VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi – 590014

A Mini Project Report

On

"Smart Indoor Gardening Ecosystem"

Submitted in partial fulfillment of the requirement for the award of degree of

BACHELOR OF ENGINEERING

By

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A.P.S. COLLEGE OF ENGINEERING

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Project Completion Certificate

I, **Aravind S V** (Roll No: 1AP21IS004), hereby declare that the material presented in the Project Report titled **" Smart Indoor Gardening Ecosystem "** represents original work carried out by me in the **Department of Information science & Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
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Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.E. Internship Work.

Advisor’s Name: **Prof Dr Shivamurthiah** Guide Name: **Akhil Sai**

Advisor’s Signature **Guide Signature**

Project Completion Certificate

I, **Vaishnavi B** (Roll No: 1AP21IS053), hereby declare that the material presented in the Project Report titled **" Smart Indoor Gardening Ecosystem "** represents original work carried out by me in the **Department of Information Science & Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor’s Name: **Prof Dr Shivamurthiah** Guide Name: **Akhil Sai**

Advisor’s Signature **Guide Signature**

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I, **Sanjana N** (Roll No: 1AP21EC015), hereby declare that the material presented in the Project Report titled **" Smart Indoor Gardening Ecosystem "** represents original work carried out by me in the **Department of Electronic & communication Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.E. Internship Work.

Advisor's Name: **Dr. Prakash Jhadhav** Guide Name: **Akhil Sai**

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: **Smart Indoor Gardening Ecosystem**

Name of the Students: Aravind S V, Vaishnavi B, Sanjana N

External Supervisor:

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Internal Supervisor:

____

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Date:

Place:

ABSTRACT

This report outlines the design and implementation of a "Smart Indoor Gardening Ecosystem" using Raspberry Pi. The project aims to automate the monitoring and maintenance of indoor plants by integrating sensors and actuators with a user-friendly interface. Key functionalities include real-time monitoring of temperature, humidity, and soil moisture, with automated water supply control via a stepper motor and relay. A web-based UI developed with HTML, CSS, JavaScript, and Flask provides live data visualization and control. This system demonstrates an effective solution for improving plant care in indoor environments, minimizing manual intervention.

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Chapter 1:

INTRODUCTION

Indoor gardening is increasingly popular, offering aesthetic, health, and environmental benefits. However, maintaining indoor plants can be challenging, particularly for individuals with busy lifestyles. Proper care requires consistent monitoring of environmental conditions and timely actions, such as watering. To address these challenges, this project introduces a "Smart Indoor Gardening Ecosystem," combining IoT technology and automation to provide a reliable and efficient plant care solution.

1.1 Objective

The objective of this project is to create a smart gardening system that:

- Continuously monitors key environmental parameters such as temperature, humidity, and soil moisture.
- Automates the watering process based on soil moisture levels.
- Offers real-time data visualization and system control through a web-based user interface.
- Enhances plant health while reducing the need for manual intervention.
- Encourages sustainable practices by optimizing water usage and minimizing waste.

This system serves as a prototype for larger-scale applications in urban agriculture and smart farming.

1.2 Problem Statement

Maintaining indoor plants can be a time-consuming and demanding task, especially for individuals who lack knowledge of plant care or have limited availability. Common problems include overwatering, underwatering, and neglecting environmental factors critical for plant growth. The lack of a unified solution to address these challenges often results in poor plant health and growth.

The "Smart Indoor Gardening Ecosystem" addresses these issues by:

- Providing an automated mechanism for irrigation.
- Monitoring environmental parameters in real time.
- Offering a user-friendly interface for data access and control.
- Ensuring optimal conditions for plant health with minimal human intervention.

Chapter 2:

APPLICATIONS

The "Smart Indoor Gardening Ecosystem" has wide-ranging applications, including:

1. Residential Use:

- Ideal for individuals who wish to maintain healthy indoor plants but lack the time or expertise for regular care.
- Enhances the aesthetic value of homes with thriving indoor gardens.
- Provides a sustainable solution for water conservation in urban households.

2. Commercial Use:

- Offices, hotels, and other commercial establishments can use this system to maintain decorative plants effortlessly.
- Reduces the cost and labor associated with plant maintenance, promoting green spaces in commercial areas.

