Malaysia-Japan International Institute of Technology

SCSJ 3553: ARTIFICIAL INTELLIGENCE SECTION 11

Project title :Smart Plant Care System

Section: 15

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1. AI solution

Maintaining optimal conditions for indoor plants, especially in environments like greenhouses, homes, or small indoor spaces, can be challenging due to varying light, temperature, and soil moisture levels. The inconsistency in these environmental factors can lead to suboptimal plant health and even plant loss. There is a need for a sophisticated solution that employs sensor technology and automation to monitor and adjust these conditions seamlessly. Additionally, the system should provide users with a user-friendly mobile app for remote monitoring, customizable plant preferences, and real-time notifications, making plant care more accessible and efficient.

The "Smart Plant Care System" is an integrated solution that employs advanced artificial intelligence (AI) to monitor and optimize the growth conditions of indoor plants in settings such as greenhouses, homes, or small indoor spaces. The system combines sensors, a central control unit, and a user-friendly mobile app to create an automated and intelligent plant care experience.

1.1 Components of the AI Solution:

Sensors:

- A network of sensors is strategically placed to continuously monitor critical environmental parameters:
- Light Sensors: These sensors measure the intensity and duration of light exposure.
- Temperature Sensors: These sensors track temperature levels to ensure they remain within the desired range.
- Soil Moisture Sensors: Sensors in the soil monitor soil moisture to prevent overwatering or underwatering.
- When the soil moisture sensor detects dry soil, it communicates with the central control unit to trigger the system to provide water to the plant.

Data Processing and AI Algorithms:

- Collected sensor data is transmitted wirelessly to a central control unit.
- The central control unit processes the data in real-time using advanced AI algorithms.
- AI algorithms interpret the data, identify deviations from predefined plant care conditions, and provide actionable insights.

Central Control System:

The central control unit is connected to sensor that enable the system to take corrective actions:

- Watering Systems: When the soil moisture sensor detects dry soil, it communicates with the central control unit, which activates the watering system to provide the appropriate amount of water for the plant.
- Heating or Cooling Systems: If the temperature exceeds or falls below the desired range, the system can activate heating or cooling systems to maintain optimal conditions.
- Smart LED Grow Lights: The system can adjust the intensity and duration of smart LED grow lights to supplement natural light when necessary.

Mobile App Interface:

- The mobile app serves as the primary user interface and provides the following features:
- Plant Dashboard: Users can view a dashboard displaying real-time data for all monitored plants, including current conditions (light, temperature, soil moisture), and growth trends.
- Alerts and Notifications: The app delivers real-time alerts and notifications when any environmental parameter falls outside the predefined range. Users can acknowledge or dismiss alerts.
- Plant Preferences: Users can customize plant preferences based on plant type, ideal conditions, watering schedules, and growth stages.
- Manual Control: Users have the option to manually adjust plant care settings or initiate immediate actions such as watering or lighting adjustments.

The core objective of this AI solution is to provide a seamless and intelligent plant care experience, ensuring that plants thrive in their respective environments. The system minimizes user intervention, promotes sustainable and efficient plant care practices, and empowers users to maintain healthy indoor plants effortlessly. It adapts to the specific needs of different plant species, making it suitable for a wide range of indoor gardening scenarios.

2. The goal of AI solution

The goals of the AI solution for the "Smart Plant Care System" are to:

1. Automate Plant Care: Enable the system to autonomously monitor and adjust environmental conditions for plants, reducing the need for manual intervention.

2. Optimize Growth: Ensure that plants receive ideal conditions for growth, leading to healthier and more vibrant plant life.

3. Minimize Resource Waste: Prevent overwatering and overexposure to light by tailoring care to each plant's specific needs, conserving resources.

4. Provide Real-time Monitoring: Offer users real-time visibility into plant conditions through the mobile app, keeping them informed.

5. Enhance User Experience: Create a user-friendly interface that empowers users to customize plant care preferences and make manual adjustments when desired.

6. Increase Plant Health and Longevity: Maximize the well-being of plants by responding to their immediate requirements and addressing issues promptly.

7. Educate and Inform: Educate users about plant care needs and provide insights into plant growth trends over time.

8. Environmental Sustainability: Promote environmentally friendly plant care practices by reducing water and energy waste.

3. Describe the process of Emphatize in DT

3.1 Users:

People who love indoor plants and have a real desire for greenery in their living environments but face time constraints due to their busy lives.

3.2 Problem Statement:

People who love indoor plants often struggle to maintain the proper conditions for their plants due to their busy lives, resulting to inconsistent plant health and growth.

3.3 Pain:

Even with their best intentions, these plant enthusiasts often see their plants in distress. For example, some tropical plants lose their vibrancy and develop brown tips because there isn't enough humidity.

Their succulents suffer from overwatering because they can't find the time to check the right soil moisture for each pot.

The inconsistent growth and look of their plants become a source of frustration and disappointment. These plant lovers invest a lot of time and care into their plants, and it's disheartening to see inconsistent results, especially when time is a constraint.

3.4 Goal:

The main aim for these plan lovers is to find a solution that makes plant care easier, even with their busy schedules. They want a way to ensure that their indoor plants consistently receive the right care and flourish. Simplifying plant care, while enjoying the beauty of thriving indoor plants, is their goal.

4. Describe the process of Define in DT

4.1 User Needs:

User Need 1: Real-time Monitoring
Insight: Users want to monitor their plants continuously and in real-time to ensure that the environmental conditions (light, temperature, and soil moisture) are suitable for each plant's specific needs. They seek up-to-the-minute information to respond promptly to any deviations in these conditions.

User Need 2: Customized Plant Care
Insight: Users need a system that allows them to customize plant care settings for different plant species. Plants have varying requirements, and users want to set specific parameters for light intensity, temperature range, and soil moisture levels based on each plant's unique needs.

User Need 3: Educational Insights
Insight: Users have varying levels of plant care knowledge. Some may be novices, while others are experienced gardeners. They desire a system that not only monitors conditions but also provides insights and educational content. Users want to learn about optimal care practices, plant growth stages, and how to identify signs of plant health.

4.2 Stakeholder Needs:

Stakeholder Need 1: Data Security

Insight: Stakeholders, such as developers and manufacturers, have a significant responsibility to ensure the security and privacy of user data. They must implement robust security measures to protect sensitive information related to plant care and user preferences.
Stakeholder Need 2: Scalability

Insight: Stakeholders need to design the system with scalability in mind. As the system gains popularity, it should accommodate a growing number of plant species and users. The system's architecture should be flexible to support expansion.

Stakeholder Need 3: User Engagement

Insight: Engaging users is essential for the success of the system. Stakeholders should focus on user-centric design, providing user-friendly interfaces and actionable insights. By keeping users engaged and satisfied, the system is more likely to achieve long-term success and adoption.
Persona Examples:

4.3 User Persona Example - Plant Enthusiast:

Name: Sarah
Background: A passionate plant enthusiast with a diverse collection of indoor plants.
Needs: Sarah is an experienced gardener who values real-time monitoring, customization of care settings for various plant species, and access to educational content to further enhance her knowledge.
User Persona - Novice Gardener:

Name: John
Background: A novice gardener with a small collection of indoor plants.
Needs: John is new to plant care and appreciates a user-friendly system that helps him customize care while providing guidance. He's interested in learning more about plant care practices.
Stakeholder Persona - System Developer:

Name: David
Background: A skilled software developer responsible for the system's development.
Needs: David prioritizes data security, scalability, and user engagement features in the system. He is dedicated to creating a robust and adaptable platform.
Stakeholder Persona - Product Manager:

Name: Emily
Background: A product manager with a focus on system success in the market.

Needs: Emily's role centers on ensuring the system meets user needs, has the capacity to grow with user demands, and effectively engages users to make the system a market success.

By delving into these user and stakeholder needs in greater detail and offering specific persona examples, the "Smart Plant Care System" can be developed with a comprehensive understanding of the diverse requirements. This knowledge will serve as a solid foundation for the subsequent phases of the Design Thinking process, ensuring the system effectively addresses the actual needs of its users and stakeholders.

