

PLANT MOISTURE LEVEL MONITORING SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Biotechnology
Interdisciplinary project

By

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DEPARTMENT OF BIOTECHNOLOGY

SCHOOL OF BIO AND CHEMICAL ENGINEERING

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Ragamalika. S(Reg. No. 41230042), Vivekanandhan Gayathri (Reg. No. 41230075) who carried out the Interdisciplinary Project entitled "PLANT MOISTURE LEVEL MONITORING SYSTEM" under our supervision from January 2024 to April 2024.

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DECLARATION

We, **Ragamalika. S (Reg. No. 41230042), Vivekanandhan Gayathri (41230075)** hereby declare that the Project Report entitled “**PLANT MOISTURE LEVEL MONITORING SYSTEM**” done by me under the guidance of **Dr. P. Prakash, M. Tech., Phd.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Biotechnology.

DATE: 06-05-2024

PLACE: CHENNAI



SIGNATURE OF THE CANDIDATE

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ABSTRACT

Maintaining proper soil moisture is crucial for plant health. Over-watering can suffocate roots and invite diseases, while under-watering leads to drooping and browning. A moisture monitor addresses these issues by alerting when moisture levels drop, using sensors, wireless communication, and data processing. These sensors track soil moisture accurately, transmitting data for analysis. Machine learning and predictive analytics then provide actionable insights, aiding in irrigation scheduling and plant health management. The user interface offers intuitive dashboards and alerts based on real-time data and weather conditions. This proactive approach conserves water, improves crop quality, and boosts agricultural productivity. The system is scalable, adaptable to various soils and crops, and complements existing agricultural practices, making it a valuable tool for precision agriculture and sustainability. This technology-driven solution tackles water management challenges, enhances crop resilience, and supports global food security.

Keywords: *Moisture content, Moisture monitor, Data processing, Environmental sustainability.*

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LIST OF SYMBOLS AND ABBEREVIATIONS

%RH	Percentage Relative Humidity
VWC	Volumetric Water content
MOIST	Moisture
TEMP	Temperature
HUMP	Humidity
COND	Conductivity
IRRIG	Irrigation
AMB. TEMP	Ambient Temperature
LED	Light-Emitting Diode
PPM	Parts Per Million
CM	Centimeters
VWC	Volumetric Water Content
EC	Electrical Conductivity

CHAPTER 1

INTRODUCTION

In modern agriculture and horticulture, the optimization of water usage is crucial for sustainable and efficient plant growth. One of the key parameters influencing water management is soil moisture. Monitoring soil moisture levels accurately and in real-time has become a fundamental aspect of precision agriculture. To address this need, advanced plant soil moisture monitoring systems have been developed, integrating sensor technology, data analytics, and automation. The evolution of technology has ushered in a new era of precision agriculture, where data-driven insights and real-time monitoring play a transformative role. (Smith, J., & Johnson, A., 2020)

Plant soil moisture monitoring systems represent a convergence of cutting-edge sensor technology, data analytics, and automation, revolutionizing how we perceive and manage soil water dynamics. At the core of these systems are advanced sensors capable of measuring soil moisture levels with unprecedented accuracy and granularity. These sensors, often based on principles like capacitance, resistivity, or neutron scattering, are embedded in the soil at strategic locations across fields or gardens. They continuously gather data on soil moisture content, transmitting this information to a central data processing unit or a cloud-based platform in real-time. The data collected from these sensors is not merely raw numbers but a treasure trove of insights waiting to be unlocked. (Smith, J., & Johnson, A., 2020)

This intelligence extends beyond basic moisture levels, encompassing parameters such as temperature, humidity, and even nutrient content in some advanced systems. The benefits of employing a plant soil moisture monitoring system are manifold. Firstly, it enables precise irrigation scheduling, ensuring that plants receive the optimal amount of water at the right time. This precision minimizes water waste, reduces energy consumption associated with irrigation, and mitigates the risk of overwatering or underwatering, both of which can have detrimental effects on plant health. By conserving water and energy, they align

with global efforts to address water scarcity and climate change resilience in agriculture. They also facilitate the adoption of drip irrigation, fertigation, and other water-efficient techniques, fostering sustainable farming practices. Beyond the immediate benefits to crop yield and water management, plant soil moisture monitoring systems play a crucial role in research and innovation. The data generated can be analyzed to understand soil-plant interactions better, optimize fertilizer application, detect early signs of stress or disease, and even forecast crop performance based on environmental conditions. In essence, plant soil moisture monitoring systems are not just tools; they are catalysts for a paradigm shift in agriculture. (Gaurav Patil *et al.*, 2021)

We live in a world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. One such field is that of agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. Plant monitoring forms an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum produce. Automating a plant monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Automation is process control of industrial machinery and processes, thereby replacing human operators. (Gaurav Patil *et al.*, 2021)