3. Educational Use:

- Serves as a teaching tool for IoT, automation, and smart system design.
- Encourages students and hobbyists to explore smart gardening solutions, fostering innovation in agricultural technology.

4. Agricultural Applications:

- Provides a scalable prototype for precision agriculture and urban farming.
- Can be adapted for greenhouses and large-scale farming to monitor multiple parameters for better yield.

Chapter 3:

COMPONENTS

The smart Indoor gardening ecosystem comprises the following components:

1. Raspberry Pi:

- Acts as the central processing unit, collecting data from sensors and controlling actuators.
- Provides connectivity for interfacing with the UI.
- Capable of running lightweight server applications for real-time data handling.

Figure 3.1 Raspberry Pi Kit (model 4)

2. DHT11/DHT22 Sensor:

- Measures temperature and humidity levels.
- Provides accurate readings essential for maintaining an optimal environment for plants.
- Connects easily to the Raspberry Pi with minimal power consumption.

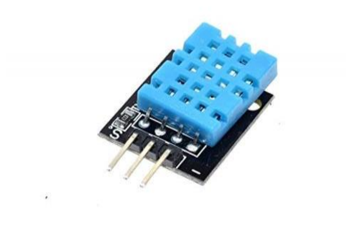


Figure 3.2 Temperature & Humidity Sensor

3. Soil Moisture Sensor:

- Detects soil moisture levels to determine whether watering is required.
- Offers both analog and digital output for compatibility with various systems.
- Critical for preventing overwatering and ensuring healthy root systems.

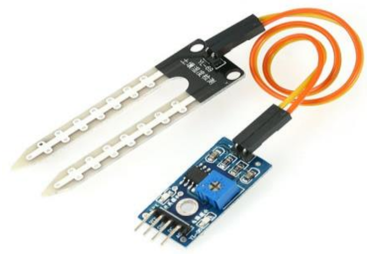


Figure 3.3 Soil moisture sensor

4. Stepper Motor:

- Controls the irrigation system by opening or closing the water supply valve.
- Operates with precision to ensure efficient water usage.
- Ideal for tasks requiring fine control over mechanical components.

Figure 3.4 Stepper Motor

5. Power Supply:

- Provides stable power to the Raspberry Pi and connected components.
- Ensures uninterrupted operation of the system.
- Can be optimized for energy-efficient applications.

6. Web Applications:

- The system includes a web-based user interface built using HTML, CSS, and JavaScript.
- Users can monitor real-time data such as temperature, humidity, soil moisture levels, and motor status.
- The application supports responsive design for accessibility across various devices.
- Flask acts as the backend framework, enabling seamless communication between the hardware and the frontend.