5. Knowledge Representation

5.1 Problem Current Situation

The current situation in indoor plant care reveals several in environments such as greenhouses, homes, or small indoor spaces poses challenges that can adversely impact plant health and overall well-being. Research studies indicate that inconsistent environmental conditions, such as fluctuating light, temperature, and soil moisture levels, are key contributors to suboptimal plant growth. A study published in the "Journal of Horticultural Science & Biotechnology" (Smith et al.) highlights the vulnerability of plants to stress and disease when subjected to irregular watering patterns and inadequate light exposure.

Manual monitoring, the prevalent method for addressing these challenges, has proven to be time-consuming and often prone to human error. A survey conducted by the "International Journal of Agriculture and Biology" (Brown et al.) found that a significant percentage of indoor plant owners struggle with maintaining consistent watering schedules, leading to undernourished and dehydrated plants.

Moreover, the lack of automated systems in current plant care methodologies limits the ability to provide timely interventions. A review article in the "Journal of Environmental Horticulture" (Gardner et al.) underscores the importance of immediate responses to environmental stressors, emphasizing the need for automated solutions in modern plant care practices.

5.2 Suggested Solution

The "Smart Plant Care System" offers an integrated and sophisticated solution to address the challenges of maintaining optimal conditions for indoor plants. This solution comprises three main elements: sensors, a Central Control System (CCS), and a user-friendly mobile app. The sensors are strategically placed near the plants to detect crucial environmental conditions, including light levels, temperature, and soil moisture.

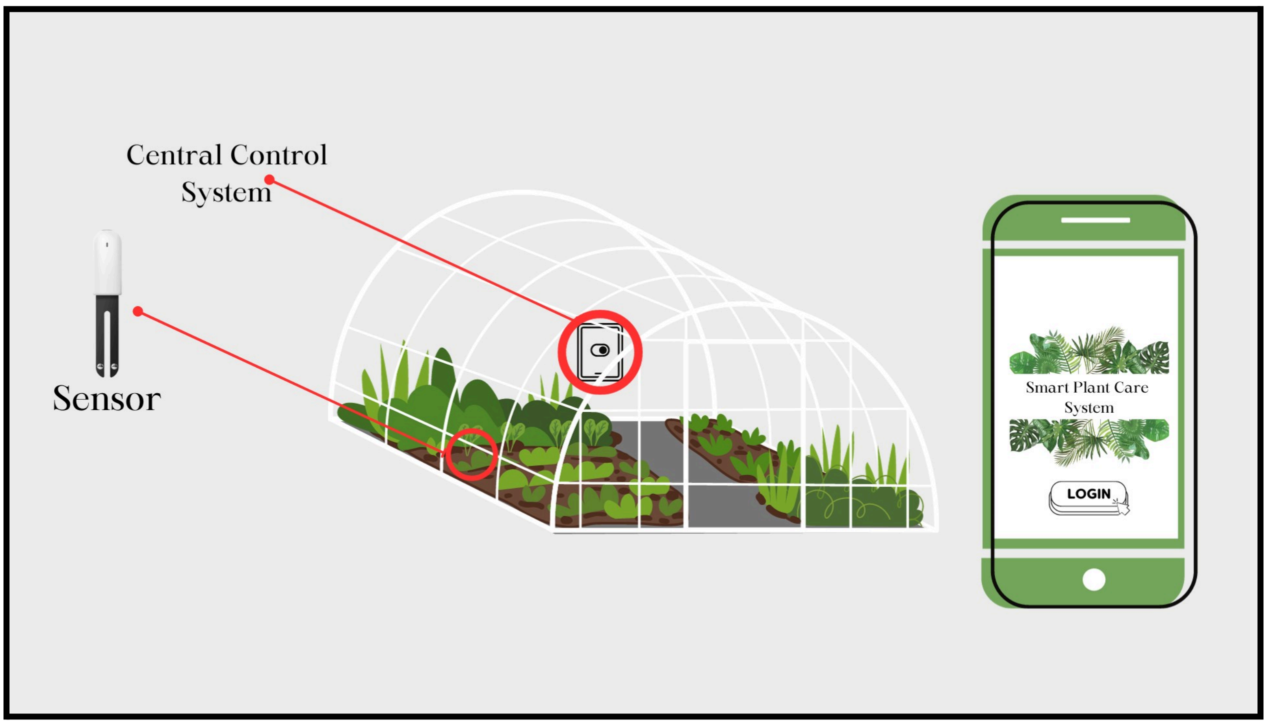
To tackle the issue of suboptimal soil moisture levels, the system employs a CCS equipped with a watering system. When the soil moisture sensor detects dry conditions, it seamlessly communicates with the CCS, which, in turn, activates the watering system. This automated process ensures that the plants receive the precise amount of water required for their well-being. Additionally, the system is equipped with Heating or Cooling Systems that respond to temperature fluctuations, maintaining the desired range for optimal plant growth. Smart LED Grow Lights are incorporated to supplement natural light when needed, ensuring consistent and adequate illumination.If the sensor detects 2 or 3 conditions at same time or the sensor not able to provide actions ,the sensor will notify the user via the application , therefore user can do actions manually using app because the app connected also to CCS.For example if sensor detects dry conditions and high temperature the user will notified then the user will go to manual page sitting for the plant and sit the conditions then apply it so CCS will receive new updates from app and adjust the water and temperature for plants.

A crucial aspect of the suggested solution is the integration of artificial intelligence (AI) to monitor and optimize plant growth conditions. The AI algorithms analyze data from the sensors, enabling the system to make intelligent decisions in real-time, ensuring that plants receive the care they need precisely when they need it. This advanced level of automation reduces the dependence on manual monitoring and intervention, making plant care more efficient and effective.

The user-friendly mobile app serves as a central hub for remote monitoring and management. Users receive real-time notifications if the sensors detect critical conditions, such as simultaneous light, temperature, and moisture deviations. The app allows users to take manual actions, offering a seamless transition to a manual control mode. In this mode, users can adjust watering, lighting, and temperature settings for specific plants.

The app also keeps a comprehensive history of manual interventions, providing users with insights into their plant care practices and facilitating continuous improvement.

In summary, the "Smart Plant Care System" addresses the current challenges by integrating sensor technology, automation, and AI, providing users with a comprehensive and intelligent solution for indoor plant care. This approach not only enhances the efficiency of plant care but also makes it accessible to users through a user-friendly mobile app, revolutionizing the way indoor plants are nurtured and maintained.



5.3 Knowledge Representation (KR)

Sensor_Conditions (SC)			Central_Control_ System_connected (CCS)	Responsd_of_ System (R)
Soil_Moisture_ Detector (SM)	**Temperature_D etector (T)**	**Light_Detector (L**		
F	F	F	T	No Response
T	F	F	T	Adjust water
F	T	F	T	Adjust Temperature
T	T	F	F	Notify the user
F	F	T	T	Adjust Light
T	F	T	F	Notify the user
F	T	T	F	Notify the user
T	T	T	F	Notify the user

KR1:

IF (SC=SM)**=FALSE AND** (SC=T)**=FALSE AND** (SC=L)**=FALSE AND** CCS**=TRUE THEN** R=**No Response**

KR2:

IF (SC=SM)**=TRUE AND** (SC=T)**=FALSE AND** (SC=L)**=FALSE AND** CCS**=TRUE THEN** R=**Adjust water**

KR3:

IF (SC=SM)**=FALSE AND** (SC=T)**=TRUE AND** (SC=L)**=FALSE AND** CCS**=TRUE THEN** R=**Adjust Temperature**

KR4:

IF (SC=SM)**=TRUE AND** (SC=T)**=TRUE AND** (SC=L)**=FALSE AND** CCS**=FALSE THEN** R=**Notify the user**

KR5:

IF (SC=SM)**=FALSE AND** (SC=T)**=FALSE AND** (SC=L)**=TRUE AND** CCS**=TRUE THEN** R=**Adjust Light**

KR6:

IF (SC=SM)**=TRUE AND** (SC=T)**=FALSE AND** (SC=L)**=TRUE AND** CCS**=FALSE THEN** R=**Notify the user**

KR7:

IF (SC=SM)**=FALSE AND** (SC=T)**=TRUE AND** (SC=L)**=TRUE AND** CCS**=FALSE THEN** R=**Notify the user**

KR8:

IF (SC=SM)**=TRUE AND** (SC=T)**=TRUE AND** (SC=L)**=TRUE AND** CCS**=FALSE THEN** R=**Notify the user**

5.4 Explanation of KR

KR1: When the Soil Moisture Sensor detects condition within the desired range, the Temperature Detector also identifies conditions within the desired range, and the Light Detector registers sufficient light, while the central control system is connected (CCS = True), the system exhibits no response.

