UMACHARAN PATNAIK ENGINEERING SCHOOL

BERHAMPUR

IOT PROJECT REPORT
ON
"SMART IRRIGATION SYSTEM"

Submitted to:

S.C.T.E. & V.T, ODISHA, BHUBANESWAR

FOR

PARTIAL FULFILMENT FORWARDS THE AWARD OF DIPLOMA IN COMPUTER SCIENCE & ENGG.FROM U.C.P. ENGINEERING SCHOOL (BERHAMPUR)

Under The Esteemed Guidance of: -

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U.C.P. Enginnering School (Berhampur)

DIPLOMA
IN
COMPUTER SCIENCE & ENGG. & INFORMATION TECHNOLOGY UCP ENGINEERING SCHOOL, BERHAMPUR-10

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CERTIFICATE

This is to certify that the project work entitled "SMART IRRIGATION SYSTEM" by Subhasish Sahu (F21012007062), Sayed Ahemmad (F21012007052), Mohan Kumar Dash (F21012007032), Haripada Sahoo (F21012007024), Suvam Kumar Bhola (F21012007068), G. Khetrabasi Reddy (F21012007022), Lokanath Maharana (F21012007029), Pratik Kumar Sahoo (F21012007041), Saswat Das (F21012007051), Narayan Sahu (F21012024010), Amlan Baibhab Dash (F21012007004), Aishwarya Raj (F21012024003), Ayush Parida (F 21012007011), Nilanchala Mahanty (F21012007035), and Preetam Kumar Mohapatra (F 21012024011) was carried out under my supervision in partial fulfillment of the requirements for the diploma in Computer Science and Engineering (CSE) & Information Technology during the session 2023 - 2024 at UCP Engineering School, Berhampur.

Signature & Seal of The

Guide with Date

Acknowledgement

It is our earnest duty to express our thanks to all those who contributed directly or indirectly to our project.
Firstly, we would like to thank UCP Engineering School, Berhampur - 760010 , and the Computer Science Department for giving us an opportunity . We would like to express our gratitude to our Project Guide Smt .SUMITRA MAHAPATRA (Lect .) &, SMT . NAINA PATEL(Lect.) who initiated us to complete this project and guided us timely.
Finally , we extend our appreciation to all staff members and our friends for their excellent suggestions and coordination.
There might be some problems and extra requirements with this system . In the future , these problems will be corrected accordingly . For this, your valuable suggestions are most welcome.

DECLARATION

We, students of the Sixth Semester, Computer Science and Engineering, UCP Engineering School, hereby declare that the project work titled "SMART IRRIGATION SYSTEM" has been carried out by us and submitted in partial fulfillment of the course requirements for the award of the Diploma of Engineering in Computer Science and Engineering of UCP Engineering School, Berhampur, during the academic year 2021-2024.

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Introduction

Introduction

The increasing demand for efficient and sustainable agriculture practices has led to the development of various technologies aimed at improving crop yield while conserving resources. One such technology is automated irrigation systems, which utilize sensors to monitor soil moisture levels and adjust watering accordingly. In this report, we present the integration of a soil moisture monitoring system with an automated watering system using Arduino Uno microcontroller and related components.

The primary objective of this project is to create a smart irrigation system that can monitor soil moisture levels in real-time and automatically water plants when necessary. By accurately measuring soil moisture and providing water only when needed, this system aims to optimize water usage, prevent overwatering or underwatering, and ultimately promote healthier plant growth.

This report outlines the components used in the system, the methodology employed for integration, the circuit diagram depicting the connections between various components, and the code explanation detailing the functionality of the Arduino program. Additionally, it presents the results and observations from testing the system in a real-world environment, along with conclusions drawn from the project and suggestions for future enhancements.

Overall, this project demonstrates the potential of combining sensor technology with microcontrollers to create efficient and sustainable solutions for agricultural practices, paving the way for further advancements in precision farming techniques.

