Figure **1.5Complementary Circuit (left)Figure 1.6 Soil Moisture Sensor (right)**

I2C_LCD

As shown in the fig (1.7) I2C_LCD is an easy-to-use display module; it can make display easier. Using it can reduce the difficulty of make, so that makers can focus on the core of the work. We developed the Arduino library for I2C_LCD, user just need a few lines of the code can achieve complex graphics and text display features.

Figure 1.7 LCD Display

BUZZER

As shown in the figure1.8 buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (Piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

Figure 1.8 Buzzer

RELAY MODULE

As shown in the figure1.9 the 4 Channels Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and Raspberry pi etc. The relays terminal (COM, NO and NC) is being brought out with screw terminal. A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a separate low-power signal. A relay with calibrated operating characteristics and sometimes multiple operating coils is used to protect electrical circuits from overload.

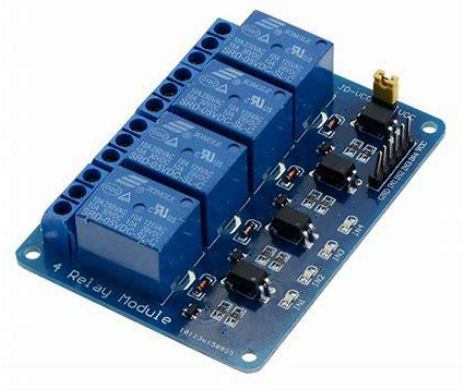


Figure 1.9 Relay

WATER PUMP

As shown in the figure2.0 this is Micro Submersible Water Pump DC 3V-5V, can be easily integrate to your water system project. The water pump works using water suction method which drain the water through its inlet and released it through the outlet.

Figure 2.0 Submersible Motor Pump

JUMPER WIRES

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed

Though jumper wires come in a variety of colors, the colors don't actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power.

As shown in the figure2.1Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of

the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to-male wire is what you'll need.

Figure 2.1 Jumper Wires

SOLAR PANEL

A solar panel is a device that converts sunlight into electricity by using photovoltaic (PV) cells. PV cells are made of materials that generate electrons when exposed to light. The electrons flow through a circuit and produce direct current (DC) electricity, which can be used to power various devices or stored in batteries. Solar panels are also known as solar cell panels, solar electric panels, or PV modules.

As shown in the figure2.2 Solar panels are usually arranged in groups called arrays or systems. A photovoltaic system consists of one or more solar panels, a inverter that converts DC electricity to alternate current (AC) electricity, and sometimes other components such as controllers, meters, and trackers. A photovoltaic system can be used to provide electricity for off-grid applications, such as remote homes or cabins, or to feed electricity back into the grid and earn credits or payments from the utility company. This is called a grid-connected photovoltaic system.

Some advantages of solar panels are that they use a renewable and clean source of energy, reduce greenhouse gas emissions, and lower electricity bills. Some disadvantages are that they depend on the availability and intensity of sunlight, require maintenance and cleaning, and have high initial costs. Solar panels are widely used for residential, commercial, and

industrial purposes, as well as for space and transportation applications.

Figure 2.2 Solar panel

BATTERIES

As shown in the figure2.3 A battery is an energy source consisting of one or more electrochemical cells and terminals on both ends called an anode (-) and a cathode (+). Electrochemical cells transform chemical energy into electrical energy. Inside the battery is an electrolyte, often consisting of soluble salts or acids, it serves as a conductive medium, allowing the electric charge to travel through the battery. When a battery is disconnected, the charge at the positive and negative ends is equal, meaning there is no electric current. When connected to an outside resistance or device, the battery experiences an imbalance in charge that pushes electrons through the device's conductive material to the positive end of the battery. But while the electrons—or the negative charge—are what moves through the circuit, the electric current is measured following the positive charge's direction, which flows from the positive to the negative end inside the battery, and vice versa outside it.

Depending on its voltage and load, a single battery can power anything from a car's motor or a computer to a cell phone or a light bulb. When it comes to most electronic devices, working with the wrong voltage could result in your device not turning on or risk frying its

electrical components, sometimes beyond repair. The right voltage battery would be able to power a device without hindering its performance or harming its hardware. Also, depending on the device's consumption of energy and the battery's load, a single battery charge could last you anywhere from a few hours to multiple days.

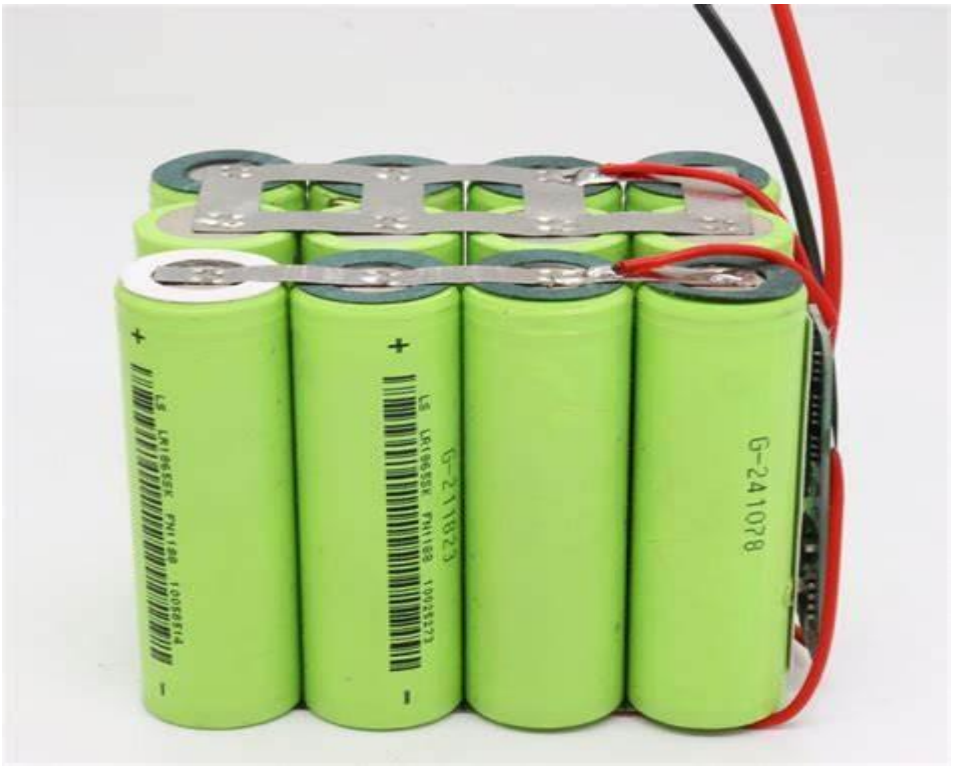


Figure 2.3 Battery

5.2 Software Requirements:

THING SPEAK

Thing Speak allows you to build an application around data collected by sensors. Features of Thing Speak include real-time data collection, data processing, visualizations, apps, and plugins. At the heart of Thing Speak is a Thing Speak Channel. A channel is where you send your data to be stored as shown in figure2.4.