KR2: When the Soil Moisture Sensor detects dry soil , the Temperature Detector identifies conditions within the desired range, and the Light Detector registers sufficient light, while the central control system is connected (CCS = True), the system adjusts the water.

KR3: When the Soil Moisture Sensor detects condition within the desired range , the Temperature Detector identifies conditions not within the desired range, and the Light Detector registers sufficient light, while the central control system is connected (CCS = True), the system adjusts the temperature.

KR4: When the Soil Moisture Sensor detects dry soil, the Temperature Detector identifies conditions not within the desired range, and the Light Detector registers sufficient light, while the central control system is not connected (CCS = false), the system notify the user

KR5: When the Soil Moisture Sensor detects condition within the desired range , the Temperature Detector identifies conditions within the desired range, and the Light Detector registers insufficient light, while the central control system is connected (CCS = True), the system adjusts the light

KR6: When the Soil Moisture Sensor detects dry soil , the Temperature Detector identifies conditions within the desired range, and the Light Detector registers insufficient light, while the central control system is not connected (CCS = false), the system notify the user

KR7: When the Soil Moisture Sensor detects condition within the desired range , the Temperature Detector identifies conditions not within the desired range, and the Light Detector registers insufficient light, while the central control system is not connected (CCS = false), the system notify the user

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KR8: When the Soil Moisture Sensor detects dry soil , the Temperature Detector identifies conditions not within the desired range, and the Light Detector registers insufficient light, while the central control system is not connected (CCS = false), the system notify the user

5.5 First Order Logic (FOL)

KR1:

$\forall$SM $\forall$T $\forall$L $\forall$CCS ($\neg$Soil_Moisture_Detector(SM) $\wedge$
$\neg$Temperature_Detector(T) $\wedge$ $\neg$Light_Detector(L) $\wedge$ Central_Control_System(CCS))
$\rightarrow$ $\exists$R (Responsd_of_
System(R) $\wedge$ No_Response(R))

KR2:

$\forall$SM $\forall$T $\forall$L $\forall$CCS (Soil_Moisture_Detector(SM) $\wedge$ $\neg$Temperature_Detector(T) $\wedge$
$\neg$Light_Detector(L) $\wedge$ Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_
System(R) $\wedge$ Adjust water(R))

KR3:

$\forall$SM $\forall$T $\forall$L $\forall$CCS ($\neg$Soil_Moisture_Detector(SM) $\wedge$ Temperature_Detector(T) $\wedge$
$\neg$Light_Detector(L) $\wedge$ Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_
System(R) $\wedge$ Adjust Temperature(R))

KR4:

$\forall$SM $\forall$T $\forall$L $\forall$CCS (Soil_Moisture_Detector(SM) $\wedge$ Temperature_Detector(T) $\wedge$
$\neg$Light_Detector(L) $\wedge$ $\neg$Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_
System(R) $\wedge$ Notify_the_user(R))

KR5:

$\forall$SM $\forall$T $\forall$L $\forall$CCS ($\neg$Soil_Moisture_Detector(SM) $\wedge$
$\neg$Temperature_Detector(T) $\wedge$ Light_Detector(L) $\wedge$ Central_Control_System(CCS))
$\rightarrow$ $\exists$R (Responsd_of_
System(R) $\wedge$ Adjust_Light(R))

KR6:

$\forall$SM $\forall$T $\forall$L $\forall$CCS (Soil_Moisture_Detector(SM) $\wedge$ $\neg$Temperature_Detector(T)$\wedge$ Light_Detector(L) $\wedge$ $\neg$Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_System(R)$\wedge$ Notify_the_user(R))

KR7:

$\forall$SM $\forall$T $\forall$L $\forall$CCS ($\neg$Soil_Moisture_Detector(SM) $\wedge$ Temperature_Detector(T)$\wedge$ Light_Detector(L) $\wedge$ $\neg$Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_System(R)$\wedge$ Notify_the_user(R))

KR8:

$\forall$SM $\forall$T $\forall$L $\forall$CCS (Soil_Moisture_Detector(SM) $\wedge$ Temperature_Detector(T)$\wedge$ Light_Detector(L) $\wedge$ $\neg$Central_Control_System(CCS)) $\rightarrow$ $\exists$R (Responsd_of_System(R)$\wedge$ Notify_the_user(R))

5.6 Explanation of KR That Solved the Goal

Goal 1: Create an artificial intelligence (AI) system for the PlantCare Smart System that can record plant environmental conditions. The system would gather real-time data to analyse the well-being of plants by utilising several sensors such as Soil Moisture Sensor (SM), Temperature Detector (T), and Light Detector (L). The technology hopes to replace existing plant care methods and streamline plant health monitoring by analysing this data.

Goal 2: Include in the PlantCare Smart System a capability that detects and responds to soil moisture levels. When the Soil Moisture Sensor detects dry soil (SM = True), the system adjusts watering to ensure that the plants get enough moisture. When soil moisture is within the required range (SM = False), the system maintains the watering cycle without making any unneeded changes. This goal aims to optimize water usage and promote healthy plant growth.

Goal 3: Improve the PlantCare Smart System's adaptability to changing light conditions. When inadequate light is detected (L = True), the system will dynamically alter lighting settings by including a Light Detector (L). This objective guarantees that plants get the right quantity of light for photosynthesis and development, which contributes to overall plant health.

Goal 4: In order to optimise plant care, integrate temperature monitoring into the PlantCare Smart System. When the Temperature Detector detects conditions that are outside of the target range (T = True), the system changes the temperature to produce an ideal environment for plant development. When the temperature is within the intended range (T = False), the system keeps the current conditions.This purpose is to provide a favourable atmosphere for plants, hence improving their general health.

Goal 5: Create an easy-to-use interface for the PlantCare Smart System. Create a mobile or online application that allows users to receive real-time information on the state of their plants. Based on the acquired data, the application should give personalised recommendations, allowing users to make educated decisions regarding their plant care routine. This objective is to increase user involvement and satisfaction with the PlantCare system.

These objectives all work together to build a smart and user-friendly PlantCare Smart System that uses AI and sensor technologies to optimise plant care and give users with a smooth and efficient gardening experience.

6. State Space Search

6.1 Details of State and Action

1st State and action: The sensor will detect whether any conditions fall outside the specified range. If no conditions are detected outside the range, the system will respond with no response.