Aim

The aim of this project is to develop a smart irrigation system that integrates soil moisture monitoring with automated watering functionality. The primary objectives include:

1. Real-time Soil Moisture Monitoring: Implementing a sensor-based system to continuously monitor the moisture levels in the soil.
2. Automated Watering: Controlling a water pump based on the soil moisture readings to automatically water plants when the soil becomes dry.
3. Water Conservation: Optimizing water usage by providing water only, when necessary, thereby preventing overwatering and reducing water wastage.
4. Plant Health Optimization: Promoting healthier plant growth by ensuring that plants receive the appropriate amount of water according to their moisture requirements.

By achieving these objectives, the project aims to demonstrate the feasibility and effectiveness of using Arduino-based technology for precision irrigation in agricultural and gardening applications.

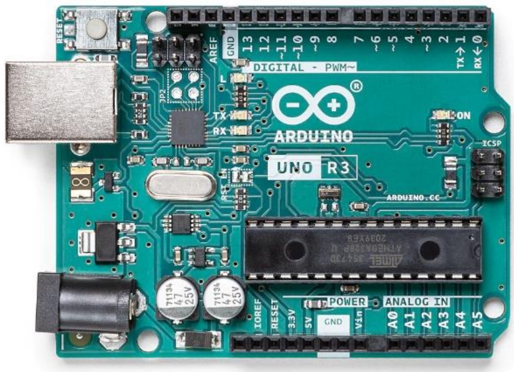
Objectives

The objectives of this project are as follows:

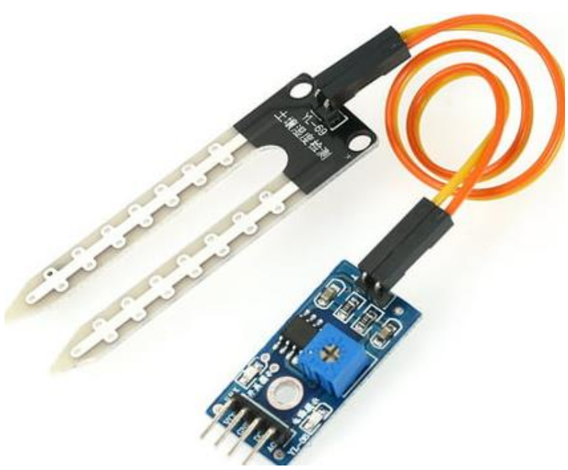
1. **Integration of Soil Moisture Monitoring**: Incorporate a soil moisture sensor into the system to continuously measure the moisture level of the soil.
2. **Real-time Data Acquisition**: Implement a mechanism to capture and process the soil moisture readings in real-time.
3. **Automated Watering Control**: Develop logic within the Arduino program to interpret the soil moisture data and trigger the water pump accordingly.
4. **Precision Irrigation**: Ensure that the watering process is optimized to deliver the right amount of water to the plants based on their moisture requirements.
5. **User Interface**: Display the soil moisture level and watering status on an LCD screen for user convenience and monitoring purposes.
6. **Efficiency and Resource Conservation**: Design the system to conserve water by activating the water pump only when necessary, thus preventing overwatering and minimizing water wastage.
7. **Reliability and Stability**: Create a robust and stable system that operates consistently and reliably under varying environmental conditions.

By accomplishing these objectives, the project aims to demonstrate the effectiveness of integrating soil moisture monitoring with automated watering to promote sustainable and efficient irrigation practices in agricultural and gardening settings.

Components Used

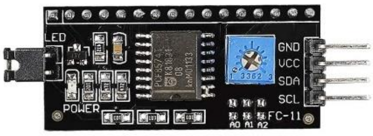


1. **Arduino Uno**: The Arduino Uno is a microcontroller board based on the ATmega328P chip. It serves as the central processing unit of the system, responsible for interfacing with sensors, controlling the water pump, and displaying information on the LCD screen.



