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:
Sai Charan Teja

2023 - 2024

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A P S COLLEGE OF ENGINEERING

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PROJECT COMPLETION CERTIFICATE

I, **NITHISH KUMAR S** (Roll No:1AP21CS033), 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: Dr. Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

PROJECT COMPLETION CERTIFICATE

I, **PRAGNA S** (Roll No:1AP21IS023), 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 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: Dr. Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

PROJECT COMPLETION CERTIFICATE

I, **MAHENDRA R** (Roll No: 1AP21EC006), 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 Electronics and Communication Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor's Name: Dr. Prakash Jhadav **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: Smart Agriculture System

Name of the Students:

1. **Nithish Kumar S**
2. **Pragna S**
3. **Mahendra R**

External Supervisor:

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Internal Supervisor:

____

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Date:

Place:

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ABSTRACT

The Smart Agriculture System that will integrate IoT components, automation, and real-time weather data to optimize irrigation. It will utilize a Raspberry Pi to control a stepper motor for irrigation based on soil moisture levels and weather conditions. The system will read soil moisture data from an MCP3008 analog-to-digital converter, while weather information will be fetched from the OpenWeatherMap API. The Flask web application will serve as a dashboard to display sensor data, including temperature, humidity, soil moisture, and irrigation status. It will also show an upcoming irrigation schedule based on the weather forecast. Notifications will be sent to the user via the Twilio API to keep them updated on irrigation activities. The stepper motor will operate continuously when soil moisture is low and will stop when the soil is sufficiently hydrated. This system will provide an automated solution for farmers, ensuring efficient water use and improving crop management by integrating machine learning, IoT, and real-time data.

Chapter 1

INTRODUCTION

This project combines hardware components like stepper motors and soil moisture sensors with software tools such as Flask and APIs to create a robust smart agriculture system. The system automates irrigation by analyzing real-time soil moisture levels and weather forecasts, ensuring efficient water usage and reducing manual intervention. A web dashboard provides insights into the system's performance, sensor data, and upcoming irrigation schedules.

2.1 Objective

The primary objectives of the Smart Agriculture System are to design and implement an efficient irrigation system that optimizes water usage. The system aims to collect and monitor soil moisture and environmental data in real time, enabling automated irrigation based on dynamic weather and soil conditions. A web-based dashboard will be developed for users to visualize the collected data and manage the system remotely. Additionally, the system will notify users of critical irrigation events through SMS, ensuring timely interventions and better resource management.

2.2 Problem Statement

- Water management is a crucial issue in agriculture, particularly in regions with water scarcity.
- Traditional irrigation methods often lead to wastage, inefficiency, and inconsistent crop health.
- This project aims to solve these problems by implementing an IoT-enabled system.
- The system will automate irrigation, reducing the need for manual intervention.
- It will enhance productivity by providing real-time monitoring and control

Chapter 2

APPLICATIONS

- **Agricultural Fields**

  In large-scale farms, especially in regions with water scarcity, the Smart Agriculture System helps optimize water usage. It uses sensors to monitor soil moisture and weather conditions in real-time, ensuring that water is only used when necessary. This prevents over-irrigation and helps conserve water resources, which is critical in areas facing droughts or limited water supply. Additionally, it can be scaled to monitor multiple fields and provide data analytics to improve crop yields and resource efficiency.

- **Home Gardening**

  The system simplifies irrigation for personal gardens or lawns. Homeowners can automate watering schedules based on the moisture levels of the soil, ensuring that plants receive the right amount of water without manual intervention. This reduces the time and effort spent on maintaining a garden while also promoting water conservation. The system can be controlled remotely, allowing users to adjust settings or monitor conditions from a smartphone or computer.

- **Greenhouses**

  In controlled environments like greenhouses, maintaining the right temperature, humidity, and soil moisture is crucial for the healthy growth of crops. The Smart Agriculture System helps by constantly monitoring these conditions and adjusting irrigation systems accordingly. It can automate watering and nutrient delivery, reducing human error and maintaining optimal conditions for plant growth. The system also helps reduce water wastage by ensuring irrigation only occurs when needed.

- **Research and Education**

  The Smart Agriculture System can be used in educational settings to demonstrate the principles of Internet of Things (IoT), automation, and sustainable farming practices. Students and researchers can interact with the system to understand how sensors work, how data is collected and analyzed, and how automated systems can be used to improve agricultural efficiency. It serves as a hands-on learning tool for those studying agriculture, environmental science, and technology.