Figure 2.4 Thing Speak Software

WEBSITE

Figure 2.5 Website

An Introduction To The Web Hosting Service Provider

As you all are aware of the fact by now, the 000webhost.com is free of cost and an amazing quality web hosting service provider that provides hosting services to the users on the Internet.

For those who are starting their first project of website building then this is something that might help you out. 000webhost is the ultimate catch when it comes to trying out

some ideas about a free website. Absolutely free of any expenses, it is a fairly good way of getting dedicated and impressive services of hosting.

An Insight into The Features

1) Free Hosting:

This amazing and impressive feature of the hosting service makes it different from all the other in the market. The free web hosting services that are found on the Internet are often found to have ads plastered all over the wall and that amounts to a slow and awaited loading time of the page. This is something that you don't have to worry in the case of 000webhost.com.

2) cPanel, PHP, MySQL Support:

Another one of the best features of this particular WordPress web hosting service provider is the cPanel support that you get with it. Apart from that, you are also provided with the flexibility of running the PHP accounts and the MySQL accounts as well. For more interesting offers, you might have to jump to the paid plan but the free ones are pretty good as well.

3) Site Builder:

When it comes to the companies providing web hosting services, there are many different options available on the market. Well, the site builder, to begin with, is an interesting and impressive one. With the impressive drag-drop feature added here, it is easy to add almost anything to the website that you are building with their service.

4) Support From the Team:

One of the most amazing things about the platform of 000webhost is the support team and forum of the site. The company is well-known for its reliable services and support to those users who are in need. There are live chat and helpline services that would listen to every single query that you have and find instant help for you as well. All you have to do is state your query or issue on the forum page and the efficient support team will instantly fix or provide some helpful guidance to take you out of the mess. But that's not even the best part.

PYTHON 3:

The software of this system has been developed with Python 3. Using other Python versions is possible but may require the adaptation of the code. The project is oriented to create a whole unit of different sensors working together. Each one should deliver information to the Raspberry Pi. The different modules are stored in independent scripts (see Figure 2.6). Afterwards, they all have been integrated in the main script, also note that this kind of architecture makes easier the integration to a different system, which can be designed to need all, modify them or use none of the modules.

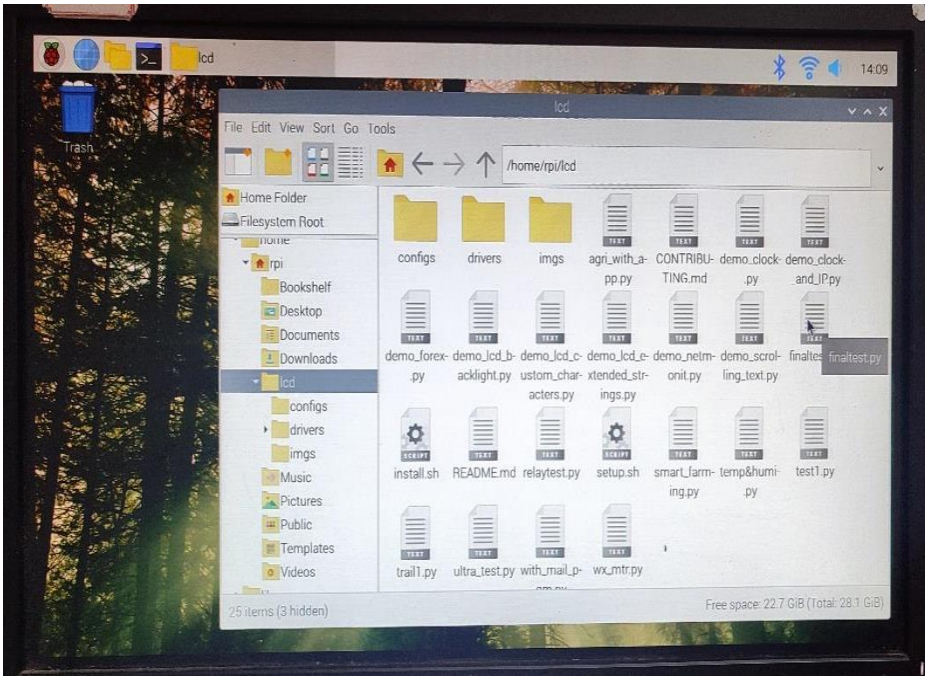


Figure 2.6 Modular Disposal in Desktop (left)

Chapter 6

IMPLEMENTATION

An implementation of this system is done with sensors, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. Sensors are the device which converts the physical parameter into the electric signal. A measured data is also displayed on IoT platform in order to control any system remotely from anywhere in the world.

