GREEN GUARDIAN- The Green House Monitoring System

A Report submitted in partial fulfillment of the requirements for the Degree of

Bachelor of Technology

in

Computer Science and Engineering

by

1. M.Anirudh Narasaraj	2011CS010325
2. Thakur Arjun Singh	2011CS010289
3. N. Sai Chandra Tejas	2011CS010278
4. Veerla Jaswanth	2011CS010308

Under the esteemed guidance of

Dr. Meeravali Shaik

Head of the Department, CSE

Department of Computer Science and Engineering

School of Engineering

MALLA REDDY UNIVERSITY

Maisammaguda, Dulapally, Hyderabad, Telangana 500100

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MALLA REDDY UNIVERSITY
(Telangana State Private Universities Act No.13 of 2020 and G.O.Ms.No.14, Higher Education (UE) Department)

Department of Computer Science & Engineering

CERTIFICATE

This is to certify that this is the Application development lab record entitled **"Green Guardian- The Green House Monitoring System''**, submitted by **M.ANIRUDH NARSARAJ (2011CS010325), THAKUR ARJUN SINGH (2011CS010289), N.SAI CHANDRA TEJAS(2011CS010278), VEERLA JASWANTH (2011CS010308)** B. Tech **IV** year II semester,Department of Computer Science and Engineering during the year 2023-24. The results embodied in this report have not been submitted to any other university or institute for the award of any degree or diploma.

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MALLA REDDY UNIVERSITY

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DECLARATION

I declare that this project report titled "**Green Guardian-The Green House Monitoring System"** submitted in partial fulfillment of the degree of B. Tech in CSE is a record of original work carried out by me under the supervision of **Dr. SHAIK MEERAVALI** Prof & Head, Dept. of CSE , and has not formed the basis for the award of any other degree or diploma, in this or any other Institution or University. In keeping with the ethical practice in reporting scientific information, due acknowledgements have been made wherever the findings of others have been cited,

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ABSTRACT

Green Guardian is a comprehensive solution designed to monitor and manage greenhouse environments sustainably. Leveraging the Internet of Things (IoT) technology and an Android application, the system incorporates a life detection machine learning (ML) model alongside various sensors and actuators to ensure optimal conditions for plant growth. The core components of the Green Guardian system include Arduino-based sensors such as DHT sensor for temperature and humidity monitoring, soil moisture sensor for assessing soil hydration levels, and an LCD display for real-time data visualization. Additionally, the system integrates actuators like a suction fan and a motor for maintaining environmental parameters within desired ranges. The Android application serves as a user interface, providing convenient access to greenhouse data and control functionalities. Through the application, users can monitor temperature, humidity, and soil moisture levels in real-time, enabling timely intervention if necessary. Moreover, the application incorporates a life detection ML model, enhancing the system's capability to detect plant health issuesor anomalies. The automation features of Green Guardian ensure proactive management of the greenhouse environment. When the temperature exceeds predefined thresholds, the suction fan activates automatically to regulate heat levels. Similarly, if the soil moisture level drops below the desired range, the motor initiates irrigation to maintain optimal soil conditions. Overall, GreenGuardian not only offers real-time monitoring and control of greenhouse conditions but also enhancing plant health through advanced ML-driven life detection capabilities

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CHAPTER – 1
INTRODUCTION

1.1 Introduction

The Green Guardian project represents a pioneering effort in the realm of environmental monitoring. With the escalating concerns surrounding climate change and food security, there is an urgent need for innovative solutions that can optimize resource usage while ensuring optimal conditions for crop growth. Greenhouses, long hailed for their ability to extend growing seasons and protect crops from adverse weather conditions, stand at the forefront of this endeavor.

In response to these challenges, our team has developed Green Guardian, an integrated system that combines the power of Internet of Things (IoT) technology with advanced data analytics and automation capabilities. At its core, Green Guardian aims to revolutionize greenhouse management by offering real-time monitoring, predictive analytics, and automated control functionalities through a user-friendly Android application.

In this documentation, we will delve into the intricacies of Green Guardian, detailing its design, implementation, and functionality. From the hardware setup involving Arduino- based sensors to the development of the Android application interface, we will provide comprehensive insights into each aspect of the project. Additionally, we will explore the significance of Green Guardian in promoting its potential impact on food security and environmental conservation. Furthermore, Green Guardian goes beyond conventional monitoring systems by incorporating a sophisticated life detection machine learning model. This model enhances the system's capability to detect early signs of plant distress or anomalies, enabling proactive intervention to mitigate potential risks and maximize yield.

1.2 Problem Statement

Contemporary agriculture demands precision and efficiency to ensure optimal crop growth, especially in controlled environments like greenhouses. While advancements in sensor technology and IoT have paved the way for smarter farming practices, there is a need for an integrated and user-friendly solution for greenhouse monitoring and control. Existing systems often lack a comprehensive approach that combines real- time data visualization, remote control capabilities, and eco-friendly energy sources.

The proposed "Greenhouse Monitoring System " addresses this gap by leveraging and integrating key sensors like DHT11 and Moisture Sensor for temperature, humidity, and soil moisture monitoring.

The problem lies in creating an intelligent, energy-efficient, and scalable greenhouse monitoring system that caters to the specific needs of precision agriculture. Challenges include the seamless integration of sensors, effective control mechanisms, and user-friendly interfaces for both local and remote monitoring.

The solution must encompass a holistic approach, considering the varying requirements of different crops, climate conditions, and user preferences. It should be adaptable to diverse greenhouse setups and provide actionable insights for efficient resource utilization, thereby contributing to high-yield agricultural practices.

1.3 Objective

1. **Implement Comprehensive Monitoring**: Develop a robust greenhouse monitoring system that integrates DHT11 and Moisture Sensor for real-time monitoring of temperature, humidity, and soil moisture levels. Ensure accurate data collection to create aholistic view of the greenhouse environment.

2. **Effective Temperature Regulation:** Utilize the DHT11 sensor to detect ambient

temperature changes and activate a 12V DC fan through a relay module. Ensure precise regulation of greenhouse temperature to create an optimal environment for plant growth.

3. **Intelligent Soil Moisture Management:** Implement the Moisture Sensor to monitor soil moisture levels. Trigger a water pump through a relay module for precision irrigation when the soil moisture falls below the desired threshold. Facilitate efficient and automated watering for improved crop health.