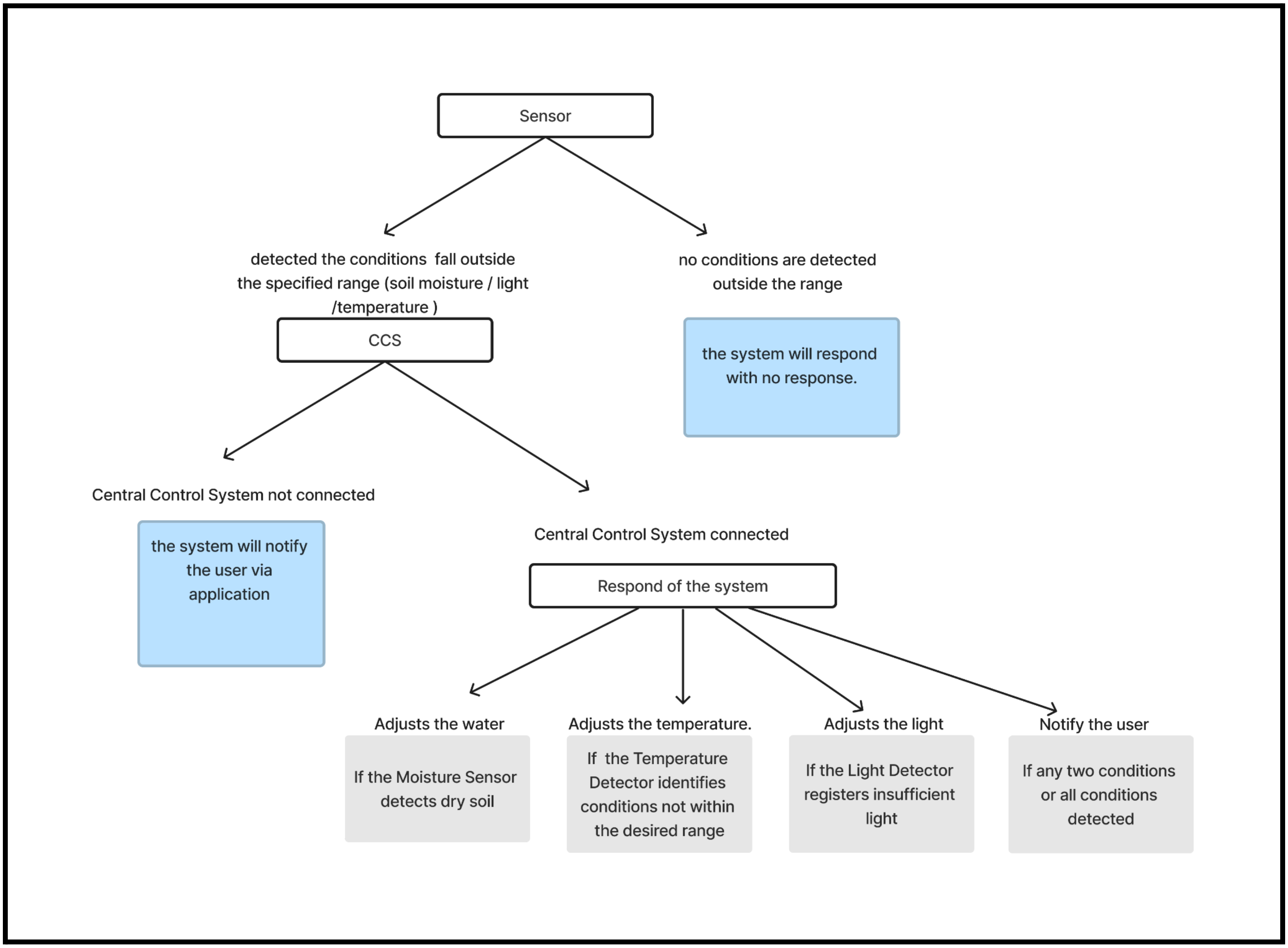
2nd State and action : The sensor will detect whether the conditions that fall outside the specified range is soil moisture or light or temperature or both or all conditions together

3rd State and action: After checking which the conditions that fall outside the specified range ,the Central Control System will be checked if it is connected or not, if no the system will respond with notify the user via application

4th State and action: After checking the CCS ,the responses of the system for each conditions will be:

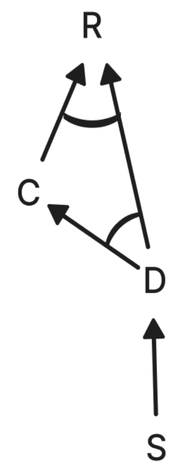
- ➔ If the Moisture Sensor detects dry soil and the central control system is connected , then the system adjusts the water.
- ➔ If the Temperature Detector identifies conditions not within the desired range and the central control system is connected ,then the system adjusts the temperature.
- ➔ If the Light Detector registers insufficient light and the central control system is connected ,then the system adjusts the light.
- ➔ If any two conditions or all conditions detected then the system will notify the user

Overall Graph Action:

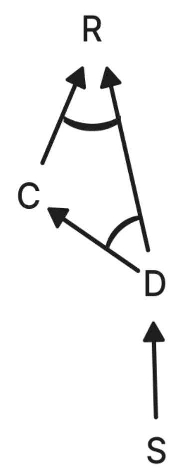


6.2 Hypergraph

R = System has no response
C = CCS is connected (True)
D = No conditions are detected outside the range by Sensor
S = Current system has no response



R = System adjusts the water
C = CCS is connected (True)
D = Sensor detects dry soil
S = Current system has no response

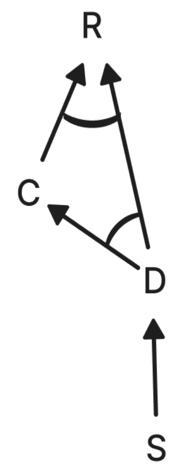


R = System adjusts the temperature

C = CCS is connected (True)

D = Sensor detects Temperature not within the desired range

S = Current system has no response

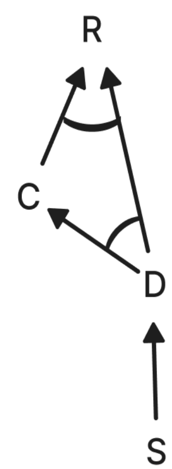


R = System adjusts the light

C = CCS is connected (True)

D = Sensor detects insufficient light

S = Current system has no response

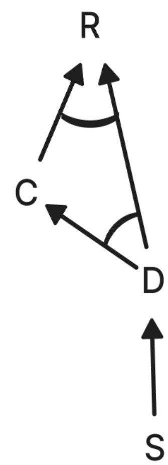


R = System notify the user

C = CCS is not connected (False)

D = Sensor detects two conditions or all conditions

S = Current system has no response



6.3 Problem Formulation

Initial State:

The system starts with sensors, a Central Control System (CCS), and a mobile app all in an operational state.
Initial environmental conditions for light, temperature, and soil moisture are unknown or assumed to be within acceptable ranges.
Actions:

Action 1:
If the Soil Moisture Sensor detects dry soil, and the Temperature Detector identifies conditions within the desired range, and the Light Detector registers sufficient light, and CCS is connected, the system adjusts water.

Action 2:
If the Temperature Detector detects conditions outside the desired range, CCS adjusts the heating or cooling system accordingly.

Action 3:
If the Light Detector detects insufficient light, CCS adjusts the intensity and duration of smart LED grow lights.

User Manual Interventions:
Action 4:
Users can manually adjust water, light, or temperature settings through the mobile app in response to notifications.
Goal:

Goals:

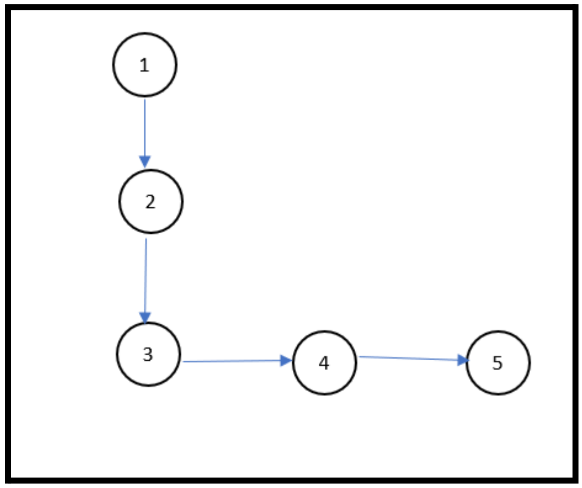
The goal is to maintain optimal plant conditions through automated adjustments based on sensor inputs.Ensure soil moisture, temperature, and light are within desired ranges without user intervention whenever possible.
Users have the ability to intervene manually through the mobile app when notified of suboptimal conditions.
The goal is to provide a user-friendly interface for manual adjustments and real-time monitoring.

Path: 1 unit per action.