6.1 Pin Diagram of Raspberry Pi:

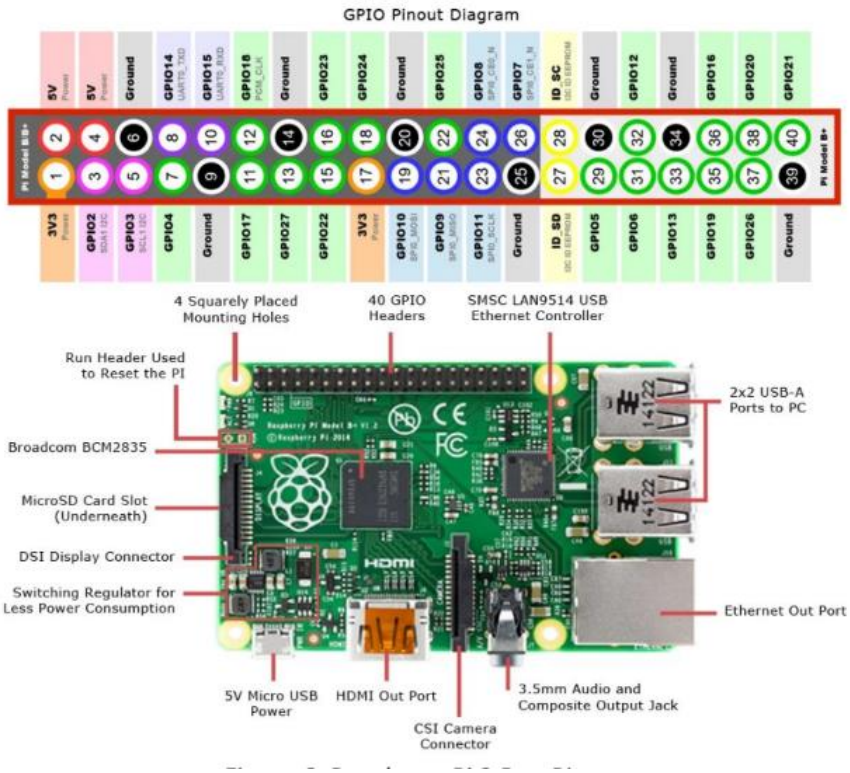


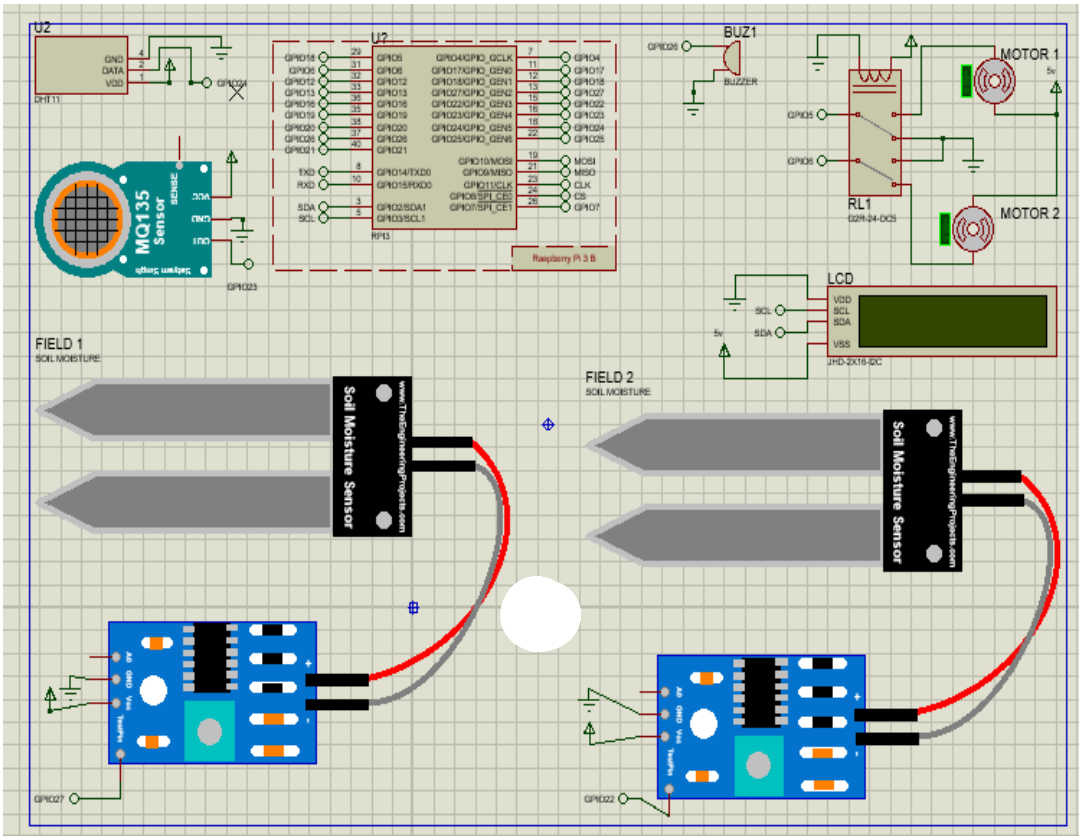
Figure 2.7 Raspberry Pi 3 B -Pinout

There are 40 GPIO pins on the Raspberry Pi 3 B, which have two states – On and Off. These states can be controlled by programming languages like Python. Here a list of the types of pins

Types and total pins	Use of pin
Power 2 x 5V pins and 2 x 3.3V pins	As the name suggests, these pins are used to supply power to external components.
GPIO	General-purpose I/O pins are used to turn devices like cameras, LEDs on and off.
GND	GND stands for Ground and is used to provide grounding to the circuits
UART	Universal Asynchronous Receiver/Transmitter pins are used for serial communication to transmit and receive serial data.
I2C	I2C pins allow us to connect sensors. These pins also have a fixed 1.8 kΩ pull-up resistor to 3.3v.
SPI	Serial Peripheral Interface Bus pins are also used to connect external accessories but with a different protocol.

Table 1.0 Pinout of Raspberry Pi 3 B

6.2 Circuit Diagram



I2C Protocol: LCD

The connections used are only 4: VCC (3.3V), GND, SDA (Pin3) and SCL (Pin5). The module works on a scrolling text LCD manner then refreshes the screen when humidity and temperature sensors are picked up.

In I2C protocol it is extremely important addressing the information. In simple, each I2C device should have an own address. When connecting any I2c device, it could be checked:

i2cdetect -y 1

Also, see that the output returns ADDRESS=0x27. Therefore, the LCD display is accessible via I2C Protocol, address 2.9.

```
pi@Raspberry:~ $ sudo i2cdetect -y 1
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- 27 -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --
pi@Raspberry:~ $
```

Figure 2.8 I2C Address of LCD

DHT11

The electrical connection is simple, as it only requires a 3.3-5.5 V power feed and a bidirectional port is offered to trigger a new sample and receive its value (see Figure 3.0).

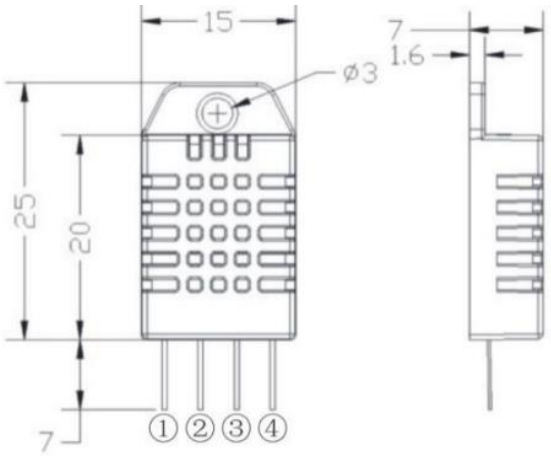


Figure 2.9 DHT11 module

Pin	Name	Description Board (BCM)
1	VDD	Power (3.3-5v)
2	DATA	18(GPIO24)
3	NC	Empty
4	GND	Ground

Table 1.1 pin connections of DHT11 module

Optocoupler Relay

This section shows the electrical devices that are needed in order to make the Prototype system work. As a prototype, two main wired outputs are set: the irrigation system (water pump) and Tank water level.

Furthermore, the functioning is simple: a device must feed its VCC (3.3 – 5 V) and GND pins and each of the channels to control also should have a wire connection (i.e. In2). In this way, when the Raspberry Pi or host device turns a certain GPIO its relay channel will also change.