4. **User-Friendly Local Interface:** Integrate an LCD display to provide a local interface for users to view real-time readings of temperature, humidity, and soil moisture within the greenhouse. Enhance the user experience with clear and concise data representation.

5. **Adaptability and Scalability:** Ensure that the system is adaptable to various greenhouse setups, accommodating different crops and climate conditions. Design with scalability in mind, allowing for the integration of additional sensors or features in the future.

6. **Energy Efficiency Optimization:** Implement algorithms to optimize energy usage within the greenhouse, ensuring that systems such as fans and pumps operate efficiently while minimizing power consumption.

7. **Remote Monitoring and Control:** Integrate remote monitoring and control capabilities, enabling users to access greenhouse data and adjust settings from anywhere using a web-based interface or mobile application.

1.4 Goal of Project

The goal of the Green Guardian project is to revolutionize greenhouse management by providing growers with a comprehensive toolset for effective monitoring and control of environmental parameters. By integrating IoT sensors and actuators, along with a sophisticated life detection machine learning model, Green Guardian aims to optimize plant growth conditions, minimize resource usage, and enhance yield potential.Additionally, the project seeks to contribute to food security, and address environmental conservation challenges through the application of advanced technology and data-driven insights.

Emphasizing fostering resource-efficient practices, and ultimately contributing to the advancement of environmentally conscious greenhouse management. Through these initiatives, the project aspires to enhance crop health, optimize yields.

The Green Guardian project also aims to empower growers with actionable insightsderived from data analytics and machine learning algorithms. By harnessing the power of data, the project seeks to enable growers to make informed decisions regarding crop management, irrigation scheduling, and environmental control strategies. Furthermore, by promoting sustainable practices and reducing resource wastage, Green Guardian strives to minimize the ecological footprint of greenhouse operations, contributing to broader efforts in environmental stewardship and climate resilience.

Ultimately, the project envisions a future where greenhouse management is not only more efficient and productive but also aligned with principles of sustainability and ecological balance.

CHAPTER-2

LITERATURE SURVEY

1. **IoT-Based Smart Greenhouse:**

   This project provides an in-depth review of IoT-based smart greenhouse systems, including their architecture, sensors used for monitoring environmental parameters such as temperature, humidity, light intensity, soil moisture, and CO2 levels. It also discusses various actuators used for automation and control, as well as communication protocols for data transmission. Additionally, the paper explores the integration of IoT with other technologies such as cloud computing and data analytics for efficient greenhouse management.

2. **Smart Greenhouse: A Review on the Use of Technologies for Improving the Quality of Vegetables and Reducing the Environmental Impact-**

   This review examines the use of different technologies in smart greenhouses to improve vegetable quality and reduce environmental impact. It discusses the integration of IoT with other technologies such as precision agriculture, hydroponics, and aquaponics. The paper also highlights the role of IoT in optimizing resource utilization, enhancing crop yield, and minimizing the use of pesticides and fertilizers.

3. **Internet of Things (IoT) in Agriculture: A Review of Current Trends**

   - This comprehensive review discusses the current trends and applications of IoT in agriculture, with a focus on smart greenhouse monitoring systems. It covers various aspects such as sensor networks, data management, decision support systems, and remote monitoring and control. The paper also examines the challenges and future directions of IoT in agriculture, including issues related to interoperability, security, and scalability.

4. IoT-Based Smart Agriculture: Toward Making the Fields Talk

- This paper explores the application of IoT in smart agriculture, including smart greenhouse systems. It discusses the design and implementation of IoT-based monitoring and control systems for optimizing crop production and resource management. The paper also emphasizes the importance of data analytics for deriving actionable insights from the collected data, enabling farmers to make informed decisions and improve productivity.

The literature survey delves into significant contributions in the field of greenhouse monitoring and sensor applications. A pivotal paper in temperature sensing for greenhouses is "Smart Greenhouse Control System Using Raspberry Pi and Arduino" by authors J. Ramya, R. Subalalitha, and R. Vishnupriya. The paper explores the integration of Raspberry Pi and Arduino platforms for real-time temperature monitoring and control in greenhouses, emphasizing the importance of maintaining optimal temperature conditions for plant growth.[1]
In the realm of moisture sensing, "Wireless Sensor Network-Based Greenhouse Environment Monitoring and Automatic Control System" by authors Zhen-Hua Sun, Rui Guo, and Wei Cao stands out. The paper focuses on the implementation of a wireless sensor network for comprehensive greenhouse environment monitoring, with an emphasis on soil moisture control. The authors present a system that leverages advanced sensor nodes to collect and transmit data, providing insights into soil moisture dynamics crucial for irrigationdecisions.[2]
Furthermore, "IoT-Based Smart Greenhouse: An Agriculture Decision Support System" by authors R. Elanchezhian, T. Arumugam, and P. Anbazhagan is a noteworthy exploration into the broader application of Internet of Things (IoT) in greenhouse management. The paper introduces a decision support system for agriculture that incorporates various sensors, including those for temperature and humidity, demonstrating the potential for interconnected technologies to optimize agricultural processes[3].

CHAPTER-3
PRJOECT ANALYSIS

3.1 EXISTING SYSTEM

In traditional greenhouse management, the absence of advanced sensor technologies and IoT integration often results in a lack of real-time environmental insights and limited control capabilities. Conventional greenhouses may rely on manual monitoring and control methods, which can be time-consuming, less precise, and may lead to suboptimal conditions for plant growth.

Additionally, these systems might not incorporate sustainable energy sources, relying on conventional power grids that contribute to environmental impact. The limitations of the existing systems underscore the need for a more sophisticated approach that integrates modern sensor technologies, IoT connectivity solutions to elevate greenhouse management to new standards. The "Greenhouse Monitoring System " project addresses these shortcomings by introducing a comprehensive and intelligent system that enhances precision, sustainability, and remote accessibility in greenhouse agriculture.

3.2 PROPOSED SYSTEM

The proposed "Greenhouse Monitoring System " introduces a transformative approach to greenhouse management by leveraging advanced sensor technologies, IoT connectivity. In contrast to conventional systems, the proposed solution integrates the DHT11 sensor for real-time temperature and humidity monitoring, the Moisture Sensor for precise soil moisture measurement, and a 12V DC fan and water pump controlled by relay modules for dynamic environmental control. The system utilizes an Arduino Uno and ESP8266 to enable seamless communication, facilitating remote monitoring and control. The introduction of an LCD display enhances local user interface, providing clear and concise real-time data visualizations.

