VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi – 590014.

Internship Report

On

"SMART AGRICULTURE SYSTEM "

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

BACHELOR OF ENGINEERING

By

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Under the guidance of:
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2023 - 2024

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

A P S COLLEGE OF ENGINEERING

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Project Completion Certificate

I, **Jhaansi A**(Roll No: 1AP21CS403), hereby declare that the material presented in the Project Report titled **"Smart Agriculture System"** represents original work carried out by me in the **Department of Computer science and 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.
- I understand that the work may be screened for any form of academic misconduct.

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.Tech. Internship Work.

Advisor's Name: **Guide Name:**

Dr.Shivamurthaiah M Sai Charan Teja

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Rakshitha T N**(Roll No: 1AP21IS029), hereby declare that the material presentedin the Project Report titled **"Smart Agriculture System"** represents original work carried out by me in the **Department of information science and Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor's Name: **Guide Name:**

Dr.Shivamurthaiah M Sai Charan Teja

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Ramya C L**(Roll No: 1AP21EC012), hereby declare that the material presentedin the Project Report titled **"Smart Agriculture System"** represents original work carried out by me in the **Department of Electronics and Communication Engineering** at the **APS college of Engineering, Bangalore** during the tenure
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Advisor's Name: **Guide Name:**

Dr.Shivamurthaiah M Sai Charan Teja

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: Smart Agriculture System

Name of the Students:1 Jhaansi A (1AP21CS403)

2 Rakshitha T N(1AP21IS029)

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External Supervisor:

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Date:

Place:

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Chapter 1

ABSTRACT

The Smart Agriculture System will seamlessly integrate IoT components, automation, and real-time weather data to enhance irrigation efficiency. Powered by a Raspberry Pi, the system will manage a stepper motor to regulate irrigation based on soil moisture levels and weather forecasts. Soil moisture data will be captured through an MCP3008 analog-to-digital converter, while weather updates will be retrieved from the OpenWeatherMap API.

A Flask web application will act as the system's dashboard, providing a clear display of key metrics such as temperature, humidity, soil moisture levels, and irrigation status. The stepper motor will operate as needed, initiating irrigation when soil moisture is low and halting it once the soil reaches optimal hydration.

By combining IoT, machine learning, and real-time data analysis, this system offers an automated and efficient solution for farmers, promoting effective water management and improved crop productivity.

Chapter 2

INTRODUCTION

The Smart Agriculture System is an advanced, automated irrigation solution designed to optimize water usage and improve crop health by leveraging real-time data and efficient automation. Powered by a Raspberry Pi, the system is built around a combination of sensors that monitor soil moisture, temperature, and humidity, providing continuous feedback on the field's environmental conditions. The soil moisture sensor plays a crucial role in determining whether irrigation is necessary by detecting how much water the soil retains. If the soil moisture drops below a predefined threshold, the system triggers the stepper motor to activate the irrigation system, ensuring that crops receive the appropriate amount of water. Once the soil reaches an optimal moisture level, the system automatically shuts off the irrigation to prevent overwatering, helping conserve water and reduce waste.

The temperature and humidity sensor provides valuable insights into the environmental conditions that can impact plant health. By continuously monitoring these factors, the system can adjust irrigation schedules and take into account weather patterns that might affect soil moisture (such as rainfall or changes in temperature). This ensures that water is applied efficiently, not just based on soil conditions but also factoring in the broader environmental context.

Objective

The Smart Agriculture System aims to automate irrigation management by utilizing soil moisture data to control a stepper motor, ensuring efficient water usage and activation only when necessary. It enables real-time monitoring of soil moisture, temperature, and humidity, providing up-to-date insights into field conditions. The system promotes resource conservation by halting irrigation when the soil is adequately hydrated and supports environmental adaptability by tracking temperature and humidity to assist farmers in making informed decisions. With a user-friendly web-based dashboard, it displays key metrics such as soil moisture levels, temperature, humidity, and irrigation status in an accessible format. Ultimately, the system enhances farming productivity by streamlining operations, conserving resources, and reducing manual effort.

Problem Statement

1. Water is often wasted in agriculture due to inefficient irrigation practices.
2. Traditional irrigation methods take a lot of time and effort, making them difficult to scale.
3. Farmers struggle to monitor soil moisture, temperature, and humidity in real time.
4. A better solution is needed to save water, reduce manual work, and improve farming efficiency.