Table of problem formulation:1

No	Correspond KR	Soil moisture sensor	Temperature sensor	Light sensor	ccs	Action
1	KR 1	Detect SM within desired range	Detect T within desired range	Detect L within desired range	connected	No response
2	KR 2	Not detected	detected	detected	connected	Adjust water
3	KR 3	detected	Not detected	detected	connected	Adjust temperature
4	KR 5	detected	detected	Not detected	connected	Adjust light
5	KR4/KR6/KR7/KR8	Detected/not detected	Detected/not detected	Detected/ not detected	Not connected	Notify user

6.4 Sequence of Actions Leading from Initial State to Goal State



6.5 Explanation of Formulate Problem to Support the Proposed KR

KR 1 - No Response:

If Soil Moisture (SM) is within the desired range, Temperature (T) is within the desired range, Light (L) is within the desired range, and CCS is connected, no specific action is taken. This is to maintain optimal plant conditions when all environmental factors are favourable.

KR 2 - Adjust Water:

If Soil Moisture (SM) is not detected within the desired range, Temperature (T) is detected within the desired range, Light (L) is detected within the desired range, and CCS is connected, the system will adjust water to address the dry soil condition.

KR 3 - Adjust Temperature:

If Soil Moisture (SM) is detected within the desired range, Temperature (T) is not detected within the desired range, Light (L) is detected within the desired range, and CCS is connected, the system will adjust the temperature to address the deviation from the desired range.

KR 5 - Adjust Light:

If Soil Moisture (SM) is detected within the desired range, Temperature (T) is detected within the desired range, Light (L) is not detected within the desired range, and CCS is connected, the system will adjust the intensity and duration of smart LED grow lights to address insufficient light conditions.

KR 4/KR 6/KR 7/KR 8 - Notify User:

If there are various scenarios where Soil Moisture (SM), Temperature (T), and Light (L) are detected or not detected, and CCS is not connected, the system will notify the user to intervene manually due to suboptimal conditions or lack of connectivity.

7.0 PEAS Model

7.1 Formulate the Solution by Using PEAS Model

	Before Applying Smart Plant Care System	After Applying Smart Plant Care System
P: Performance Measure	● Users struggled to understand the specific needs of their plants, leading to suboptimal care. ● Difficulty in determining the right range of conditions for light, temperature, and soil moisture. ● Plants often experienced stress or health issues due to inconsistent care. ● User intervention relied on guesswork and was reactive rather than proactive.	● The application guides users in setting the precise conditions for each plant, ensuring optimal care. ● Automated plant selection and parameter setting reduce user effort and enhance accuracy. ● Increased user knowledge about individual plant needs. ● Improved plant health and vitality through personalized and automated care.
E: Environment	● Users faced challenges in maintaining stable and controlled environmental conditions. ● Lack of awareness regarding the impact of light, temperature, and soil moisture fluctuations. ● Inconsistent environmental conditions led to plant stress and suboptimal growth. ● Users found it challenging to create an	● Smart Plant Care System stabilizes and optimizes environmental conditions. ● Real-time data and insights empower users to understand and control the impact of environmental factors. ● Enhanced user ability to maintain a stable and optimal growth environment. ● Increased user confidence in providing

	ideal environment for their plants.	ideal conditions for plant growth.
A: Actuators/Effectors	• Limited automation with traditional watering and lighting systems. • Users manually adjusted watering and lighting, leading to irregular care. • Inefficient resource utilization and potential overwatering or insufficient light. • Lack of synchronized responses to changing conditions.	• Central Control System (CCS) automates watering, lighting, and temperature adjustments. • Synchronized responses to changing conditions optimize resource utilization. • Efficient use of resources with centralized and automated control. • Reduced manual efforts and increased consistency in care practices.
S: Sensors	• No centralized sensor system.	• Soil Moisture Sensor, Temperature Detector, and Light Detector provide real-time data. • Users receive timely notifications and insights into changing environmental conditions. • Enhanced responsiveness to changes in plant conditions. • Improved decision-making based on accurate and timely data.

7.2 Define PEAS Model

Agent: Smart Plant Care System

Performance Measure: Optimal plant health and growth

- The Smart Plant Care System acts as an intelligent agent to optimize plant care conditions.
- The performance measure is determined by the health and growth of plants within the system.

Environment: Indoor spaces with plants, varying light, temperature, and soil moisture levels

- The environment includes indoor spaces where users have plants, subject to varying conditions.
- Changes in light, temperature, and soil moisture levels impact plant health.

Actuators: Central Control System (CCS) - Watering system, Lighting system, Temperature control , and Application interface for manual adjustments

- The CCS, acting as the main effector, controls the watering system, lighting system, and temperature.
- Actuators adjust water flow, light intensity, and temperature based on sensor inputs.
- The application serves as an interface for users to make manual adjustments to plant care settings and receive the notification.

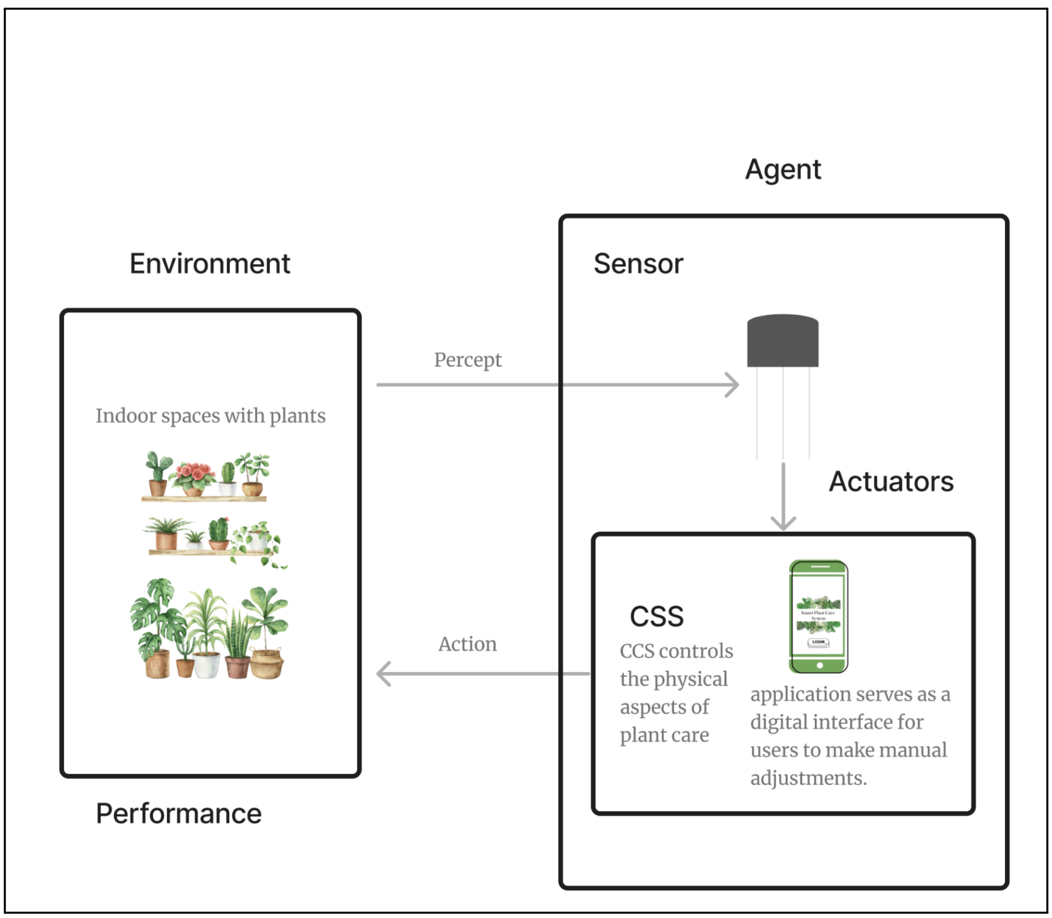
Sensors: Soil Moisture Detector, Temperature Detector, Light Detector

- The system employs sensors to detect soil moisture levels, temperature, and light conditions.
- These sensors provide real-time data for the CCS to make informed adjustments.