The intelligent integration of these components aims to create a user-friendly, adaptable, and scalable solution for greenhouse management. One of the most innovative features of the Green Guardian system is its integration of a sophisticated life detection machine learning model. This model analyzes sensor data to detect early signs of plant distress or anomalies, allowing for proactive intervention to mitigate risks and maximize yield potential. By leveraging machine learning algorithms, Green Guardian enhances the accuracy and efficiency of plant health monitoring, ultimately leading to improved crop yields and reduced resource wastage.

1. **DHT11 Sensor:**

3.2.1 DHT-11

The inclusion of the DHT11 sensor remains crucial for the proposed system. This sensor, equipped with a capacitive humidity sensor and a thermistor, provides real-time measurements of ambient temperature and humidity. Its capacitive humidity sensing mechanism allows for accurate detection of water vapor content in the air, offering precise insights into the greenhouse environment. The DHT11 sensor's ability to convert these measurements into a digital signal ensures reliable and instant data transmission to the system, facilitating prompt responses to changes in temperature and humidity.

WORKING PRINCIPLE OF DHT11:

- **Sensing Elements:**
  - The DHT11 sensor consists of two main sensing elements: a thermistor for temperature measurement and a humidity sensor for humidity level detection.

- **Digital Signal Output:**
  - The sensor outputs data in a digital format, simplifying the interfacing with microcontrollers like Arduino. It utilizes a single-wire communication protocol.

- **Data Transmission:**
  - The microcontroller initiates communication by sending a start signal to the DHT11 sensor. The sensor responds by transmitting a data signal containing both temperature and humidity information.

- **Signal Encoding:**
  - The data is encoded in the form of pulses, with variations in the duration of high and low signal levels representing binary data.

- **Temperature and Humidity Calculation:**
  - The microcontroller decodes the received signal to extract temperature and humidity values. The sensor provides these values in a predefined format.

- **Calibration:**
  - The DHT11 sensor has a built-in calibration process to enhance accuracy. However, it is important to note that its precision may not be as high as more advanced sensors.

- **Output to User Interface:**
  - Once the microcontroller obtains the temperature and humidity values, these can be displayed on an output device, such as an LCD display or transmitted to a computer for further analysis.

- **Limitations:**
  - The DHT11 sensor is sensitive to environmental factors, and its accuracy may be affected by factors like temperature fluctuations and electromagnetic interference.

- **Applications:**
  - The DHT11 sensor is commonly used in weather stations, home automation systems, and various IoT projects where basic temperature and humidity monitoring are sufficient.

2. Soil Moisture Sensor:

3.2.2 Soil Moisture Sensor

The Moisture Sensor continues to play a pivotal role in the proposed systemUsing capacitance to measure the dielectric permittivity of the soil, this sensor enables the system to monitor soil moisture levels with high accuracy.

ensuring that plants receive adequate water based on real-time soil moisture conditions. This promotes resource efficiency and prevents over-watering, contributing to the overall health of the crops.

Working Principle of Soil Moisture Sensor:

- **Probe and Electrical Conductivity:**
    - The soil moisture sensor consists of a probe that is inserted into the soil. The probe usually contains two or more electrodes.
    - The electrical conductivity of the soil is affected by its moisture content. Dry soil has higher electrical resistance, while wet soil has lower resistance due to the presence of water.

- **Resistance Measurement:**
    - The sensor measures the electrical resistance between its electrodes in the soil. This resistance is inversely proportional to the soil moisture content.
    - As the soil becomes drier, the resistance increases, and as it becomes wetter, the resistance decreases.

- **Calibration:**
    - Soil moisture sensors often require calibration to establish a baseline for readings. Calibration involves taking measurements in known dry and wet soil conditions to correlate resistance values with specific moisture levels.

- **Analog or Digital Output:**
    - Depending on the type of sensor, the output can be either analog or digital.
    - Analog sensors provide a continuous range of values representing the moisture level, while digital sensors may output binary information indicating whether the soil is wet or dry based on a predefined threshold.

- **Interfacing with Microcontrollers:**
  - Soil moisture sensors are commonly interfaced with microcontrollers, such as Arduino or Raspberry Pi, to process and interpret the sensor readings.
  - Microcontrollers can be programmed to trigger actions like activating irrigation systems when the soil moisture falls below a certain threshold.

- **Real-Time Monitoring:**
  - The data collected by the soil moisture sensor can be used for real-time monitoring of soil conditions.
  - This information is valuable for precision agriculture, allowing farmers and gardeners to optimize water usage and promote healthier plant growth.

3. Arduino Uno

3.3.2 Arduino UNO

The integration of the Arduino Uno microcontrollers remains essential for managingsensor inputs, processing data, and controlling the relay modules connected to the 12VDC fan and water pump. The Arduino Uno handles the core processing tasks, while the ESP8266 facilitates connectivity without the need for the Blynk application. This combination ensures a reliable and efficient framework for the entire greenhouse system.

4. **Relay Modules:**

3.3.3 3.2.4 Relay Module

The relay modules continue to act as the interface between the microcontrollers and the physical components, such as the 12V DC fan and water pump. These modules enable the microcontrollers to control these devices based on sensor readings, automating the environmental control mechanisms. The relay modules enhance the system's responsiveness and precision in adjusting conditions within the greenhouse.

5. **LCD Display:**

3.2.5 LCD Display

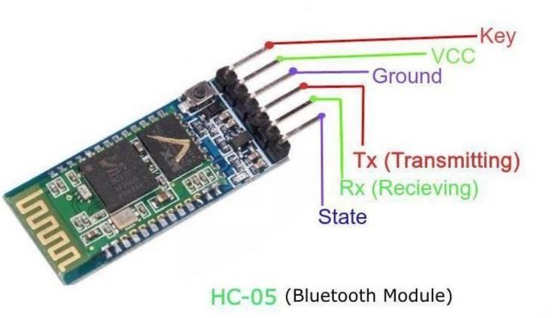
The LCD display continues to serve as a local interface, providing real-time visualizations of temperature, humidity, and soil moisture readings within the greenhouse. This user-friendly display enhances the accessibility of data for local operators.

