Kingdom of Saudi Arabia
Ministry of Education
Jouf University
College of Computer and Information Sciences

In fulfillment of the requirements for the degree of
Bachelor in Software Engineering

MY PLANT PAL

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2025/2026

PROJECT IN BRIEF

Project title: My Plant Pal

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Date Started: 31/08/2025

Date Completed: 04/12/2025

DECLARATION

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CERTIFICATION

It is certified that the contents and form of the project entitled "MY PLANET PAL" submitted by Norah Alhumaid, Shmookh Albaas ,Dania Al-Said, Sarah Almasoud has been found satisfactory for the requirements.

For the award of the degree of

Software Engineering

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Chapter 1

PROJECT OVERVIEW

1.1 Introduction

Home gardening and plant care have become increasingly popular in recent times, especially with the growing awareness of environmental conservation and the importance of green spaces. However, many plant enthusiasts face challenges such as diagnosing plant diseases and determining the appropriate watering and fertilization schedules, particularly those lacking sufficient scientific knowledge.

To address these challenges, the "My Plant Pal" project offers the perfect solution. This project aims to develop a smart platform for plant management and care using artificial intelligence. It provides accurate plant disease diagnosis, as well as automated watering and fertilization schedules tailored to each plant type and environmental condition. Through this platform, users can also interact with agricultural experts and share experiences with the community, enhancing the culture of plant care at home.

This project highlights the use of artificial intelligence in home gardening and underscores the increasing importance of technology in improving the quality of life and promoting sustainable agricultural practices. Thus, "My Plant Pal" represents a significant step toward simplifying plant care and serves as an integrated platform for users of all levels, from beginners to experts in the field of agriculture.

1.2 Project Scope

This project aims to develop a smart online system for plant management and care. The system allows users, such as farmers and gardening enthusiasts, to manage their plants, monitor their health, and receive reminders for plant care tasks. The system includes advanced technologies such as automatic plant disease diagnosis using artificial intelligence, and the creation of automated watering and fertilization schedules tailored to the plant type and surrounding environmental conditions. Additionally, the system provides an interactive communication platform between users and agricultural experts, enabling direct consultations and experience sharing.

1.3 Problem Description

Many people interested in home gardening or plant care struggle to accurately determine their plants' needs. Key challenges identified through surveys and previous studies include:

- Difficulty diagnosing plant diseases
- Inability to determine appropriate watering and fertilization schedules for each plant type.
- Lack of experience or scientific knowledge among users, leading to incorrect plant care decisions.
- The limitations of existing systems, such as the ”Your Agricultural Guide ” app, which lacks artificial intelligence, suffers from poor performance, and has limited user interaction.

1.4 Proposed Solution

The proposed solution is to develop a smart platform called "My Plant Pal", providing a unified system for plant management and care using artificial intelligence and community interaction.

The system will allow users to:

- Automatically diagnose plant diseases by analyzing leaf and soil images using accurate AI models.
- Automatically generate and adjust irrigation and fertilization schedules based on plant type and environmental conditions.
- Receive notifications and reminders to track important agricultural tasks such as irrigation, fertilization, and harvesting.
- Access an interactive community space that allows users to share their experiences and plant photos, with the ability to communicate directly with agricultural experts.

The solution aims to simplify plant care, enhance user confidence, and promote sustainable agricultural practices.

1.5 Proposed System Components

The proposed system is composed of integrated modules designed to support plant health management through user interaction, expert consultation, and administrative control. Each component plays a distinct role in ensuring system functionality, data flow, and service delivery.

1. **User Interface Module**

- Account creation, login/logout, and password recovery
- Profile management (view/edit/delete)

2. **Expert Interaction Module**

- Responding to user inquiries and messages
- Managing expert sessions (accept/reject)

3**. Admin Control Module**

- Account creation, modification, and deletion
- Access to all user and expert profiles

4. **Plant Management Module**

- Adding new plants and plantations
- Weather data analysis and health diagnostics
- Generating manual and automated care schedules
- Delivering plant-specific recommendations

5. **Messaging & Communication Module**

- Enabling secure messaging between users and experts
- Maintaining communication logs and history

6.**Plant & Soil Analysis Module (AI Engine)**

- Uses machine learning models to analyze plant and soil images.
- Diagnoses plant diseases and provides confidence scores.

1.6 Proposed System Output

The proposed system is expected to generate a range of outputs that support user interaction, expert communication, and administrative oversight. These outputs reflect the system's ability to manage accounts, requests, profiles, and data flow across different roles.

- Confirmation messages for account creation, deletion, and profile updates
- Expert request status (accepted/rejected)
- Request management dashboard for admin (view/edit/delete)
- AI-based diagnosis for plant and soil health
- Auto-generated watering and fertilizing schedules
- Smart notifications for care tasks and climate alerts
- Plant management, profile control, and progress reports

1.7 Main Features of the Proposed System

The proposed plant-care system offers a unified platform that supports users, experts, and administrators. Its functionality is designed around AI automation, task management, expert interaction, with a strong focus on offering a simple, intuitive, and accessible user experience.

Below is an overview of the system's primary features:

1. Plant Profile & Care Management

- The system enables users to manage detailed plant profiles and monitor their growth over time.
- It provides automated support for creating and adjusting care routines.
- Users can easily view their plants and upcoming responsibilities in one place.

- The system helps users stay on track by allowing progress updates and sending reminders when important tasks are overdue.

2. AI-Powered Analysis

- The platform incorporates AI to examine plant and soil images and generate meaningful insights.
- It assists users by identifying potential issues and updating plant information based on the analysis.
- Results are communicated clearly to guide users toward better care decisions.

3. Intelligent Assistance & Recommendations

- Provides proactive, personalized care guidance by analyzing real-time data like weather and plant conditions.
- Generates dynamic watering and fertilizing schedules that adapt to the plant's type and environment.

4. Community Interaction & Expert Support

- The platform provides a clear communication space where users can submit inquiries and share experiences, tips, and plant updates.
- The system structures conversations so users can easily seek help while experts can respond with guidance efficiently.
- It supports direct communication with experts for more informed assistance.

1.8 Conclusion

In conclusion, the proposed system offers a comprehensive solution for plant care and expert support, built with a strong emphasis on user experience. The design prioritizes clarity, simplicity, accessibility, and trust, ensuring that users can navigate the system effortlessly, understand AI results, manage plants efficiently, and interact with experts and the community without barriers.

By integrating AI diagnosis, personalized schedules, weather-based insights, and community engagement into a single platform, the system reduces complexity while improving usability and user satisfaction. The modular and scalable architecture further ensures reliability and long-term maintainability, while a user-centric design ensures the platform remains intuitive and empowering for individuals of all experience levels and backgrounds.

Ultimately, the system will effectively simplify plant care, making it an intuitive and reliable tool for every

Chapter 2

SYSTEM ANALYSIS

2.1 Introduction

This chapter provides a comprehensive analysis of the proposed system. It begins with an explanation of the data collection process, through which diverse information was gathered from several sources: surveys, similar applications, and previous research related to plant care. From the collected data, it extracts various system requirements including functional and non-functional requirements. It also discusses general constraints that must be considered when using the system.

The chapter also includes graphical representations, such as the use case diagram, which illustrates the different interactions between users and the system, as well as a detailed description of the anticipated use cases. Finally, a comprehensive summary of the findings reached in this chapter is provided.

2.2 Data collection

This section covers the data collection methods used in the study related to plant care. It begins with the analysis of data gathered from a survey with 61 participants to understand user needs and the challenges they face in plant care. The section also discusses similar applications, such as "Your Agricultural Guide" and reviews previous research that utilized artificial intelligence for diagnosing plant diseases and providing suitable solutions.

2.2.1 Questionnaire

As part of developing a smart plant care system, this survey was conducted to understand user behavior and actual needs in the field of home gardening. A total of 61 participants responded, with an average completion time of

approximately 3 minutes, reflecting strong engagement with the topic. The most represented age group was 18–24 years, accounting for 66% of responses, indicating a clear interest among youth in plants and environmental care. The survey aimed to identify key challenges users face—such as difficulty diagnosing plant diseases or determining watering and fertilizing schedules—as well as to evaluate the effectiveness of existing applications and propose new features that meet user expectations.
All detailed responses are included at the end of the report for full review and analysis.

2.2.2 Similar system

The "Your Agricultural Guide" application is an electronic application launched by the Ministry of Environment, Water, and Agriculture in the Kingdom of Saudi Arabia. It aims to provide agricultural guidance to farmers and those interested in agriculture in a modern and easy way. The program offers information and advice on proper farming methods, pest control, and water conservation, and allows communication with agricultural experts for direct consultations.

While the "Your Agricultural Guide" application provides several benefits, such as offering diverse services, valuable agricultural information and useful announcements, it still suffers from several limitations.
These include a limited range of supported plant types, an excessive number of services with weak responsiveness, server overlaps, lack of AI-based features, and poor performance after updates.
Overall, the application is beneficial but requires updates and improvements to enhance its usability and effectiveness.

2.2.3 Research Papers

1. **Smart Crop Care – AI-Driven Plant Disease Detection [1]**

Problem: Plant diseases cause major crop losses due to the lack of early detection and expert diagnosis. Farmers often resort to harmful pesticides, risking health, and the environment.

Solution: A smart platform that uses AI and cloud computing to diagnose plant diseases instantly via mobile images. It also provides treatment suggestions, expert interaction, and predictive disease maps based on geo-tagged data.

Results: The CNN model achieved over 95% accuracy, validated by plant pathologists using real farm images collected over 7 months.

Future Work: Integrate soil health and climate data, expand disease coverage, and automate dataset updates to reduce expert dependency.

2. Plant Care and Disease Detection Using Pattern Recognition [2]

Problem: Busy schedules, limited botanical knowledge, and difficulty identifying plant diseases hinder proper plant care.

Solution: A mobile app using a CNN model trained on 125,319 leaf images to detect diseases from camera scans. It also offers care schedules, reminders, and personalized plant profiles.

Results: Achieved 97% accuracy and 98% F1-score. Reliable across lighting conditions and camera angles. Outperformed similar models like MobileNet and grape leaf detectors.

Future Work: Expand the dataset, add features like pest control and soil analysis, and improve model robustness for real-world variability.

3. Historical Review of Medicinal Plants Usage [3]

Problem: Synthetic drugs are losing effectiveness and causing more side effects, prompting a return to natural remedies.

Objective: Highlight the historical significance of medicinal plants and their therapeutic role across civilizations.

Solution: Validate traditional plant-based treatments scientifically and integrate them into modern medicine through standardized extracts and complementary approaches.

Examples of Medicinal Plants: Chamomile, parsley, onion, garlic, mint, coriander, poppy, and tea leaves.