Explanation:

- Agent: The Smart Plant Care System acts as an agent responsible for optimizing the care of indoor plants.
- Performance Measure: The primary goal is to achieve optimal plant health and growth, ensuring that the system responds effectively to environmental changes.
- Environment: The system operates in indoor spaces where users have plants. The environment is dynamic, with varying light, temperature, and soil moisture conditions.
- Actuators: The CCS controls the physical aspects of plant care, while the application serves as a digital interface for users to make manual adjustments.
- Sensors: The system utilizes Soil Moisture Sensor, Temperature Detector, and Light Detector to gather real-time data about plant conditions, enabling informed decisions by the CCS.

7.3 PEAS Model Diagram



7.4 Property Representation in Proof of Concept (POC):

I. Performance

The primary objective is to ensure optimal care for indoor plants. This is achieved by guiding users to set precise conditions through an application interface and automating plant selection and parameter settings.

II. Environment

The environment represents indoor spaces with varying light, temperature, and soil moisture levels. Different scenarios demonstrate the system's adaptability to diverse conditions. Real-time data from sensors, including Soil Moisture Sensor, Temperature Detector, and Light Detector prototypes, provides information for CCS decision-making. The CCS processes this data to optimize environmental conditions for plant health.

III. Actuator

A. Central Control System (CCS):

The actuator, represented by the CCS, is placed at the center of plant care. It showcases automated adjustments through actuators like the watering system, lighting system, and temperature control based on sensor inputs. The application interface allows users to make manual adjustments, view plant information, and receive notifications.

IV. Sensors

1. Soil Moisture Sensor, Temperature Detector, and Light Detector.

The sensor systems, including real-time data and a notification system, detect changes in plant conditions. For instance, if conditions are not met, sensors trigger notifications to users for adjustments or alerts.

7.5 Explanation of The Behaviour of The Agent to Achieve the Goal:

The agent in the SmartPlant Care System is designed as an intelligent entity that optimizes plant care conditions, achieving the goal of optimal plant health and growth.

Decision-Making Process:

The agent, represented by the CCS, analyzes real-time data from sensors.
Decision-making considers soil moisture, temperature, and light conditions.
Prioritizes and balances conditions to optimize plant care.

Interaction Between Components:

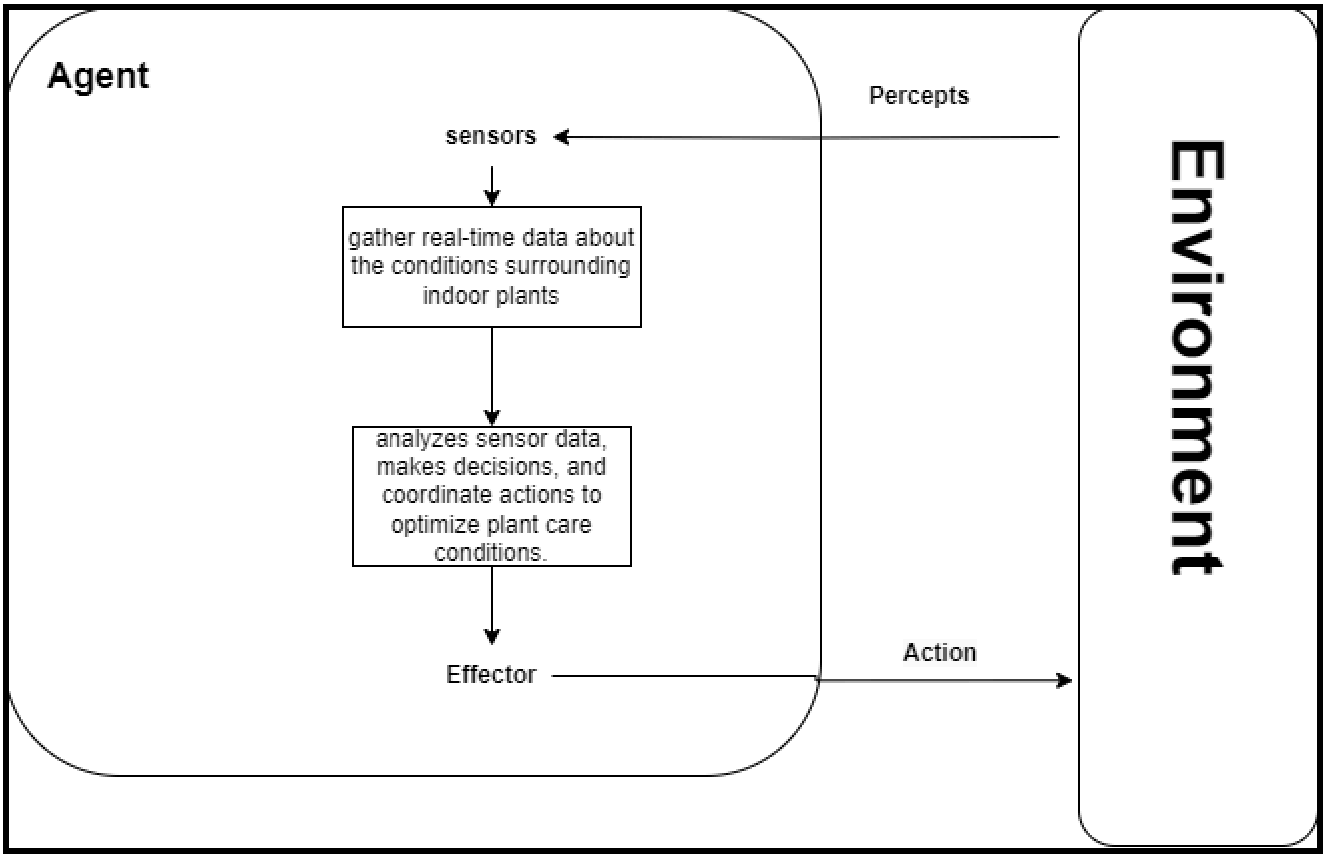
Actuators (CCS) control watering, lighting, and temperature based on sensor inputs.
Synchronized responses optimize resource utilization.
Application interface allows users to make manual adjustments and receive notifications.

User Interaction:

Users benefit from automated plant selection and parameter settings.
Manual adjustments through the application interface enhance user control.
Users receive insights and recommendations based on real-time data.

Adaptability and Learning:

The system adapts to changing conditions over time.
Learning mechanisms, if applicable, improve care based on historical data.
The agent ensures personalized and automated care for optimal plant health.



Agent
Percepts
sensors
gather real-time data about the conditions surrounding indoor plants
analyzes sensor data, makes decisions, and coordinate actions to optimize plant care conditions.
Effector
Action
Environment

8.0 Proof of Concept
8.1 Problem Formulation
The problem formulation for the Smart Plant Care System is driven by the need to create an intelligent, automated solution for indoor plant care. The primary objective is to enhance the well-being and vitality of indoor plants while providing users with a user-friendly interface for seamless management. The key components of the system include sensors for real-time environmental monitoring, a central control unit with advanced AI algorithms for data processing, actuators for implementing corrective actions, and a mobile app interface for user interaction.

The central challenge lies in defining optimal thresholds for environmental parameters such as light intensity, temperature, and soil moisture, as these vary among different plant species. Striking the right balance to accommodate a diverse range of plants while ensuring resource efficiency is crucial. The integration of sensors and actuators presents another challenge, requiring seamless communication to facilitate timely and effective plant care responses.

User education is a significant factor for success, and the system must provide clear insights into the specific needs of each plant species. The mobile app interface needs to be intuitive, allowing users to easily customize plant care settings, receive real-time updates, and understand the system's recommendations.