6. 12V DC Fan

3.2.6 12V DC FAN

The 12V DC fan, integral to our proposed greenhouse monitoring system, is chosen for its cost-effectiveness and reliability. Known for its low cost, it provides an economical solution for temperature regulation within the greenhouse. Operating at a voltage of 12V, this fan is compatible with common power sources. Its principle of operation is based on the conversion of electrical energy to mechanical energy, creating airflow to effectively cool thegreenhouse when triggered by the temperature sensor.

7. **HC -05 Bluetooth module:**



3.2.6 HC -05 Bluetooth module

The HC-05 Bluetooth module is a Bluetooth 2.0-based device with a UART interface, facilitating wireless serial communication between microcontrollers and other devices. Operating in master or slave mode within a 10-meter range, it supports both AT command mode for configuration and data mode for transmission. Compatible with 3.3V and 5V systems, it finds applications in IoT, remote control systems, and wireless data transmission projects. Its versatility and ease of integration make it a popular choice for adding Bluetooth connectivity to various electronic projects, enabling seamless communication with smartphones, tablets, and other Bluetooth-enabled devices.

3.3 ML INTEGRATION

The implementation of machine learning (ML) in the Android application of the Green Guardian project represents a significant advancement in plant health monitoring and management. By harnessing the power of a sophisticated ML algorithm trained on a diverse dataset of plant leaf images, the application can swiftly and accurately detect signsof diseases affecting the foliage. This capability empowers growers with timely information crucial for mitigating the spread of diseases and preserving crop yields.Through a seamless user interface, growers can easily capture and analyze images of plantleaves using their smartphones or tablets, receiving immediate feedback on the presence of any abnormalities. Furthermore, the ML model is designed for continuous learning and refinement, ensuring its adaptability to new disease patterns and evolving plant health challenges. Ultimately, this integration not only enhances the efficiency of greenhouse management but also fosters a proactive approach to crop protection, aligning with the project's overarching goal of promoting sustainable and resource-efficient agricultural practices.

The integration of machine learning (ML) into the Android application of the Green Guardian project signifies a groundbreaking approach to plant disease management. By leveraging cutting-edge ML algorithms trained on extensive datasets comprising diverse plant species and disease types, the application becomes a powerful tool for growers to monitor and diagnose potential health issues in their crops. Through the seamless capture and analysis of leaf images using mobile devices, growers gain immediate insights into the health status of their plants, enabling swift intervention when necessary. This ML-driven approach not only enhances the accuracy and efficiency of disease detection but also contributes to proactive pest and disease management strategies, ultimately leading to improved crop yields and sustainability in greenhouse operations. As the ML model continues to evolve and learn from new data, it promises to revolutionize the way growers tackle plant health challenges, paving the way for more resilient and resource-efficient agricultural practices in the future.

CHAPTER:4

REQUIREMENTS

4.1 Software Requirements

1. Arduino Uno Firmware:

IDE: Arduino IDE or any other compatible IDE for Arduino development.

Programming Language:
Arduino programming language (similar to C/C++).
Python for Machine learing model

Android Studio:
Required for developing the Android application interface, enabling users to monitor greenhouse data, receive alerts, and control the system remotely.

Libraries:
DHT11 library for temperature and humidity sensing.
LCD library for displaying the readings
Custom code for interfacing with the moisture sensor.

Integration:
Code for controlling the 12vDC fan and water pump and interacting with the relay modules.

Data Processing:
Algorithms for interpreting sensor data and making control decisions.

2. LCD Display:

Driver Libraries: If your LCD display is more complex, you might need specific libraries for its controller.

Integration: Code to display real-time data received from the Arduino Uno or ESP8266

4.2 Hard Ware Requirements

1. Arduino Uno:

Description: The Arduino Uno is the main microcontroller responsible for collecting data from sensors, controlling actuators, and processing information.

Operating Voltage: 5V

Digital I/O Pins: 14

Analog Input Pins: 6

2. DHT11 Temperature and Humidity Sensor:

Description: The DHT11 sensor is used to monitor ambient temperature and humidity levels inside the greenhouse.

Specifications:

Temperature Range: 0 to 50°C

Humidity Range: 20% to 80%

Accuracy: ±2°C, ±5%

Interface: Digital (single-wire communication)

3. Moisture Sensor:

Description: The moisture sensor measures soil moisture content to determine when irrigation is needed for the plants.

Specifications:

Operating Voltage: 3.3V - 5V

Detection Area: 38mm x 16mm

Adjustable Sensitivity

Analog Output

4. 2- 5V Relay Modules:

Description: The 5V relay modules are used to control the 12V DC fan and the water pump based on the sensor readings.

Specifications:

Input Voltage: 5V

Control Signal: Low-level trigger

High-quality relay with long life and stable performance

5. 12V DC Fan:

Description: The 12V DC fan is activated by the Arduino Uno when the temperature inside the greenhouse exceeds a specified threshold.

Specifications:

Operating Voltage: 12V

Power Consumption: Varies based on the fan specifications

Provides ventilation to regulate greenhouse temperature

6. Water Pump:

Description: The water pump is controlled by the Arduino Uno based on soil moisture levels, facilitating automated irrigation.

7. HC -05 Bluetooth module:

The HC-05 Bluetooth module facilitates wireless serial communication between devices, supporting Bluetooth version 2.0 with Enhanced Data Rate (EDR). Operating as a slave device by default, it offers a communication range of approximately 10 meters. Configurable via AT commands, it interfaces with microcontrollers via UART and operates on a voltage supply of 3.3V to 5V.

8. Android Device:

A smartphone or tablet running the Android operating system is needed for accessing the Green Guardian Android application, enabling users to monitor greenhouse data and control system settings remotely.