Chapter 3

APPLICATIONS

- **Precision Irrigation:**

  Precision irrigation is a central feature of the system, where water is delivered to crops based on precise soil moisture measurements. The sensors continuously monitor the soil, detecting when it becomes too dry, triggering the irrigation motor to water the plants. Once the soil reaches the ideal moisture level, the system automatically halts the irrigation process. This approach reduces water waste and ensures that crops receive the optimal amount of water required for healthy growth, preventing both overwatering and under watering, which can harm plant health.

- **Remote Monitoring:**

  The system features an intuitive web dashboard that provides live data on soil moisture, temperature, humidity, and irrigation status. Farmers can access this information remotely from any device, allowing them to monitor field conditions without needing to be on-site. This is particularly beneficial for large farms or locations that are hard to reach frequently, offering added convenience and supporting better decision-making with real-time insights.

- **Research and Education:**

  The Smart Agriculture System can be utilized in educational environments to showcase the concepts of the Internet of Things (IoT), automation, and sustainable farming techniques. Students and researchers can engage with the system to learn how sensors operate, how data is gathered and processed, and how automation can enhance agricultural productivity. It acts as a practical learning resource for individuals studying agriculture, environmental science, and technology.

- **Sustainable Farming:**

  By combining automation and real-time monitoring, the system fosters the efficient use of resources. It helps conserve water by activating irrigation only when necessary and lowers energy consumption through precise management of the irrigation process. This solution aligns with sustainable farming principles, enhancing long-term agricultural productivity while minimizing its environmental footprint, making it an essential tool for environmentally responsible farming practices.

- **Crop yield Management:**
  The Smart Agriculture System improves growing conditions by delivering accurate data and automated control, enabling farmers to refine their farming practices. By ensuring that crops receive the optimal amount of water and are cultivated under ideal environmental conditions, the system promotes better crop health and increased yields. This solution is especially valuable in areas where unpredictable weather or limited resources impact agricultural productivity.

- **Labor Reduction:**
  Automating tasks like irrigation monitoring and control greatly minimizes the need for manual labor. Farmers no longer have to check soil conditions or manage irrigation schedules manually, as the system handles these tasks automatically. This enables farmers to concentrate on other important activities, boosting overall efficiency and productivity. The decreased reliance on manual work also makes farming more accessible to those with limited labor resources.

Chapter 4

COMPONENTS

4.1 Raspberry pi 4 Model B

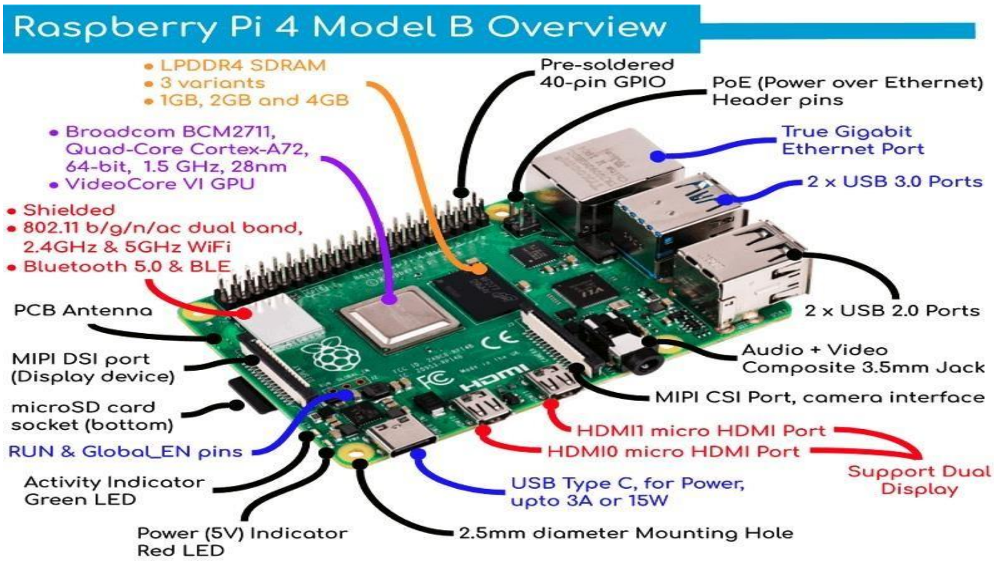

Figure 4.1: Raspberry pi 4 Model B.

The Raspberry Pi 4 Model B is a powerful single-board computer designed for a variety of applications, from education to industrial automation. It features a quad-core ARM Cortex-A72 processor, up to 8GB of RAM, dual micro-HDMI ports supporting 4K output, and USB 3.0 connectivity. Its GPIO pins enable easy interfacing with sensors, motors, and other peripherals, making it ideal for hardware projects. Built-in Wi-Fi, Bluetooth, and Ethernet provide versatile networking options. The Pi 4 is a versatile platform for learning, prototyping, and deploying IoT and embedded systems solutions.

