Sri Lanka Institute of Information Technology

Smart Plant Caring System

Software Requirement Specification

Professional Engineering Practice and Industrial Management - IE2090

Project ID: PEP_19

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Table of Contents

Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

The software requirements specified in this document pertain to the Plant Caring System project, specifically identified as Project Charter - 2024 IE2090. This document outlines the necessary information for decision-makers to approve project funding during the Initiating Phase. It encompasses the needs, scope, justification, and resource commitment, facilitating the sponsor's decision to proceed or not with the project

1.2 Document Conventions

This SRS follows standard conventions for organizing software requirements. Each requirement statement is accompanied by its priority level to ensure clarity and facilitate development prioritization. Higher-level requirements' priorities are assumed to be inherited by detailed requirements unless stated otherwise.

1.3 Intended Audience and Reading Suggestions

This document is intended for various stakeholders involved in the Plant Caring System project, including developers, project managers, marketing staff, users, testers, and documentation writers. Developers and project managers should focus on understanding the technical specifications and project objectives outlined in subsequent sections. Marketing staff should pay attention to business needs and impacts, while users and testers can glean insights into the system's functionality and features. The document is organized logically, starting with an overview of the project, followed by detailed descriptions of project objectives, justification, and scope.

1.4 Product Scope

The Plant Caring System is designed to enable urban customers to effortlessly cultivate garnish herbs in their kitchens. The system aims to provide mental relaxation and access to fresh plant ingredients for individuals residing in urban areas with limited space for traditional gardening. The project is targeted for completion within a timeframe of 3 months, with an estimated budget of Rs 12000.00. The system's key benefits include enhancing operational efficiency, promoting environmental responsibility, and positively impacting customer satisfaction through the provision of fresh herbs and automated plant care solutions

1.5 References

- [1]"Arduino - Home", Arduino. cc, 2022. Available: https://www.arduino.cc/
- [2]"Arduino Uno Rev3", Arduino Online Shop, 2022. Available: https://store-usa.arduino.cc/products/nodemcu-esp8266
- [3]“Water Your Garden with IoT - Soil Moisture Sensors,” “Water Your Garden with IoT - Soil Moisture Sensors,” *www.youtube.com*. https://www.youtube.com/watch?v=pgGpuws7f9o (accessed Apr. 26, 2022)
- [4]“DroneBot Workshop,” *DroneBot Workshop*, 2016. https://dronebotworkshop.com/