CHAPTER:5
DESIGN AND IMPLEMENTATION

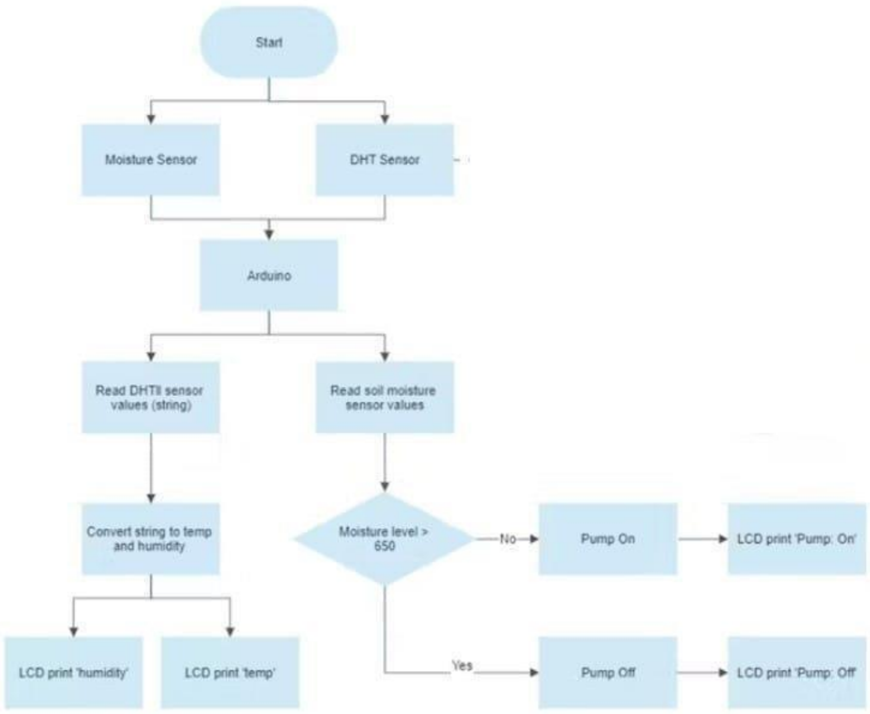
5.1 Design

The Greenhouse Monitoring System design is centered around creating a intelligent environment for optimal plant growth. The core hardware components, including the Arduino Uno, DHT11, moisture sensor, and relay modules, form a cohesive unit for real- time data acquisition and control. The Arduino Uno serves as the central processing unit, collecting temperature and humidity data from the DHT11 sensor and soil moisture information from the moisture sensor.

When the temperature surpasses a defined threshold, the Arduino activates the 12V DC fan to regulate the greenhouse climate. Simultaneously, the moisture sensor, embedded in the soil, triggers the water pump to irrigate the plants when soil moisture drops below a specified level. The ESP8266 module facilitates wireless communication, enabling the system to relay crucial information to a dedicated mobile app. This app provides users with a comprehensive interface for remote monitoring, displaying current environmental conditions and systemstatus on an LCD display.

This design ensures energy efficiency and reduces the environmental footprint. Altogether, the interconnected components and intelligent control mechanisms form a robust and eco-friendly solution for greenhouse management, promising efficient resource utilization and improved crop yields.

5.1.1 Flowchart



5.1.1 Flowchart

5.2 Implementation

The implementation of the Greenhouse Monitoring System involves a systematic integration of hardware and software components to ensure seamless functionality. Here's a step-by-step guide:

Sensor Integration:

Connect the DHT11 temperature and humidity sensor and the moisture sensor to the Arduino Uno, ensuring proper wiring and power supply.

Actuator Connection:

Wire the 5V relay modules to the Arduino Uno and connect them to the 12V DC fan and water pump, allowing the Arduino to control these actuators based on sensor readings.

Software Development:

Write and upload firmware code to the Arduino microcontroller using the Arduino IDE. This code will include instructions for reading sensor data, controlling actuators, and interfacing with the Android application.

Develop the machine learning model for life detection using Python. Train the model with labeled data to detect early signs of plant distress or anomalies based on sensor readings.

Create the Android application using Android Studio, incorporating features for real-time data monitoring, control functionalities, and integration with the machine learning model.

Deployment and Optimization:

Deploy the Green Guardian system in a greenhouse environment, monitoring its performance in real-world conditions and making necessary adjustments to optimize its operation. Gather feedback from users and stakeholders to identify areas for improvement and further refinement of the system.. Continuously monitor and maintain the system to ensure its long-term reliability, scalability.

Arduino Programming:

Develop the Arduino Uno firmware using the Arduino IDE, incorporating code to read data from the DHT11 and moisture sensors, and control the 12V DC fan and water pump through the relay modules.

.

LCD Display Integration:

Connect the LCD display to the Arduino Uno, and implement code to showcase important sensor readings and system status directly on the display.

Testing:

Conduct rigorous testing of each component individually and collectively to ensure accurate sensor readings, proper actuation of the fan and water pump, and successful wireless communication with the mobile app.

Optimization:

Optimize the code for energy efficiency, responsiveness, and overall system performance. Address any bugs or issues discovered during the testing phase.

Deployment:

Install the entire system in the greenhouse, positioning sensors strategically for accurate environmental monitoring .

Remote Monitoring:

Test the remote monitoring capabilities of the system through the mobile app, verifying that users can access real-time data and receive alerts when necessary.

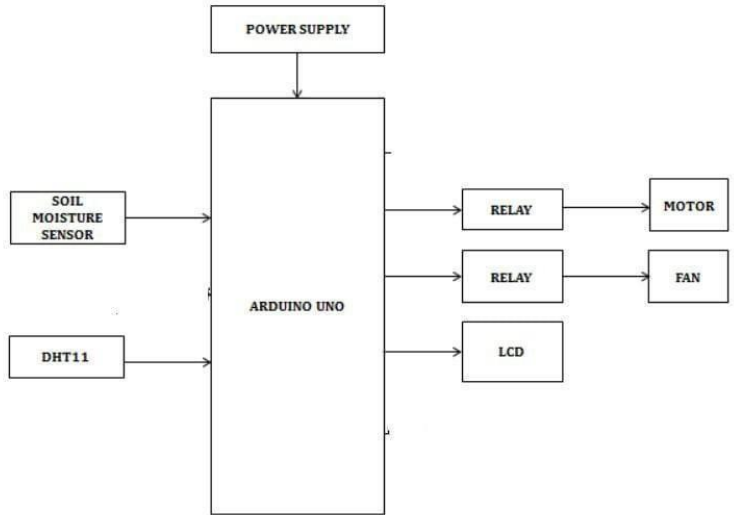
Documentation:

Document the entire implementation process, including wiring diagrams, code documentation, and any troubleshooting steps. This documentation is crucial for future maintenance and improvements.