- **Government Initiatives**

  Governments can adopt the Smart Agriculture System to promote sustainable farming practices and water conservation across large agricultural areas. By implementing the system at a national or regional level, governments can encourage farmers to adopt water-saving techniques, which is crucial in areas where water resources are limited. The system can also provide valuable data for policymakers to develop strategies for water management, environmental sustainability, and agricultural policies. This scalability makes it an ideal solution for large-scale adoption in agricultural development programs.

Chapter 3

COMPONENTS

4.1 Raspberry pi 4 Model B

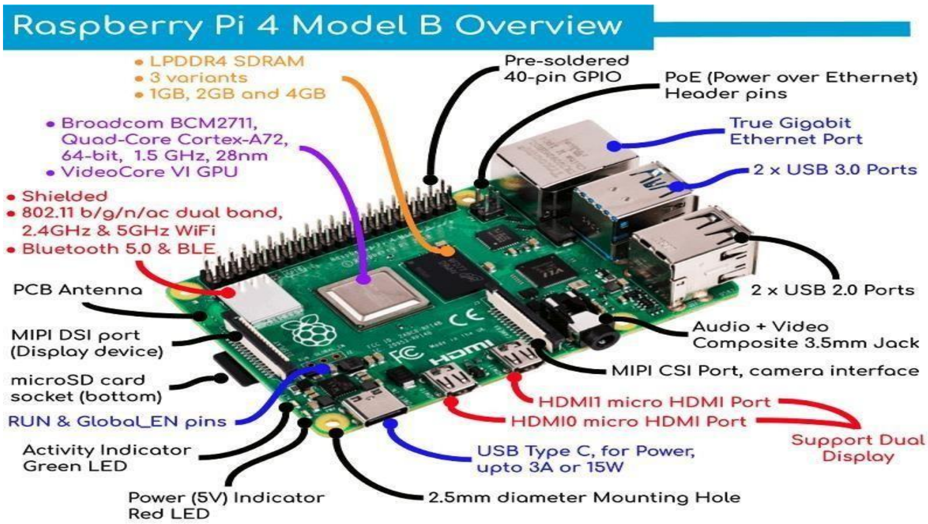


Figure 4.1: Raspberry pi 4 Model B.

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.

4.2 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.

4.3 Soil Moisture Sensor

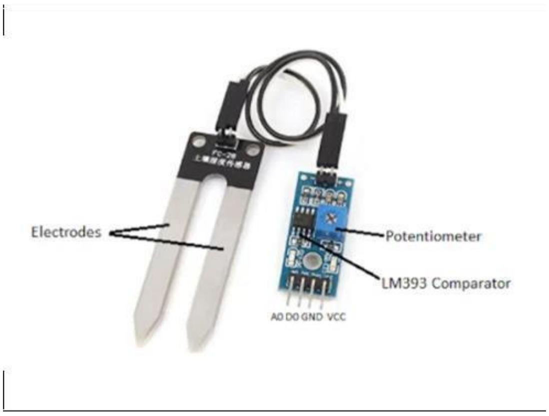


Figure 4.3: Soil Moisture Sensor.

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.

4.4 Temperature and Humidity Sensor

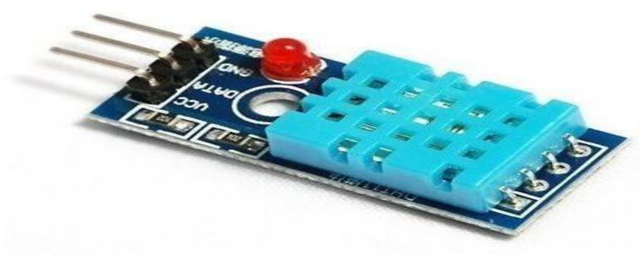


Figure 4.4: Temperature and Humidity Sensor.

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.

4.5 Flask Web Server (Software Component)

The Flask web server hosts the web application that displays the current status of the system, including moisture levels, distance readings, and motor direction. It serves as an interface forusers to monitor and manage the system remotely.