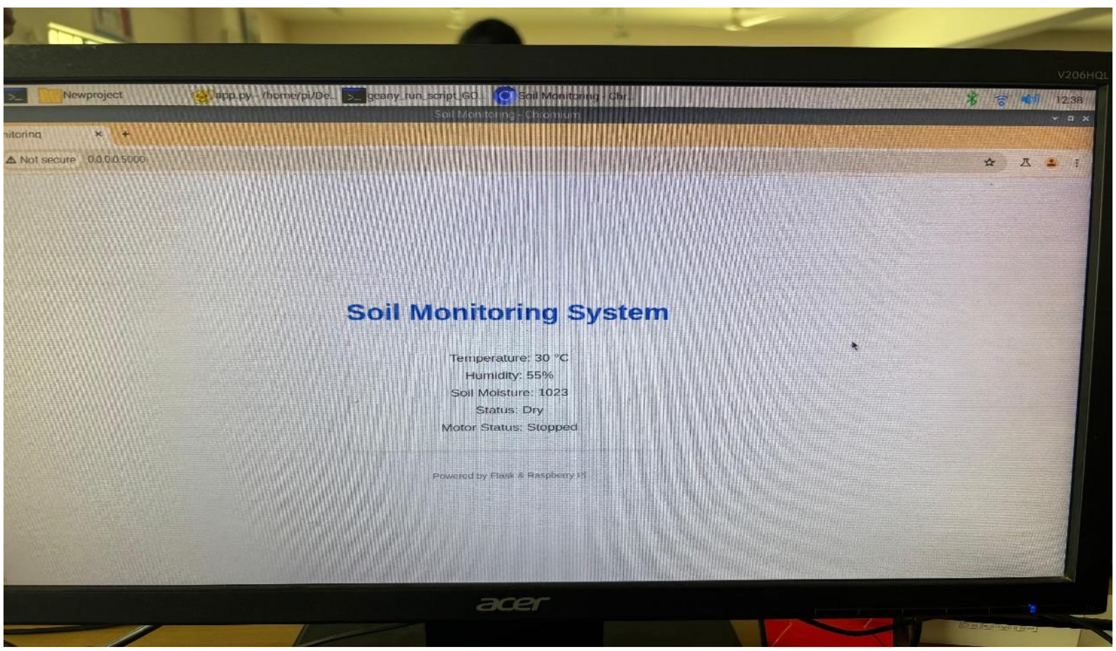


Figure 3.5 Web-based User interface

7. Flask Framework:

- Powers the backend, handling data flow between sensors and the user interface.
- Facilitates communication between the hardware and software components of the system.

8. HTML, CSS, JavaScript:

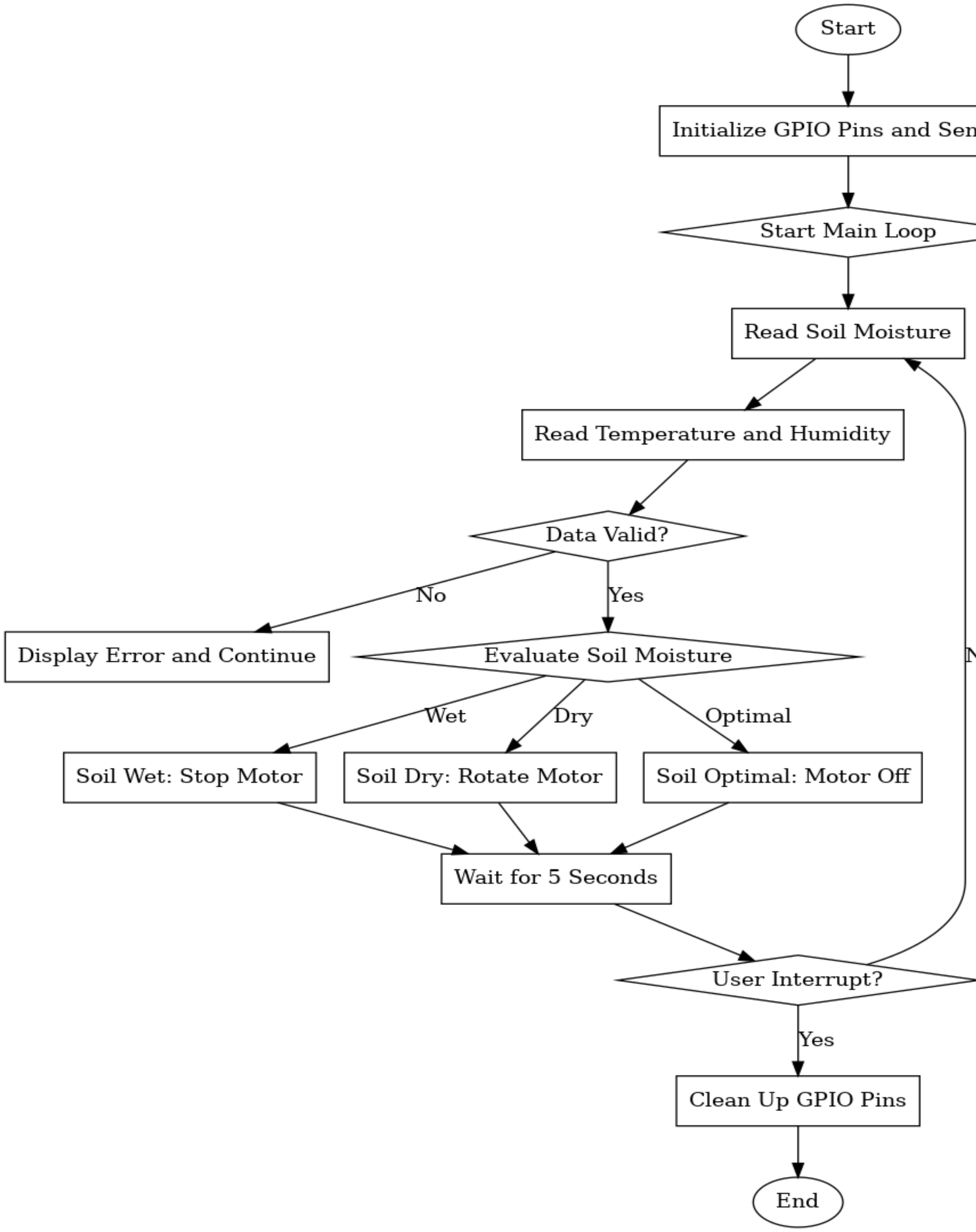
- Builds the frontend for a user-friendly interface.
- Allows users to monitor system parameters and control actions in real time.
- Enhances user interaction with responsive and visually appealing design.