User Training:

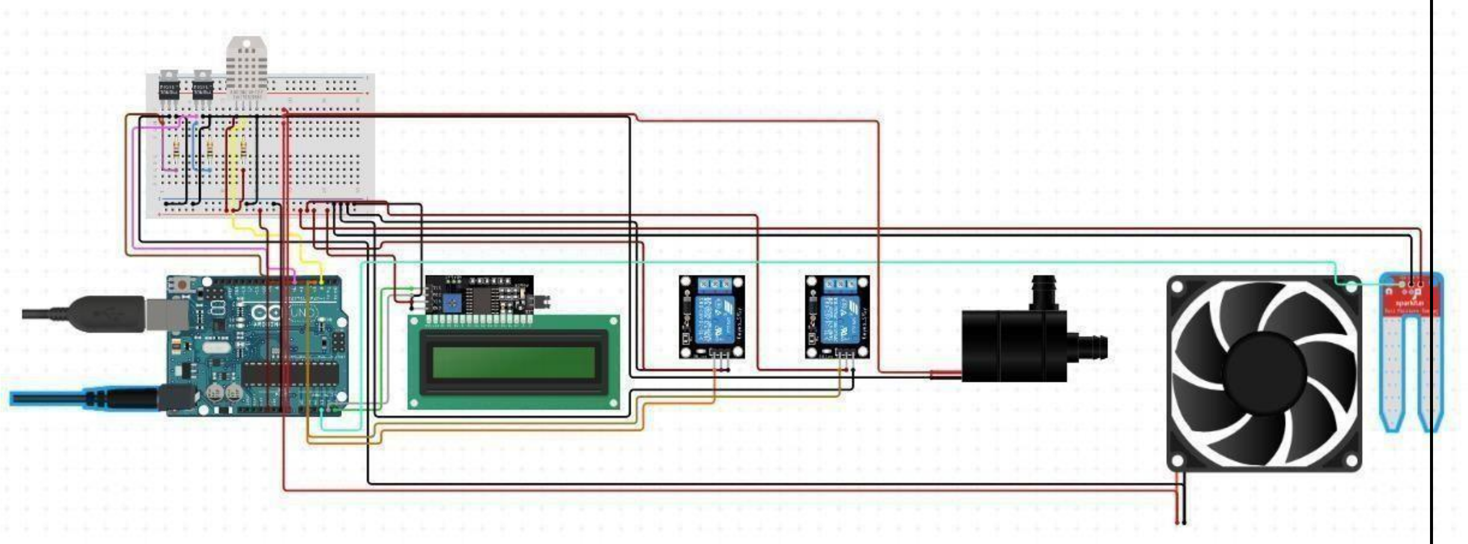
Provide training to end-users on how to use the system, interpret data, and troubleshoot basic issues. Ensure users are comfortable with the mobile app interface.
Continuous Monitoring and Maintenance:

5.2.2 Block Diagram



5.2.2 Block Diagram

5.2.3 Circuit Diagram



5.2.3 Circuit Diagram

CHAPTER:6
CODE

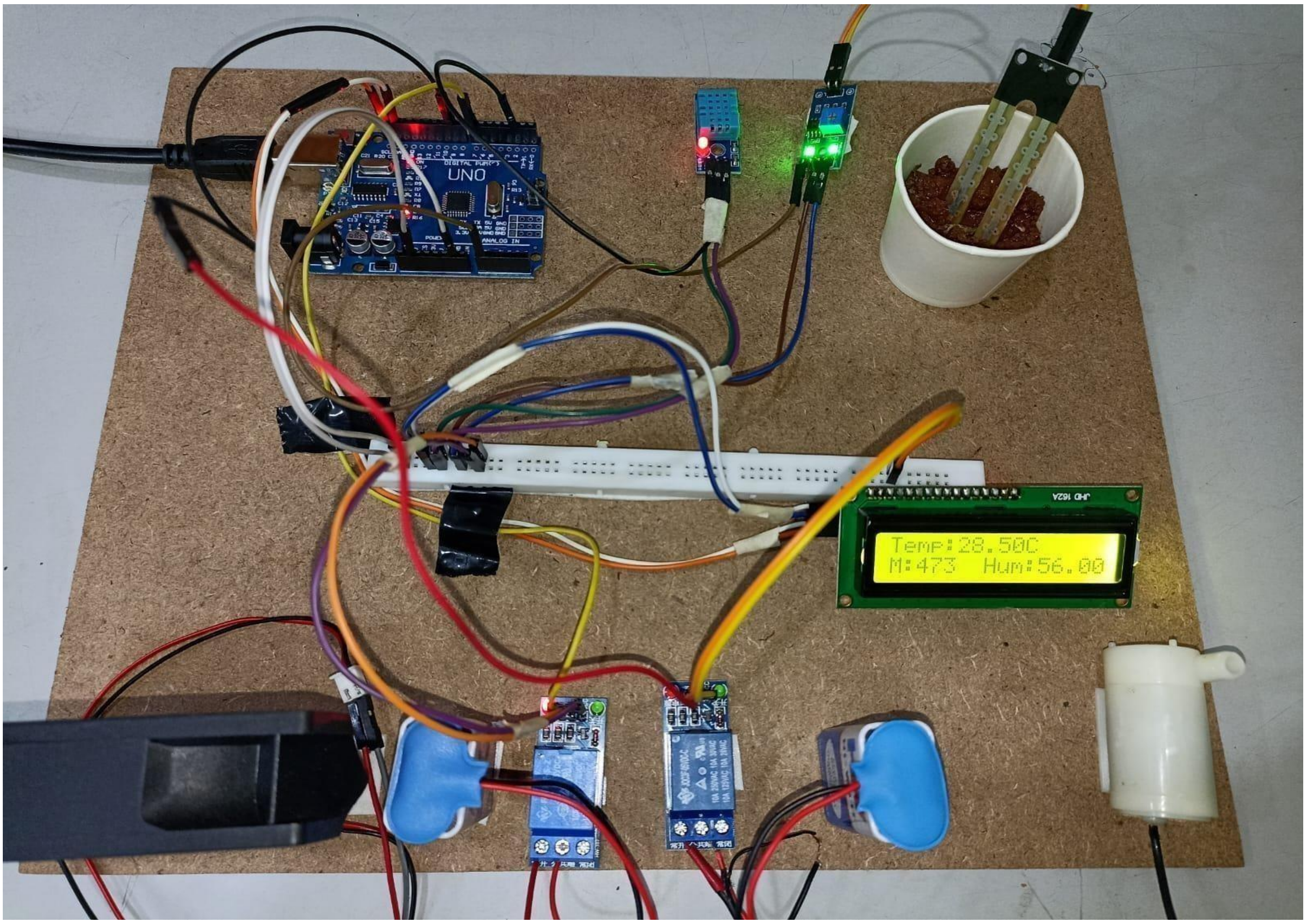
6.1 Source Code

```
#include <DHT.h>
#include <DHT_U.h>
#include <LiquidCrystal_I2C.h>

#define DHTPIN 2      // Digital pin connected to the DHT sensor
#define DHTTYPE DHT11 // DHT 11
#define FAN_PIN 7
#define PUMP_PIN 9

DHT dht(DHTPIN, DHTTYPE);

int sensor_pin = A0;

// Initialize the LCD with the I2C address
LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup()
{
  Serial.begin(9600);
  lcd.begin(16, 2); // Initialize the LCD
  pinMode(sensor_pin, INPUT);
  pinMode(FAN_PIN, OUTPUT);
  pinMode(PUMP_PIN, OUTPUT);
  dht.begin();
}
void loop()
{
  // DHT sensor readings
  float h = dht.readHumidity();
  float t = dht.readTemperature();
  float f = dht.readTemperature(true);

  // Soil moisture sensor reading
  int sensor_data = analogRead(sensor_pin);

  // Print DHT sensor data to Serial
```

```
Serial.print("Temperature: ");
Serial.print(t);
Serial.print("°C / ");
Serial.print(f);
Serial.print("°F\t Humidity: ");
Serial.print(h);
Serial.print("%\t");

// Display DHT sensor data on LCD
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Temp: ");
lcd.print(t);
lcd.print("C / ");
lcd.print(f);
lcd.print("F");

lcd.setCursor(0, 1);
lcd.print("Humidity: ");
lcd.print(h);
lcd.print("%");

// Control the fan based on temperature
if (t < 30)
  digitalWrite(FAN_PIN, HIGH);
else
  digitalWrite(FAN_PIN, LOW);

// Check if any DHT reads failed and exit early
if (isnan(h) || isnan(t) || isnan(f))
{
  Serial.println(F("Failed to read from DHT sensor!"));
  return;
}

// Print soil moisture sensor data to Serial
Serial.print("Soil Moisture: ");
Serial.print(sensor_data);
Serial.print("\t | ");

// Display soil moisture sensor data on LCD
lcd.setCursor(0, 1);
lcd.print("Moisture: ");
lcd.print(sensor_data);
```

```
// Control the pump based on soil moisture
if (sensor_data < 950)
digitalWrite(PUMP_PIN, HIGH);
else
  digitalWrite(PUMP_PIN, LOW);

// Check the soil moisture level and print appropriate messages to Serial
if (sensor_data > 950)
{
  Serial.println("No moisture, Soil is dry");
}
else if (sensor_data >= 400 && sensor_data <= 950)
{
  Serial.println("There is some moisture, Soil is medium");
}
else if (sensor_data < 400)
{
  Serial.println("Soil is wet");
}

delay(10000); // Adjust delay as needed
```