In this paper the presented plant monitoring system technology to provide feedback to the user through smart phone. The automated system will reduce the need of manpower, hence reducing the error. For a large scale area, it is quite impossible for a farmer to monitor the efficiency of the system by implementing this technology, the farmers can easily monitor the system using their smart phone. Also due to busy life these days we are not able to keep proper care of plants such as watering plant, to check whether plant is getting sufficient sunlight etc. (Gaurav Patil *et al.*, 2021)

CHAPTER 2

REVIEW OF LITERATURE

2.1 BLOCK DIAGRAM

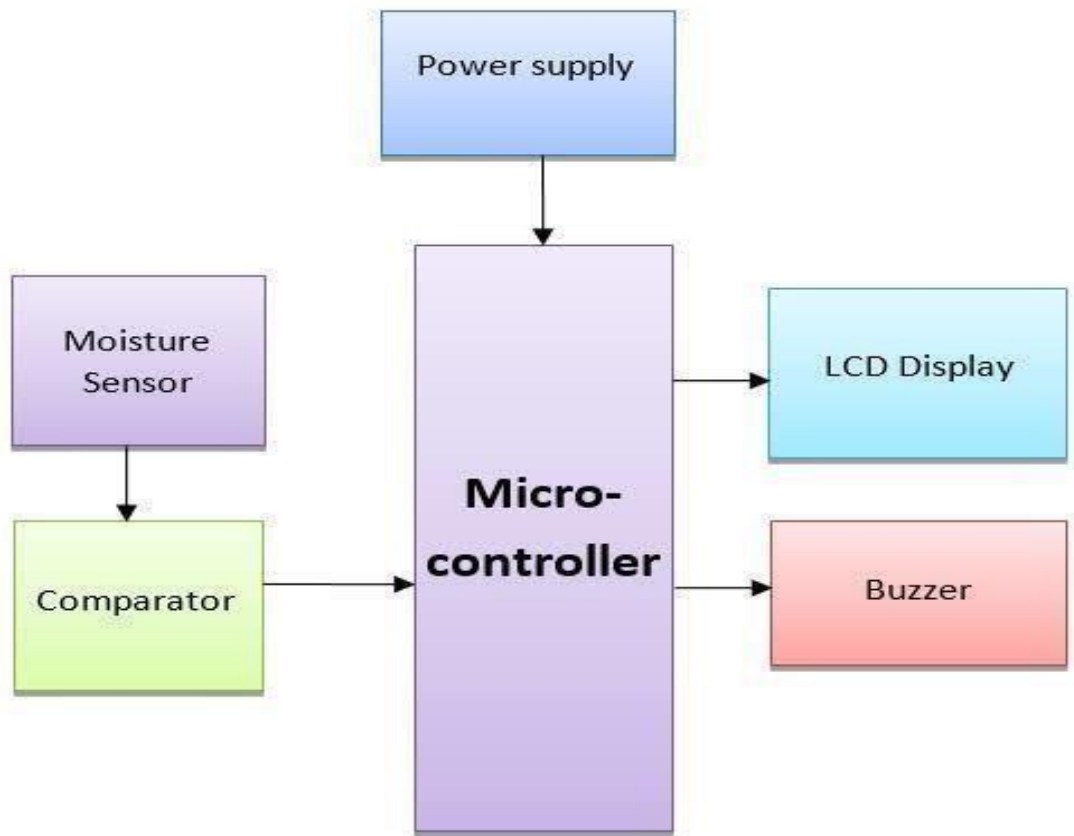


Figure 2.1: Implementation of the plant moisture monitor

A plant moisture monitoring system typically consists of several components that work together to measure and manage the moisture level of plants. Here's a basic block diagram of such a system:

Sensors: These are the devices that directly measure the moisture level in the soil. Common types include soil moisture sensors or hygrometers. They detect the moisture content and convert it into an electrical signal. (Absar *et al.*, 2023)

Microcontroller or Microprocessor: This is the brain of the system. It receives the electrical signals from the sensors, processes the data, and controls the system's

overall operation. It may be an Arduino, Raspberry Pi, or a dedicated microcontroller designed for this purpose. (Absar *et al.*, 2023)

Power Supply: This provides electrical power to the system. It can be a battery, solar panel with a battery backup, or a direct power source depending on the application and design requirements. (Absar *et al.*, 2023)

Display: This component shows the moisture level readings to the user. It can be an LCD screen, LED indicators, or a graphical interface on a computer or mobile device.