2. Overall Description

2.1 Product Perspective

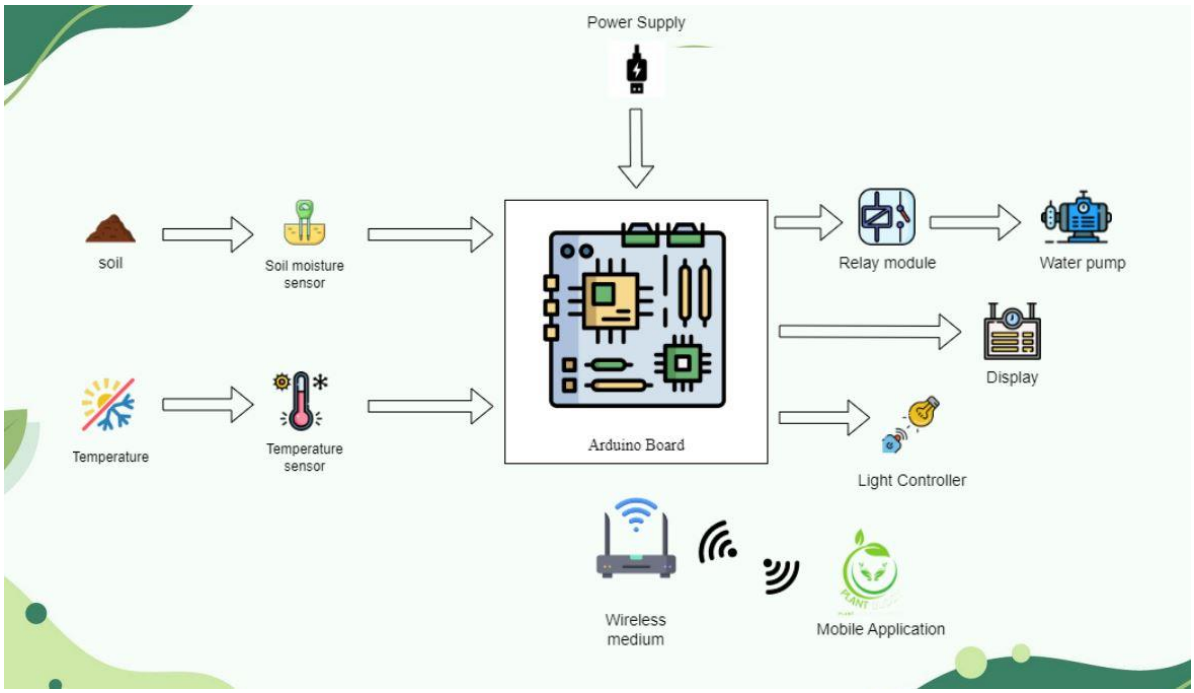
The Smart Plant Care System is designed to provide a comprehensive solution for monitoring and maintaining the health of indoor plants, meaning it takes less time and effort to get their daily garnish herbs from their kitchens. It integrates sensor technologies to capture key environmental parameters including moisture levels, humidity, temperature and light exposure. Automatic data collection and visualization through user-friendly interfaces and data can be read even from a mobile phone.

Basic features:
1. Sensor Integration: The system includes several sensors:
    - Moisture Sensor: Monitors soil moisture levels to prevent over- or under-watering.
    - Humidity Sensor: Measures air humidity to ensure optimal growing conditions.
    - Temperature Sensor: Monitors ambient temperature to prevent extremes that can damage plants.
2. Data Monitoring and Analysis: Captured data is processed and presented through a user-friendly interface:
    - Real-Time Monitoring: Users can access live data readings of their plant environment.
    - Historical Data Analysis: The system records trends over time to optimize plant protection strategies.
3. Alerts and Notifications:
    - Customizable Alerts: Users receive notifications based on predefined thresholds (eg, low moisture levels).
    - Actionable Insights: Alerts include actionable recommendations to improve plant health.
4. User interface:
    - Mobile App: Allows users to remotely monitor and control the system.
    - Dashboard: Provides summarised plant health data and trends for quick assessment.

Automation and Control:
- Integrating irrigation systems: Optional integration with automated irrigation systems for precise plant hydration.
- Light System

2.2 Product Functions

- Soil Moisture Checking
- Wifi Module App
- Display Systems & Light Systems
- Water Pumping System



2.3 User Classes and Characteristics

1. Home Gardeners
   - Enthusiastic about gardening.
   - Often have limited time to dedicate to plant care.
   - May have varying levels of experience in gardening.

2. Urban Dwellers
   - Often live in small spaces like apartments or condos.
   - Seek low-maintenance gardening solutions.
   - Interested in integrating greenery into urban living spaces.

3. Commercial Growers (Optional for advanced systems).
   - Nurseries, greenhouses, or professional growers.
   - Manage large-scale plant cultivation operations.
   - Focus on maximizing yields and minimizing resource use.

2.4 Operating Environment

The operating environment for the smart plant care system project includes hardware, software, and external factors that affect the performance and functionality of the system.

1. Hardware Requirements
    - Sensor Devices
    - Microcontroller or Processing Unit
    - Communication Modules
    - Power Supply
    - Display
2. Software Components
    - Firmware
    - User Interface (UI) Software
    - Data Storage
3. External Factors
    - Environmental Conditions
    - Network Connectivity
    - User Interaction

2.5 Design and Implementation Constraints

1. Just pick a small houseplant that will grow in the cage we're creating. That is, since different plants need different environmental conditions, it is difficult to maintain different conditions in the same room.