Pin	Name	Description Board (BCM)
1	VCC	Power (3.3-5v)
2	GND	Ground
3	IN1	29(GPIO18)
4	IN2	37(GPIO26)
5	COM	Motor com
6	N. O	Ground
7	VCC	Motor VCC

Table 1.2 Pin Connection of Relay and Motor

Connection Table of Ultrasonic Sensor:

Pin	Name	Description Board (BCM)
1	VCC	Power (3.3v-5v)
2	TRIG	11(GPIO17)
3	ECHO	13(GPIO27)
4	GND	Ground

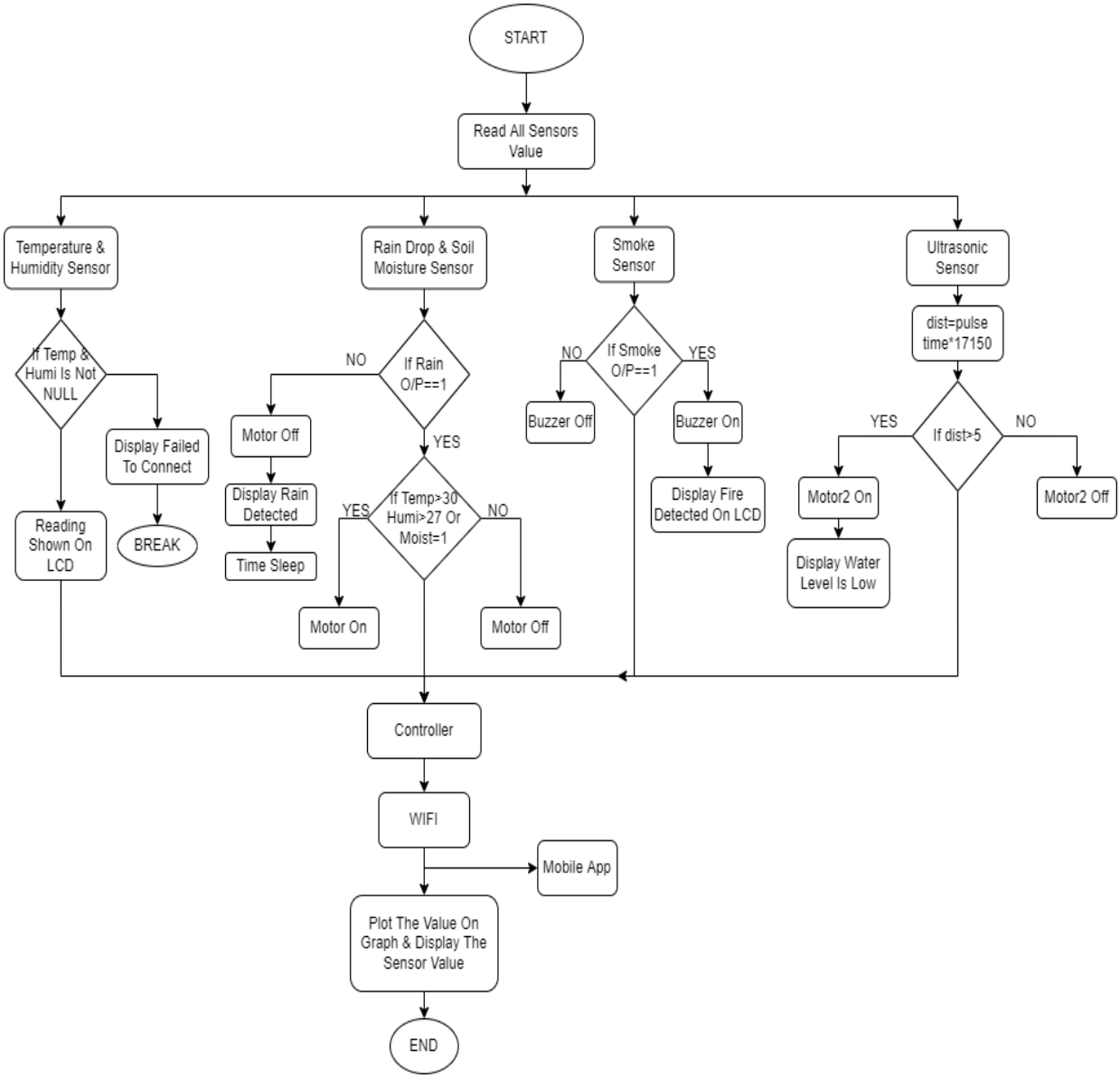
Table 1.3 Ultrasonic sensor pin connection

Different sensor connection table:

SI No.	Module Name	Pinout Number Board (BCM)
1	MQ135 sensor	16(GPIO23)
2	Rain drop sensor	33(GPIO13)
3	Soil moisture sensor	31(GPIO6)
4	Buzzer	35(GPIO19)

Table 1.4 Different Sensor Pin Connection

6.3 Flow Chart of Smart Farming



Flow chart for enhanced agriculture and control system

First of all, it should be noted that the Raspberry Pi is the main element of the prototype, as it processes all the sensors' information and provides the system with its network connectivity. The next flowchart corresponds to the Python script that runs on the Raspberry Pi and several considerations may be exposed. Temperature and Humidity are sensed and displayed on lcd display, if controller fail to communicate with sensor, we get an error message of connection failed, if not so sensed data is published to website.

Now on a second loop soil moisture will be keep sensing the field if farming field is dry motor 1 is activated and water is supplied through pipe if it's not true motor is switched off it means rain is detected or enough water is available on field. Next MQ135 will keep sensing the field if it detects the fire, loop is not true buzzer is activated if not will operated in normal sleep mode.

Ultrasonic sensor will keep continuous monitoring of distance if distance is greater than threshold motor 2 is activated and tank is filled with water and if loop is not true motor is switched off. Overall sensed data is pushed to controller and controller manages interfacing between hardware device and cloud server then sensor data is published over IoT on real time.

Chapter 7

RESULT AND DISCUSSIONS

Our Project is used to enhance agricultural productivity, address agricultural-based issues, such as food demand, and make farms more connected and intelligent. It offers a new model of product based on independent modules that required a progressive integration and continuous testing. For this reason, each of the sensors that compose the Smart Farming Prototype, as well as those that have been explained worked perfectly on individual scripts. Therefore, the project was oriented to first research on a particular type of sensor, then designing a small script that make it work and, finally, the main project considerations for a particular target project finaltest.py code is the main Python script and represents the whole Smart farming Prototype with IOT functionalities. Here we are displaying the temperature, humidity, motor 1, 2 on/off status on our own website. And also, we are able to plot graph of temperature and humidity with respect to variation in time. This helps us in understanding the concept of IOT internally connected with the agriculture system.

7.1 Checking for Air Temperature and Humidity:

Temperature and humidity of the particular area places a very important role in growing particular crops which requires the same environment for their growth So, we are measuring the temperature and humidity using the DHT11 It is a cheap and best sensor which sends the signals to raspberry Pi and the results are displayed on the lcd and motor is turned on if the weather is too hot or more than the threshold value.