Stepper Motor

Figure 4.2: Stepper Motor.

A stepper motor is a precision motor that moves in discrete steps, allowing for accurate control of position and speed. It operates by energizing coils in a specific sequence to produce controlled rotations, making it ideal for applications requiring precise movement, such as robotics, CNC machines, and 3D printers. Stepper motors are known for their reliability and ability to function without the need for feedback systems in many cases.

Soil Moisture Sensor

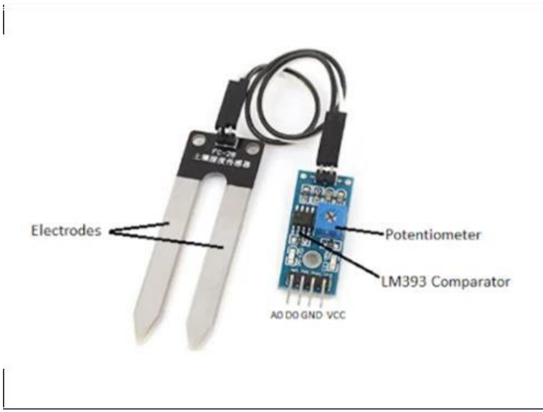

Figure 4.3: Soil Moisture Sensor.

The soil moisture sensor detects soil water content using two electrodes that measure conductivity, which increases with higher moisture. It includes an LM393 comparator and a potentiometer to set a moisture threshold. The sensor has four pins: VCC (power), GND (ground), DO (digital output for threshold detection), and AO (analog output for precise readings). It outputs a signal based on the soil's moisture level, making it ideal for smart agriculture, automated irrigation, and garden monitoring systems.

Temperature and Humidity Sensor

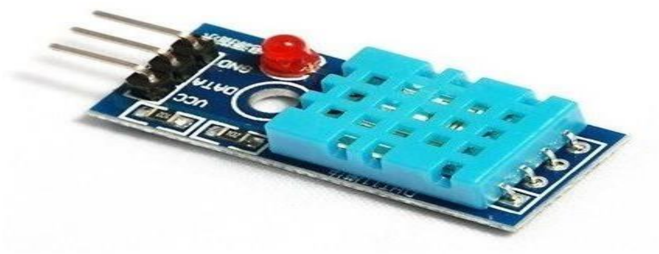

Figure 4.4: Temperature and Humidity Sensor.

The DHT11 is a digital sensor used to measure temperature (0°C to 50°C) and humidity (20% to 90%) with moderate accuracy. It operates on 3.3V to 5V and communicates via a single data pin, making it easy to interface with microcontrollers like Arduino and Raspberry Pi. Compact and affordable, it is ideal for applications like home automation, weather monitoring, and educational projects.