Communication Module: This module enables the system to communicate with external devices or networks. It can be a Wi-Fi module, Bluetooth module, or a wired connection like Ethernet, allowing data to be transmitted to a smartphone, computer, or a cloud-based platform. (Absar *et al.*, 2023)

Control Unit: This part of the system implements control algorithms based on the moisture level readings. For example, it can activate irrigation systems or send alerts to the user when the moisture level is too high or too low. (Absar *et al.*, 2023)

Irrigation System: In some designs, the moisture monitoring system is integrated with an irrigation system. The control unit triggers the irrigation system based on the moisture readings, ensuring optimal watering for the plants. (Absar *et al.*, 2023)

By combining these components, a plant moisture monitoring system can effectively measure, display, and manage the moisture levels in plants, helping to maintain healthy growth conditions. (Absar *et al.*, 2023)

2.2 CIRCUIT DIAGRAM

2.2.1 Simple automatic media dispenser:

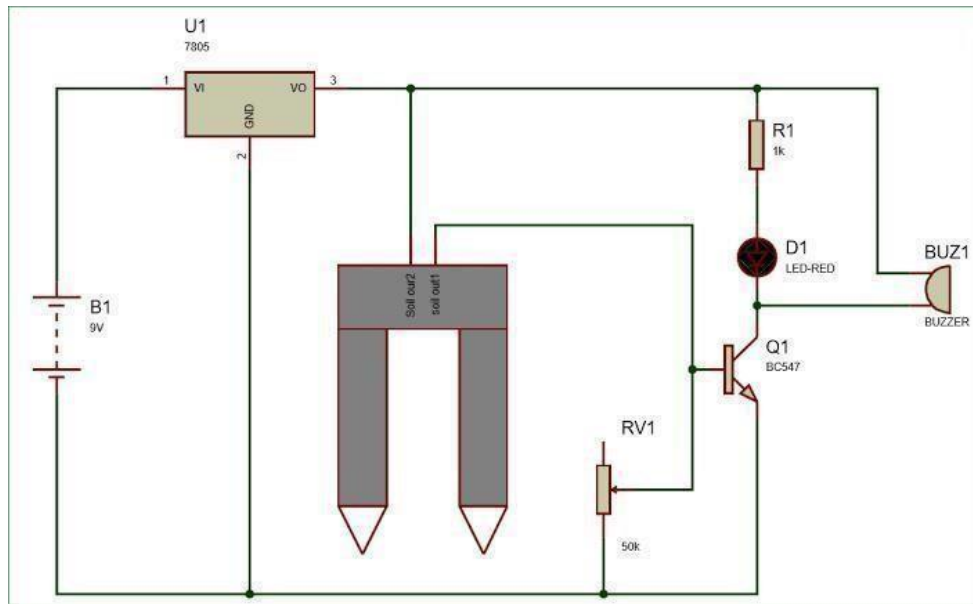


Figure 2.2: Soil Moisture Sensor Circuit

HL-69 hygrometer soil moisture sensor: Connect the VCC pin of the HL-69 sensor to the power supply's positive terminal (usually 5V). (Siregar B et al.,2018)
 Connect the GND pin of the sensor to the ground (0V) of the power supply.
 Connect the AOOUT pin of the sensor to an analog input pin of your microcontroller. (Siregar B et al.,2018)

Microcontroller (MCU): An MCU, like Arduino or ESP8266/ESP32, processes the data from the sensor and controls the system's operations.

Power Supply: The system needs a power source, often a battery. Connect the power supply to the MCU (usually 5V or 3.3V). Connect the sensor data pin to one of the MCU's analog or digital input pins. Also, connect any necessary ground and voltage pins. (Siregar B et al.,2018)

Wireless Module: For remote monitoring, you might include a Wi-Fi or Bluetooth module to send data to a smartphone or a cloud server. If you're adding wireless capabilities, connect the communication pins (like TX, RX for UART communication or SPI/I2C pins) of the wireless module to the corresponding pins on the MCU. Also, connect power and ground. (Siregar B et al.,2018)

Power Supply: Connect the power supply (battery or DC adapter) to the appropriate power input pin on the MCU. Make sure the voltage and current rating match the MCU's requirements. (Siregar B *et al.*,2018)

Display Module: If you're using a display, connect it to the MCU according to its specifications. Usually, this involves connecting power, ground, and data pins. (Siregar B *et al.*,2018)

Transistor/MOSFET: Depending on the power requirements of your system, you might use a transistor or MOSFET to control higher current loads, such as a water pump for irrigation. The MCU can control the transistor/MOSFET to turn the pump on or off based on moisture levels. (Siregar B *et al.*,2018)

Relay Module: Similar to a transistor/MOSFET, a relay can be used to control highpower devices like water pumps or solenoid valves. The MCU triggers the relay to switch these devices on or off. (Siregar B *et al.*,2018)

LEDs: LEDs can be used for visual indicators, like showing when the system is active, when moisture levels are below or above a certain threshold, or to indicate communication status in wireless systems. (Siregar B *et al.*,2018)

2.3 COMPONENT DESCRIPTION

2.3.1 HL-69 hygrometer soil moisture sensor:

The HL-69 hygrometer sensor is designed specifically to measure the moisture content in soil. It typically consists of two probes that are inserted into the soil. As soil moisture changes, the sensor's electrical resistance varies, allowing it to accurately detect moisture levels. This data is crucial for agricultural applications, as it helps determine when and how much to water plants, preventing overwatering or underwatering, which can both be detrimental to plant health. (Chung WY *et al.*,2013)