2.3 Requirements

This table presents a set of functional requirements for a technical system designed to serve both users and experts, likely in the field of agriculture or plant care. It outlines which features are accessible to each user type, such as account creation, growth and treatment planning, and community forum interaction. This classification supports system analysis by clearly defining roles and ensuring an efficient, tailored user experience for each group.

2.3.1 Functional Requirements

Table 1: Functional Requirements

The requirement		Users	Experts	Admin
1	The system shall allow new users to create an account through a sign-up process.	x	x	
2	The system shall allow registered users to login	x	x	
3	The system shall allow users to reset their password	x	x	
4	The system shall verify expert/farmer's identity credentials.		x	
5	The system shall allow users to view/edit their profile.	x	x	
6	The system shall allow users to create and edit plant profiles.	x	x	
7	For each plant, the system shall manually/automatically generate /edit a watering schedule based on the plant type.	x	x	
8	For each plant, the system shall manually/automatically generate /edit a fertilizing schedule based on the plant type.	x	x	
9	The system shall analyze uploaded plant images using AI models to create plant profile/diagnose plant diseases and provide results.	x	x	

10	The system shall display the user's list of plants and their associated upcoming tasks on the home screen.	x	x	
11	The system shall send notifications/ reminders to remind users of upcoming tasks.	x	x	
12	The system shall allow users to customize notification of preferences.	x	x	
13	The system shall allow users to mark a task as complete.	x	x	
14	The system shall allow users to take/store regular plant photos and track growth progress over time to provide health insights.	x	x	
15	The system shall allow users to upload or capture soil images for AI-based health analysis.	x	x	
16	The system shall allow users to share photos, tips, and success stories in the Community forum/gallery.	x	x	
17	The system shall sync reminders with calendars.	x	x	
18	The system shall provide the user with care recommendations based on weather conditions.	x	x	
19	The system shall provide notifications with advice on harvesting and cultivation.	x	x	
20	The system shall allow users to ask questions and receive expert answers through chat or Q&A.	x	x	
21	The system shall include a Marketplace section where users can browse, view, and purchase plants and gardening supplies. (extension of the idea)	x	x	
22	The system shall implement escalation reminders if a critical task like fertilizing is missed for too long.	x	x	
23	The system shall award achievements for consistent care.	x	x	

24	The system shall unlock badges when a plant reaches growth milestones.	x	x	
25	The system shall allow the admin to create new user or expert accounts with valid registration details.			x
26	The system shall allow the admin to permanently remove any user or expert account when necessary.			x
27	The system shall allow the admin to review and either approve or reject upgrade requests from users seeking expert status.			x
28	The system shall allow the admin to reset or change a user's password upon request or as needed.			x
29	The system shall allow the admin to generate, view, and export reports, summarizing user activity, expert interactions, and system performance.			X

2.3.2 Non-Functional Requirements

Table 2: Non-Functional Requirements

Performance & Efficiency	-The system shall rapidly process AI images (for plant and soil detection) to ensure a smooth user experience.
Scalability	-The system shall be designed to efficiently handle an increasing number of users, plants, and expert interactions without performance degradation. -The system architecture shall allow flexible allocation of computing and storage resources to support user growth and seasonal usage peaks. -The marketplace module shall scale to accommodate increasing numbers of vendors, listings, and transactions.

	-The infrastructure shall allow horizontal scaling of the AI recognition service as the user base grows.
Usability & Accessibility	-The application shall present an intuitive, user-friendly interface suitable for both beginners and experts in agriculture. -All navigation, icons, and terminology shall be clear and consistent. -The interface shall support Arabic and English language options. -The system shall be accessible to users with visual or motor limitations -limited hand movement- (e.g., readable fonts, contrast, responsive layout).
Reliability & Availability	-The system shall maintain continuous availability (24/7) under normal operating conditions. -Scheduled maintenance periods shall be communicated to users in advance. -AI modules provide consistent outputs and handle corrupted or unreadable images gracefully
Maintainability & Modularity	-The system shall use a modular architecture separating AI processing, user interface, database, and marketplace components. -Code shall be documented to allow easy maintenance and upgrades. -Updates to the AI model (e.g., adding new plant types) shall not require changes to other modules.
Accuracy & Reliability of AI	-The plant and soil detection model shall deliver correct detection results for supported plant and soil types under normal operating conditions. -The recommendation engine shall be trained and validated with credible agricultural and botanical data sources. -AI outputs shall include confidence scores or disclaimers when uncertainty is high.

Interoperability	-The system shall integrate with weather APIs to generate climate-based recommendations and alerts. -It shall support third-party payment gateways for marketplace transactions. -It may optionally connect to IoT soil or moisture sensors for enhanced accuracy.

2.4 General Constraints

These constraints define the technical and operational boundaries that must be considered when using the system. They include technical aspects such as internet connectivity, device support, and permission management, in addition to security and organizational considerations. These constraints aim to enhance security and ensure a stable and efficient user experience.

- The system operates in two modes:
  - With internet connection: to enable the use of artificial intelligence and exchange messages with experts.
  - Without internet connection: the system is limited to displaying notifications only.
- In case of not registering in the application, the user has the authority to use artificial intelligence technologies only five times in the current version.
- The system accepts images or scanning to recognize plants, but it does not support videos or uploading other files.
- The system performance depends on internet speed and connection quality.

2.5 Use Case Diagram

This use case diagram provides a comprehensive overview of how users interact with the "My Plant Pal" application, designed to deliver a holistic plant care experience. It illustrates the relationships between the User, Admin, and System actors, covering a wide range of functionalities such as scanning plants, viewing detailed information, tracking plant health, and accessing expert tips and guidance. The diagram serves as a foundational tool for system analysts and developers to understand the functional requirements and identify key scenarios that must be supported to ensure a rich and effective user experience.

Notes:

- All other use cases have the *precondition*: "User must be logged in."
- No need to link "Login" to everything via «include».

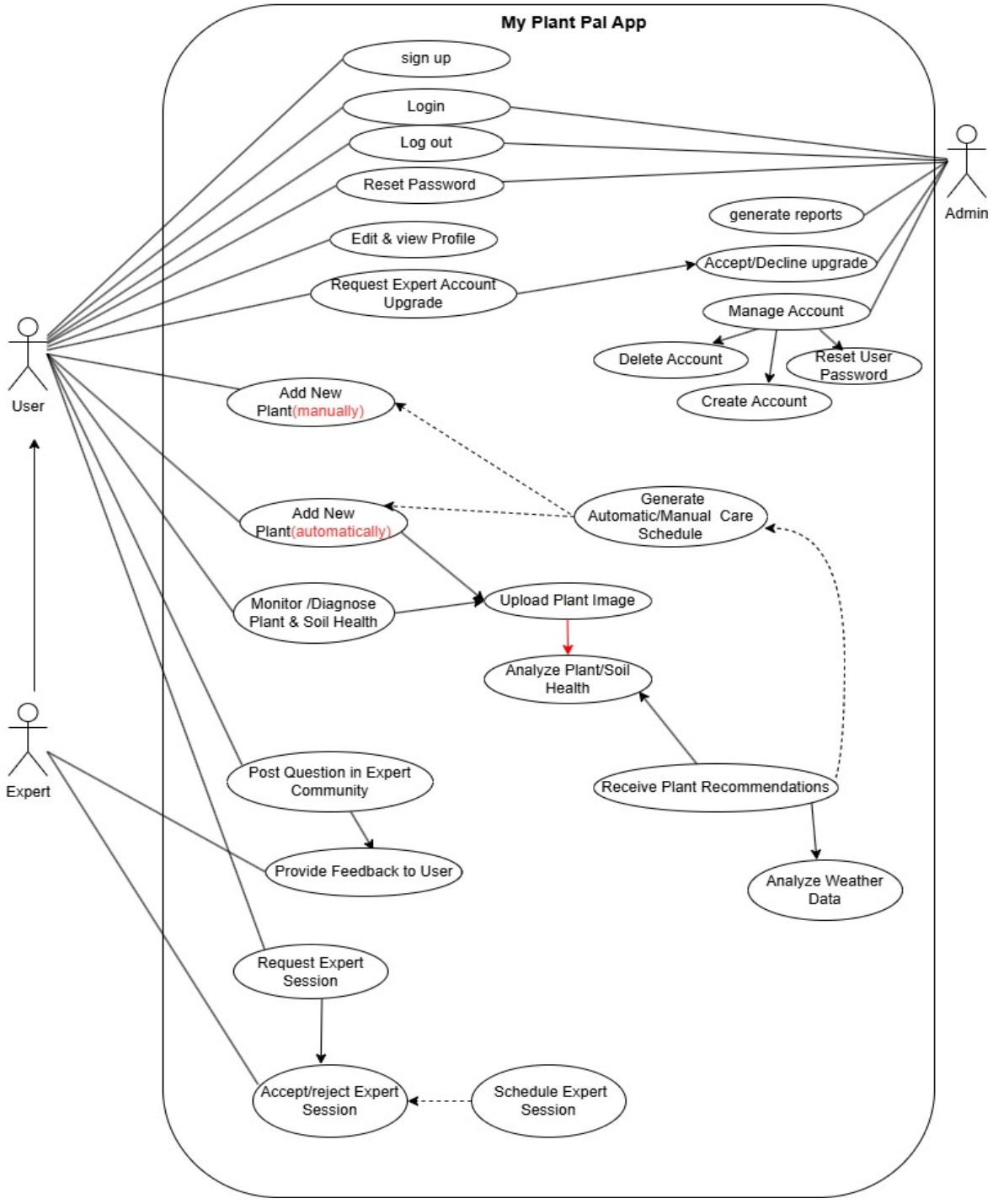


Figure 1 : My Plant Pal Use Case Diagram

2.6 Use Case Description

This section presents a comprehensive description of the primary use cases within the system. Each use case specifies the interaction between the system and its actors to accomplish a particular objective. The descriptions include essential components such as brief overviews, preconditions, postconditions, relationships, and detailed flows of events, thereby illustrating the functional behavior of the system under different Conditions.

Table 3: Request Expert Session

Use Case Name: Request Expert Session	**ID: UC - 1**
Primary Actor: user	
Brief Description: This use case allows the user to request help from an agricultural expert by opening a consultation session to receive guidance or diagnose plant-related issues (diseases, pests, care instructions, etc.).	
Trigger: The user selects the "Request Expert Session" option from the consultation or support section in the application	
Preconditions: 1-The user must be logged into the system. 2-The user has an active internet connection.	
Postconditions: 1-A consultation session request is successfully submitted and created in the system. 2-The expert can view and respond to the user's request. 3-The user can track or chat within the session.	
Relationships: **Association:** user **Include:** Accept/reject Expert Session **Extend:**	
Normal Flow of Events: 1.The user navigates to the "Request Expert Session" section. 2.The system displays a consultation request form.	