Chapter 5

FLOW CHART

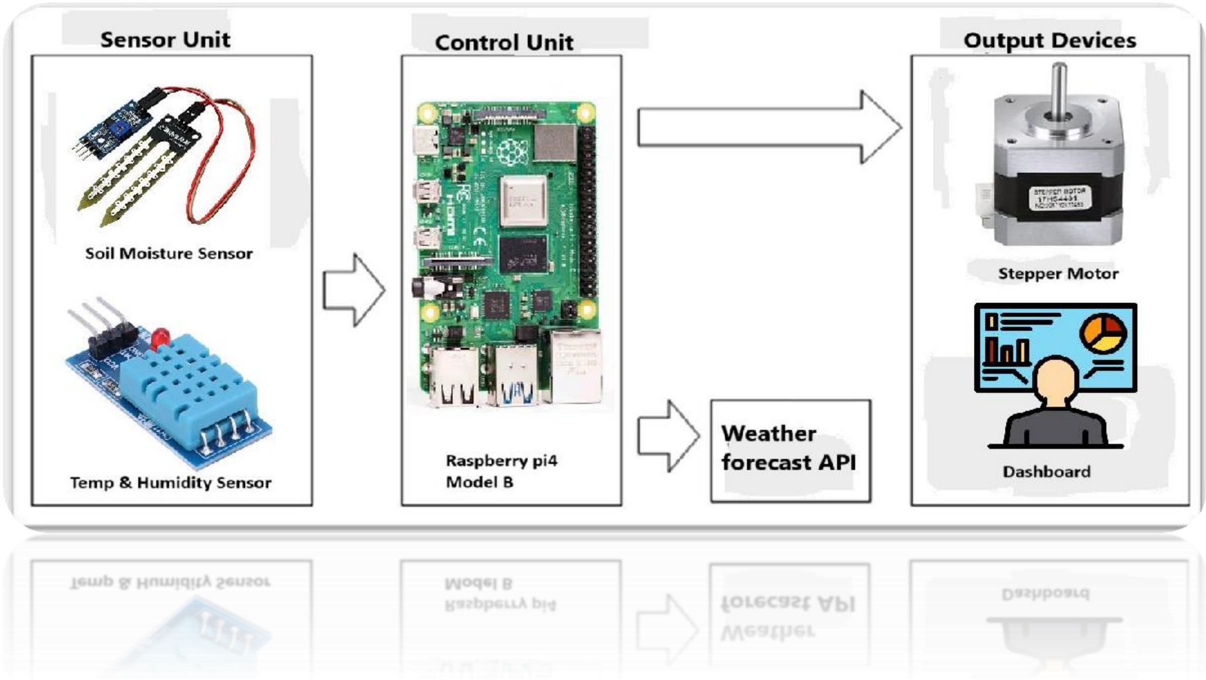

Figure 5.1: Flowchart

The brief explanation of the components in the figure 5.1 which is the flowchart of the project is as follows

Sensor Unit:

- The **Soil Moisture Sensor** detects the moisture level in the soil.
- The **Temperature and Humidity Sensor** monitors the environmental conditions, such as air temperature and humidity, which influence the irrigation process.

Control Unit:

- The **Raspberry Pi 4** acts as the central control unit. It receives data from the sensors (soil moisture, temperature, and humidity).
- Weather API: Provides external weather data for decisions.

Output Devices:

- Stepper Motor: Controls irrigation/mechanical tasks.
- Dashboard: Displays weather and system status.

Chapter 6

CONCLUSION

In conclusion, the Smart Agriculture System utilizing Raspberry Pi, sensors, and weather data integration provides an efficient, automated approach to managing irrigation. By continuously monitoring soil moisture, temperature, and humidity, the system ensures that crops receive the right amount of water, reducing water wastage and improving crop yield. The use of the Weather API allows for better planning based on real-time forecasts, further enhancing water conservation and resource management.The system's ability to display key metrics on a dashboard and sends alerts keeps farmers informed ,making it an effective tool for sustainable farming and optimized agricultural practices.

Chapter 7

FUTURE WORK

- **Machine Learning Integration**: Use predictive algorithms for better irrigation scheduling and crop management based on historical and real-time data.
- **Drone Integration**: Employ drones for real-time field monitoring, improving irrigation precision and crop health tracking.
- **Mobile Application:** Develop a user-friendly mobile app for remote access and control.
- **Energy Efficiency**: Incorporate renewable energy sources like solar panels to reduce energy consumption and make the system more sustainable.
- **Pest and Disease Detection**: Add IoT-based sensors or image recognition to detect pests and diseases, enabling timely interventions.

Chapter 8

APPENDIX

Pseudo Code

Initialization

1. **Setup GPIO**
    - Configure GPIO pins for LCD, stepper motor, and sensors.
    - Initialize LCD for display.
    - Setup stepper motor pins and define step sequence.
2. **Setup ADC (MCP3008)**
    - Initialize SPI for ADC communication to read soil moisture levels.
3. **Initialize Flask and WebSocket**
    - Create Flask app and enable WebSocket for real-time communication.

Functions

1. **LCD Functions**
    - Initialize LCD and display messages.
    - Toggle enable pin for LCD commands and data.
2. **Stepper Motor Functions**
    - Define motor step sequence and GPIO pin setup.
    - Rotate motor based on steps and direction.
3. **Sensor Reading Functions**
    - **Soil Moisture**: Read analog data from ADC.
    - **Temperature & Humidity**: Read data from the DHT sensor.

Flask Application

1. **Route**: Serve HTML page for the user interface.
2. **WebSocket Emission**: Emit sensor data (soil moisture, temperature, humidity, and status) to the web interface every 5 seconds.

Background Thread

1. Continuously perform:
    - Read soil moisture, temperature, and humidity.
    - Determine system status (Dry/Normal).
    - Emit real-time sensor data to WebSocket.
    - Activate stepper motor if soil moisture exceeds the threshold.

Main Server

1. Setup GPIO and initialize components.
2. Start the Flask server with WebSocket.
3. Handle cleanup (GPIO reset, close SPI) on exit.

Execution

- Start the Flask server when the script is executed.