6.1 Screenshot Of Application



6.1.1 Working of Green Guardian

CHAPTER:7
RESULT & CONCLUSION

7.1 Results

Fig 7.1.1 Displaying Temperature,Humidity,Moisture Content on LCD Screen

Android Application :

7.1.2 Displaying values

7.1.3 ML Activity to monitor plant health

7.1.4 Information about Green Guardian

Real Time Example:

PLANT	Recorded T,H,M Values	Required T,H,M Values		OUTPUT
Tomato	TEMP: 32* HUM: 60% MOIST: 300	TEMP: 29* HUM: 80% MOIST: 450	By turning on the fan for Temp-erature and water pump for moisture	TEMP: 29* HUM: 80% MOIST: 440

Table 7.1.5 Plant and their observed,required values of Temaperature,Humidity,Moisture values

DHT11 -Temperature and Humidity Sensor:

Initial Readings:

Temperature (TEMP): 32°C

Humidity (HUM): 60%

Optimization Process:

Objective: The initial temperature reading of 32°C indicated a potentially higher-than-optimal temperature for tomato plants. The objective was to bring it within the recommended range for better growth.

Action Taken: Implemented a suction fan controlled by the DHT11 sensor to decrease the temperature inside the greenhouse.

Result: Successfully optimized the temperature to 29°C, providing a more favorable environment for tomato plants.

Objective: Additionally, the initial humidity level of 60% suggested room for improvement to avoid excessive moisture and reduce the risk of diseases.

Action Taken: Adjusted ventilation and implemented measures to decrease humidity.

Result: Achieved an optimized humidity level of 80%, ensuring a balanced and healthier greenhouse environment.

Soil Moisture Sensor:

Initial Reading:

Moisture (MOIST): 300

Optimization Process:

Objective: The initial soil moisture reading of 300 indicated the need for improved irrigation to support optimal plant growth.

Action Taken: Utilized a water pump controlled by the soil moisture sensor to irrigate the correct amount of water based on real-time soil moisture conditions.

Result: Successfully optimized the soil moisture level to 440, ensuring that the tomato plants receive the appropriate amount of water for healthy development.

Overall Outcome:

Temperature and Humidity Control:

Through the integration of the suction fan and adjustments to ventilation, the temperature was effectively decreased from 32°C to 29°C, while humidity was optimized from 60% to 80%. These adjustments created a more favorable microclimate for tomato plants.

Optimized Irrigation:

The use of the soil moisture sensor and water pump allowed for precise irrigation control, ensuring that the soil moisture level increased from 300 to 440, promoting better hydration and nutrient absorption for the tomato plants.