2. When the water tank is empty, it does not refill automatically. It needs to be refilled.

3. There is no power backup when facing a power outage.

2.6 Project Documentation

The following project documentation components will be provided
• SRS Document
• Final Report

2.7 User Documentation

• User Guide – A user guide will be provided to the users in order to inform them on how to use the system.
• SRS Document – It specifies the software & hardware requirements for the system.
• Final Report

2.8 Assumptions and Dependencies

1. Assumptions
   - If the sensor does not work, the system will not work properly.
   - There is little chance of insect damage.

2. Dependencies
   - When there is a power interruption the system will completely shut down.

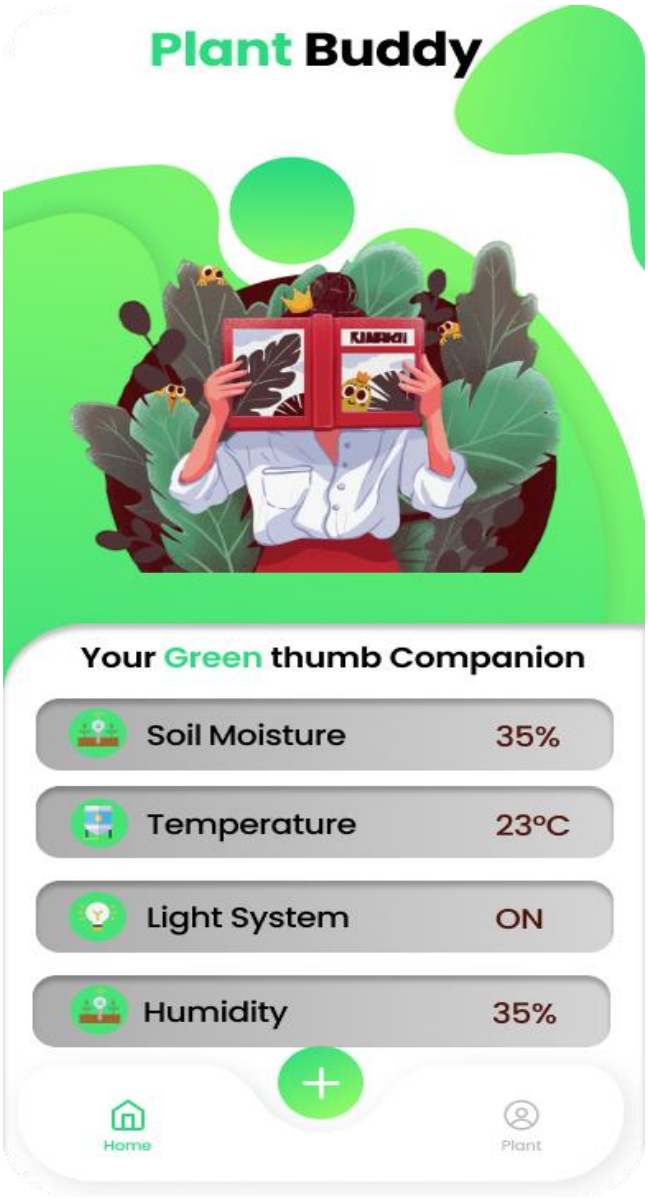
3. External Interface Requirements

3.1 User Interfaces

Sample AI-generated user interface

As shown in the above diagram the user interfaces for the Smart Plant Caring System are;

- Mobile Interface
- Humidity Sensor
- Temperature Sensor
- Soil Moisture Sensor
- Lights