3.The user enters the question or issue description (optionally uploads a plant image). 4.The user submits the request. 5.The system validates the input. 6.The system creates a new consultation session. 7.The system notifies the available experts. 8.The expert reviews the request and prepares to respond.
Alternate/Exceptional Flows: 1-No internet connection The system displays an error message and pauses submission. 2-No expert available The system places the session in a waiting queue or offers automated recommendations

Table 4: Add New Plant (Manually)

Use Case Name: Add New Plant (Manually)	**ID: UC - 2**
Primary Actor: User	
Brief Description: This use case allows the user to manually add a new plant by entering its details such as name, type, and optional care preferences. The system may auto-generate basic schedules based on the plant type.	
Trigger: The user selects "Add New Plant (Manually)" to manually add a new plan.	
Preconditions: 1. The user must be logged into the system.	
Postconditions: 1. A new plant profile is created and stored under the user's account. 2. A basic watering/fertilizing schedule may be auto-generated based on the plant type	
Relationships: **Association:** User **Include: -**	

Extend: Generate Watering/Fertilizing Schedule.
Normal Flow of Events: 1. User selects "Add New Plant (Manually0)". 2. System displays a plant details form. 3. User enters plant details (name, species/type, age, description, care preferences). 4. System validates the entered data. 5. User confirms submission. 6. System creates the plant profile and links it to the user's account. 7. System checks if plant type exists in database and generates an initial care schedule (watering/fertilizing). ---> (optional) 8. System displays confirmation and the newly created plant profile.
Alternate/Exceptional Flows: 3a- Missing required fields System prompts user to complete all mandatory fields before proceeding. 7a. Plant type not recognized System prompts user to manually configure care schedule or skip. 3a- System error occurs System displays an error message and logs the issue.

Table 5: Add New Plant (Automatically)

Use Case Name: Add New Plant (Automatically)	**ID: UC - 3**
Primary Actor: User	
Brief Description: This use case enables the user to add a plant by uploading or capturing an image. The system uses AI to identify the plant type and automatically creates a plant profile. If recognized, the system generates basic care schedules.	
Trigger: The user selects "Add New Plant (Automatically)" and uploads a plant image.	
Preconditions: 1. The user must be logged into the system. 2. The user has a plant image available or access to a camera.	

Postconditions:

1. A plant profile is created and stored under the user's account.
2. A watering/fertilizing schedule is automatically generated (if identification is successful).

Relationships:

Association: User

Include: Upload Plant Image

Extend: Generate Watering/Fertilizing Schedule.

Normal Flow of Events:

1. User selects "Add New Plant (Automatically)".
2. System prompts user to upload or capture a plant image.
3. User captures or uploads an image.
4. System validates image format and quality.
5. System analyzes the image using AI for plant identification.
6. System identifies plant type and retrieves relevant plant data.
7. System automatically creates a plant profile and generates care schedules.
8. System displays the new plant profile and identification results.
9. User confirms or edits the auto-filled plant information.
10. System saves final profile.

Alternate/Exceptional Flows:

3a. Poor image quality

System prompts user to retake or re-upload the image.

5a. AI cannot identify plant

System notifies user and extends Add New Plant (Manually).

6a. System returns multiple matches

System requests user to select the correct plant type from suggestions.

5b. Technical failure (AI unavailable)

System informs user and suggests manual addition.

Table 6: Monitor / Diagnose Plant & Soil Health

Use Case Name: Monitor / Diagnose Plant & Soil Health	**ID: UC - 4**
Primary Actor: User	
Brief Description: This use case allows the user to assess the current health status of a selected plant and its soil conditions. The system performs image-based or sensor-based analysis and provides a diagnostic report with recommendations.	
Trigger: user selects "Monitor / Diagnose Plant & Soil Health" to check on the plant's health condition.	
Preconditions: 1. The user is logged into the system. 2. The plant must already exist in the user's plant list.	
Postconditions: 1. The system provides health status feedback and recommendations. 2. Diagnosis results may update the plant's care log or suggest schedule adjustments.	
Relationships: **Association:** User **Include:** Upload Plant Image **Extend: -**	
Normal Flow of Events: 1. User selects a plant and chooses "Monitor / Diagnose Plant & Soil Health." 2. System prompts the user to upload a new image or reuse the latest stored plant image/sensor data for re-analysis. 3. User uploads image or confirms use of existing data. 4. System analyzes visual or sensor data to detect plant/soil health conditions. 5. System suggests recommendations (e.g., watering, sunlight adjustment, fertilizing). 6. User reviews diagnosis and recommendations. 7. System logs the diagnosis in plant history.	
Alternate/Exceptional Flows: 3a. No valid image/data available	

System requires an image upload or input and does not proceed until provided. 4a. Technical/system error occurs System displays error and prompts retry.

Table 7: Post Question in Expert Community

Use Case Name: Post Question in Expert Community	**ID: UC - 5**
Primary Actor: User	
Supporting Actor: Expert	
Brief Description: This use case allows the user to post a question in the expert community to seek advice from verified experts or the community. The user can provide details about their plant, attach images or recent diagnosis results, and receive responses from experts (community members).	
Trigger: The user selects "Post Question" from the expert community section, to seek advice from verified experts.	
Preconditions: 1. The user is logged into the system. 2. The expert community module is active.	
Postconditions: 1. The question is logged and visible in the expert community. 2. Experts and/or community members are notified about the new question. 3. Responses are stored in the system and linked to the user's question**.**	
Relationships: **Association:** User **Include:** Provide Feedback to User. **Extend: -**	
Normal Flow of Events: 1.User selects "Post Question."	

2. System displays question submission form. 3. User writes the question, attach plant's details (optional). 4. System validates required fields. 5. User submits the question. 6. System logs the question and forwards it to relevant experts or the community feed. 7. System notifies experts/community members about the new question. 8. Experts/community members review question and prepare responses. 9. System allows responses to be submitted and linked to the question. 10.Receive Expert or Community Feedback (user receives responses).
Alternate/Exceptional Flows: 3a. Required fields not filled System requests user to provide missing question details or plant selection. 10a. User requests live (one-to-one) consultation Extend: Request Expert Session.

Table 8: Receive plant Recommendations

Use Case Name: Receive plant Recommendations	**ID: UC - 6**
Primary Actor: user	
Brief Description: This use case allows the user to receive personalized recommendations for plant care, such as watering schedules , sunlight needs, and soil improvement tips , based on analysed plant and soil health data.	
Trigger: the system has completed analyzing plant/soil health or the user requests recommendations	
Preconditions: -user must be logged into the system -the plant/soil analysis process must be completed successfully .	

Postconditions:

-the user receives a list of plant care recommendations

-recommendations are stored in the user's account for later viewing

Relationships:

Association: user

Include: Analyze plant/soil health

Extend: Generate automatic/manual care schedule

Normal Flow of Events:

1. The user uploads a plant image or provides plant/soil
2. The system analyses the plant and soil health
3. The system matches the analysis results with the plant care database
4. The system generates a list of care recommendations
5. The user view the recommendations within the app

Alternate/Exceptional Flows:

1. Analysis fails due to poor image quality or missing data:
   the system prompts the user to re-upload or re-enter data.
2. No suitable recommendations are found:
   the system suggests consulting an expert

2.7 Conclusion

In conclusion, this chapter presented a comprehensive analysis of the proposed Smart Plant Care System It began with data collection to understand users' needs and challenges in home gardening, followed by a comparison of similar systems and a review of related studies to identify the system's essential features.

In addition, both functional and non-functional requirements were defined to ensure that the system will be practical, efficient, and reliable.

Overall, this analysis serves as a roadmap for designing an intelligent and effective agricultural application that bridges technology and sustainability in plant care.

Chapter 3

SYSTEM DESIGN

3.1 Introduction

This chapter presents the fundamental modeling techniques used to analyze and design the PLANT PAL application. It includes the Sequence Diagram, Activity Diagram, Class Diagram, and Entity Relationship Diagram (ERD), which together provide a structured view of the system's workflow, interactions, and overall architecture.

3.2 Sequence Diagrams

The Sequence Diagrams in this section illustrate how the main processes in the PLANT PAL application are executed over time. They show the interactions between users and the system, highlighting the flow of messages and actions required to complete tasks such as adding plants, monitoring health, and engaging with the expert community. These diagrams help clarify the dynamic behavior of the system and provide a clear view of how each process unfolds from start to finish.

Request Expert Account Updgrade

The sequence diagram shows how a user submits a request to upgrade their account to an expert level. The user provides their information, the request is reviewed, and the system later informs them whether it was approved or rejected.