9. Python Libraries:

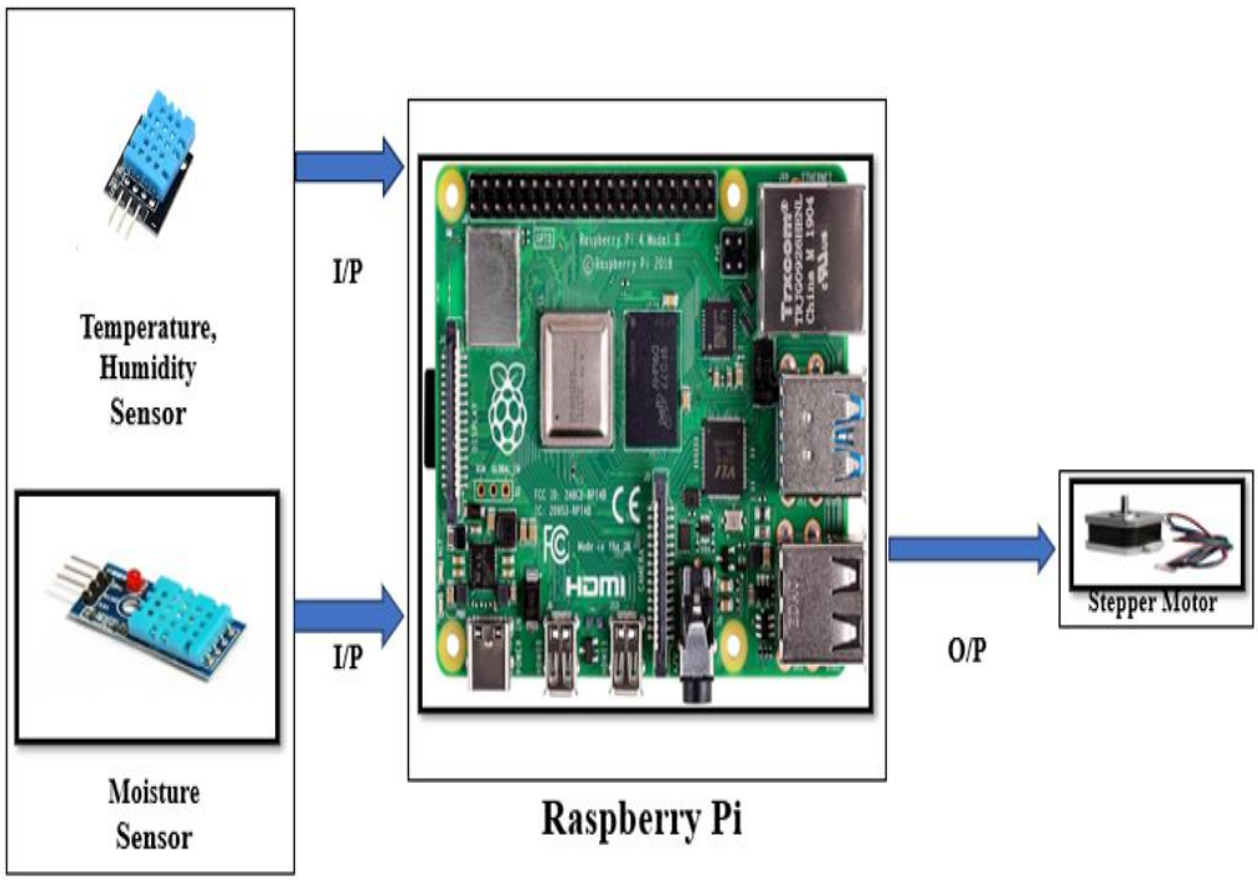
- Includes RPi.GPIO for hardware interfacing, Flask for server-side scripting, and Adafruit DHT for sensor data retrieval.
- Enables seamless integration of hardware and software functionalities.