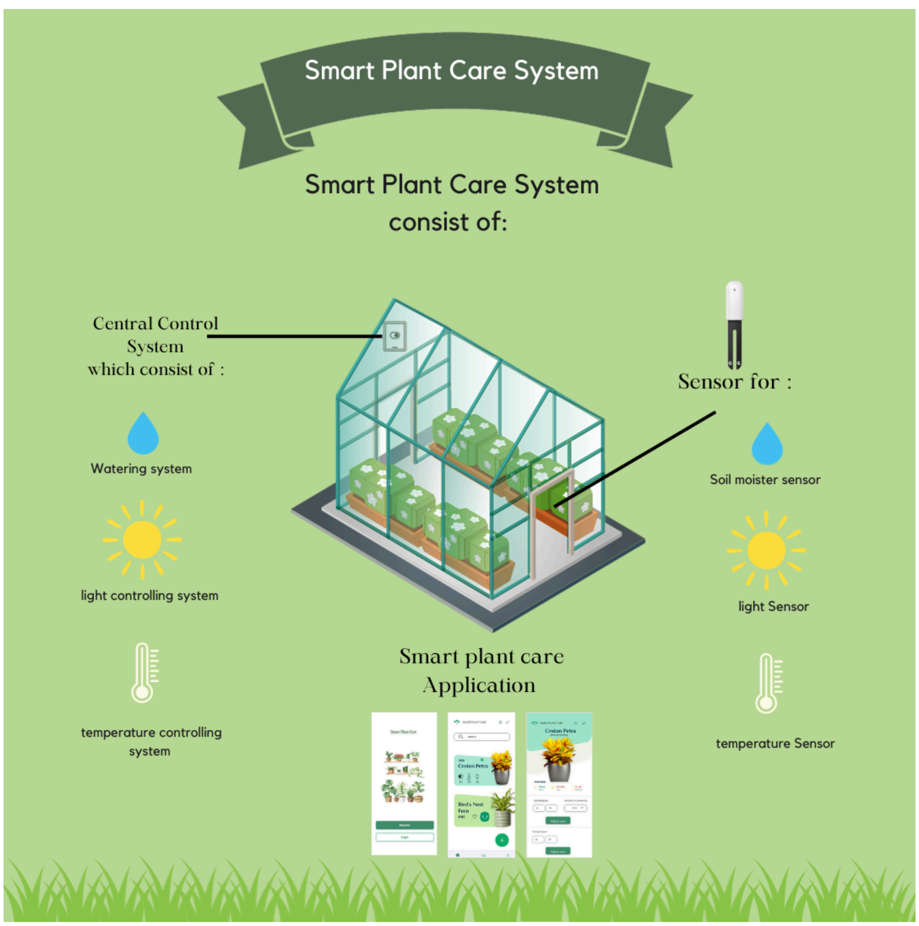
Constraints include the necessity for resource efficiency to minimize water and energy consumption, ensuring the system aligns with environmental sustainability goals. Compatibility with various plant species adds complexity, requiring adaptability to diverse growth requirements.

The success of the system is contingent on plant health and growth, measured through continuous monitoring and optimization. Additionally, user satisfaction is a crucial metric, assessed by the ease of use of the mobile app, the effectiveness of notifications, and the overall user experience in managing plant care.

As the system evolves, ongoing evaluation will focus on its ability to autonomously respond to changing environmental conditions, the accuracy of recommendations, and the positive impact on plant health over time. This comprehensive problem formulation serves as a guiding framework for the development and implementation of the Smart Plant Care System, ensuring a holistic approach to indoor plant care management.

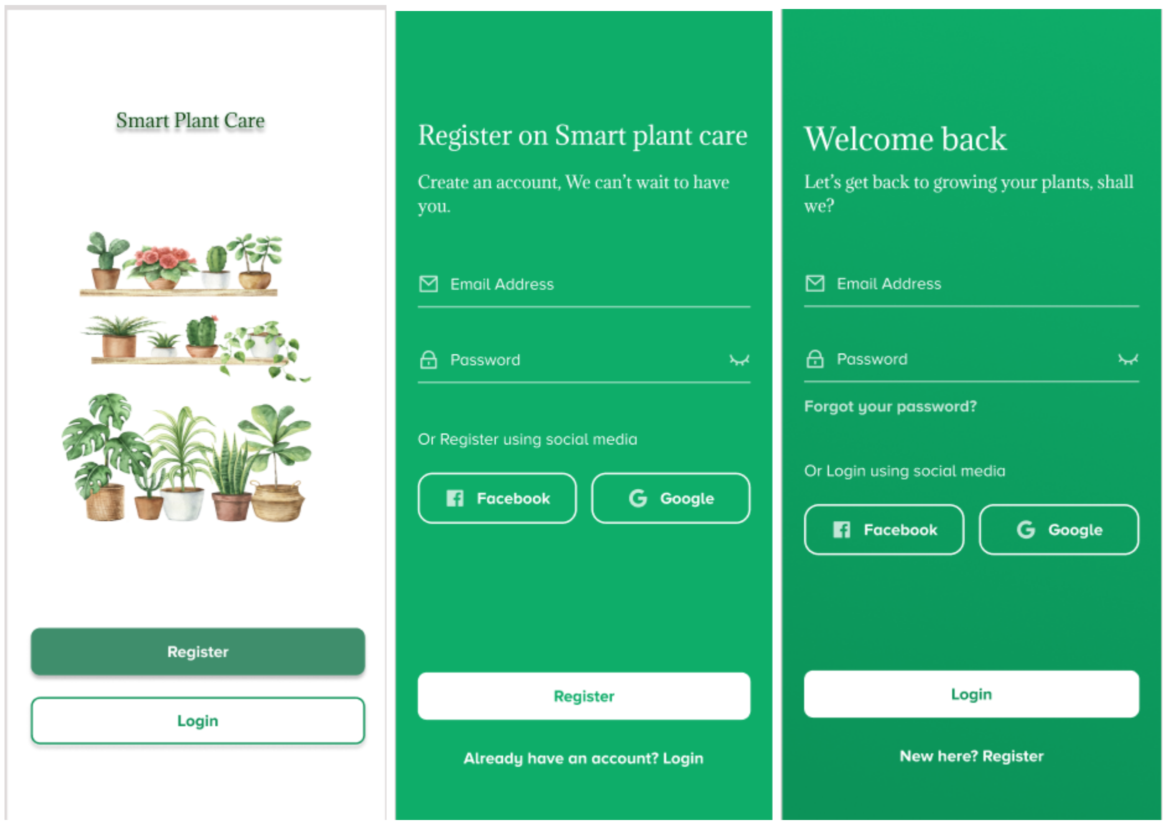
8.2 Design Concept:

The design concept for the Smart Plant Care System envisions a sophisticated yet user-centric approach to indoor plant care. At its core, the system integrates advanced sensors to continuously monitor environmental factors such as light intensity, temperature, and soil moisture. This wealth of data is processed in real-time by a central control unit equipped with artificial intelligence algorithms. These algorithms make intelligent decisions and trigger adaptive responses through actuators, ensuring optimal conditions for plant growth. The user experience is paramount, facilitated through an intuitive mobile app interface. Here, users can customize settings, receive real-time updates on plant conditions, and access educational insights to enhance their understanding of specific plant needs. The system prioritizes resource efficiency, striking a balance between effective plant care and sustainable practices. Continuous improvement is embedded in the system through learning algorithms, enabling it to adapt and refine recommendations over time. Real-time notifications keep users informed, fostering an interactive and educational relationship between users and their plants. Scalability and compatibility make the system versatile, catering to various indoor settings. This design concept aims to redefine plant care by seamlessly integrating technology, user empowerment, and sustainability for a comprehensive and intelligent solution.