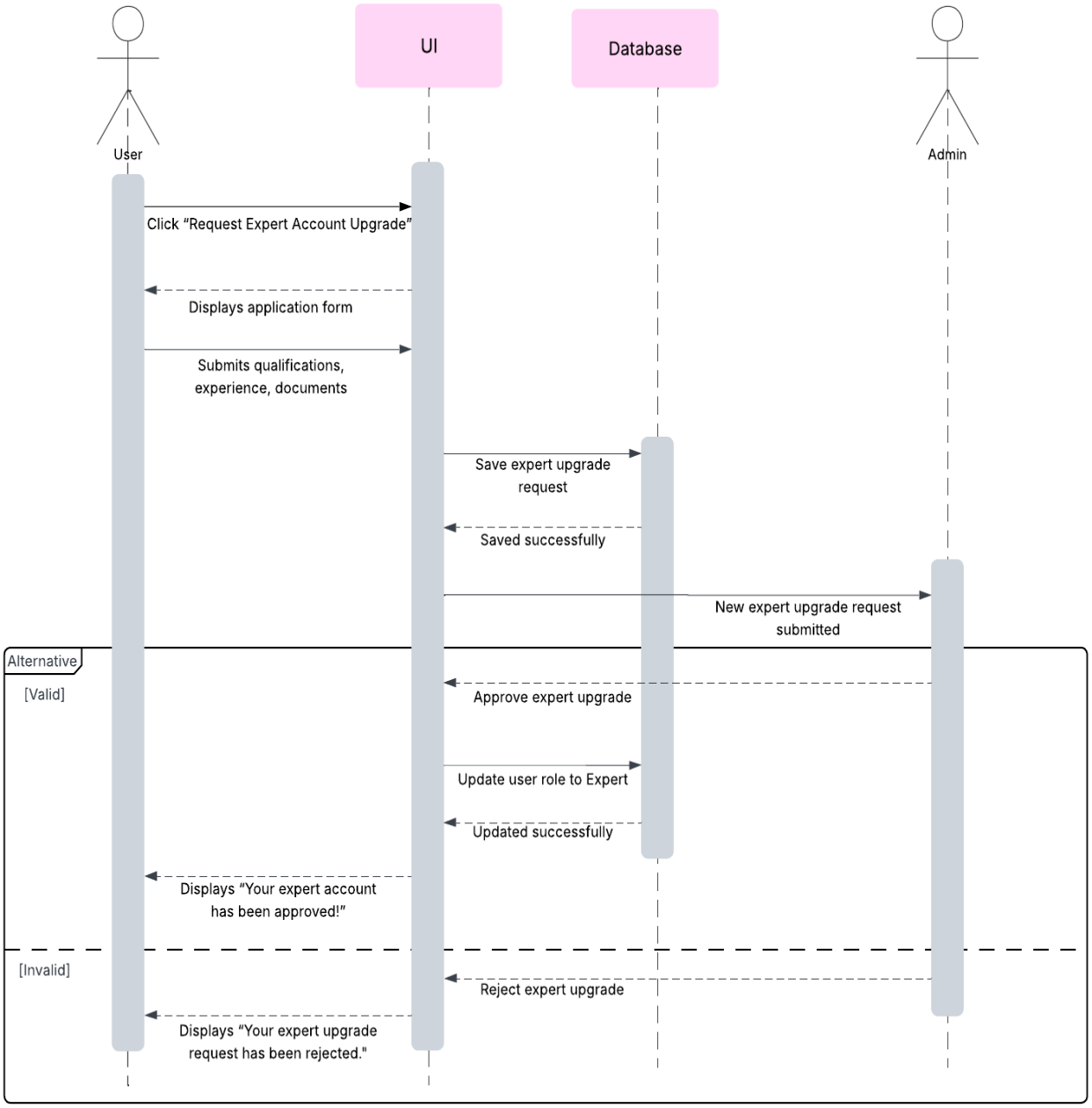


Figure 2: Request Expert Account Updgrade Seguence digram

Add New Plant (Manually)

The sequence diagram shows how a user adds a new plant by entering the plant details themselves. After the user submits the information, the system saves it and confirms that the plant has been added.

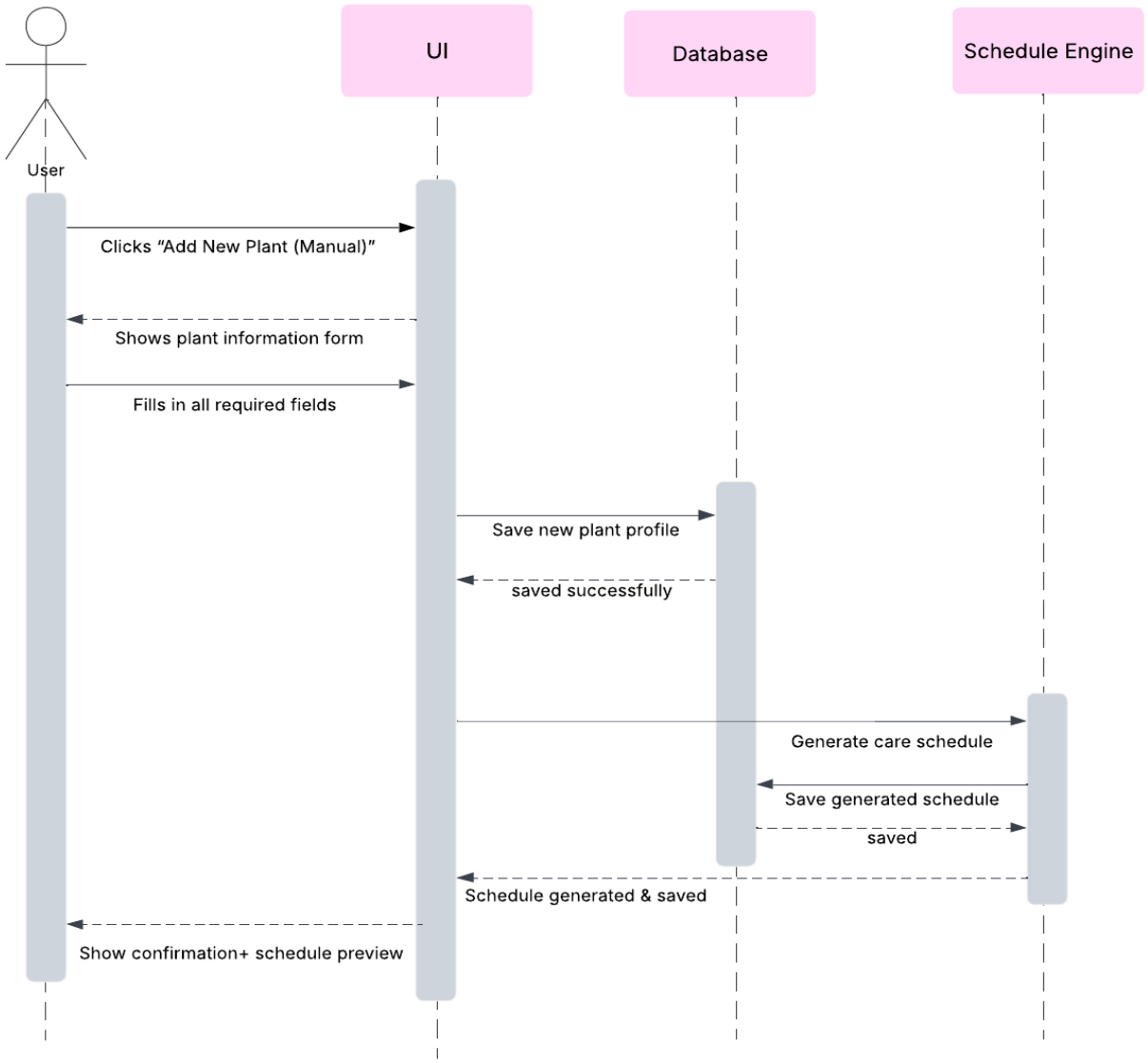


Figure 3: Add New Plant Manually Sequence Diagram

Add New Plant (Automatically)

The sequence diagram shows how the system automatically adds a plant by identifying it from a photo and generating care instructions for the user.

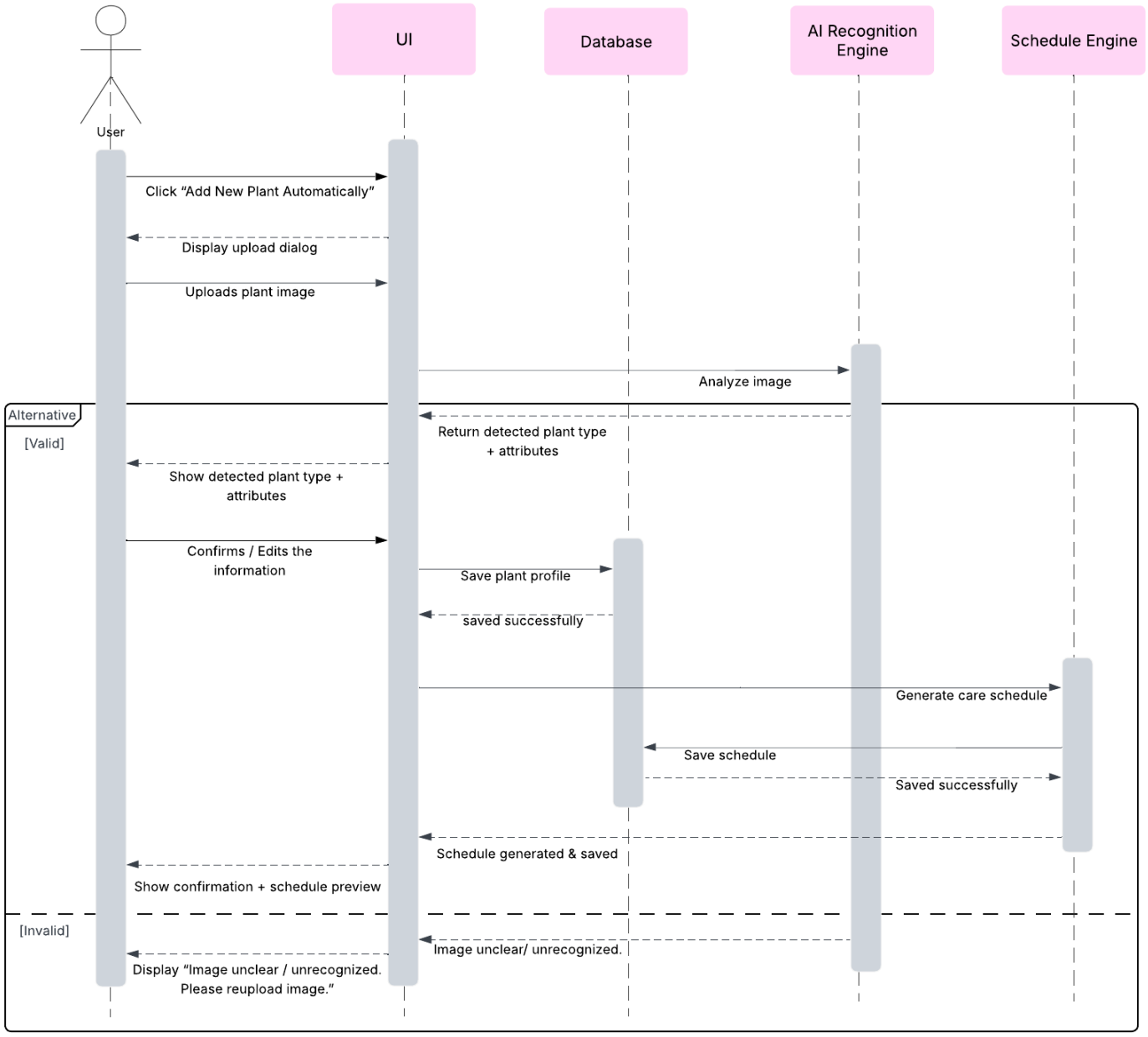


Figure 4: Add New Plant Automatically Sequence Diagram

Monitor / Diagnose Plant & Soil Health

The sequence diagram shows how the system checks the health of a plant or soil and provides the user with condition updates and care recommandations.