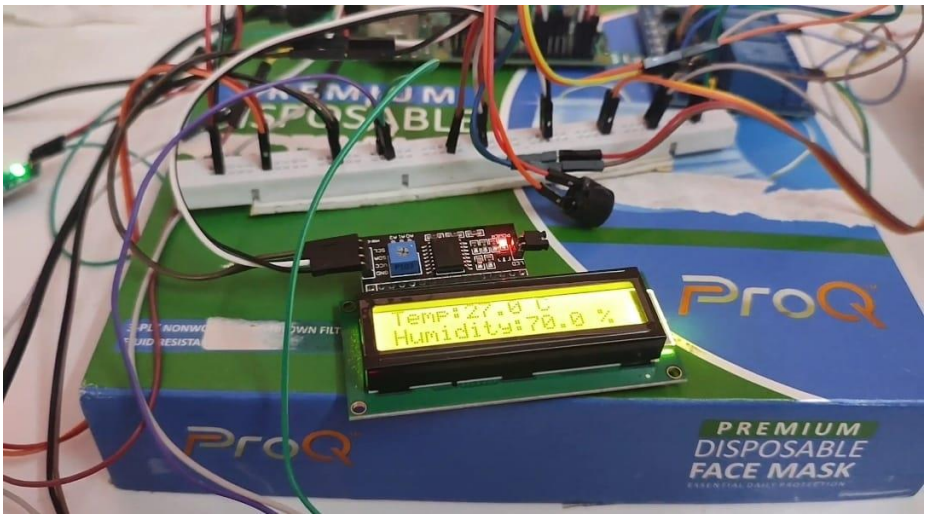
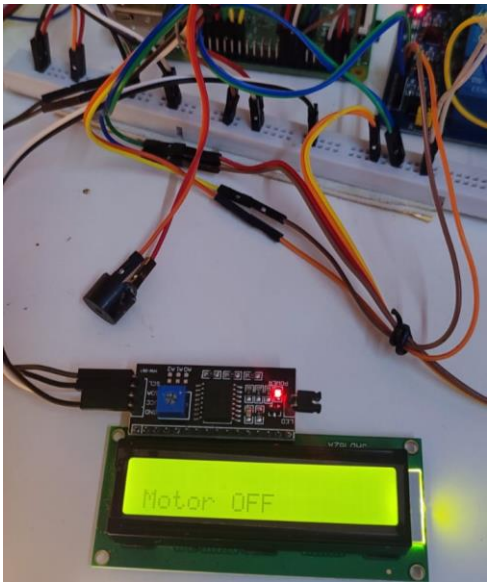


Figure 3.0 Temperature and Humidity Display on LCD

7.2 Checking for Soil Moisture:

Moisture, temperature, humidity is the basic information we need to know while growing the crops which requires particular, we need to calculate these results. Here we check the moisture content of soil using moisture sensor if sensor output is low relay is switched on and **motor 1** is switched on, if sensor output is high, it reflects that moisture is present on soil, then relay is made low and **motor 1** is switched off, on each stage motor status is displayed on Lcd.



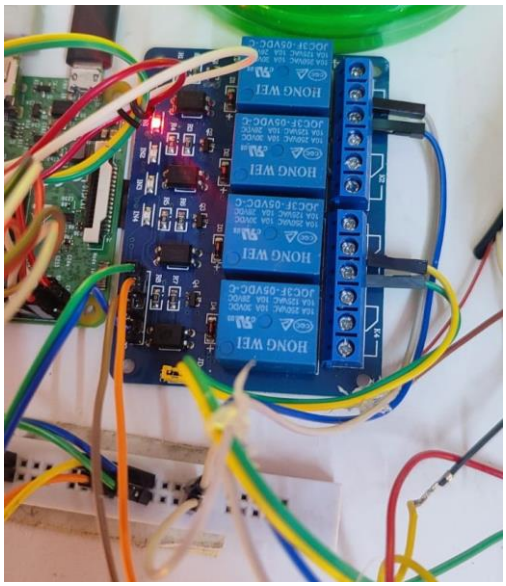


Figure 3.1 Motor off status display On Lcd

Figure 3.2 Relay switched off and motor 1 off

7.3 Checking for Rain Drop

We are going to check the rain status with a help of rain drop sensor which sends the information when the plates of the sensor come in contact with the rain drop so that we can infer that rain would come and we can cover the crops by which we can avoid the floods or overflow of water so that crops are saved from climatic change occurring in the today's world.

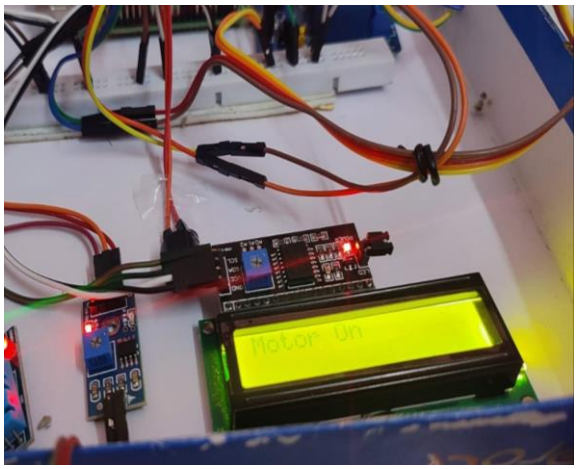
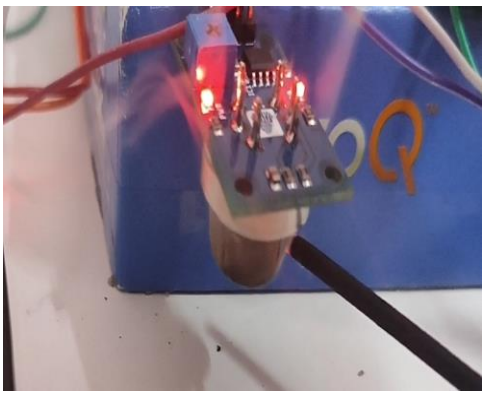


Figure 3.3 Rain status Display on Lcd

Figure 3.4 Motor on Update display on Lcd and motor 1 On

7.4 Checking for Fire/ Smoke

When we come to agriculture the important thing is storing of the grains, seeds, yields, fertilizer etc. These things should not come in contact with the fire from anywhere and we cannot look into it every time. So, we are using the smoke sensor and buzzer, if the smoke is detected mq135 sensor is activated and sends a high signal to Rpi port these signals is used to alert the user through buzzer and also alert message is displayed on LCD(figure 3.7).



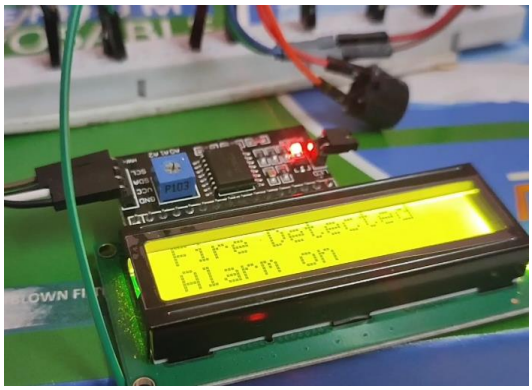


Figure 3.5 smoke detected by mq135 sensor (right)

Figure 3.6 fire alert on LCD (left)

7.5 Checking for Water Level

Smart farming will not be successful until wastage of water is controlled, we are controlling the flow of water using ultrasonic sensor if water level is less than the threshold, motor 2 is switched on by switching the relay module high, on each stage water level is displayed on

lcd and water is filled in the tank. If water level is greater than the threshold, than motor is switched off automatically this process keep continuing and water flow is controlled.

