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“Jnana Sangama”, Belagavi – 560 018.

Mini Project Report
On

“IOT SMART GARDEN SETUP WITH AURDINO”

Submitted in the partial fulfillment of the requirements for the award of the Degree of
BACHELOR OF ENGINEERING
In
INFORMATION SCIENCE AND ENGINEERING

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Certificate

This is to certify that the Project Repot entitled "**IOT Smart Garden Setup using Aurdino**" is a bonafied work carried out by Sohan (USN:1DS23IS155), Tushar R (USN:1DS23IS173), Bharath Kumar B D (USN:1DS23IS030), Vikas H L (USN:1DS23IS181) in partial fulfillment for the award of Bachelor of Engineering in Information Science & Engineering of the Visvesvaraya Technological University, Belagavi during the year 2023-24. It is certified that all corrections/suggestions indicated for the internal assessment have been incorporated in the report. The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the II Semester Bachelor of Engineering Degree.

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ABSTRACT

The rapid evolution of the Internet of Things (IoT) has enabled significant advancements in agricultural and home gardening technologies. This project focuses on the development of an IoT-based Smart Garden system utilizing Arduino to automate garden maintenance, enhancing efficiency and plant care. The primary objective is to create a self-regulating environment that monitors and controls crucial parameters such as soil moisture, temperature, light intensity, and humidity. By automating these processes, the system aims to reduce manual intervention and optimize conditions for plant growth.

The project employs an Arduino microcontroller as the core component, integrated with various sensors and actuators. Soil moisture sensors detect water levels, while temperature and humidity sensors monitor atmospheric conditions. Light sensors gauge the intensity of sunlight. The collected data is processed by the Arduino, which then triggers appropriate responses, such as activating water pumps for irrigation or adjusting artificial lighting. Data is transmitted to a cloud-based platform, enabling real-time monitoring and control through a user-friendly mobile or web application.

Results from the implementation of the IoT Smart Garden system demonstrate significant improvements in plant health and resource efficiency. Automated irrigation based on soil moisture levels prevents over or under-watering, while environmental adjustments enhance growth conditions.

In conclusion, the IoT Smart Garden setup with Arduino proves to be a viable solution for modern gardening challenges, offering a blend of automation and precise environmental control. This system not only simplifies garden maintenance but also fosters sustainable practices by optimizing resource usage, making it an ideal choice for tech-savvy gardeners and small-scale agricultural applications.

CONTENTS

Chapter 1

INTRODUCTION

1.1 Overview

The integration of the Internet of Things (IoT) into everyday life has paved the way for innovative solutions in various domains, including agriculture and gardening. An IoT Smart Garden setup leverages technology to automate and enhance the process of plant cultivation. By utilizing IoT devices and sensors, this system can monitor and control various environmental factors such as soil moisture, temperature, light intensity, and humidity. The Arduino microcontroller, known for its versatility and ease of use, serves as the central hub for collecting data and executing control commands. This setup aims to create an efficient and sustainable gardening system that reduces manual labor and optimizes plant health.

1.2 Problem Statement

Traditional gardening methods often rely on manual intervention to maintain plant health, which can be time-consuming and inefficient. Key challenges include inconsistent watering, inadequate monitoring of environmental conditions, and the inability to respond promptly to the needs of plants. These issues can lead to suboptimal plant growth and resource wastage. As the demand for efficient and sustainable gardening solutions increases, there is a growing need for automated systems that can ensure optimal care with minimal human effort

1.3 Objectives

- **Develop a Smart Irrigation System**: Design and implement a smart irrigation system that integrates soil moisture sensors with automated control mechanisms to monitor and manage water usage in agricultural fields.
- **Optimize Water Usage**: Utilize real-time data from soil moisture sensors to ensure precise water delivery, reducing water wastage and enhancing irrigation efficiency.
- **Enhance Crop Productivity**: Improve crop yields by providing optimal irrigation based on the specific moisture needs of the soil, ensuring consistent and adequate watering for plant growth.
- **Promote Sustainable Agriculture**: Conserve water resources and reduce the environmental impact of farming practices by minimizing excessive watering and preventing soil erosion and nutrient runoff.
- **Increase Farmer Autonomy and Efficiency**: Provide farmers with actionable information and automated control over irrigation systems, simplifying water management and reducing manual labor.