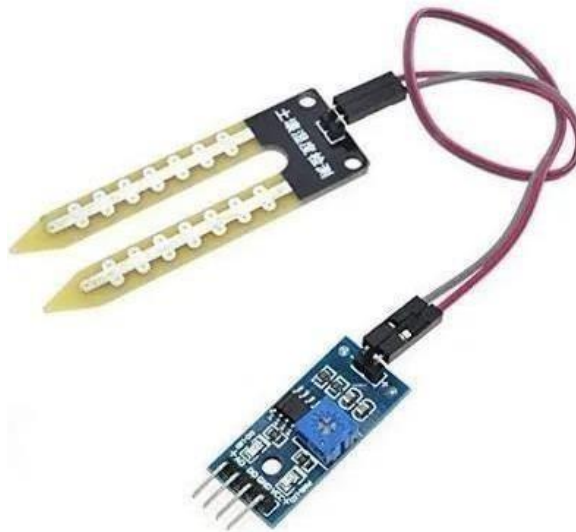


Figure 2.3: HI-69 hygrometer soil moisture sensor

2.3.2 Peizo buzzer:

A piezo buzzer is a type of transducer that converts electrical energy into mechanical vibrations, producing sound waves. Unlike traditional speakers, piezo buzzers are compact, efficient, and emit a distinctive buzzing sound. They are often used in electronic devices for alarms, notifications, and alerts. In soil moisture monitoring systems, a piezo buzzer can be employed to audibly signal when soil moisture levels are outside the desired range, prompting immediate attention from gardeners or farmers. (Chung WY *et al.*, 2013)



Figure 2.4: Piezo buzzer

2.3.3 LED:

LEDs are semiconductor devices that emit light when current passes through them. They come in various colors and are highly efficient, durable, and versatile. In soil moisture monitoring setups, LEDs are commonly used as visual indicators. For example, a green LED might indicate optimal soil moisture levels, while a red LED could signify that the soil is too dry and requires watering. LEDs provide clear and immediate feedback, making them valuable in monitoring systems. (Chung WY *et al.*,2013)



Figure 2.5: LED

2.3.4 Arduino board:

An Arduino board is a microcontroller platform that provides a programmable interface for interacting with electronic components. It consists of a microcontroller unit (MCU), input/output pins, a USB interface for programming, and other components. Arduino boards are popular in DIY electronics projects due to their ease of use and versatility. In soil moisture monitoring systems, an Arduino board processes data from sensors like the HL-69 hygrometer and controls outputs like LEDs and buzzers based on predefined conditions set in the program. (Chung WY *et al.*,2013)



Figure 2.6: Arduino board

2.3.5 Bread board:

A breadboard is a reusable prototyping tool used to build and test electronic circuits without permanent soldering. It consists of a grid of interconnected holes, with metal strips running underneath to provide electrical connectivity. Breadboards allow components to be easily inserted and connected using jumper wires, making it simple to prototype and modify circuits. In soil moisture monitoring systems, a breadboard provides a convenient platform for arranging and connecting the various components of the system during development and testing phases. (Chung WY *et al.*,2013)



Figure 2.7: Bread board

2.3.6 Jumper wire (female to female) :

Jumper wires are essential for creating electrical connections between components on a breadboard or circuit board. They are usually flexible and come in various lengths and colors. Jumper wires allow for easy prototyping and experimentation, as they enable the quick and temporary connection of components without the need for soldering. In soil moisture monitoring projects, jumper wires facilitate the flow of data and power between the Arduino board, sensors, LEDs, and other elements of the system. (Chung WY *et al.*, 2013)



Figure 2.8: Jumper wire

2.4 WORKING

This Soil Moisture Detector Circuit is very simple. Here we have used a soil moisture detector probe to sense the moisture in the soil and an NPN transistor to trigger the Buzzer and LED. This soil moisture detector is built using general purpose PCB. Buzzer and LED are used as an indication of soil moisture detection. (Absar *et al.*, 2023)

Working on this circuit is straightforward and clearly understandable. Here we have connected one wire of probe directly to VCC and another probe to the base of the transistor Q1 and 50k potentiometer RV1 is used for adjusting the sensitivity of the circuit. Now when there is no moisture in soil then probes does not allow 7805 to supply any voltage to the base of transistor Q1 so the LED and

Buzzer remain turned off. Now, whenever both probes will come in contact with soil moisture or water then both the probe gets shorted because water/moisture is the conductor of current. And when probes get shorted then the base of the transistor gets connected to the output of 7805 IC. As we know when we apply some voltage to the base of an NPN Transistor it gets turn on and allow current to pass through the collector to emitter. And as soon as transistor turns on it will trigger the Buzzer and LED. The buzzer will beep until probes detect soil moisture. (Absar *et al.*, 2023)

2.4.1 Sensor Placement:

Soil moisture sensors are placed in the ground at various depths depending on the application. They measure the volumetric water content in the soil, which indicates how much water is available to plants. Sensors are typically installed at various depths to capture moisture levels throughout the root zone of plants. The number of sensors and their placement depend on factors like soil type, crop type, and irrigation methods. (Chew KM *et al.*,2020)