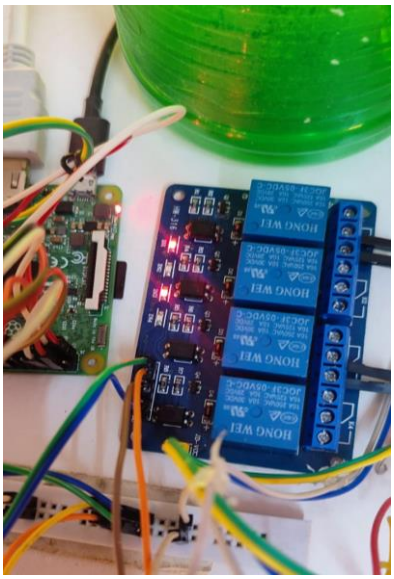


Figure 3.7 Water tank level status display on LCD

Figure 3.8 Relay switching on and motor 2 on

7.6 Solar panel observing energy

In the power management system, the solar panel plays a vital role in observing energy from sun and converting that energy in usable voltage and current to run the entire agriculture system. This power management system uses the sunflower type of system which is capable of rotation which is indirectly helping for the maximum supply of the power to all the components. Most importantly solar energy is one of the renewable resources we can use that extensively and by that we can run our entire system leads to betterment of our future world.

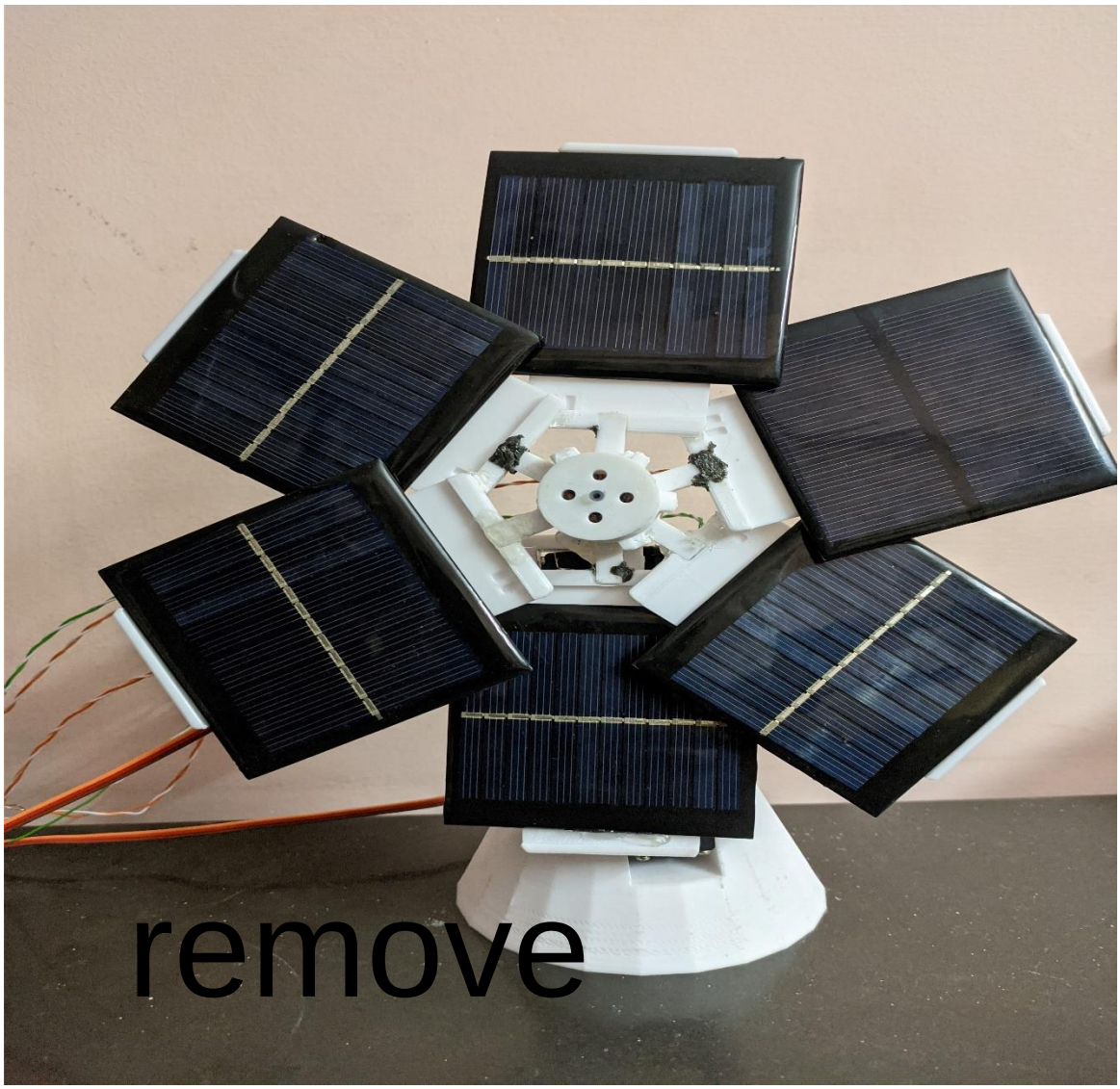


Figure 3.9 Sunflower Solar system

7.6 Displaying Sensor Data on Console Window

All the data sent from different sensors are displayed locally on console window before it been published over IoT application.