Chapter 7

FLOW CHART

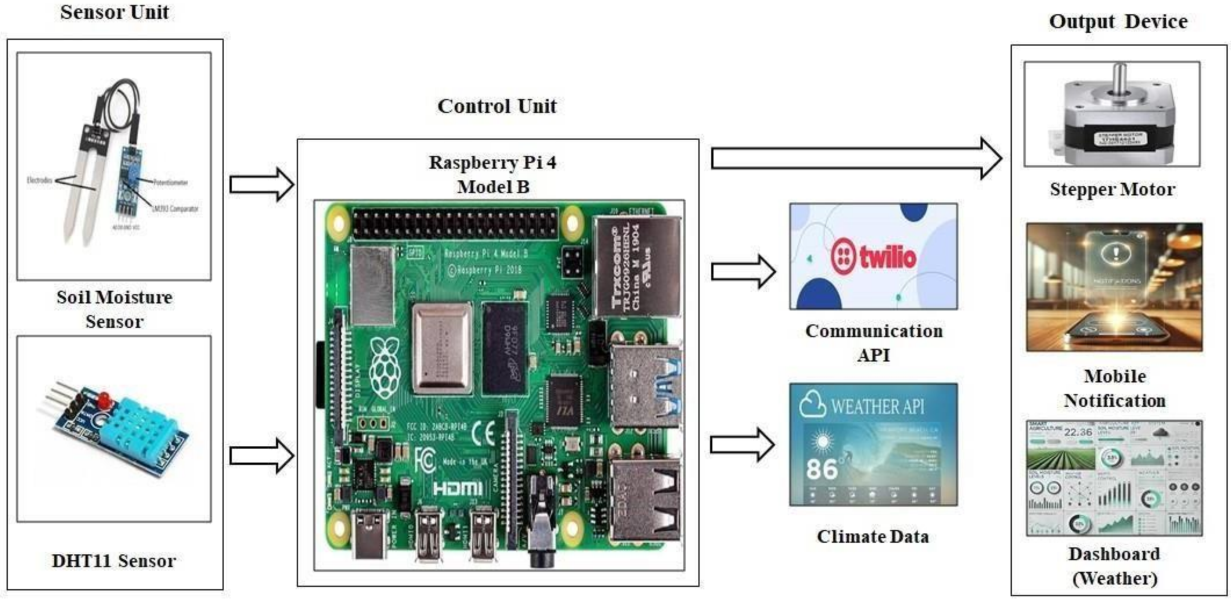


Figure 5.1: Flowchart

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

- **Sensor Unit**

  Soil Moisture Sensor: Monitors soil moisture levels.

  Temp/Humidity Sensor: Tracks ambient temperature and humidity.

- **Control Unit**

  Raspberry Pi 4: Processes sensor data.

  Twilio: Sends alerts (e.g., SMS).

  Weather API: Provides external weather data for decisions.

- **Output Devices**

  Stepper Motor: Controls irrigation/mechanical tasks.

  Mobile: Receives notifications.

  Dashboard: Displays weather and system status.

Chapter 5

CONCLUSION

The Smart Agriculture System effectively combines IoT technologies with modern agricultural practices to automate irrigation. By using real-time data from sensors and weather APIs, the system ensures efficient water usage and reduces manual intervention. The Flask-based dashboard and SMS alerts add convenience, making the system user-friendly and scalable. This project highlights the potential of IoT in transforming traditional farming into sustainable, high-tech agriculture.

Chapter 6

FUTURE WORK

- **Machine Learning:** Integrate predictive algorithms to optimize irrigation schedules based on historical data and patterns.
- **Additional Sensors:** Add sensors for temperature, humidity, pH, and light to improve crop monitoring.
- **Mobile Application:** Develop a user-friendly mobile app for remote access and control.
- **Renewable Energy:** Use solar panels to power the system for enhanced sustainability.
- **IoT Cloud Integration:** Store data on the cloud for long-term analysis and enable access from anywhere.

Chapter 7

APPENDIX

8.1 Pseudo Code

Step 1: Start

- Initialize Flask application for web dashboard.
- Import necessary libraries (RPi.GPIO, Flask, Adafruit_GPIO, threading, requests, etc.).

Step 2: Initialize Hardware Components

- Configure GPIO pins for the stepper motor.
- Set up the SPI interface for the soil moisture sensor.
- Define a sequence for the stepper motor operation.

Step 3: Fetch and Monitor Environmental Data

- Soil Moisture:
  - Read data from the soil moisture sensor using MCP3008.
  - Compare the moisture level against a predefined threshold.
- Weather Data:
  - Fetch current weather data (temperature, humidity) using OpenWeatherMap API.
  - Retrieve a multi-day weather forecast for irrigation planning.

Step 4: Notifications

- Use Twilio API to send SMS notifications when irrigation status changes.