2.4.2 Data collection:

The sensors collect data at regular intervals, typically measuring moisture levels in percentage or a similar unit. This data is then sent to a central system for analysis. Sensors collect data at predefined intervals, such as every hour or every day. Some sensors have built-in data logging capabilities, storing data locally until it's retrieved by the central system. (Chew KM *et al.*,2020)

2.4.3 Data Transmission:

There are various ways data can be transmitted from the sensors to the central system. It can be wired, using cables connected to each sensor, or wireless, where sensors communicate using technologies like Bluetooth, Wi-Fi, LoRa, or cellular networks. Wired systems use cables to connect sensors to a central data collection unit. Wireless systems employ technologies like Bluetooth, Wi-Fi, LoRa (Long Range), Zigbee, or cellular networks for data transmission. Wireless systems offer

more flexibility and scalability but may have range limitations depending on the technology used. (Chew KM *et al.*,2020)

2.4.4 Data Analysis:

Once the data is processed, it's analyzed to determine soil moisture levels across the monitored area. This information helps in making decisions about irrigation schedules, optimizing water usage, and understanding soil health.

- Analyzing historical data helps in understanding soil moisture trends over time.
- Statistical analysis and machine learning algorithms can be applied to detect patterns, anomalies, and correlations with other environmental variables (e.g., temperature, rainfall). (Chew KM *et al.*,2020)

2.4.5 Decision Making:

Based on analyzed data, decisions can be made regarding irrigation scheduling, fertilizer application, and crop management.

Automated decision-making systems can adjust irrigation based on real-time sensor data and predefined thresholds. (Chew KM *et al.*,2020)

2.4.7 Alerts and Notifications:

Based on predefined thresholds or algorithms, the system can generate alerts or notifications. For example, if soil moisture drops below a certain level, it can trigger an alert to notify farmers to irrigate the crops. The system can generate alerts via email, SMS, or push notifications on a mobile app. Alerts are triggered when moisture levels fall below or exceed specified thresholds, indicating potential drought stress or overwatering. (Chew KM *et al.*,2020)

The system often has a user interface, which can be a dashboard or a mobile app, where users can visualize real-time and historical data, set preferences, and receive alerts. (Chew KM *et al.*,2020)

A user-friendly interface, such as a web dashboard or mobile app, allows users to monitor soil moisture levels, view historical data, and configure system settings.

Graphs, charts, and maps can visualize data for better understanding and decisionmaking. (Chew KM *et al.*,2020)

2.5 APPLICATIONS:

Agriculture: Optimizing irrigation schedules based on real-time soil moisture data can enhance crop yields, conserve water, and prevent overwatering or underwatering.

Environmental Monitoring: Monitoring soil moisture levels in forests, grasslands, and wetlands can help in assessing ecosystem health, predicting droughts, and managing wildfire risks. (Chew KM *et al.*,2020)

Landscaping and Gardening: For homeowners, landscapers, and gardeners, a soil moisture monitoring system can ensure proper watering of lawns, plants, and gardens, leading to healthier vegetation and water savings. (Chew KM *et al.*,2020)

Research and Education: Soil moisture data is crucial for research in areas like hydrology, climate change, and soil science. Educational institutions use these systems to teach students about environmental monitoring and sustainable practices.

Water Resource Management: Municipalities and water authorities use soil moisture monitoring to manage water resources efficiently, especially in areas prone to water scarcity or drought. (Chew KM *et al.*,2020)

Construction and Engineering: Monitoring soil moisture during construction projects helps in assessing soil stability, preventing erosion, and ensuring the longevity of structures. (Chew KM *et al.*,2020)

Sports Turf Management: Maintaining optimal soil moisture levels on sports fields like golf courses, football fields, and baseball diamonds is critical for turf health and playability. (Chew KM *et al.*,2020)

2.5.1 Advantages

Optimized Water Use: By accurately measuring soil moisture levels, the system helps in optimizing irrigation schedules, preventing water waste through overwatering, and ensuring plants receive the right amount of water they need. (Althubaiti *et al.*, 2017)

Improved Crop Yields: Farmers can use soil moisture data to make informed decisions about planting, irrigation, and nutrient management, leading to healthier crops, increased yields, and reduced losses due to drought or water stress. Resource Conservation: Efficient water use based on soil moisture data contributes to water conservation efforts, especially in regions facing water scarcity or drought conditions, promoting sustainable agricultural practices. (Althubaiti *et al.*, 2017)

Cost Savings: By avoiding unnecessary water use and reducing the risk of crop damage due to water stress or saturation, farmers and other users save on water costs, energy for pumping, and expenses related to irrigation equipment maintenance.

Environmental Impact: Proper soil moisture management helps in preserving soil health, minimizing runoff and soil erosion, maintaining water quality in nearby water bodies, and reducing the overall environmental footprint of agricultural and landscaping activities. (Althubaiti *et al.*, 2017)

CHAPTER 3

AIM AND SCOPE

The aim of the plant monitoring system is to collect and analyze data related to the growth and health of plants. This plant health monitoring system can provide realtime information on environmental factors such as soil moisture, temperature, humidity, light intensity, and nutrient levels, which can have a significant impact on the growth of plants.