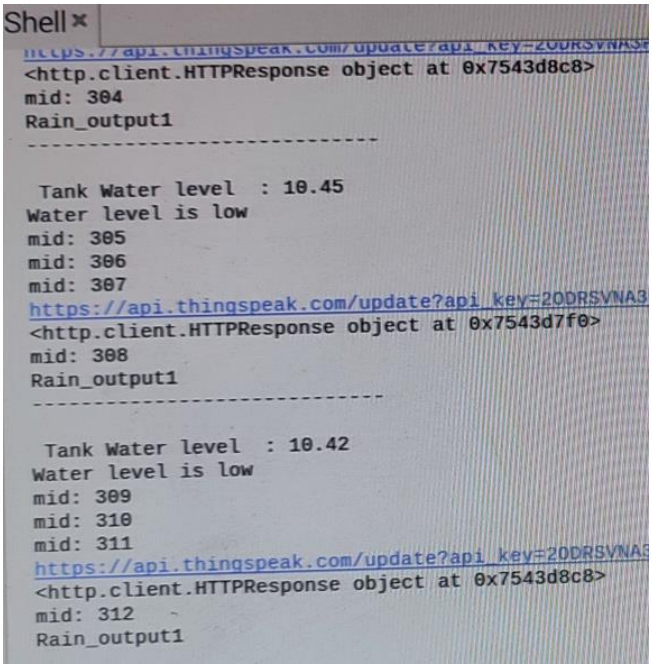


Figure 4.0 sensor data displayed locally

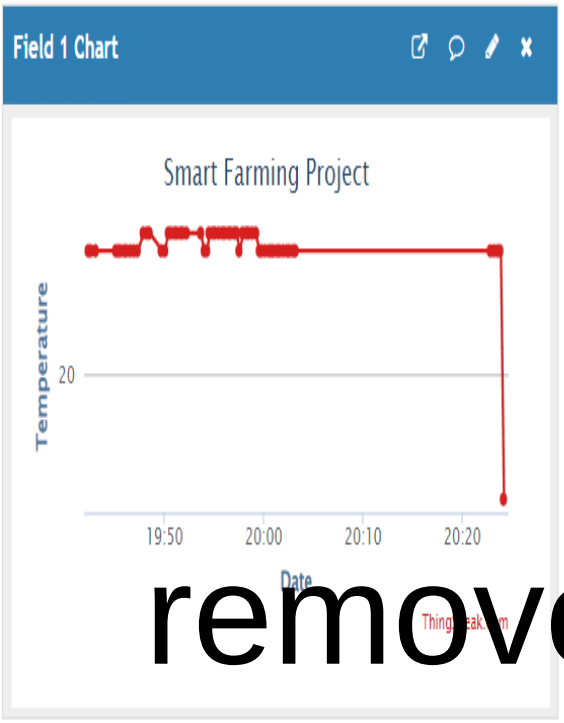
7.7 Publishing sensor data over IoT

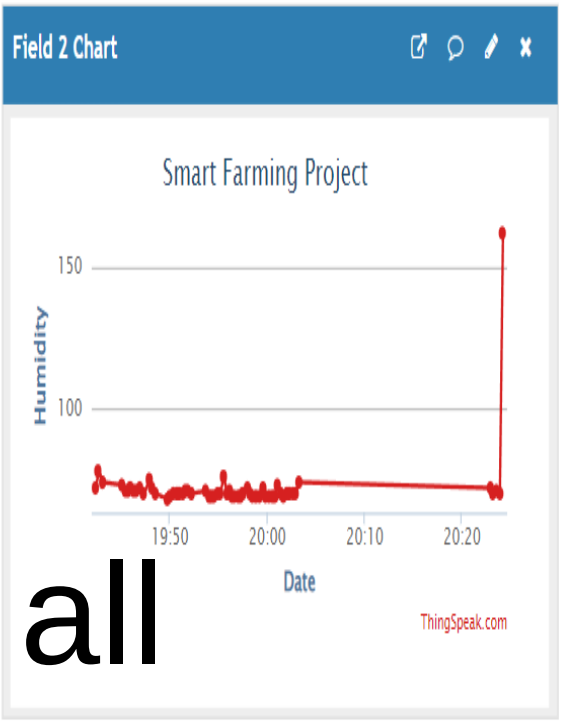
The system has checked for the performance with the help of thing speak.com platform to check the Temperature, humidity rain and soil parameters. The figure depicted enables the performance the smart Farming being operational

Days	Temperature (^{0}C)	Humidity (%)
1	29	75
2	32	76
3	34	63
4	33	61
5	42	44
6	35	69
7	37	64
8	36	64
9	35	68
10	30	68

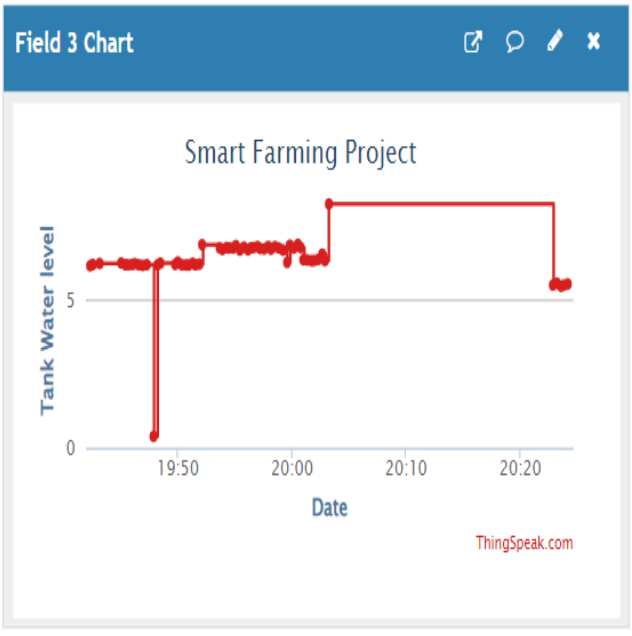
Table 1.5: Different Sensors Output Values used in Farming field at Day Time (8:00 AM to 10:00 AM)

Below three graphs illustrate the visualization of Smart Farming System in Thing Speak cloud and MQTT dashboard using python programming