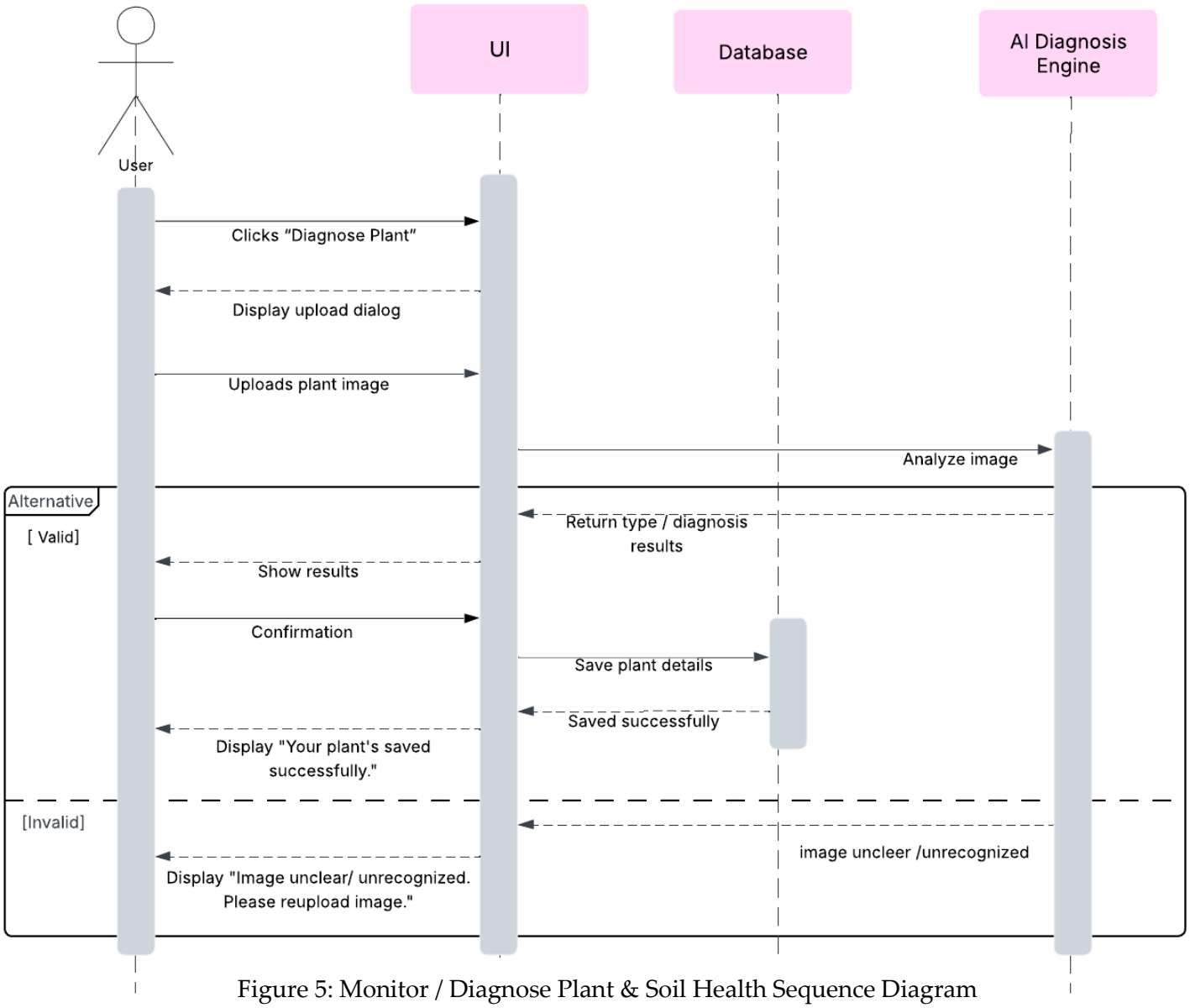


Figure 5: Monitor / Diagnose Plant & Soil Health Sequence Diagram

Post Question in Expert Community

The sequence diagram shows how a user submits a question to the expert community, making it visible for experts to respond.

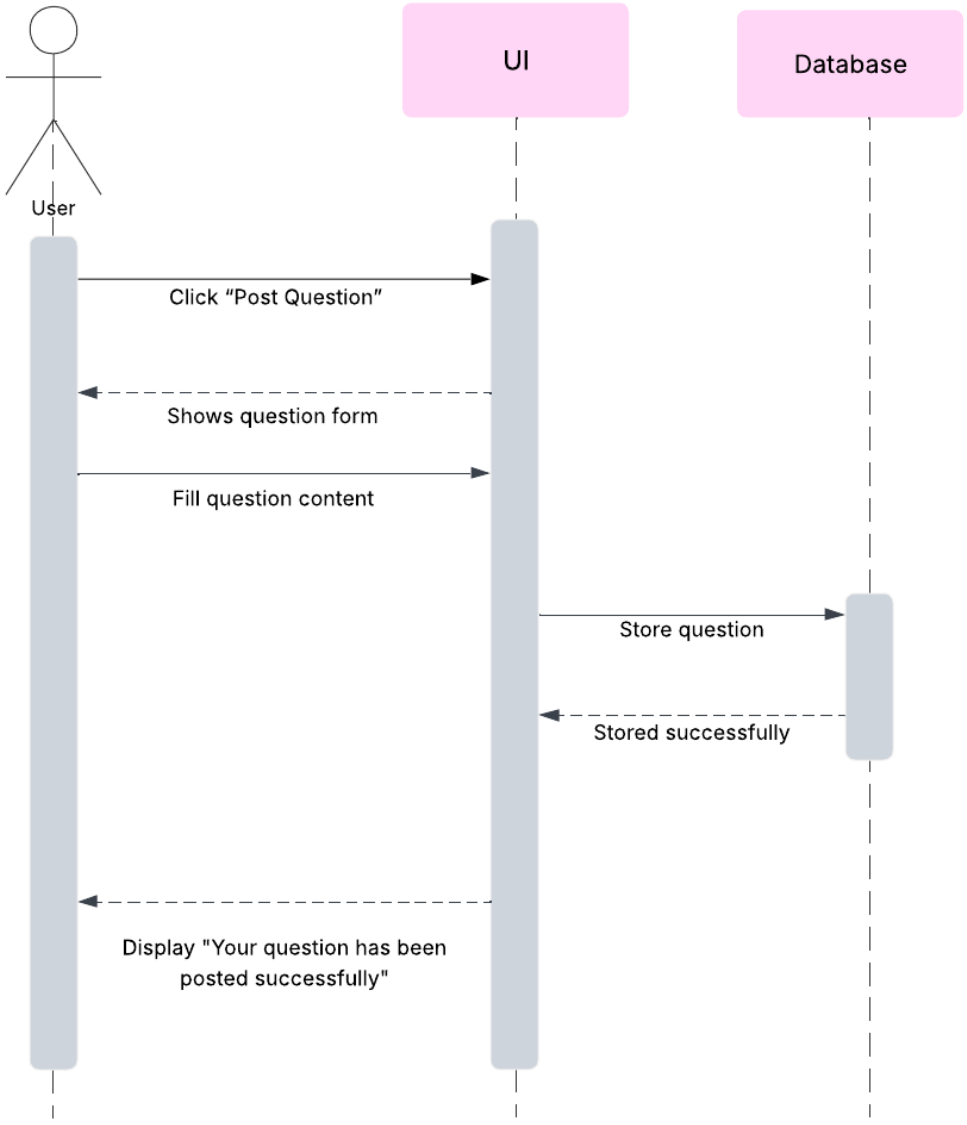


Figure 6: Post Question in Expert Community Sequence Diagram

3.3 Activity Diagrams :

The Activity Diagrams in this section illustrate the main workflows within the PLANT PAL application. These diagrams provide a clear representation of how users interact with the system and how each process progresses from start to finish. Through visualizing steps such as signing up, logging in, posting questions to experts, and requesting expert sessions, the diagrams help identify the decision points, possible system responses, and the overall flow of activities. This modeling approach ensures a better understanding of the system's behavior and supports the development of a more efficient and user-friendly application.

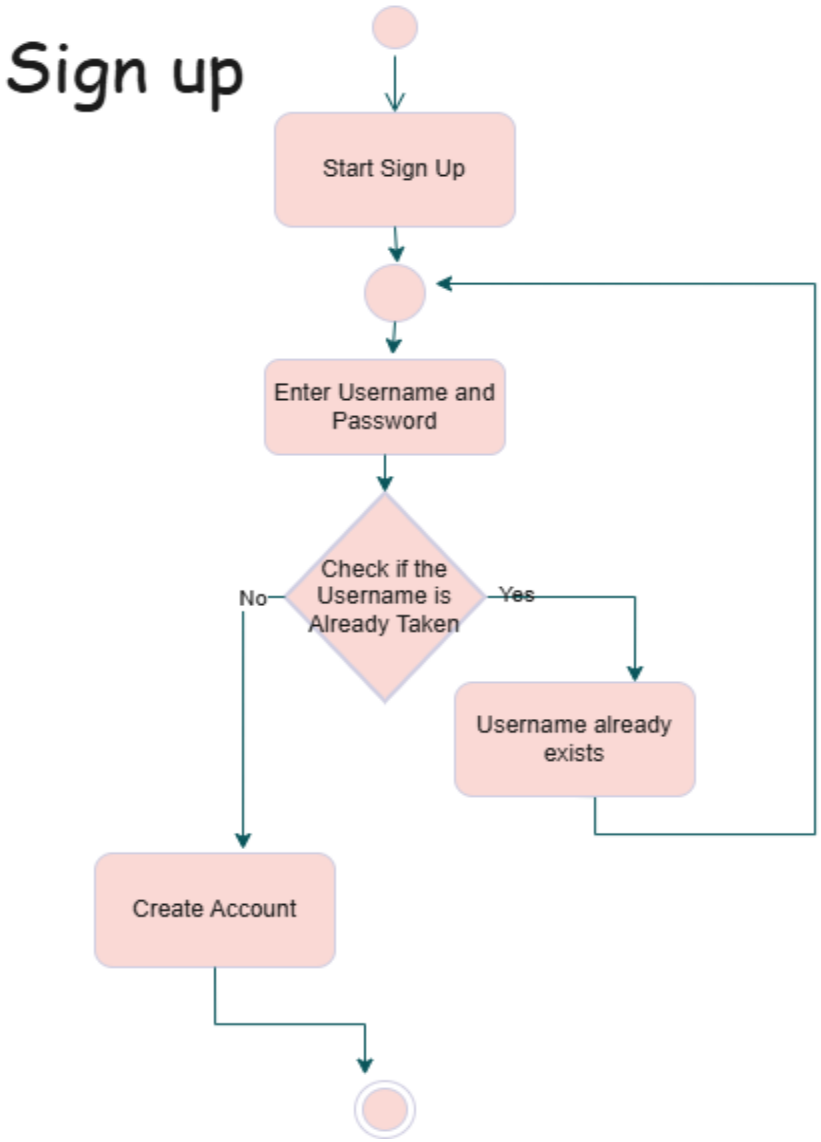


Figure 7: Sign Up Activity Diagram

The user starts the sign-up process by entering a username and password. The system checks if the username is already taken. If the username is already taken, the user is notified. If not, a new account is created.