2. **Soil Moisture Sensor**: This sensor measures the volumetric water content in the soil by detecting the resistance between two electrodes. It provides real-time data on soil moisture levels, enabling the system to determine when watering is required.

3. **Liquid Crystal Display (LCD)**: The LCD display is used to present information to the user in a readable format. It provides a visual interface for displaying the current soil moisture level, watering status, and any other relevant information.
4. **I2C Module**: The I2C module is an interface adapter that allows the Arduino Uno to communicate with the LCD display using the I2C communication protocol. It simplifies the wiring and enables efficient data transfer between the microcontroller and the display.
5. **Relay Module**: The relay module acts as a switch to control the water pump. It is used to turn the pump on or off based on the soil moisture readings obtained from the sensor. The relay module provides isolation between the low- voltage Arduino circuitry and the high-voltage water pump.
6. **Water Pump**: The water pump is responsible for delivering water to the plants. It is activated or deactivated based on the soil moisture levels detected by the sensor. The pump ensures that plants receive adequate water to maintain optimal growth and health.
7. **Jumper Wires**: Jumper wires are used to establish electrical connections between various components of the system. They facilitate the wiring process and enable communication between the Arduino and peripheral devices.
8. **6mm PVC Tube**: The PVC tube is used as a conduit for delivering water from the water pump to the plants. It directs the flow of water to the desired location, ensuring efficient irrigation and water distribution.