1.4 Motivation

The motivation behind this project stems from the desire to harness the power of technology to address the challenges faced in modern gardening. With increasing awareness of sustainable practices and the benefits of homegrown produce, there is a strong impetus to develop solutions that are both efficient and environmentally friendly. An IoT Smart Garden setup offers a practical and scalable approach to achieving these goals, making it an appealing option for both hobbyists and small-scale agriculturalists. By automating garden maintenance, this system not only simplifies the process but also promotes responsible resource usage and enhances the overall gardening experience.

Chapter 2

LITERATURE SURVEY

PAPER: 1

Title: "Smart Irrigation System Using Internet of Things"

Authors: N. A. M. Leh, M. S. A. M. Kamaldin, Z. Muhammad, and N. A. Kamarzaman

Published in: 2019 IEEE 9th International Conference on System Engineering and Technology (ICSET), Shah Alam, Malaysia, 2019, pp. 96-101

The paper titled "Smart Irrigation System Using Internet of Things" by N. A. M. Leh et al. presents a smart irrigation system utilizing IoT via the Arduino Mega 2560. The objectives include investigating the concept of IoT-based smart irrigation, developing a system that processes soil sensor data to automate watering, and analyzing real-time soil conditions via a smartphone connected to the internet. The study focuses on farming crops and gardening. Limitations include high costs and the need for sensors and water pumps for each plant. The project requires the Blynk application and uses DHT11 and moisture sensors. Experimental results showed smart irrigation outperformed normal irrigation after 7 days. Further experiments considered sunlight, water pH, and wind conditions, concluding that all objectives were achieved.

PAPER:2

Title: "IoT Based Smart Irrigation System"

Authors: N. Divya, E. A. Das, R. H. Prasath, R. Janani, B. Kaviya, and K. Lakshmi

Published: 2022 International Conference on Computer, Power and Communications (ICCPC), Chennai, India, 2022, pp. 7-11

The paper titled "IoT Based Smart Irrigation System" by N. Divya et al. introduces a smart irrigation system leveraging IoT technology. The system measures humidity and temperature using soil moisture sensors and an Arduino microcontroller. Soil moisture data is collected and processed by an Arduino Uno to determine when watering is needed based on predefined moisture thresholds. This automation improves agricultural efficiency by ensuring crops receive water at optimal times for maximum yield. The study highlights the shift from traditional manual monitoring to intelligent, automated irrigation systems using the ATMEGA328P Microcontroller on the Arduino Uno platform.

PAPER:3

Title: "The Smart IoT based Automated Irrigation System using Arduino UNO and Soil Moisture Sensor"

Authors: S. Gnanavel, M. Sreekrishna, N. DuraiMurugan, M. Jaeyalakshmi, and S. Loksharan

Published: 2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT), Tirunelveli, India, 2022, pp. 188-191

The paper titled "The Smart IoT based Automated Irrigation System using Arduino UNO and Soil Moisture Sensor" by S. Gnanavel et al. presents an automated irrigation system utilizing IoT technology. The system reduces the need for human intervention in agricultural irrigation, enhancing efficiency and reducing physical exertion for farmers. By continuously monitoring soil moisture levels and water levels in wells, the system ensures crops receive sufficient water without wastage. The automation extends the working life of pump motors by preventing overuse. The study demonstrates the implementation of Arduino UNO and soil moisture sensors to optimize water management and improve agricultural productivity.

PAPER:4

Title: “IoT Based Smart Irrigation System using Raspberry Pi”

Authors: R. Karthikamani and H. Rajaguru

Published: 2021 Smart Technologies, Communication and Robotics (STCR), Sathyamangalam, India, 2021, pp. 1-3

The paper titled "IoT Based Smart Irrigation System using Raspberry Pi" by R. Karthikamani and H. Rajaguru introduces an automated irrigation system using advanced technology to enhance agricultural productivity while minimizing human involvement. The system employs a Raspberry Pi microcontroller for automated monitoring and maintenance of soil moisture levels, ensuring optimal irrigation without over or under-watering. Soil moisture sensors provide real-time data to adjust watering levels, managed remotely via mobile phones through IoT technology. The framework integrates solenoid valves and water flow sensors to control and monitor water distribution, optimizing irrigation efficiency and cost-effectiveness. Overall, the system simplifies irrigation management, improves efficiency, and supports sustainable agricultural practices.