Software Interface for project

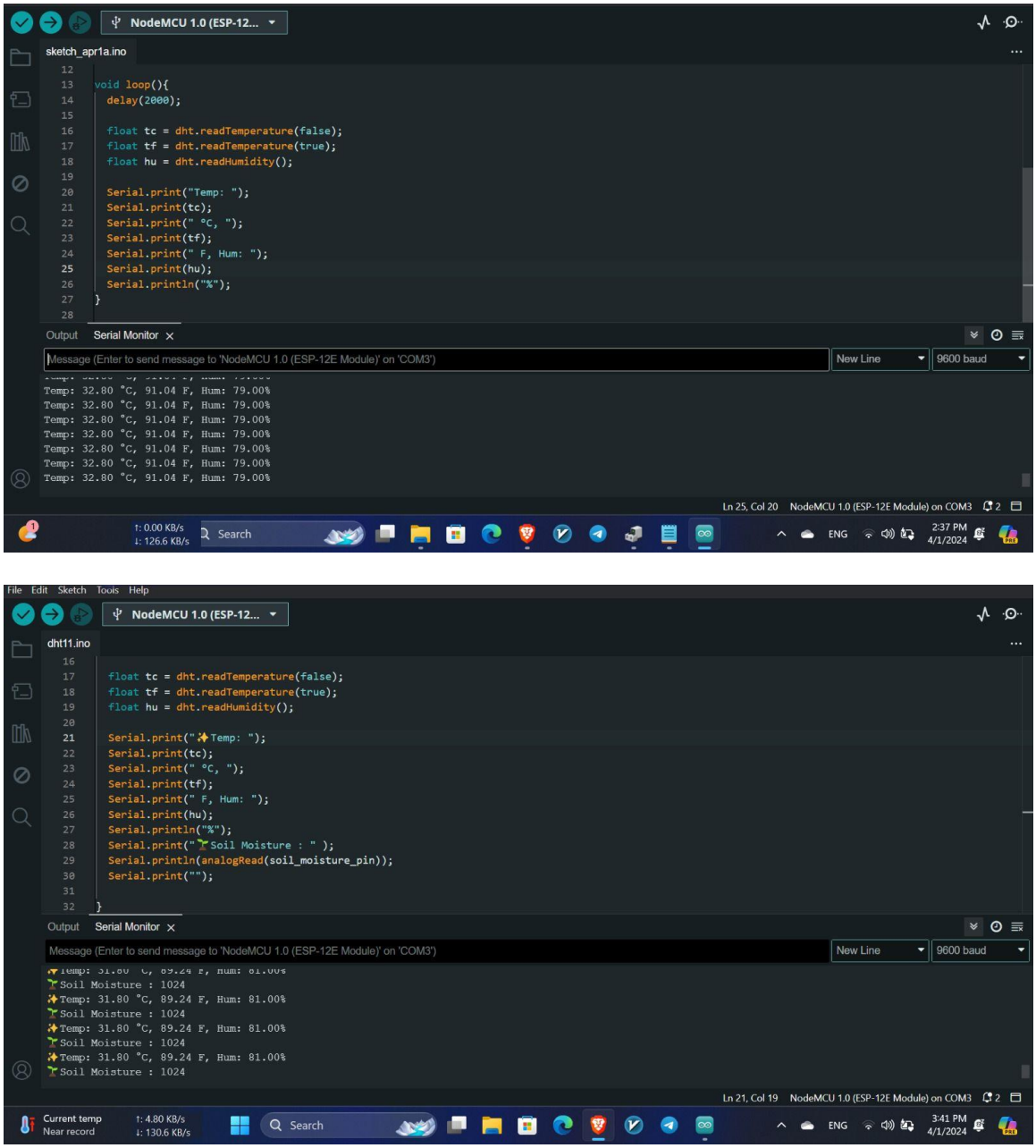
3.2 Hardware Interfaces

1. **NodeMCU ESP8266**: This is the main controller of our system. This board is used for WiFi connectivity. It can be programmed using the Arduino IDE and can communicate with the Arduino board via serial communication.
2. **Soil Moisture Sensor**: This sensor measures the moisture level in the soil. It usually has a digital output (wet/dry) and an analogue output that gives a proportional response. It can be connected to an analogue input pin on the Arduino.
3. **DHT11 Temperature and Humidity Sensor**: This sensor can measure ambient temperature and humidity. It uses a single-wire interface to communicate with the Arduino.
4. **Water Pump**: This is controlled by the Arduino based on the soil moisture level. You can use a relay module to control the pump, as the Arduino cannot drive the pump directly due to power constraints.
5. **16x2 LCD Display**: This display will show the temperature, humidity, and soil moisture level. It communicates with the Arduino via either a parallel interface or an I2C interface, depending on the model.