The scope of a plant moisture monitoring system includes the measurement of soil moisture using various techniques, data acquisition, transmission, and analysis, integration with precision agriculture practices, assessment of environmental and economic implications, and anticipation of future advancements and challenges in the field.

CHAPTER 4

MATERIALS AND EXPERIMENTAL METHOD

4.1 : Materials required:

1. HL-69 hygrometer soil moisture sensor(prong sensor and controller)
2. Piezo buzzer
3. 1x Green LED
4. 1x Red LED
5. Arduino board
6. Jumper wires
7. Breadboard
8. LCD display
9. ESP8266 Wi-Fi module
10. Connectors
11. USB cable

4.2: Methodology

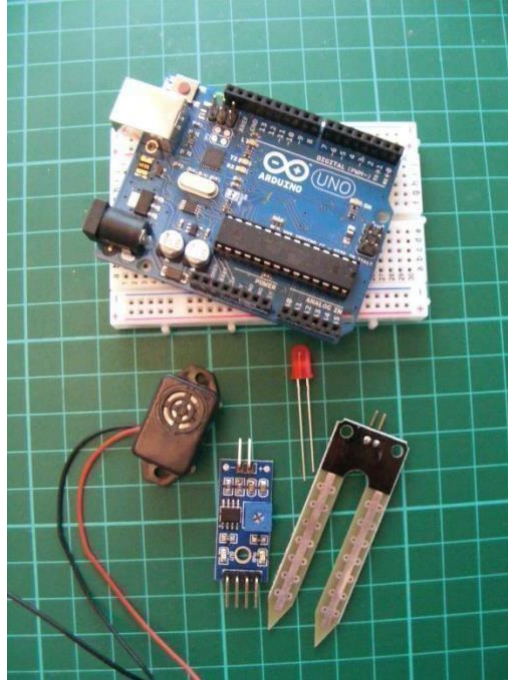


Figure 4.1: Components used in this model

We'll use an HL-69 moisture sensor in which the prongs of the sensor detect the moisture level in the surrounding soil. Damp soil conducts electricity easily, so it provides lower resistance, while dry soil conducts poorly and has a higher resistance. The sensor consists of two parts, the actual prong sensor and the controller.(Alun Williams, 2016)

The two pins on the sensor need to connect to the two separate pins on the controller (connecting wires are usually supplied). The other side of the controller has four pins, three of which connect to the Arduino. The four pins are, from left to right, AO (analog out), DO (digital out), GND, and VCC. You can read the values from the controller through the IDE when it's connected to your computer. Lower readings indicate that more moisture is being detected, and higher readings indicate dryness. The values of the soil moisture sensor will be display on the IDE in computer. (Alun Williams, 2016)

The IDE will display the value of the sensor's reading. If value was 1,000 with the sensor dry and not inserted in the soil, so this is the highest, and driest, value. To calibrate this value, turn the potentiometer on the controller clockwise to increase the resistance and counterclockwise to decrease it. When the soil is moist, this value will be below 900, so the LED and buzzer will remain off. When the value rises above 900, it means the soil is drying out, and the buzzer and LED will alert you to water your plant. (Alun Williams, 2016)

THE BUILD:

- Connect the sensor's two pins to the positive and negative pins on the controller and the prong using the Jumper wires.

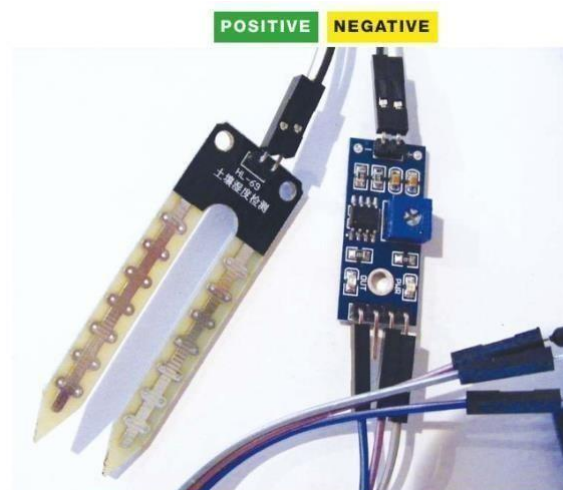


Figure 4.2: Connecting the sensor to the controller

- Connect the three prongs from the controller to +5V, GND, and Arduino A0 directly on the Arduino, as shown in the following table. The DO pin is not used.

SENSOR CONTROLLER	ARDUINO
VCC	+5V
GND	GND
A0	A0
DO	Not used

- Connect the green and red LED directly to the Arduino with the shorter, negative leg in GND and the longer, positive leg in Arduino pin 13.