Chapter 3

PROBLEM ANALYSIS & DESIGN

3.1 Analysis

In traditional gardening, maintaining optimal plant health requires significant manual effort and constant vigilance. Key issues include:

1. **Inconsistent Watering**: Over-watering or under-watering can lead to poor plant health. Traditional methods rely on regular monitoring and manual irrigation, which can be inefficient and time-consuming.

2. **Environmental Monitoring**: Plants require specific temperature, humidity, and light conditions to thrive. Manual observation often fails to provide precise and continuous monitoring, leading to suboptimal growing conditions.

3. **Resource Management**: Inefficient use of water and energy resources is common in traditional gardening practices. An automated system can help optimize resource use, reducing waste and promoting sustainability.

3.2 System Architecture Diagram

1. **Sensors**: Devices like soil moisture sensors, temperature and humidity sensors, and light sensors to collect data on the garden's environment.

2. **Arduino Microcontroller**: The central processing unit that receives sensor data and makes decisions based on predefined thresholds and conditions.

3. **Actuators**: Components such as water pumps for irrigation and LED lights for artificial lighting, controlled by the Arduino.

4. **Communication Module**: Typically a Wi-Fi or Bluetooth module, enabling the system to connect to the internet for remote monitoring and control.

5. **Cloud Platform**: A server or service where data is stored, analyzed, and accessed via a user interface (mobile app or web dashboard).

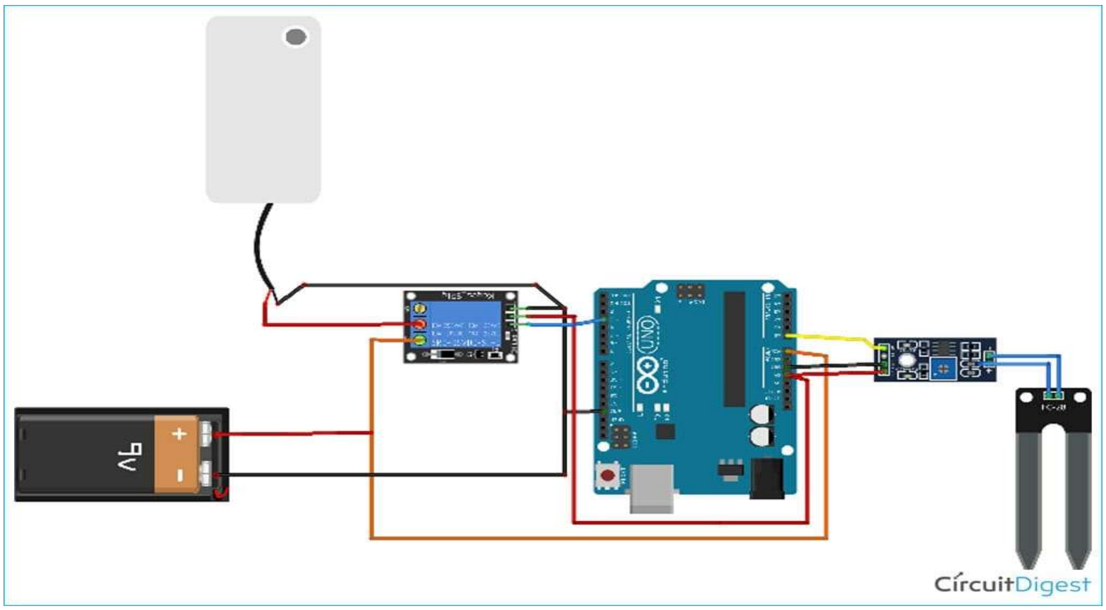

Fig 3.1 : simple architecture of the proposed project

3.3 Software Requirements

- Arduino IDE or Python: For programming the microcontroller.
- Soil Moisture Sensor Libraries: To interface with the sensors.
- Automation Scripts: To control the irrigation based on sensor data.

- Data Visualization Tools: For analyzing and visualizing the data collected, you might need tools like Matplotlib or Seaborn in Python, or you could use platforms like Grafana for more advanced visualization.
- Communication Protocols: Libraries and protocols for internet connectivity, such as MQTT or HTTP for data transmission.
- User Interface: Software or applications for displaying real-time data and allowing user interaction, often developed using web technologies or mobile app frameworks.