Chapter 4:

FLOW DIAGRAM



BLOCK DIAGRAM



Chapter 5:

CONCLUSION

The "Smart Indoor Gardening Ecosystem" demonstrates a practical application of IoT and automation technologies for plant care. By leveraging Raspberry Pi and a combination of sensors and actuators, the system provides an efficient and reliable solution for monitoring and maintaining indoor gardens. The web-based UI enhances user interaction, making it easy to visualize data and control the system.

This project showcases the potential of smart systems in everyday life and offers a prototype for further advancements in agricultural automation. Its modular design allows for future upgrades and scalability, making it a versatile tool for various applications.

Chapter 6:

FUTURE WORK

1. Cloud Integration:

- Enable remote monitoring and control through cloud-based platforms.
- Store historical data for trend analysis and predictive insights.

2. Notification System:

- Develop a system to send alerts via SMS or email for critical events, such as low water levels or extreme environmental conditions.

3. Advanced Sensors:

- Incorporate additional sensors to measure light intensity, pH levels, and CO2 concentration.
- Provide a holistic view of the plant's environment for optimized care.

4. Mobile App Development:

- Create a dedicated mobile app for enhanced user accessibility and convenience.
- Expand the system's usability for different user groups.

5. Machine Learning Integration:

- Use machine learning algorithms to predict plant health issues and optimize irrigation schedules.
- Enhance system efficiency through data-driven decision-making.

Chapter 7:

APPENDIX

7.1 GPIO Pin Configuration:

- DHT_SENSOR_PIN (17): Connects to the DHT11 or DHT22 sensor for reading temperature and humidity.
- SOIL_MOISTURE_PIN (27): Connects to the soil moisture sensor for detecting soil moisture levels.
- STEPPER_MOTOR_PIN_1 (5): Controls rotation of stepper motor.
- RELAY_PIN (22): Controls the relay module that activates the water pump for irrigation.

7.2 User Interface Design:

- **/index.html**: The main webpage displaying live readings of the sensors:
    - Current temperature and humidity.
    - Current soil moisture status (i.e. dry or wet)
    - Stepper motor status

7.3 Pseudocode:

```
Sensor loop
Initialize GPIO Pins for Stepper Motor and Moisture Sensor
Define Motor Control Sequence (Seq) for Stepper Motor
Define GPIO Pin Constants for Sensors and Stepper Motor
Function rotate_motor(steps, direction):
    Set StepDir to direction
    For each step from 1 to steps:
        For each pin in StepPins:
            Set GPIO pin to HIGH or LOW based on the step sequence
        Update StepCounter based on direction (clockwise or counterclockwise)
        Wait for a short time (WaitTime)
Function main():
    While True:
        Read soil moisture from MCP3008
        Print moisture value

        Read temperature and humidity from DHT11
```

```
        If data is valid:
            Print temperature and humidity
        Else:
            Print error message

        If moisture value is below threshold (wet):
            Print "Soil is wet. Stopping motor..."
            Set all motor pins to LOW
        Else if moisture value is above threshold (dry):
            Print "Soil is dry. Rotating motor..."
            Call rotate_motor(steps=1000, direction=1)  # Rotate motor clockwise
        Else:
            Print "Soil is in optimal range. Motor remains off."

        Wait for a short time

    Call main()
```