Step 5: Control Stepper Motor

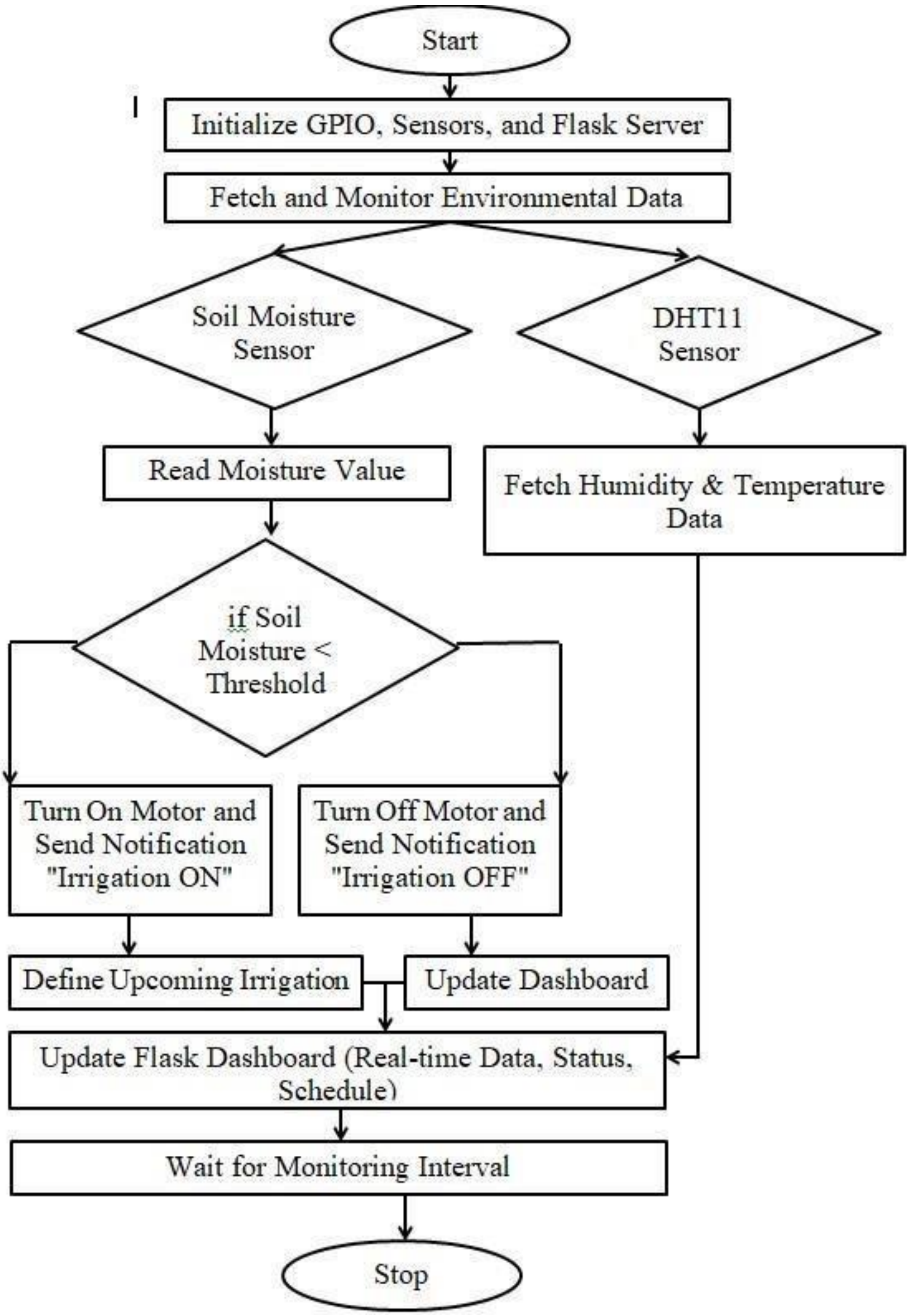
- Define a continuous stepper motor control function using the GPIO pins and sequence.
- Start or stop the motor based on irrigation status (dry or wet soil).

Step 6: Web Interface

- Create a route (`/`) for the Flask application to:
  - Display real-time sensor readings (temperature, humidity, soil moisture).
  - Show irrigation status and upcoming irrigation schedules.
  - Update the motor control status.

Step 7: Clean Up

- On application exit, clean up GPIO pins to reset hardware components safely.


Start
Initialize GPIO, Sensors, and Flask Server
Fetch and Monitor Environmental Data
Soil Moisture Sensor
DHT11 Sensor
Read Moisture Value
Fetch Humidity & Temperature Data
if Soil Moisture < Threshold
Turn On Motor and Send Notification "Irrigation ON"
Turn Off Motor and Send Notification "Irrigation OFF"
Define Upcoming Irrigation
Update Dashboard
Update Flask Dashboard (Real-time Data, Status, Schedule)
Wait for Monitoring Interval
Stop