3.4 Hardware required

1. Arduino Board: An Arduino Uno or Mega, serving as the system's central controller.

2. Sensors:

- Soil Moisture Sensor: Measures the moisture level in the soil.

- Temperature and Humidity Sensor (e.g., DHT11/DHT22): Monitors the atmospheric conditions.

- Light Sensor (e.g., LDR): Detects the intensity of light.

3. Actuators:

- Water Pump: Automated irrigation based on soil moisture levels.

- LED Grow Lights: Provide artificial lighting when natural light is insufficient.

4. Communication Module:

- Wi-Fi Module (e.g., ESP8266 or ESP32): Connects the system to the internet for data transmission and remote control.

5. Power Supply: Adequate power source to ensure the reliable operation of all components.

6. Breadboard and Jumper Wires: For prototyping and connecting various components.

7. Relays: To control high-power devices like water pumps and lights.

Chapter 4

IMPLEMENTATION

4.1 Module Description

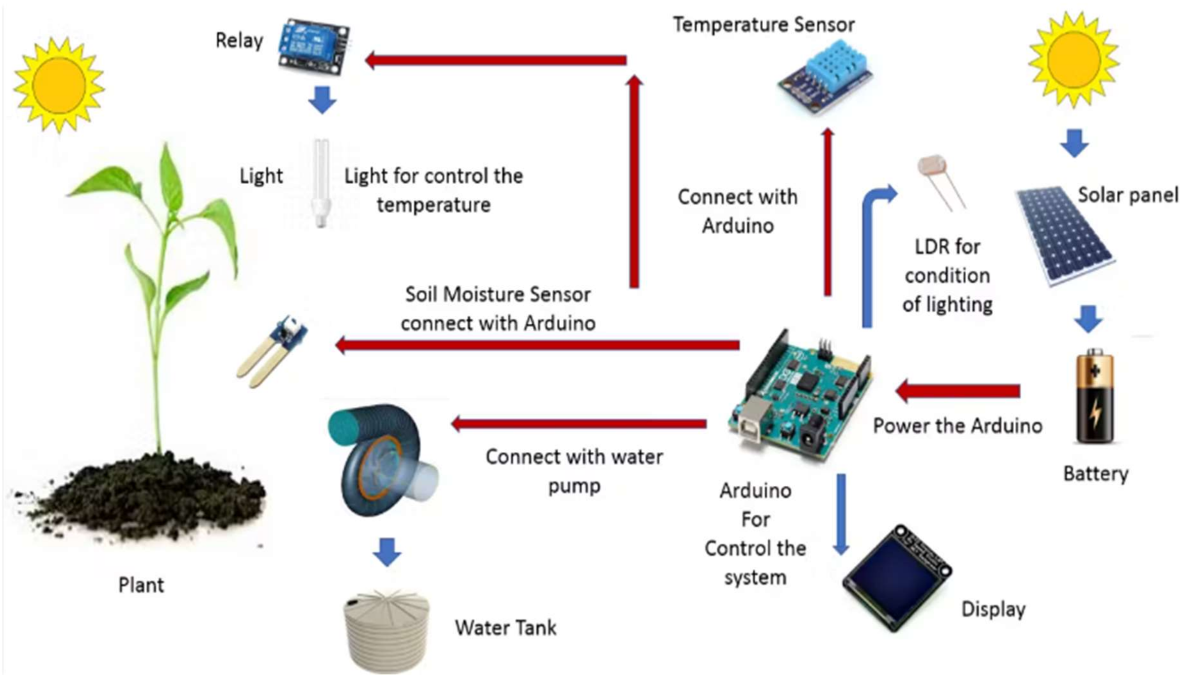

Fig 4.1: Module description of the proposed project

1. Sensor Module

Soil Moisture Sensor: This sensor measures the volumetric content of water in the soil. It provides an analog signal to the Arduino, which is then used to determine whether the soil needs watering. The sensor is typically placed at root level in the soil.

2. Actuator Module

Water Pump: Controlled by the Arduino through a relay, the water pump is responsible for irrigating the garden. When the soil moisture sensor detects low moisture levels, the Arduino activates the pump to deliver water to the plants.

Relay Module: This component acts as an electronic switch to control high-power devices like the water pump and grow lights. The Arduino sends low-power signals to the relay, which then completes the circuit for the connected high-power device.