The logical and physical characteristics of each interface are as follows:

- **Arduino - NodeMCU ESP8266**: They communicate via serial communication. Physically, the TX/RX pins of both boards are connected (TX to RX and RX to TX).
- **Arduino - Soil Moisture Sensor**: The sensor is connected to an analogue input pin on the Arduino. The sensor's output voltage changes proportionally with the moisture level, which the Arduino reads as an analogue value.
- **Arduino - DHT11 Sensor**: The sensor communicates with the Arduino via a single-wire interface. The sensor sends a data packet every 2 seconds, which the Arduino reads.
- **Arduino - Water Pump**: The pump is controlled by a relay module, which acts as a switch. The Arduino controls the state of the relay (ON/OFF) based on the soil moisture level.
- **Arduino - LCD Display**: The display communicates with the Arduino via a parallel or I2C interface. The Arduino sends characters to be displayed to the LCD, which then renders the characters.

3.3 Software Interfaces



Software Interfaces for Smart Plant Caring System

To build this Software Interface, we use:

- Arduino IDE -Version 2.3.2
- Blink IoT/Arduino IoT

3.4 Communications Interfaces

For The smart plant caring system project, various communication interfaces are essential to enable data exchange, remote monitoring, and control functionalities. These interfaces facilitate interactions between different system components, such as sensors, microcontrollers, user interfaces, and external networks.

- Wi-Fi (802.11
  - Enables the system to connect to local wireless networks for internet access.
  - Allows remote monitoring and control of the plant caring system via a mobile app or web interface.

- Cellular Communication
  - 2G/3G/4G/LTE
  - Provides connectivity to cellular networks for remote monitoring and control in areas with cellular coverage.
  - Suitable for outdoor deployments where Wi-Fi or other wireless options are limited.

- Cloud Connectivity
  - HTTP/HTTPS
  - Facilitates communication with cloud-based servers for data storage, analysis, and remote access.
  - Enables seamless integration with cloud platforms (e.g., AWS, Google Cloud) for scalable data management.

- Microcontroller Communication Protocols
  - I2C (Inter-Integrated Circuit)
  - Common protocol for connecting sensors and peripherals to a microcontroller, allowing data exchange over short distances.
  - Suitable for intra-board communication within the system.

- SPI (Serial Peripheral Interface)
  - Enables high-speed communication between microcontrollers and peripherals (e.g., display modules, memory devices).
  - Supports full-duplex data transfer for efficient data exchange.

4. System Features

System Feature 1: Water Pumping System – IT22895264

F	Water pump activation
Input	Activation signal from the system
Process	Send a signal to the water pump
Output	Turn on the water pump

F	Water pump deactivation
Input	Deactivation signal from the system
Process	Send a signal to the water pump
Output	Turn off the water pump

System Feature 1: Soil Moisture Checking – IT22344342

F	Soil moisture sensing for water pump activation
Input	Soil moisture value from the system
Process	Comparing the current soil moisture value with the defined soil moisture value (If current soil moisture is lower than the defined soil moisture)
Output	Send a water pump activation signal to the system

F	Soil moisture sensing for water pump deactivation
Input	Soil moisture value from the system
Process	Comparing current soil moisture value with the defined soil moisture value (If the current soil moisture is higher than the defined soil moisture)
Output	Send a water pump deactivation signal to the system

F	Soil moisture value conversion
Input	Sensor reading from the soil moisture sensor
Process	Convert sensor value into readable percentage value
Output	Send the converted value into the system

System Feature 1:Display & Light System– IT22365200

F	Light activation
Input	The current time from the system
Process	Compare the current time and the defined light turn-on time (If the current time equals the defined light turn on time and send an activation signal to the light)
Output	Turn on the light