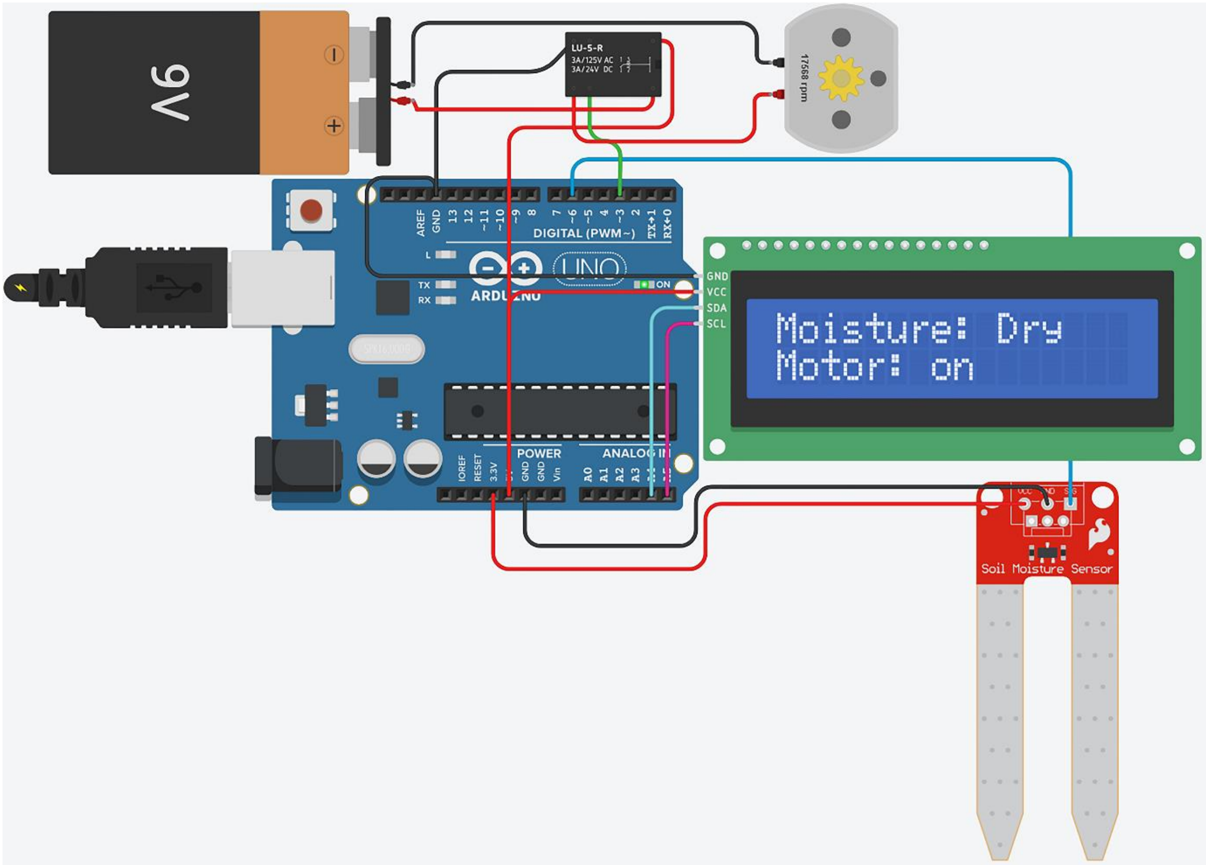


Methodology

The development of the smart irrigation system involved the following steps:

1. **Component Selection**: The first step was to identify and select the necessary components for the project, including the Arduino Uno microcontroller, soil moisture sensor, LCD display, relay module, water pump, foam board, jumper wires, and PVC tube.
2. **Circuit Design**: A circuit diagram was created to illustrate the connections between the components. This involved determining the pin assignments for each component and ensuring compatibility between them.
3. **Hardware Setup**: The hardware setup involved physically connecting the components according to the circuit diagram. This included wiring the soil moisture sensor, relay module, LCD display, and water pump to the Arduino Uno microcontroller using jumper wires.
4. **Code Development**: The Arduino code was developed to implement the logic for monitoring soil moisture levels, controlling the water pump, and displaying information on the LCD display. This involved writing code to read data from the soil moisture sensor, activate the relay module based on the moisture readings, and update the LCD display with relevant information.
5. **Testing and Debugging**: The system was tested in a controlled environment to ensure proper functionality. This involved monitoring the soil moisture readings, observing the operation of the water pump, and verifying the accuracy of the displayed information on the LCD screen. Any issues or bugs encountered during testing were identified and addressed through debugging and code refinement.
6. **Integration and Mounting**: Once the individual components were tested and verified, they were integrated into a cohesive system. The Arduino board, sensor, relay module, and other components were mounted on the foam board using adhesive or fasteners to create a compact and organized setup.
7. **Field Testing**: The system was deployed in a real-world environment to evaluate its performance under actual conditions. This involved monitoring the system's operation over an extended period, assessing its reliability, and making any necessary adjustments to optimize its performance.
8. **Documentation and Reporting**: Throughout the project, documentation was maintained to record the design, implementation, and testing processes. This documentation served as a reference for future iterations of the project and was used to generate the final project report.