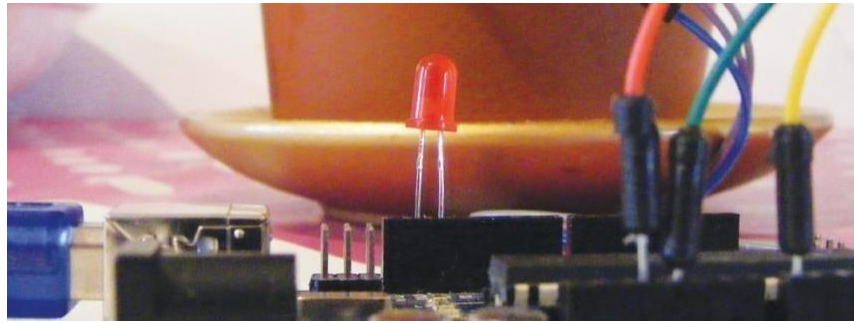


Figure 4.3: Connecting the LED to the arduino

- Connect the piezo buzzer's black wire to GND and the red wire to Arduino pin 11.
- Connect the Arduino and all components into the breadboard using connectors and also the LCD display to it and connect with arduino.
- Connect the Arduino to the computer using the USB cable. Open the Serial Monitor in the IDE to see the values from the sensor, this will also help you to calibrate your plant monitor.

The IDE will display the value of the sensor's reading. My value was 1000 with the sensor dry and not inserted in the soil, so I know this is the highest, and driest, value. To calibrate this value, turn the potentiometer on the controller clockwise to increase the resistance and counterclockwise to decrease it. When the sensor is inserted into moist soil, the value will drop to about 400. As the soil dries out, the sensor value rises; when it reaches 900, the LED will light and the buzzer will sound. (Alun Williams, 2016)

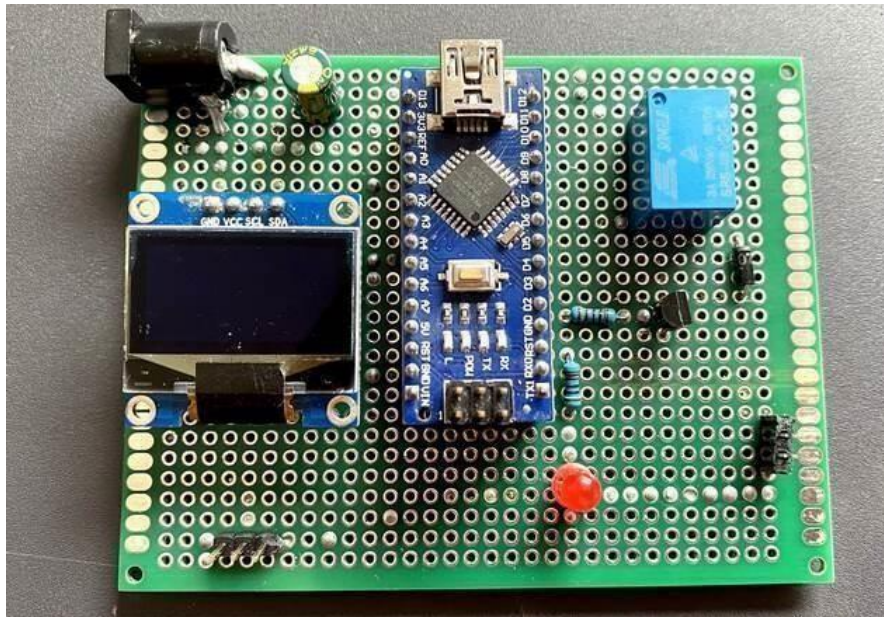


Figure 4.4: Working of the model

The sketch first defines Arduino pin A0 so that it reads the moisture sensor value. It then defines Arduino pin 11 as output for the buzzer, and pin 13 as output for the LED. Use the Serial.Println() function to send the reading from the sensor to the IDE, in order to see the value on the screen. (Alun Williams, 2016)

Change the value in the line depending on the reading from the sensor when it is dry (here it's 900). When the soil is moist, this value will be below 900, so the LED and buzzer will remain off. When the value rises above 900, it means the soil is drying out, and the buzzer and LED will alert you to water your plant. (Alun Williams, 2016)

The code for Plant Soil Moisture Monitoring System with Arduino is written in Arduino IDE:

```
if(analogRead(A0) > 900){
  const int moistureAO = 0; int AO
  = 0;
  // Pin connected to A0 on the controller
  int tmp = 0;
  // Value of the analog pin int buzzPin = 11; // Pin connected to
  the piezo buzzer int LED = 13;
```

```
// Pin connected to the LED
```

```
void setup () {  
  Serial.begin(9600); // Send Arduino reading to IDE  
  Serial.println("Soil moisture sensor"); pinMode(moistureAO,  
  INPUT); pinMode(buzzPin,  
  OUTPUT); // Set pin as output pinMode(LED, OUTPUT);  
  // Set pin as output  
}
```

```
void loop () {    tmp = analogRead(  
  moistureAO ); if ( tmp != AO ) {  
    AO = tmp;  
    Serial.print("A = "); // Show the resistance value of the sensor  
                        // in the IDE  
    Serial.println(AO);  
  }  
  delay (1000); if (analogRead(0) > 900) { // If the reading is higher than  
    900,  digitalWrite(buzzPin,  HIGH); // the buzzer will sound  
    digitalWrite(LED, HIGH); // and the LED will light delay(1000);  
    // Wait for 1 second digitalWrite(buzzPin, LOW); digitalWrite(LED,  
    HIGH);  
  } else { digitalWrite(buzzPin, LOW); // If the reading is below 900,  
            // the buzzer and LED stay off  
    digitalWrite(LED, LOW);  
  }  
}
```