remove all



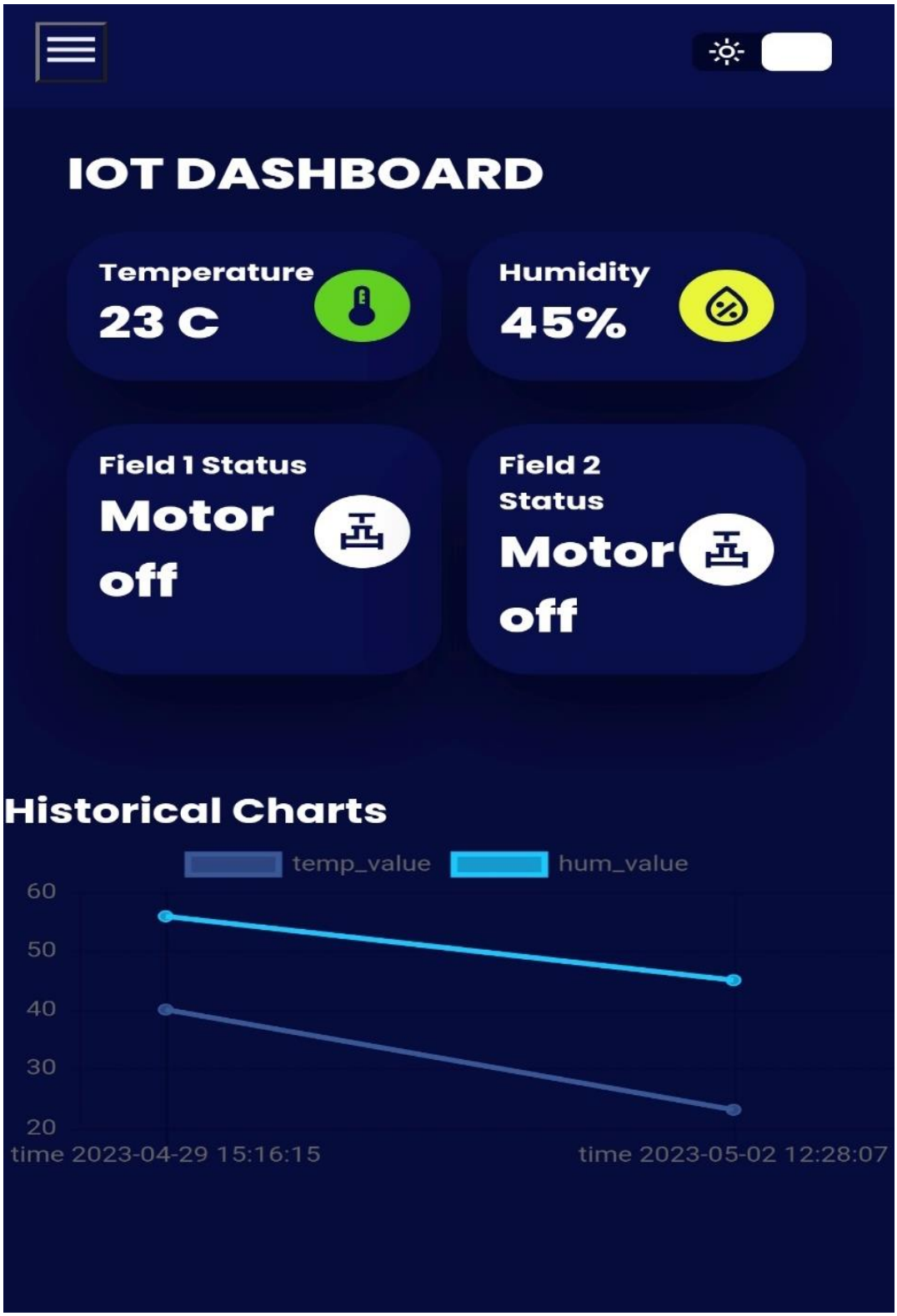


Figure 4.0 Software Implementation of a). Temperature sensor values b). Humidity sensor values c). Tank Water level d). Own Website output

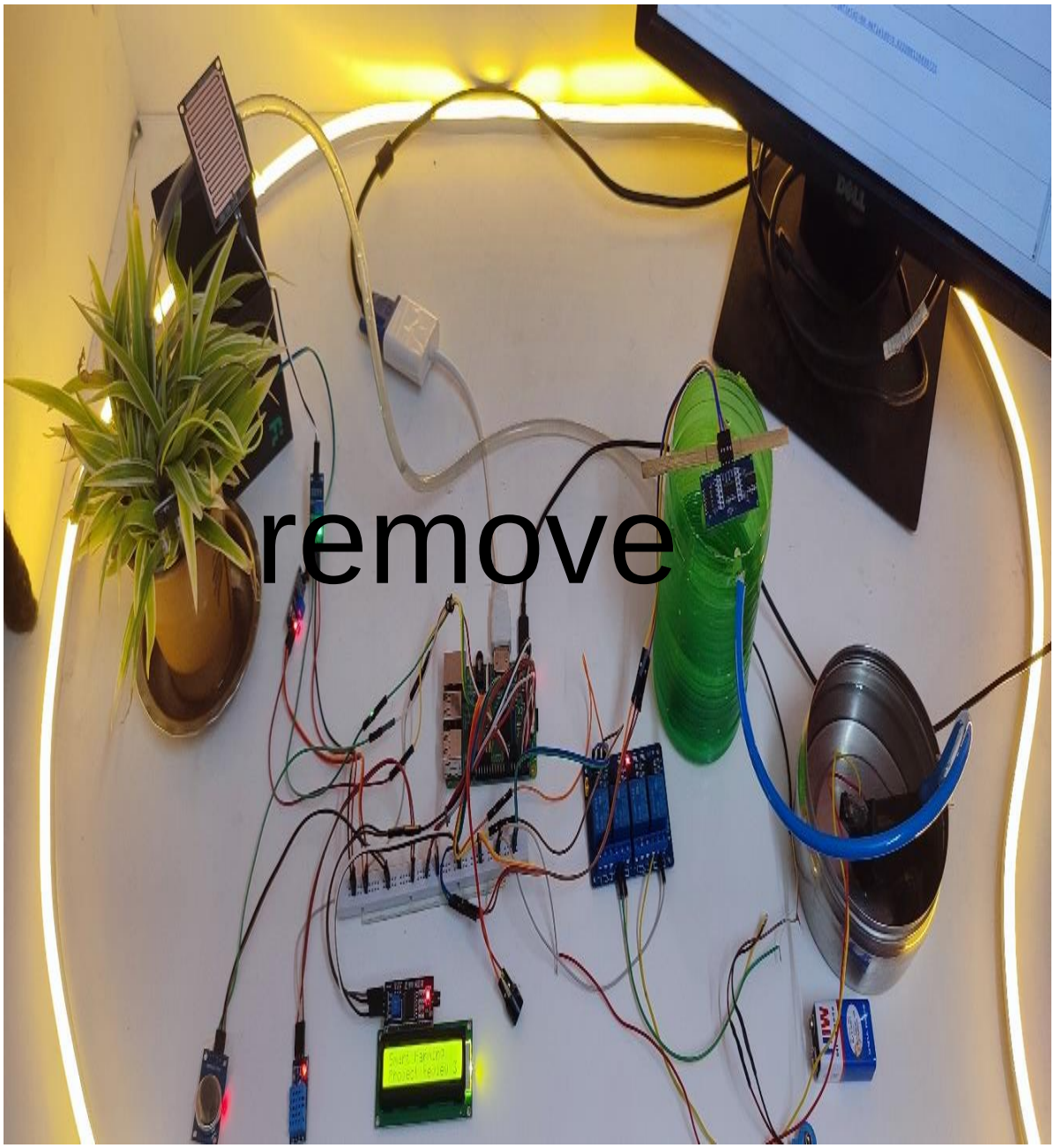


Figure 4.1: Overall Hardware implementation

Chapter 8

CONCLUSION AND FUTURE SCOPE

The smart irrigation system is suitable and cost effective for advance water resources for agricultural production. The system would provide feedback control system which will monitor and control all the activities of plant growth and irrigation system efficiently. If rain gun sensor can be added so that when it rains there won't be floods. Rain water harvesting can be done and this harvested water can be used to irrigate fields. We can also include many more water quality sensors that affect the crops.

As complete power for the system is supplied from the solar panel the power management plays a vital role in the processing of the system. This power management system helps the maximum supply of the power to all the components. Most importantly solar energy is one of the renewable resources we can use that extensively and by that we can run our entire system leads to betterment of our future world.

With the incorporation of the IOT, we can upgrade the agriculture farm. These systems enable to check the quality of the soil and with these system farmers are able to solve irrigation problems, temperature problems, humidity problems, etc. The availability of sensors for the agricultural parameters and microcontrollers can be easily interfaced with each other and with the help of Internet of Things, wireless sensor networks communication the challenges encountered by the farmers can also be reduced and a better communication path for the transfer of useful data can be achieved between various nodes.

So, farmers are able to monitor their crop on Smartphone or on computers. These systems offer a high application area to the users to improve their skill and output of the crops in better way. Use these systems help to increase the agricultural production in India in the near future. IOT capable to control the condition of the yield and growth, it can also able to check soil, temperature, humidity, etc. with help of IoT.

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