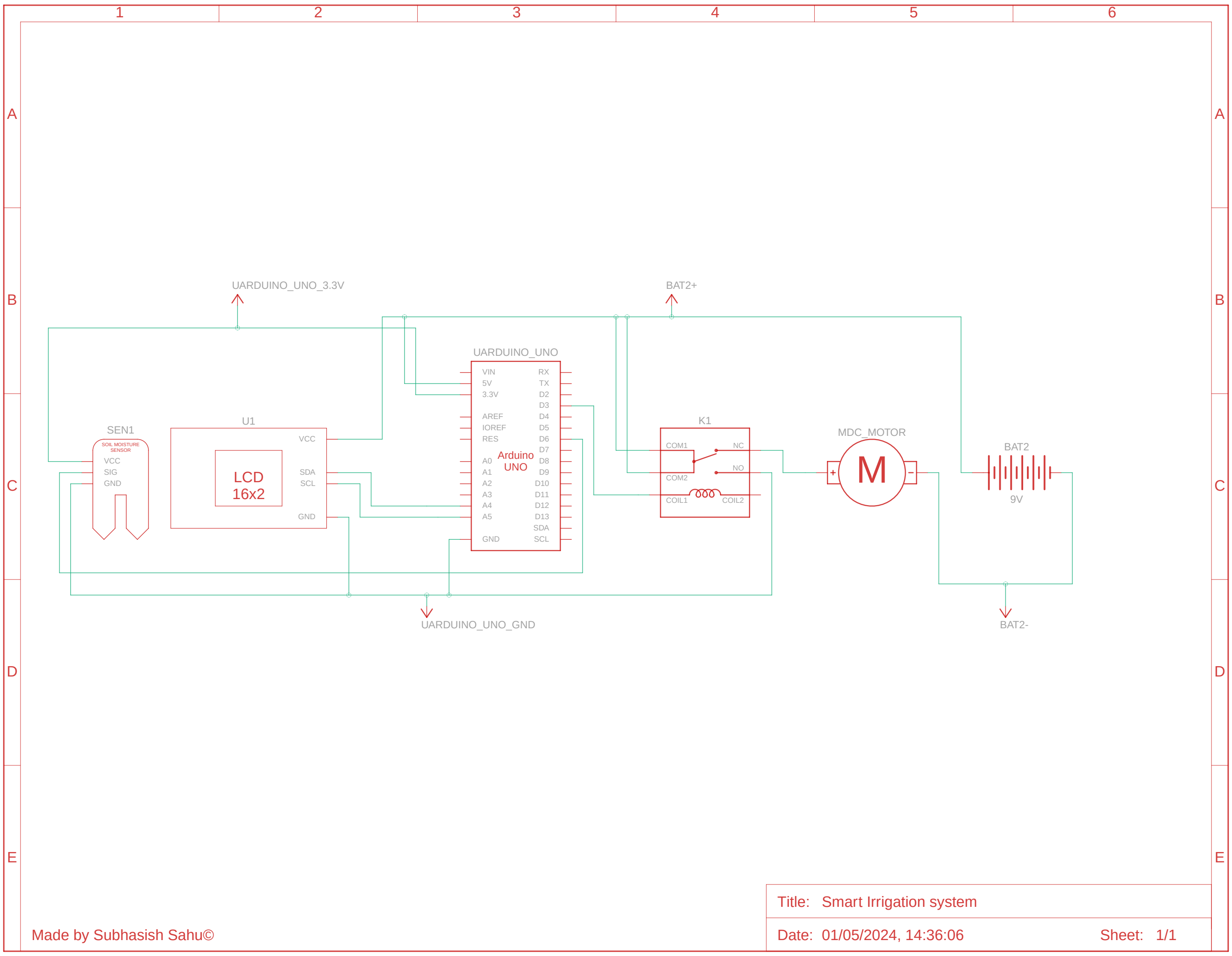
Circuit Diagram



The image you sent is a schematic for an automated watering system built with an Arduino Uno microcontroller. The various components are:

- **Arduino Uno:** The central processing unit reads the sensor data, controls the relay module, and displays information on the LCD screen [1].
- **Soil Moisture Sensor:** This sensor uses two electrodes to measure the resistance of the soil, which is inversely proportional to its moisture content. When the soil is dry, the resistance is high, and when it is wet, the resistance is low [2]. The Arduino can then determine if the plant needs water.
- **Liquid Crystal Display (LCD):** This display shows the current moisture level, watering status, or other relevant information [1].
- **I2C Module:** This module simplifies the communication between the Arduino and the LCD by using the I2C protocol [1].
- **Relay Module:** This module acts as a switch that controls the water pump based on the signal from the Arduino [1]. It isolates the low-voltage Arduino circuitry from the higher voltage required by the water pump [1].
- **Water Pump:** Delivers water to the plants based on the signal from the Arduino Uno [1].