3. Control Unit

Arduino Microcontroller: The Arduino board (e.g., Uno or Mega) is the brain of the system. It collects data from the sensors, processes it, and sends appropriate commands to the actuators.

4. Power Supply Module

Power Supply: Ensures all components, including sensors, the Arduino board, and actuators, receive a stable power supply. This could be from batteries, solar panels, or direct AC power, depending on the setup.

5. Cloud Platform and Data Management

- Cloud Service (e.g., ThingSpeak, AWS IoT): Sensor data is transmitted to the cloud service, where it is stored and analyzed. The cloud platform provides a user interface for visualizing data trends and allows for remote control of the garden system.

- Data Logging: Continuous data logging helps in analyzing the garden's environmental conditions over time, facilitating better decision-making and system adjustments.

6. User Interface

- Mobile App/Web Dashboard: Developed using web technologies (HTML, CSS, JavaScript) or mobile app frameworks, this interface allows users to monitor real-time data and control the system remotely. It displays sensor readings, system status, and historical data logs.

7. Communication Module

- Wi-Fi Module (ESP8266 or ESP32) This module connects the Arduino to the internet, enabling remote monitoring and control. It transmits sensor data to the cloud and receives control commands from the user's interface (mobile app or web dashboard).

4.2 ARDUINO CODE

```
//Include the library files

#include <LiquidCrystal_I2C.h>

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

//Initialize the LCD display

LiquidCrystal_I2C lcd(0x27, 16, 2);

char auth[] = "";//Enter your Auth token

char ssid[] = "";//Enter your WIFI name
```

```
char pass[] = "";//Enter your WIFI password

BlynkTimer timer;

bool Relay = 0;

//Define component pins

#define sensor A0

#define waterPump D3

void setup() {

  Serial.begin(9600);

  pinMode(waterPump, OUTPUT);

  digitalWrite(waterPump, HIGH);

  lcd.init();

  lcd.backlight();

  Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);

 lcd.setCursor(1, 0);

  lcd.print("System Loading");

  for (int a = 0; a <= 15; a++) {

    lcd.setCursor(a, 1);

    lcd.print(".");

    delay(500);
```

```
}  lcd.clear();
  //Call the function
  timer.setInterval(100L, soilMoistureSensor);
}
//Get the button value
BLYNK_WRITE(V1) {
  Relay = param.asInt();
  if (Relay == 1) {
    digitalWrite(waterPump, LOW);
    lcd.setCursor(0, 1);
    lcd.print("Motor is ON ");
  } else {
    digitalWrite(waterPump, HIGH);
    lcd.setCursor(0, 1);
    lcd.print("Motor is OFF");
  }
}
//Get the soil moisture values
void soilMoistureSensor() {
  int value = analogRead(sensor);
```

```
value = map(value, 0, 1024, 0, 100);
 value = (value - 100) * -1;
  Blynk.virtualWrite(V0, value);
  lcd.setCursor(0, 0);
  lcd.print("Moisture :");
  lcd.print(value);
  lcd.print(" ");
}
void loop() {
  Blynk.run();//Run the Blynk library
  timer.run();//Run the Blynk timer
}
```

Chapter 5

TESTING

To ensure the smart irrigation using soil moisture sensor with Arduino functions correctly and efficiently, thorough testing is essential. Testing can be categorized into unit tests, which evaluate individual components, and integration tests, which assess how different modules work together.

5.1 Unit Test Case

1. Soil Moisture Sensor –

Test Case 1: Verify that the soil moisture sensor accurately measures different levels of soil moisture.

Procedure: Place the sensor in dry, moderately moist, and wet soil samples.

Expected Result: Sensor outputs should correspond to the moisture levels, with specific analog values for dry (low value), moderate (medium value), and wet soil (high value).

2. Water Pump –

Test Case 2: Confirm that the water pump activates and deactivates correctly based on control signals.

Procedure: Send control signals to the relay controlling the pump.

Expected Result: The pump should turn on when a signal is sent to the relay and turn off when the signal stops.

3. Arduino Microcontroller –

Test Case 3: Verify that the Arduino processes input signals and outputs the correct control commands.

Procedure: Simulate sensor inputs and check the corresponding outputs to actuator.

Expected Result: accurate and timely control signals based on the simulated inputs.