F	Light system
Input	The current time from the system
Process	Compare the current time and the defined light turn-on time (If the current time is not equal to the defined light turn-on time)
Output	Again check the time

F	Light system
Input	The current time from the system
Process	Compare the current time and the defined light turn-off time (If the current time is not equal to the defined light turn-off time)
Output	Again check the time

F	Light deactivation
Input	The current time from the system
Process	Compare the current time and the defined light turn-off time (If the current time equals the defined light turn-off time send a deactivation signal to the light)
Output	Turn off the light

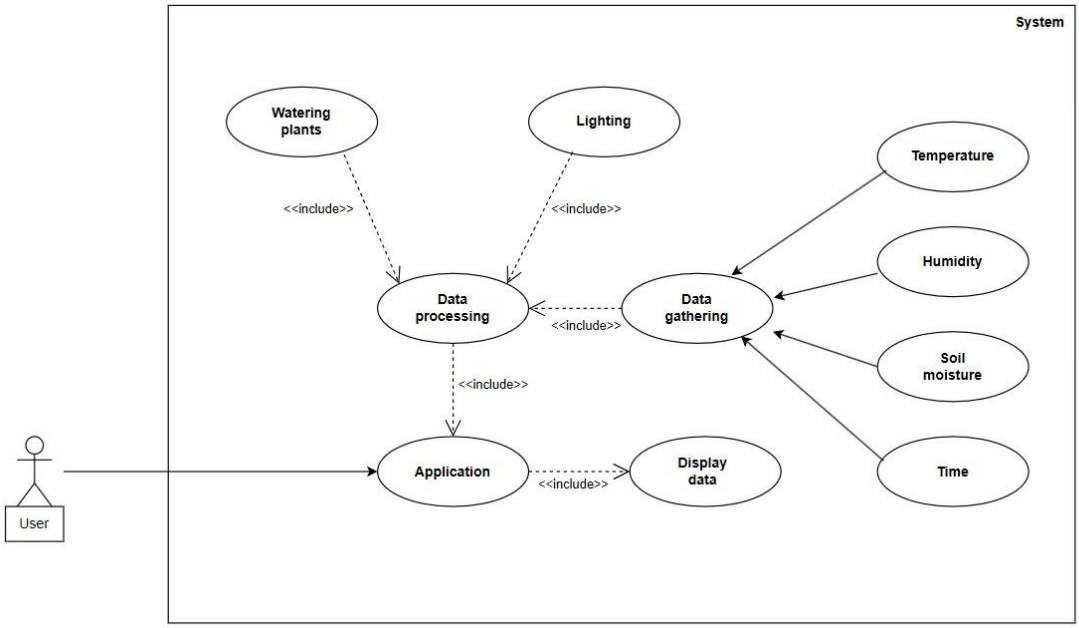
System Feature 1: Wifi Module Application– IT22360328

F	Display the current temperature in the application
Input	Sensor readings from the temperature sensor
Process	Send the temperature value to the application
Output	Display the temperature

F	Display the current humidity in the application
Input	Sensor readings from the humidity sensor
Process	Send the humidity value to the application
Output	Display the humidity