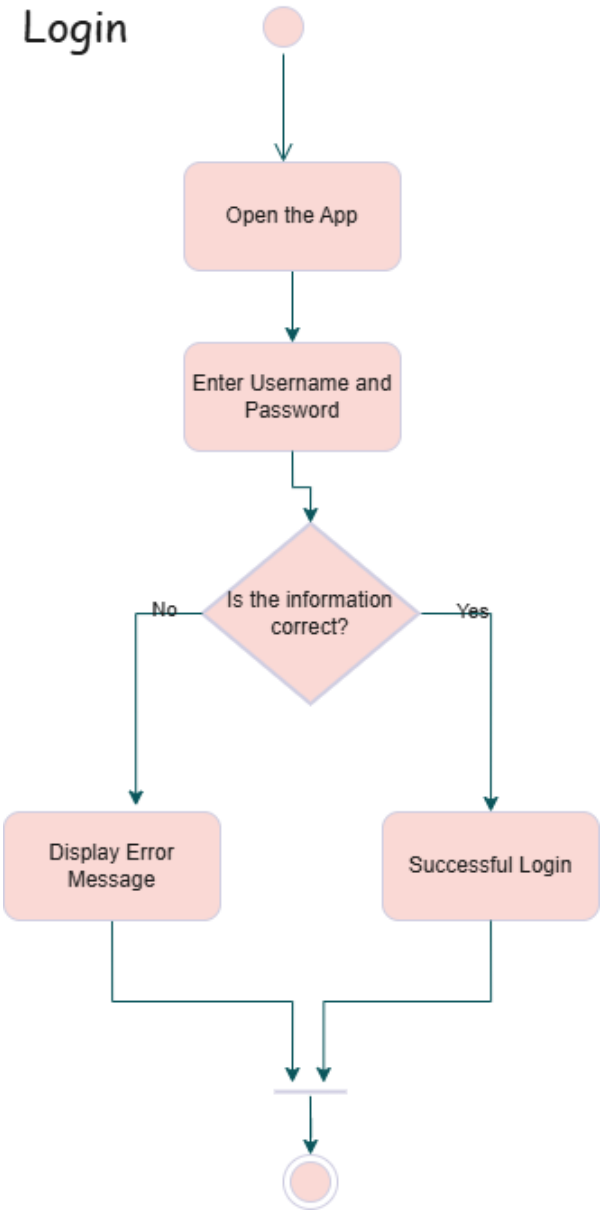


Figure 8: Login Activity Diagram

The user starts by opening the app and then enters the username and password. The system verifies the entered information, and if it's correct, successful login is granted. If the information is incorrect, an error message is displayed.

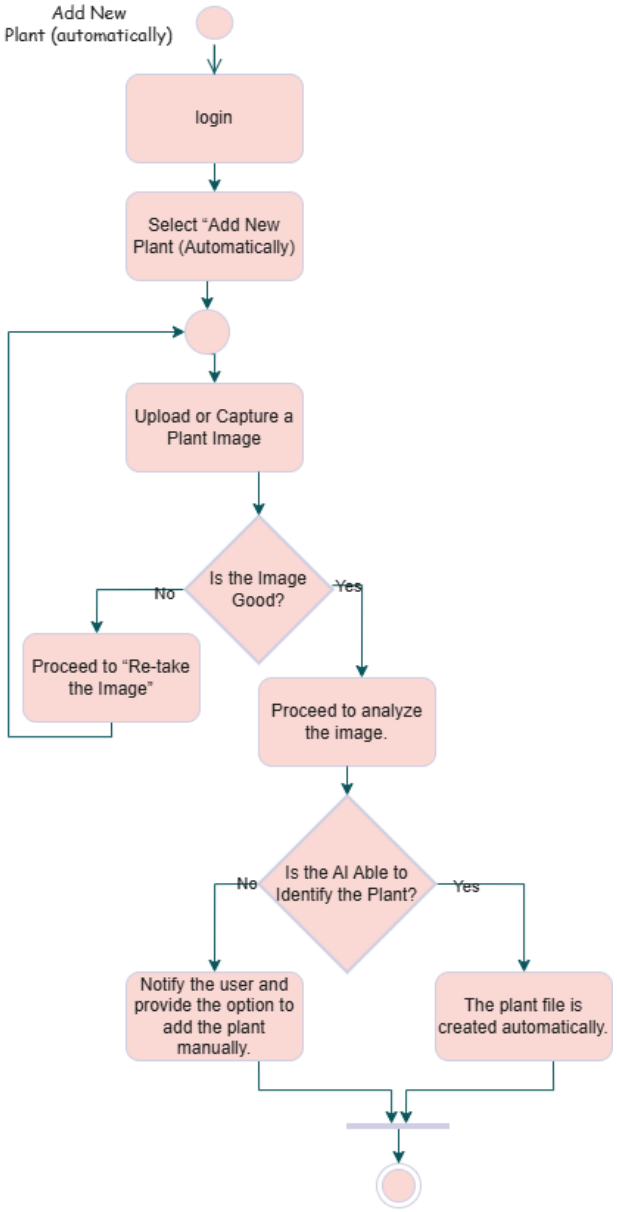


Figure 9: Add new plant(automatically)ActivityDiagram

The flowchart illustrates the process of automatically adding a new plant. The user starts by logging in and then selects the option to 'Add New Plant Automatically.' The user uploads or captures an image of the plant. The AI analyzes the image to determine whether it is good or not. If the image is not good, the user is notified and given the option to retake the image. If the image is good, the AI processes it, and if it can identify the plant, a plant file is automatically created. If the AI cannot identify the plant, the user is informed and provided with the option to add the plant manually.

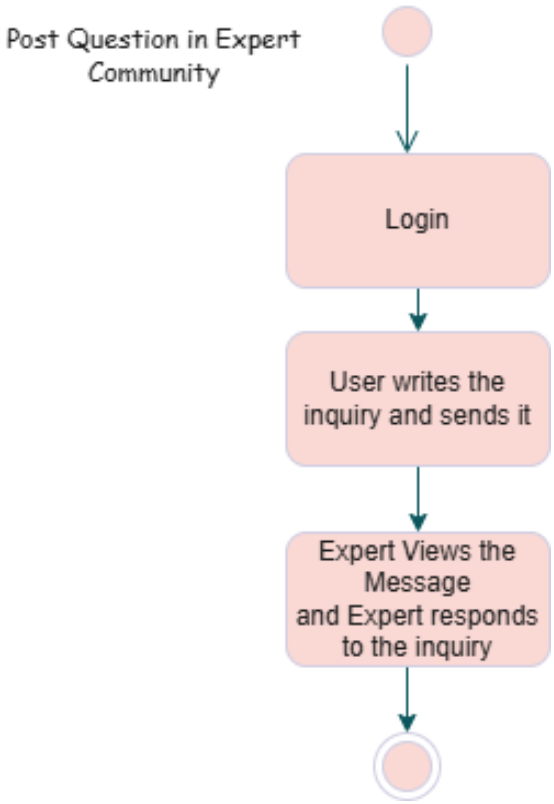


Figure 10: Post Question in Expert Community Activity Diagram

The flowchart illustrates the process of requesting an expert session. The user starts by logging in and then selects the 'Request Expert Session' option. A list of available experts is displayed. The Display the form . The user enters the required data in the provided form and then sends the request.

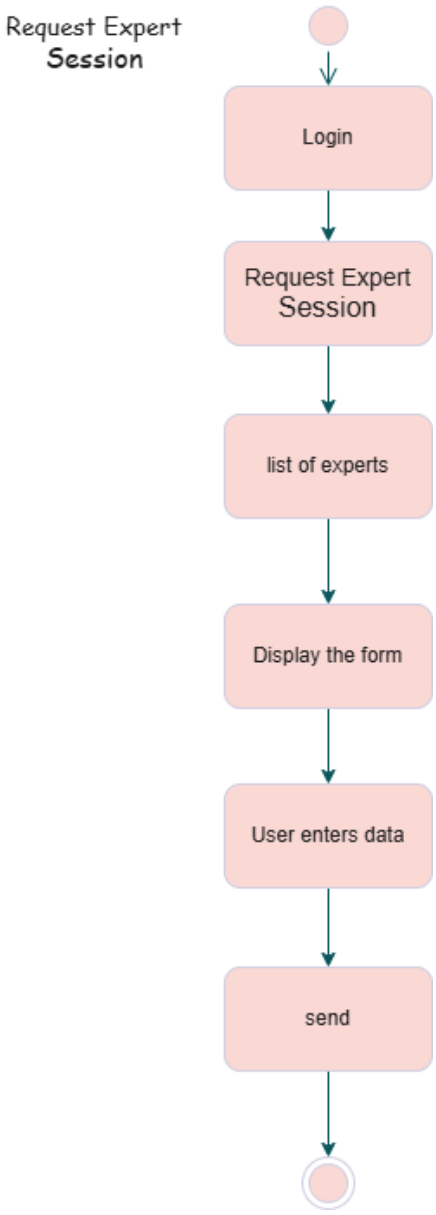


Figure 11: Request Expert Session Activity Diagram

The flowchart illustrates the process of requesting an expert session. The user starts by logging in and then selects the 'Request Expert Session' option. A list of available experts is displayed. The user enters the required data in the provided form and then sends the request.

3.4 Class Diagram

This diagram shows the main classes in a smart plant-care system and how they work together. It explains the roles of users, experts, and admins, along with how plants, care schedules, weather data, and expert session requests are managed. Each class has specific attributes and functions that help the system provide efficient monitoring and support for plant health.