CHAPTER 5

RESULTS AND DISCUSSION

The values of the soil moisture sensor will be display on the IDE in computer. The IDE will display the value of the sensor's reading. If value was 1,000 with the sensor dry and not inserted in the soil, so this is the highest, and driest, value. To calibrate this value, turn the potentiometer on the controller clockwise to increase the resistance and counterclockwise to decrease it. When the soil is moist, this value will be below 900, so the LED and buzzer will remain off. When the value rises above 900, it means the soil is drying out, and the buzzer and LED will alert you to water your plant. (Zadoo M *et al.*,2021)

If you power the Arduino UNO module, and the LED will flash (red not enough water,green enough water) and the The values of the soil moisture level will display on the LCD screenscreen. (Zadoo M *et al.*,2021)



Figure 4.5: Plant moisture monitoring system

We can implement automation by establishing communication between different household devices through the use of the Internet of Things. Automating mundane

home tasks can streamline a person's lifestyle and save a ton of time. The goal of this project was to design a circuit with sensors and make use of the Internet of things concept to monitor and analyze the data the sensors provide, informing the user when the conditions of the plant change. The primary application for this low-cost plant monitoring system is in the home. Furthermore, the idea itself is somewhat intriguing because the plant itself can request water and protection whenever it needs it. Thus, two key issues were taken into consideration when developing the IOT system: how to monitor and regulate the shade, which in turn affects how much sunlight the plant receives. The challenge of determining the ideal shade time interval was that an excessive amount would damage the food's biological structure irreversibly, resulting in eventual death, and an insufficient amount would cause starvation due to improper food preparation. (Zadoo M *et al.*,2021)

As we have already seen in many cases, the plant moisture monitoring system helps us find the moisture content of the soil whereas the plant moisture monitoring system that we created show us the moisture content in the plant. And in this project we have also added some additional features like peizo buzzer which help us in giving us sound indication when the plant is of low moisture and we also have led which displays red when low moisture content and green when the moisture content is of correct concentration.

CHAPTER 6

SUMMARY AND CONCLUSION

There has been proposed a new automatic monitoring of plants by creating algorithm for farms at indoor scenarios that is based for restricted crops. It can effectively used for a particular area and controlled by electronic gadgets. The present approach learns the optimum usage for combining several feature descriptors, as well as the many numbers of engineering works to be used in the designing. The algorithm also shows the improvement of crop according to the working is to be able to use realistic. The algorithm is divided into two different modules. The motor module is running according to soil moisture sensor modules and will operate. The approach achieving barometric pressure sensor which similar to above will operate like above sensor apart from that shows the temperature and heater will be going to work.

The IoT-based Plant Monitoring System is a powerful and versatile system that allows users to monitor and control various aspects of their plants remotely. It is a highly customizable and cost-effective solution for monitoring and controlling plants remotely. The system can be easily integrated with other devices and platforms and can be used for a wide range of applications, such as greenhouse monitoring, crop monitoring, and irrigation control. With the help of this system, the user can keep track of the temperature, humidity, soil moisture, and other important parameters of their plants and take appropriate actions to ensure the optimal growth and health of their plants. The system can be extended further by adding more sensors or actuators to monitor and control other aspects of the plants.

By connecting various soil parameters to the cloud and enabling remote control via a mobile application, the Internet of Things-based Smart Garden system has been proven to function satisfactorily. The system is designed to monitor sensor data, including moisture, humidity, temperature, and ultrasonic, as well as to actuate other parameters based on requirements. This system can be installed anywhere because of its low initial cost and ease of installation. The advancement of sensor

technology allows the system to be upgraded to the next level, allowing users to make the most economical use of their investment. The system can be altered to precisely apply fertilizers to the garden if soil nutrient sensors can be installed. This approach reduces labor costs and makes effective use of the available water resources, which increases revenue. The system's feedback will help the gardening process be implemented more effectively. It was decided to design a system to track temperature, humidity, and soil moisture content. The project offers a chance to examine the features and disadvantages of the current systems. Among the uses of water that is most prevalent is agriculture.

The suggested system can be used to automate the irrigation process by turning the motor on or off based on the sensor values, or favorable conditions of the plants. This is one of the farming practices that uses the least amount of time and helps to prevent crop damage by not over- or under-irrigating the soil. Via an Android App, the farm owner can keep an eye on the procedure online. Despite this, this project shows that farming can advance significantly through the use of automation and IOT.

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