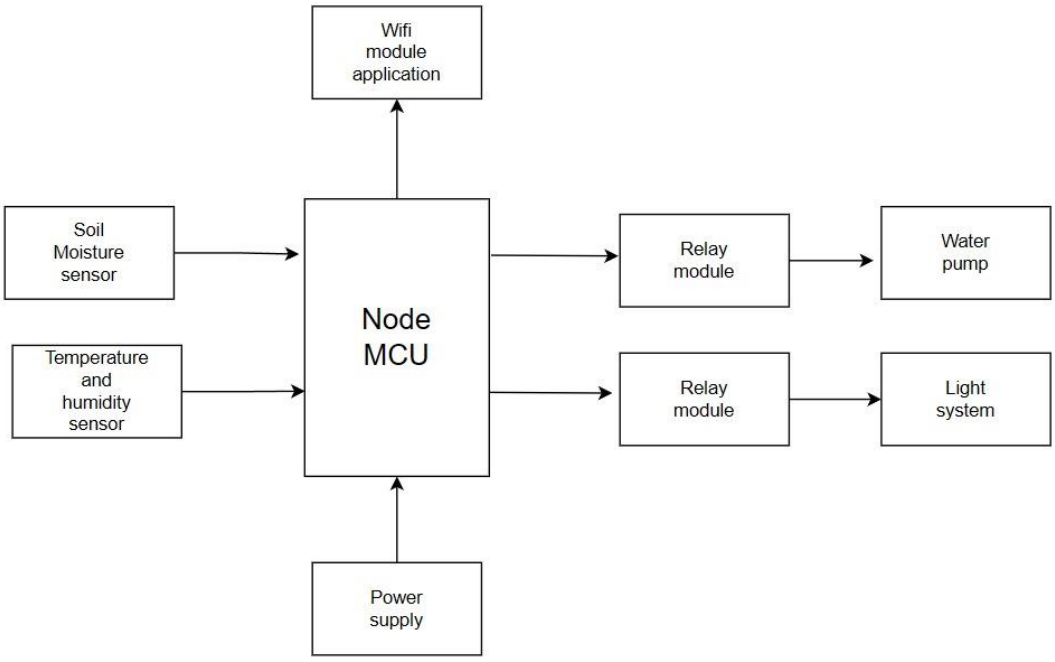
F	Display the soil moisture in the application
Input	Soil moisture value from the system
Process	Send the soil moisture value to the application
Output	Display the soil moisture value

Use case Diagram



USE CASE Diagram for Plant Caring System

Design Diagram



Design Diagram for Plant Caring System

5. Other Nonfunctional Requirements

5.1 Performance Requirements

- A proper power supply should be provided to the product.
- Soil moisture should provide accurate readings for efficient watering.
- The water pump should work when the soil moisture drops below a certain threshold. So the pump should work with a good response time.
- The temperature and humidity sensors must provide real-time and accurate data.
- The light timer should switch on and off at desired intervals with consistent timing.

5.2 Safety Requirements

- Electrical safety
  Avoid contact with electrically conductive liquids and materials, and electrical components to avoid short circuits.
- Usage safety
  After installation, the product must be handled with care as it contains water. Water may leak in case of product failure
- Environment safety
  Dispose of the electronic components responsibly.

5.3 Security Requirements

- Data Privacy:

Users should be aware that their user data (e.g. soil moisture, temperature) travels over the Internet.

- Physical Security:

Place the product in a safe and stable place.

Protect electronic devices from environmental factors

5.4 Software Quality Attributes

- Reliability:

Our product aims to ensure reliable operation, with a target of at least 99% uptime during normal operation.
It should be able to recover from failures gracefully without causing data loss or system instability.

- Maintainability:

The system should be designed with modular components and clear documentation to facilitate ease of maintenance and future enhancements.
The codebase should adhere to coding standards and best practices to simplify troubleshooting and debugging.

- Usability:

The user interface should be intuitive and easy to navigate, allowing users to interact with the system without extensive training.
A usability testing process will be conducted to ensure that the product meets the needs and expectations of our customers.

5.5 Business Rules

- User Roles and Permissions:

Users will be categorized into different roles such as administrators, regular users, and guests. Administrators will have full access to all system functions, including user management and configuration settings. Regular users will have access to basic functionalities such as monitoring plant status and adjusting settings.
Guests may have limited access, such as viewing public plant information without the ability to make changes.

- Access Control:

Only authorized users with valid credentials will be allowed to access the system.
Access to sensitive information and critical functions will be restricted based on user roles and permissions.

- Data Privacy:

Personal data collected from users, such as login credentials and plant care history, will be kept confidential and protected from unauthorized access. Compliance with data protection regulations, such as GDPR, will be ensured to maintain user privacy and trust.