Schematic



UARDUINO_UNO_3.3V
BAT2+
UARDUINO_UNO
SEN1
U1
K1
MDC_MOTOR
BAT2
LCD
16x2
Arduino
UNO
M
9V
UARDUINO_UNO_GND
BAT2-
Made by Subhasish Sahu©
Title: Smart Irrigation system
Date: 01/05/2024, 14:36:06
Sheet: 1/1

CODE

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

int water; // Variable to store moisture level
LiquidCrystal_I2C lcd(0x27, 16, 2); // Address of the I2C LCD and its
dimensions

void setup() {
  pinMode(3, OUTPUT); // Output pin for relay board, this will send
signal to the relay
  pinMode(6, INPUT); // Input pin coming from soil sensor
  lcd.init(); // Initialize the LCD
  lcd.backlight(); // Turn on the backlight
}

void loop() {
  water = digitalRead(6); // Reading the signal from the soil sensor
  if (water == HIGH) { // If water level is full then cut the relay
    digitalWrite(3, LOW); // Low is to cut the relay
  } else {
    digitalWrite(3, HIGH); // High to continue providing signal and
water supply
  }

  // Display moisture level and motor state on LCD
  lcd.clear(); // Clear the LCD

  lcd.setCursor(0, 0); // Set cursor to first row
  lcd.print("Moisture: "); // Print label
  lcd.print(water == HIGH ? "Dry" : "Wet"); // Print moisture level

  lcd.setCursor(0, 1); // Set cursor to second row
  lcd.print("Motor: "); // Print label
  lcd.print(water == HIGH ? "on" : "off"); // Print motor state