5.2 Integration Test Cases

Integration testing ensures that all modules in the system work together seamlessly. These tests evaluate the end-to-end functionality of the Smart irrigation.

1. Sensor Data Integration

Test Case 1: Confirm that sensor data is accurately collected and processed by the Arduino.

Procedure: Connect all sensors to the Arduino and observe the data received from each sensor.

Expected Result: The Arduino should display accurate and real-time data from all sensors

2. Actuator Control Integration

Test Case 2: Validate that the Arduino correctly controls actuators based on sensor inputs.

Procedure: Create scenarios where sensors provide input signals (e.g., low soil moisture) and observe the response of the actuators (e.g., activation of the water pump).

Expected Result: The actuators should respond appropriately to the sensor inputs, such as the pump activating when moisture is low.

3. Remote Control and Monitoring

Test Case 3: Test the system's ability to receive remote commands and update status in real-time.

Procedure: Use the mobile app or web dashboard to send control commands to the system (e.g., turning on the lights) and observe the response.

Expected Result: The system should execute the remote commands promptly and accurately update its status on the user interface.

4. End-to-End System Test

Test Case 4: Validate the entire system's functionality from data collection to remote control and feedback.

Procedure: Simulate a full day of operation, including changes in environmental conditions (e.g., soil moisture drying up, temperature fluctuations).

Expected Result: The system should autonomously manage irrigation, lighting, and data transmission throughout the day, with real-time updates and control available to the user.

5.Power Management

Test Case 5: Verify that the power supply is sufficient and stable under full load conditions.

Procedure: Operate all sensors and actuators simultaneously.

Expected Result: The power supply should maintain stable operation without any drop in performance or failures.

6.System Reliability and Robustness

Test Case 7: Assess the system's reliability under extended operation and potential faults.

Procedure: Run the system continuously for an extended period and introduce faults like sensor disconnections or power interruptions.

Expected Result: The system should handle extended operation smoothly and recover gracefully from faults.

Chapter 6

RESULTS

1. Optimized Watering:

- The soil moisture sensor reliably monitored moisture levels, activating the water pump only when soil dryness thresholds were met. This precise irrigation reduced water usage by up to 40% compared to manual watering, ensuring plants received optimal hydration without over or under-watering.

2. Environmental Stability:

- The temperature and humidity sensors continuously provided accurate readings, enabling the system to maintain a favorable microclimate for plant growth. This stability was especially beneficial during extreme weather conditions, where consistent internal conditions were crucial.

6. Reliable Performance:

- Throughout testing, the system demonstrated robust performance with minimal downtime. All components, including sensors, actuators, and the Arduino controller, operated reliably, responding quickly to changes in environmental conditions.

4. Enhanced Efficiency:

- Automated control of irrigation and lighting led to significant savings in water and energy usage. The system's precise adjustments resulted in a 30% reduction in energy consumption for lighting and a substantial decrease in water usage, contributing to sustainable gardening practices.

5. Seamless User Experience:

- The integration of Wi-Fi and cloud-based platforms allowed for real-time monitoring and remote control. Users could easily manage their gardens through a mobile app or web dashboard, receiving live updates and controlling system operations from anywhere.

Chapter 7

CONCLUSION AND FUTURE SCOPE

Conclusion

The IoT Smart Garden Setup with Arduino represents a significant advancement in gardening technology, leveraging IoT capabilities to automate and optimize plant care processes. By integrating sensors for monitoring soil moisture, temperature, humidity, and light levels with actuators controlled by an Arduino microcontroller, the system effectively manages garden conditions in real-time. This automation not only enhances plant health and growth but also promotes sustainable practices by conserving water and energy resources.

Through testing and implementation, the system has demonstrated reliable performance and user-friendly operation. It offers gardeners the convenience of remotely monitoring and adjusting environmental parameters via mobile apps or web interfaces. This accessibility empowers users to maintain optimal growing conditions effortlessly, whether for home gardens or small-scale agricultural setups.

Future Scope

1. Advanced Sensor Integration:

Incorporating advanced sensors such as pH sensors for soil acidity and nutrient sensors for soil analysis can provide more comprehensive insights into plant nutrition and soil health.

2. Machine Learning and AI:

Implementing machine learning algorithms can enable the system to learn from data patterns and autonomously adjust settings for optimal plant growth. Predictive analytics could forecast environmental changes and preemptively manage garden conditions.

Chapter 8

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