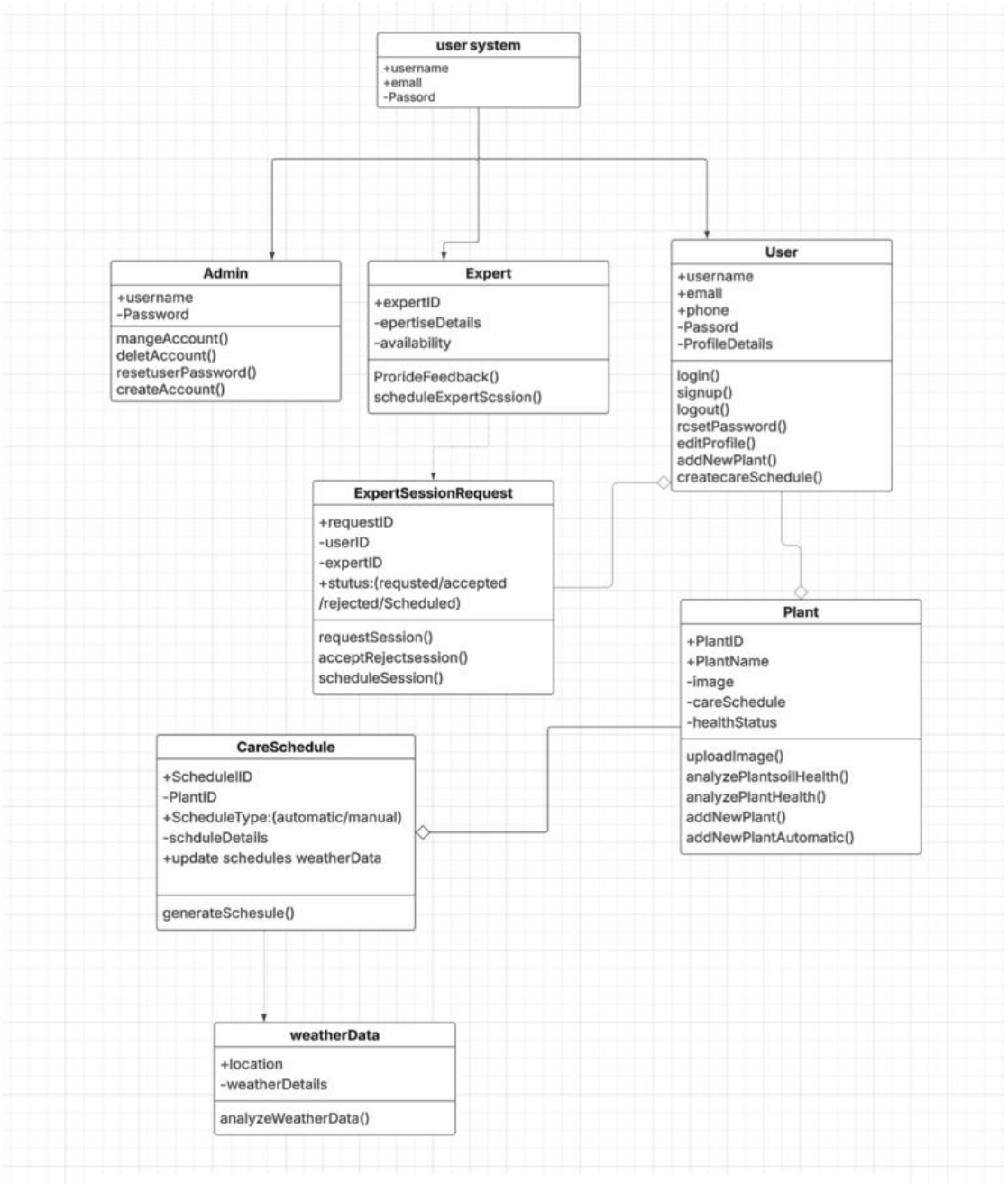


Figure 12: plant-care system Class digram

3.5 Entity Relationship Diagram

This Entity Relationship Diagram (ERD) illustrates the core structure of a Plant Health Management System, highlighting key entities such as User, Expert, Admin, and Plant, along with their interactions and functions. The system is designed to streamline communication and services among stakeholders, offering features like diagnosis, recommendations, and account management to enhance plant care and user experience.

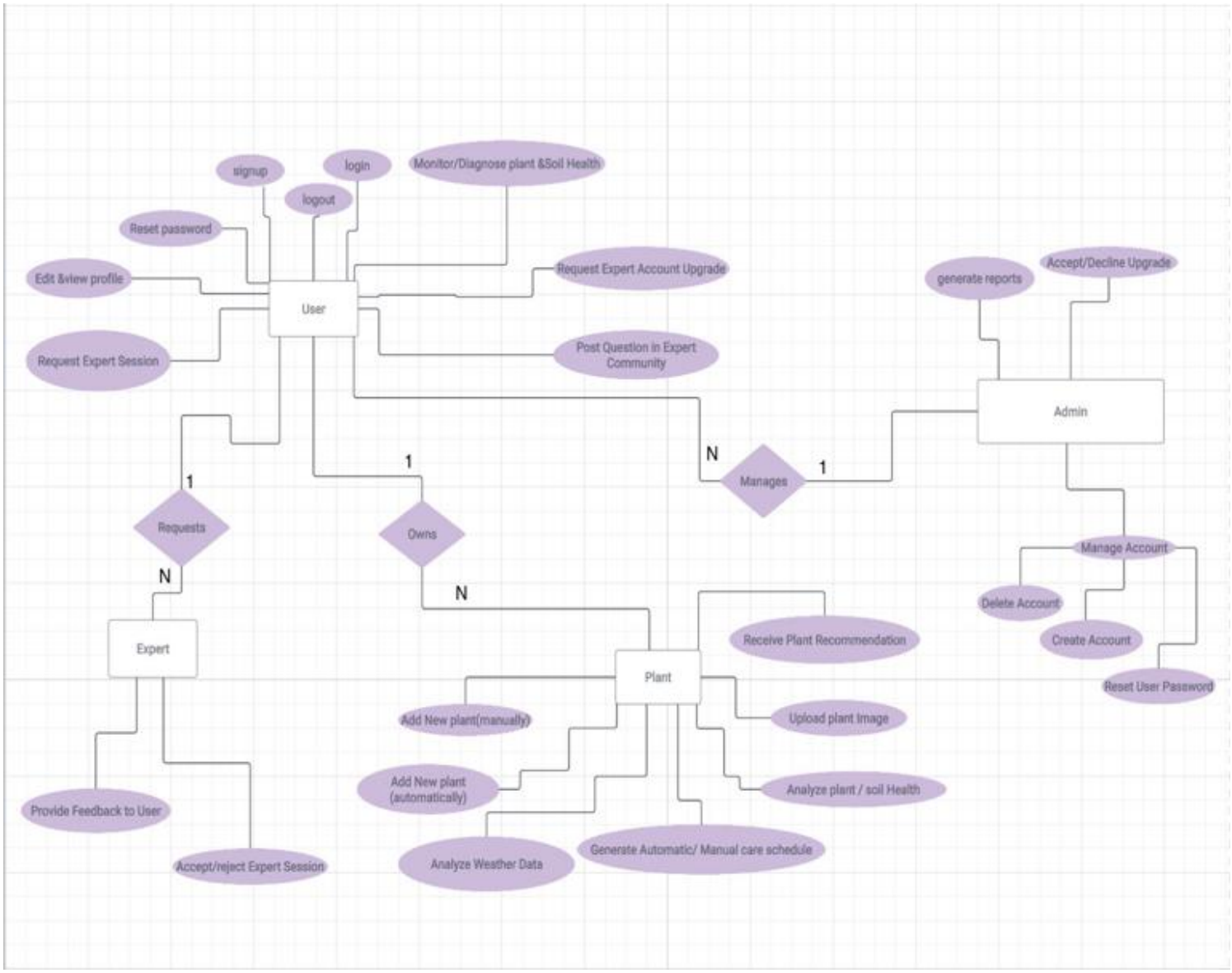


Figure 13: Plant Health Management System Entity Relationship Diagram

3.6 Diagram Database

This diagram illustrates the basic database of the system and helps in understanding how information is stored, linked, and managed to effectively support the system's functions.

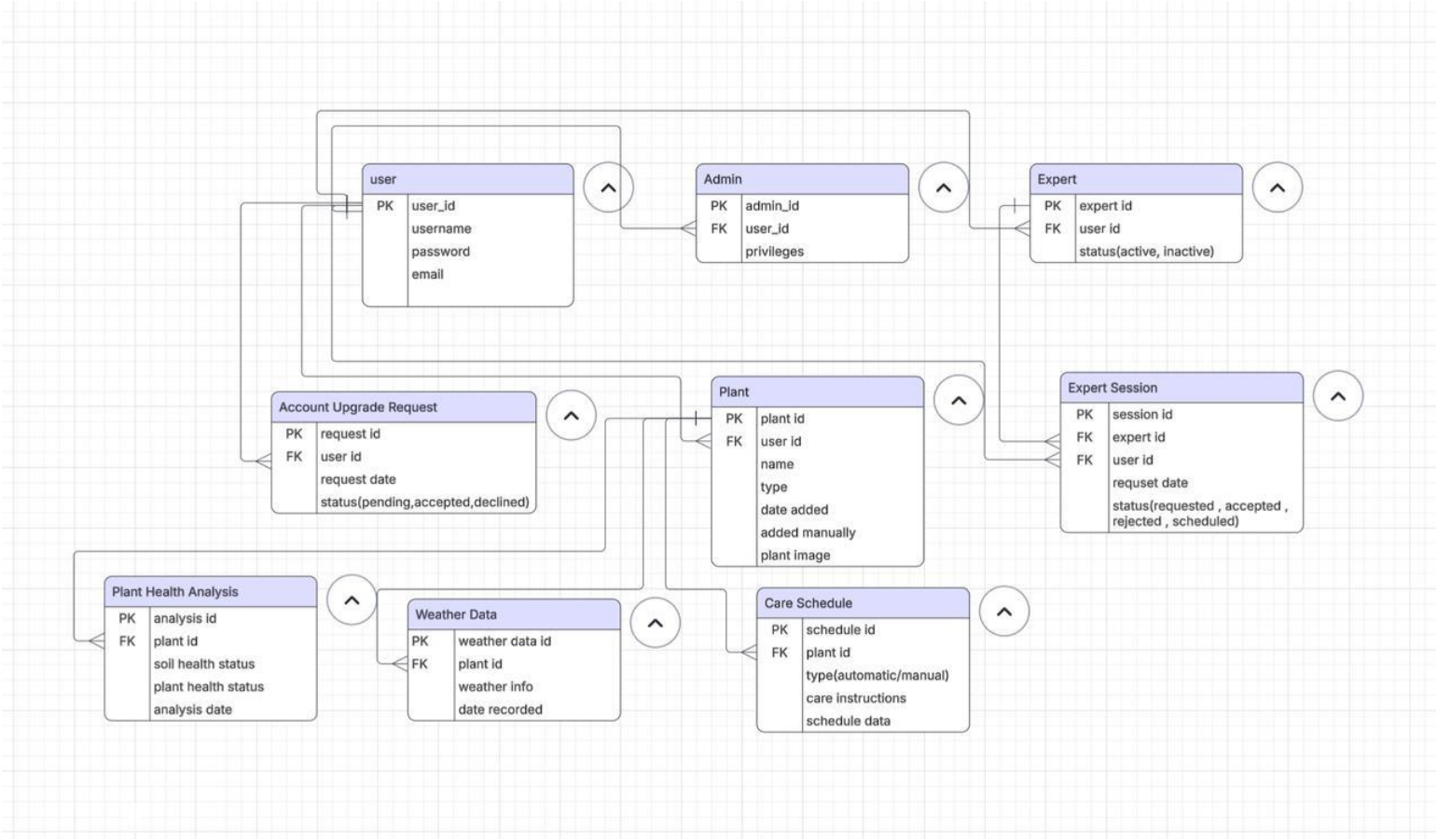


Figure 14: Database the system Diagram Database

3.7 Conclusion

The System Design chapter represents the technical backbone of the My Plant Pal project. It has presented sequence diagrams, activity diagrams, class diagrams, and database models to ensure that both functional and non-functional requirements are translated into a coherent and practical framework. The modular and scalable architecture supports maintainability, reliability, and seamless integration with external services, while the data models guarantee consistency and accuracy in managing plant and user information.