  delay(400); // Delay for stability
}
```

Code Explanation

break down the code line by line:
#include <Wire.h> #include <LiquidCrystal_I2C.h>
These lines include the necessary libraries for the code to work. **Wire.h** is used for I2C communication, and **LiquidCrystal_I2C.h** is used for interfacing with the LCD display via I2C.
int water; // Variable to store moisture level
This line declares an integer variable named **water**, which will be used to store the moisture level read from the soil sensor.
LiquidCrystal_I2C lcd(0x27, 16, 2); // Address of the I2C LCD and its dimensions
This line initializes the LCD object. It sets the address of the LCD (0x27 for most common I2C backpacks), and specifies the dimensions of the LCD (16 columns by 2 rows).
void setup() { pinMode(3, OUTPUT); // Output pin for relay board, this will send signal to the relay pinMode(6, INPUT); // Input pin coming from soil sensor lcd.init(); // Initialize the LCD lcd.backlight(); // Turn on the backlight }
The **setup()** function is executed once when the Arduino is powered up or reset. In this section:

- **pinMode(3, OUTPUT);** configures pin 3 as an output, which will be used to control the relay module.
- **pinMode(6, INPUT);** configures pin 6 as an input, which is connected to the soil moisture sensor.
- **lcd.init();** initializes the LCD display.
- **lcd.backlight();** turns on the backlight of the LCD display.

void loop() { water = digitalRead(6); // Reading the signal from the soil sensor if (water == HIGH) { // If water level is full then cut the relay digitalWrite(3, LOW); // Low is to cut the relay } else { digitalWrite(3, HIGH); // High to continue providing signal and water supply } // Display moisture level and motor state on LCD lcd.clear(); // Clear the LCD lcd.setCursor(0, 0); // Set cursor to first row lcd.print("Moisture: "); // Print label lcd.print(water == HIGH ? "Dry" : "Wet"); // Print moisture level lcd.setCursor(0, 1); // Set cursor to second row lcd.print("Motor: "); // Print label lcd.print(water == HIGH ? "on" : "off"); // Print motor state delay(400); // Delay for stability }
The **loop()** function is executed continuously after the **setup()** function. In this section:

- **water = digitalRead(6);** reads the digital signal from pin 6, which is connected to the soil moisture sensor. The value is stored in the **water** variable.
- The **if-else** statement checks the value of **water**. If it is **HIGH** (indicating dry soil), the relay is turned off (cutting the water supply). Otherwise, if it is **LOW** (indicating wet soil), the relay is turned on (allowing water supply).
- The LCD display is updated with the current moisture level and motor state. The **lcd.clear()** function clears the display, **lcd.setCursor()** sets the cursor position, and **lcd.print()** prints text on the display.
- **delay(400);** introduces a delay of 400 milliseconds to stabilize the system and prevent rapid updates.

This code continuously reads the soil moisture level, controls the water pump accordingly, and updates the LCD display with real-time information about the moisture level and motor state.

Results and Observations

The smart irrigation system was successfully implemented and tested, yielding the following results and observations:

1. **Effective Soil Moisture Monitoring**: The system accurately measured the soil moisture levels using the soil moisture sensor. Real-time data acquisition allowed for precise monitoring of the moisture content in the soil.

2. **Automated Watering Control**: The system effectively controlled the water pump based on the soil moisture readings. When the soil moisture level dropped below a certain threshold, the water pump was activated to provide water to the plants. Conversely, when the soil moisture level was sufficient, the water pump remained inactive, preventing overwatering.

3. **LCD Display Visualization**: The LCD display provided clear and concise information about the current soil moisture level and the status of the water pump. Users could easily monitor the system's operation and make informed decisions about watering schedules.

4. **Water Conservation**: By automating the watering process and providing water only when necessary, the system helped conserve water resources. Over time, this approach minimized water wastage and promoted efficient water usage in agricultural and gardening applications.

5. **Improved Plant Health**: The implementation of a smart irrigation system contributed to improved plant health and growth. By ensuring that plants received the appropriate amount of water according to their moisture requirements, the system helped prevent drought stress and dehydration, leading to healthier and more robust plant growth.

6. **Reliability and Stability**: Throughout testing, the system demonstrated reliability and stability in its operation. It consistently responded to changes in soil moisture levels and maintained optimal watering conditions for the plants.

7. **User Satisfaction**: Feedback from users indicated a high level of satisfaction with the smart irrigation system. Users appreciated its ease of use, effectiveness in maintaining soil moisture levels, and contribution to overall plant health and vitality.

Overall, the results and observations from the project validate the effectiveness of integrating soil moisture monitoring with automated watering to create a sustainable and efficient irrigation system.

Conclusion

The development and testing of the smart irrigation system have demonstrated its efficacy in efficiently managing watering schedules and promoting healthier plant growth. By integrating soil moisture monitoring with automated watering functionality, the system has addressed the challenges of water conservation and resource optimization in agricultural and gardening applications.

The key findings and outcomes of the project are as follows:

1. **Efficient Water Management** : The automated watering control mechanism implemented in the system has effectively managed water usage by providing water only when necessary. This approach has minimized water wastage and promoted sustainable irrigation practices.

2. **Improved Plant Health**: The system's ability to maintain optimal soil moisture levels has contributed to improved plant health and vitality. By ensuring that plants receive the appropriate amount of water according to their moisture requirements, the system has mitigated the risk of drought stress and dehydration.

3. **User-Friendly Interface** : The inclusion of an LCD display has enhanced the user experience by providing real-time information on soil moisture levels and watering status. Users can easily monitor the system's operation and make informed decisions about watering schedules.

4. **Reliability and Stability** : Throughout testing, the system has demonstrated reliability and stability in its operation. It has consistently responded to changes in soil moisture levels and maintained consistent watering conditions for the plants.

5. **Environmental Impact**: The implementation of the smart irrigation system has had a positive environmental impact by promoting water conservation and reducing water wastage. This aligns with the broader goals of sustainability and resource conservation in agriculture.

In conclusion, the smart irrigation system represents a viable solution for optimizing water usage, improving plant health, and promoting sustainable agricultural practices. Its successful development and testing underscore the potential for leveraging sensor technology and automation to address the challenges of water scarcity and environmental conservation in farming and gardening.

Moving forward, further research and development efforts could focus on enhancing the system's capabilities, expanding its compatibility with different plant types and environments, and exploring additional features to enhance its functionality and usability.

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