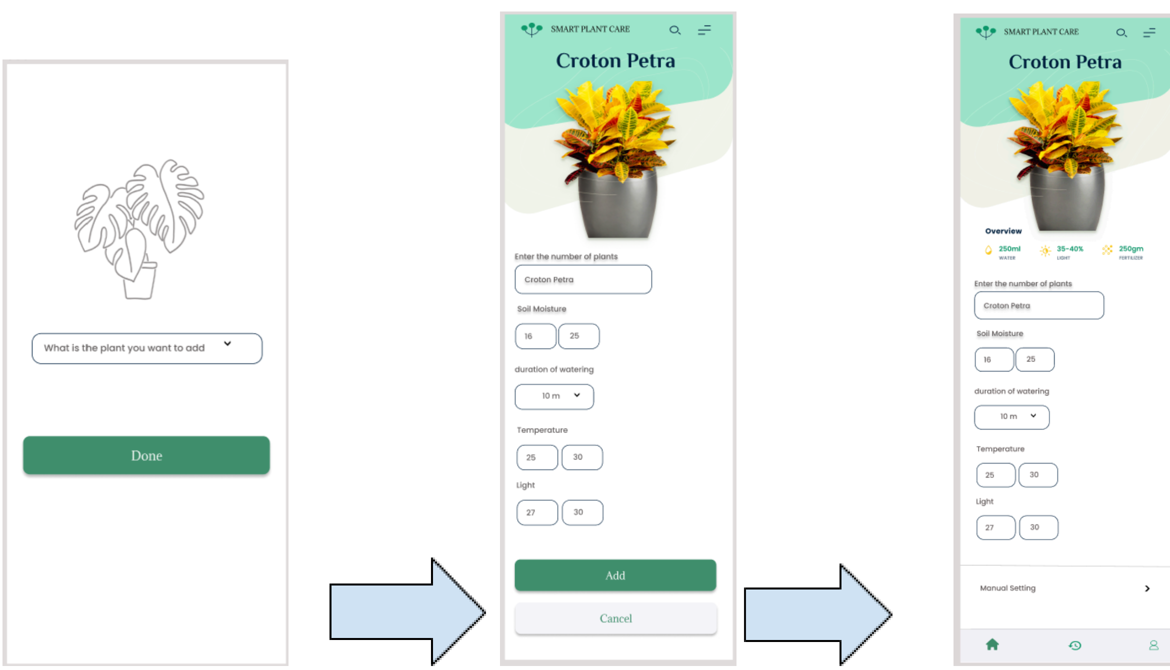
Design of the application:

If user already has account so they just click login but if they are new users so they have to register

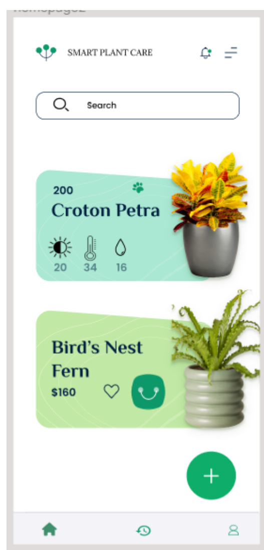


After login or register homepage will be displayed which consist of notification page, history page,and profile page

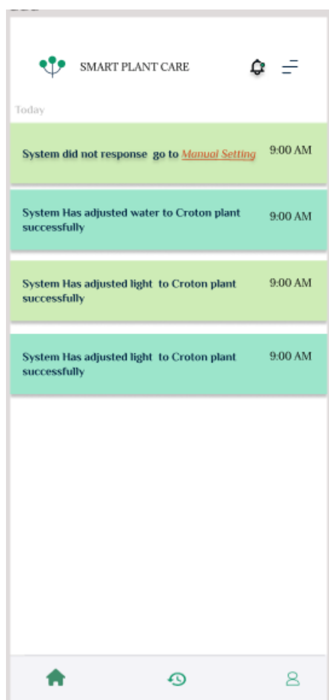
As we notice the home is empty when user want to add plants they should click on the icon + it will display page to choose the plant the user want to add , after user select plant and click done all information need to know about the plant such as the right amount of light , temperature and water will automatically displayed then user should click add so it will displayed in homepage with a current status of soil moisture , light and temperature



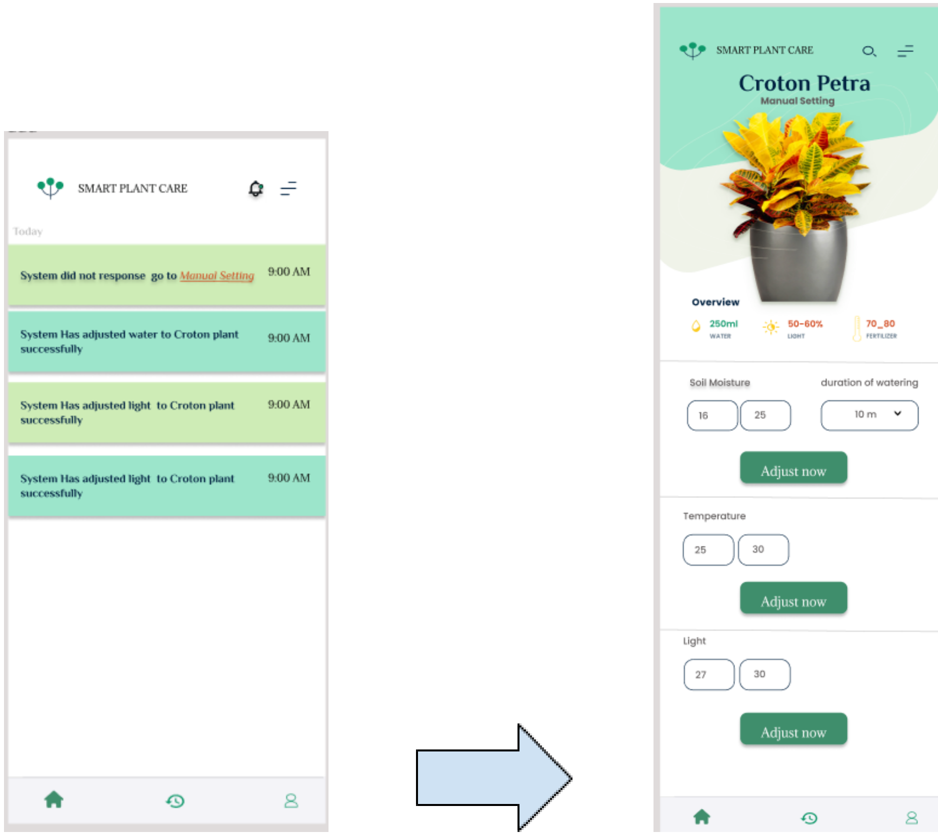
Homepage with added plants:



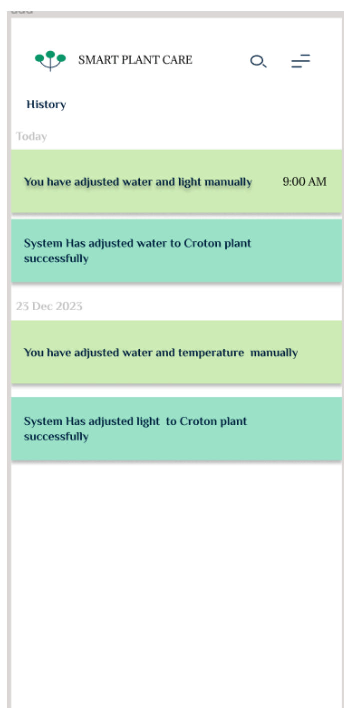
Also user can see all the updates through the notifications section :



If the system did noy respond and adjust 2 or 3 conditions it will highlighted by red the application will suggest user to do manual adjusting for the specific plant



And all that will be saved in history section :



conclusion

In conclusion, the Smart Plant Care System presents a holistic and innovative solution for indoor plant management, integrating cutting-edge technology, user-friendly interfaces, and sustainable practices. The system's design concept, centered around intelligent monitoring, adaptive responses, and user education, aims to redefine the way we care for indoor plants. By harnessing advanced sensors and AI algorithms, the system autonomously optimizes environmental conditions, ensuring plants thrive in their respective settings. The user experience is elevated through a user-friendly mobile app that not only provides real-time updates but also educates users about the specific needs of different plant species. Emphasizing resource efficiency, the system promotes a balance between effective care and environmental conservation. Learning algorithms contribute to continuous improvement, adapting to plant responses and refining recommendations over time. Real-time notifications and scalability enhance user engagement, making the system versatile for various indoor environments. In essence, the Smart Plant Care System represents a forward-thinking and sustainable approach to plant care, fostering healthier, more vibrant indoor ecosystems while empowering users with knowledge and convenience.