Ultimately, this design establishes a solid foundation for the implementation and testing phases, ensuring that the system remains user-friendly, efficient, and adaptable to future enhancements.

Chapter

4 CONCLUSION & FUTURE WORK

4.1 Achievements

The **My Plant Pal** project has accomplished several significant milestones in the field of smart agriculture and home plant care. The achievements can be summarized as follows:

1. Desigen of an Intelligent Platform

- The system utilizes **artificial intelligence** to diagnose plant diseases accurately through leaf and soil image analysis.
- Automated watering and fertilization schedules are generated and adjusted based on plant type and environmental conditions.
- A bilingual user interface (Arabic and English) was implemented to ensure accessibility for both beginners and experts.

2. Enhancement of User Experience

- Users can manage detailed plant profiles and monitor growth progress through regular photo updates.
- Smart notifications and reminders help users stay on track with essential tasks such as watering, fertilizing, and harvesting.
- A clear dashboard displays plants and upcoming responsibilities in an organized manner.

3. Community and Expert Interaction

- An interactive space was created for users to share photos, tips, and experiences.
- Direct communication with agricultural experts is supported through messaging and consultation sessions.
- Conversation logs are stored to ensure continuity and reference for future guidance.

4. Administrative Control

- Administrative features allow account management (creation, modification, deletion).
- Upgrade requests from users seeking expert status can be reviewed and approved or rejected.
- Comprehensive reports summarizing user activity, expert interactions, and system performance are generated to support oversight.

5. Innovation and Future Expansion

- Weather data integration enables climate-based recommendations for plant care.
- The system architecture was designed to be **modular and scalable**, ensuring adaptability to user growth and seasonal demand.
- Motivational features such as **achievements and badges** encourage consistent care and engagement.
- Plans for a future **Marketplace module** will allow users to purchase plants and gardening supplies directly through the platform.

6. Quality and Reliability

- The system ensures rapid image processing for a smooth user experience and maintains continuous availability under normal operating conditions.
- AI outputs are delivered with confidence scores to enhance trust and transparency.
- Integration with external services such as weather APIs and payment gateways strengthens system interoperability, with potential expansion to IoT sensors for improved accuracy.

4.2 Limitations

The development of the "My Plant Pal" system was guided by a clear scope, which inevitably introduced certain constraints. The following limitations are acknowledged to provide a transparent understanding of the system's current capabilities and to outline pathways for future enhancement.

1. **Constraints in Initial Data Collection:**
   The foundation of the system's requirements was based on a specific, limited dataset. A broader and more iterative approach to data gathering would have strengthened the validation of its features.

- **Sample Size and Diversity:** The project relied on a survey of 61 participants. While this provided valuable initial insights, a larger and more diverse sample would be necessary to ensure the system meets the needs of a wider audience, including expert gardeners, farmers, and individuals from various climatic regions.

- **Methodology:** Data collection was based mainly on a single survey and review of existing systems. Incorporating interviews with agronomists, focus groups, and early usability tests could have revealed deeper user needs and improved the design before development.

2. **Constraints in Soil Health Analysis & Monitoring:**
   The system's diagnostic capabilities are limited by its chosen technological approach.

- **Absence of Physical Sensor Integration:** The project scope does not include integration with IoT sensors. This limits the system's access to real-time, ground-level data on factors like soil moisture and nutrient levels, which are critical for highly precise care recommendations.

- **Limited Soil Analysis Capability:** As a result, the proposed soil health analysis is confined to visual assessment through image recognition. This method cannot perform detailed chemical analysis to detect specific nutrient deficiencies or soil composition issues.

These acknowledged constraints serve as a direct guide for future development work to enhance the system's capabilities and accuracy.

4.3 Future Work

AI-powered Market Recommendations:

The marketplace section can be enhanced by integrating AI-driven recommendations, where users receive personalized suggestions for plants, tools, or accessories based on the plants they own and their care needs. This will help users find the most suitable products for their gardening needs, making their shopping experience more efficient and tailored.

Discounts and Support for Gardening Tools and Supplies:

The system can provide customized support and discounts for users on gardening tools, such as fertilizers, soil, and plant care tools, based on their individual needs. Users can receive discount coupons or special offers when purchasing the necessary tools to care for their plants from partner stores, enhancing their user experience and encouraging more interest in home gardening.

Partnerships with "Saudi Green Initiative":

The system can create partnerships with environmental organizations or initiatives, both governmental and private, such as the "Saudi Green Initiative", to enable users to participate in national tree-planting campaigns or support environmental projects. For example, users can donate to green initiatives aimed at increasing green spaces in the kingdom, aligning with the country's vision for a greener future.

Development of an integrated Marketplace:

This feature would allow users to conveniently browse, view details of, and directly purchase plants and essential gardening supplies within the application.

Rewards or Incentives for Eco-Friendly Users:

To encourage more users to adopt sustainable practices, the system could offer rewards or badges to users who follow sustainable gardening practices or participate in tree-planting campaigns. These rewards could include discounts on gardening tools or environmental prizes, motivating users to continue their green initiatives and promote sustainability.

REFERENCES

Research Papers Links :

1.Smart Crop Care – AI-Driven Plant Disease Detection

by Srinivasa Rao G & T Harinadh

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5327060

2.Plant Care and Disease Detection Using Pattern Recognition

by Abdelrahman Hamdy and others.

https://iiis.journals.ekb.eg/article_403020.html

3. Historical Review of Medicinal Plants Usage

by Biljana Bauer Petrovska

https://pmc.ncbi.nlm.nih.gov/articles/PMC3358962/

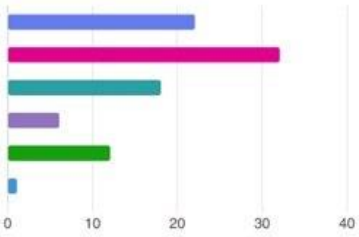
Existing System :

https://apps.apple.com/sa/app/murshiduk-مرشدك-الزراعي/id1500889672

APPENDIX

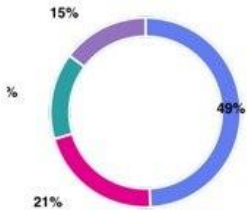
Survey Results:

5. ماهي اكثر التحديات التي واجهتك عند رعاية النباتات؟



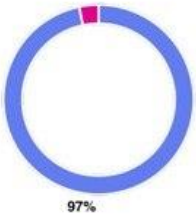
تحديد الامراض	22
معرفة عدد مرات الري/التسميد	32
عدم وجود نصائح موثوقة من خبراء	18
صعوبة في العثور على منتجات بذور موثوقة	6
لم أواجه أي تحديات	12
غير ذلك	1

6. كيف تتغلب على مشاكل النباتات؟



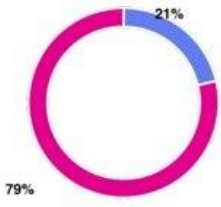
البحث بالإنترنت	30
اسأل العائلة والاصدقاء	13
أقوم بزيارة المتاجر الزراعية	9
استخدام التطبيقات المهتمه بالنباتات	9
غير ذلك	0

7. هل تعتقد ان وجود تطبيق يساعد بالتعرف على المشاكل وتقديم المقترحات سيسهم بالعناية بالنباتات؟



نعم	59
لا	2

8. هل سبق لك استخدام تطبيق لمراقبة صحة النباتات والعناية بها ؟



نعم	13
لا	48

9. اذكر أسم التطبيق ان وجد ؟

الردود الأخيرة

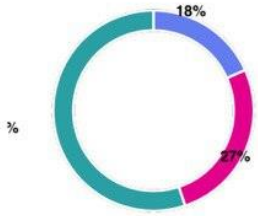
"لا يوجد"

...

6

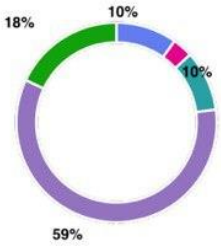
الاستجابات

10. هل ساعدك التطبيق في تحسين العنايه بالنباتات؟



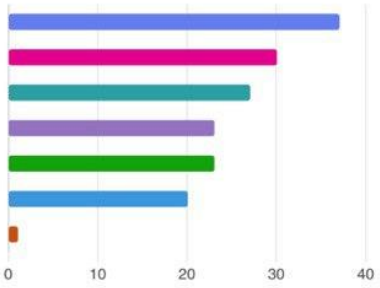
نعم	9
إلى حد ما	13
لا	27

11. ماهي المشاكل التي واجهتك داخل التطبيق؟



خدمات غير فعالة	6
عدم استجابه التطبيق بشكل سريع	2
تطبيق غير مكتمل	6
لم أواجه مشاكل	36
غير ذلك	11

12. أي من هذه الميزات تبدو اكثر فائدة لك؟ (يمكن اختيار اكثر من واحدة)



منبهات ذكية : تذكير تلقائي بالري والتسميد	37
تشخيص الأمراض والافات : رفع صورة للنبتة ليتم التعرف على المرض تلقائيا واقتراح العلاج	30
موسوعة نباتات : دليل شامل لأنواع النباتات مع ارشادات العناية	27
التواصل مع خبراء: إمكانية استشارة خبراء زراعيين	23
مجتمع نباتي : منصة للتواصل من هواة اخرين ، مشاركة الصور والاستفسارات	23
تتبع النمو : إمكانية حفظ سجل للصور والتواريخ لتتبع نمو نباتاتك مع الوقت	20
غير ذلك	1

13. هل لديك تعليقات اضافيه تساهم بتطوير التطبيقات الخاصه في تحسين العنايه بالنباتات ؟

15
الاستجابات

الردود الأخيرة

"١- ربط التطبيق بمضخات أو أنظمة ري أوتوماتيكية"

"لا"

...