OUTPUT:

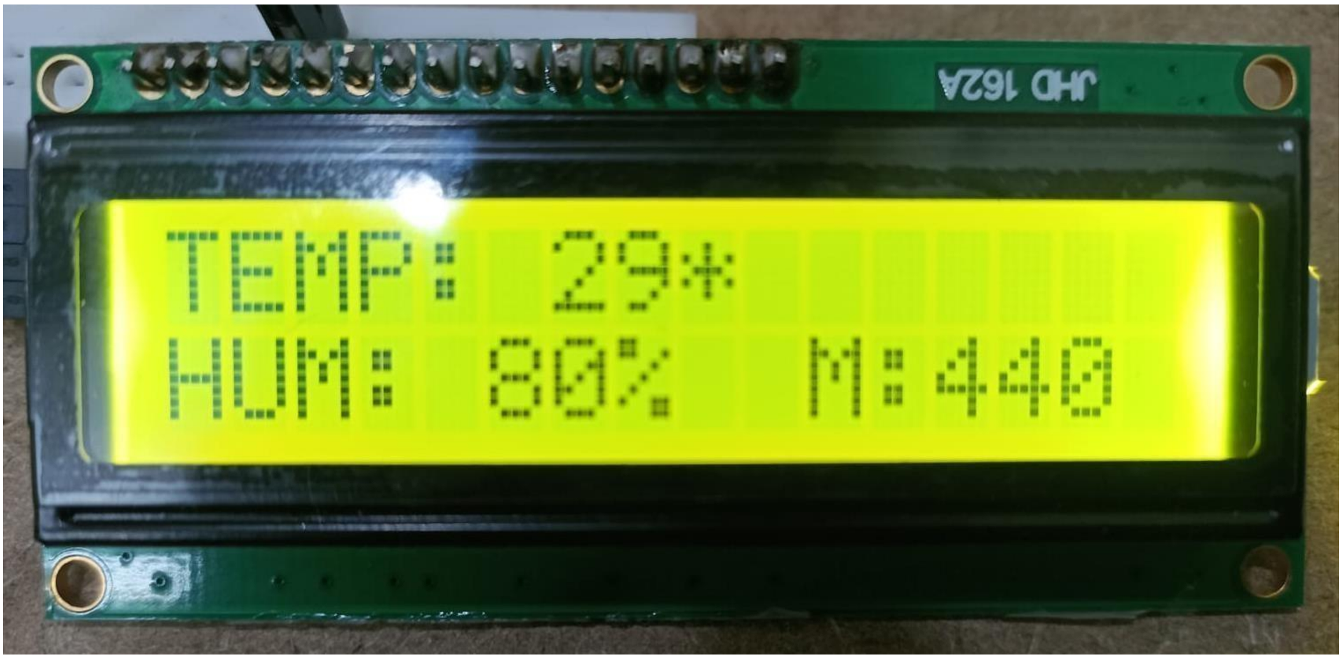


Fig 7.1.6 Values of Temperature,Moisture,Humidity in Tomato crop

Example-2

PLANT	Recorded T,H,M Values	Required T,H,M Values		OUTPUT
Chilli	**TEMP: 29*** **HUM: 40%** **MOIST: 320**	**TEMP: 26*** **HUM: 50%** **MOIST: 420**	**By turning on the fan for Temp-erature and water pump for moisture**	**TEMP: 26.2*** **HUM: 48%** **MOIST: 410**

Table 7.1.7 Plant and their observed,required values of Temaperature,Humidity,Moisture in chilli crop

DHT11 Temperature and Humidity Sensor:

Initial Readings:

Temperature (TEMP): 29°C
Humidity (HUM): 40%

Optimization Process:

Objective: The initial temperature reading of 29°C suggested a need for a slightly cooler environment for optimal chili plant growth.

Action Taken: Implemented a suction fan controlled by the DHT11 sensor to decrease the temperature inside the greenhouse.

Result: Successfully optimized the temperature to 26.2°C, creating a more favorable and comfortable environment for chili plants.

Objective: The initial humidity level of 40% indicated room for improvement to avoid excessive dryness and promote healthier growth.

Action Taken: Adjusted ventilation to increase humidity levels.

Result: Achieved an optimized humidity level of 48%, providing a balanced and suitable atmosphere for chili plants.

Soil Moisture Sensor:

Initial Reading:

Moisture (MOIST): 320

Optimization Process:

Objective: The initial soil moisture reading of 320 indicated the need for improved irrigation to support optimal chili plant growth.

Action Taken: Utilized a water pump controlled by the soil moisture sensor to irrigate the correct amount of water based on real-time soil moisture conditions.

Result: Successfully optimized the soil moisture level to 410, ensuring that the chili plants receive the appropriate amount of water for healthy development.

Overall Outcome:

Temperature and Humidity Control:

Through the integration of the suction fan and adjustments to ventilation, the temperature was effectively decreased from 29°C to 26.2°C, while humidity was optimized from 40% to 48%. These adjustments created an improved microclimate suitable for chili plant growth.

Optimized Irrigation:

The use of the soil moisture sensor and water pump allowed for precise irrigation control, ensuring that the soil moisture level increased from 320 to 410. This optimization provides adequate hydration for the chili plants, promoting robust growth.

In summary, the optimization process involved leveraging the DHT11 sensor and soil moisture sensor to regulate temperature, humidity, and irrigation. This sensor-driven approach contributed to creating an enhanced and tailored environment, fostering optimal conditions for healthy chili plant development.

Fig 7.1.1 Displaying Temperature,Humidity,Moisture Content on LCD Screen

7.2 Conclusion

The project has successfully met its primary objectives of creating an intelligent greenhouse monitoring system.

Efficient Climate Control:

The integration of temperature and humidity monitoring with the activation of the 12V DC fan ensures precise climate control within the greenhouse, fostering an optimal environment for plant growth.

Automated Irrigation:

The implementation of the moisture sensor and water pump automation provides efficient and timely irrigation, addressing the specific needs of the plants based on real-time soil moisture data.

Data Visibility:

The LCD display integrated into the system provides on-site visibility, allowing users to quickly assess critical information without relying solely on the mobile app.

The project design considers scalability, allowing for future expansions or modifications to accommodate different greenhouse sizes and environmental conditions.

User Feedback and Satisfaction:

User feedback during testing and deployment has been positive, indicating satisfaction with the system's performance and ease of use.

Future Improvements:

Identified areas for improvement, such as enhanced data analytics, integration of more sensors, and additional features, provide a roadmap for future development and innovation.

Educational and Research Value:

The project not only serves practical purposes but also holds educational and research value, providing insights into the integration of technology for environmentally consciousagricultural practices.

In conclusion, the Greenhouse Monitoring System demonstrates a successful fusion of hardware and software technologies to create an intelligent, and user-friendly

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