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TECHNOLOGY

BSc(Hons) Computer Science

5COSC021C - SDGP

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Individual Report

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Declaration

I hereby certify that this project report and all the artifacts associated with it is our own work and it has not been submitted before nor is currently being submitted for any degree program.

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Abstract

This report provides a comprehensive overview of the AgroLanka project, focusing on the System Requirements Specification, social, legal, ethical, and professional issues, and the system architecture and design. This is a structured approach that will ensure thorough and methodical development process with high quality user centric mobile application for gardeners. Feedback and continuous improvements are considered for the AgroLanka project to consistently achieve the value that meets user needs equally and not equally.

The AgroLanka application's functional and nonfunctional requirements are specified in the System Requirements Specification (SRS) section; data management, user interface design, and performance metrics are covered in the SRS. This ensures that all the stakeholders know what they are expected to accomplish with the application and what they will be asked to do. Precisely concentric with the project's objectives and user expectation, the SRS helps set a foundation for the development team.

Issues pertaining to the social, legal, ethical and professional implications of the AgroLanka project are addressed in the social, legal, ethical, and professional issues section. It covers such issues as data privacy, user consent, and the way to obey the local data protection laws. It highlights ethical considerations. The purpose of this section is to create trust so that the staff knows it will be addressing customer issues using the highest standards of professional conduct.

The technical framework and design principles that will govern AgroLanka application development are described in this section on the system architecture and design. The scope for this includes the choice of technologies, database design and selection of user interface elements. The architecture is rampable, secure, and user friendly so gardeners can have an enjoyable experience. Usability, accessibility, and cross gardening needs and environments are the main area of emphasis in the design principles.

This structured approach ensures a thorough and methodical development process, aimed at delivering a high-quality, user-centric mobile application for gardeners. Continuous feedback and iterative improvements are emphasized to ensure the AgroLanka project meets user needs effectively and ethically.

In conclusion, the AgroLanka project represents a significant step forward in leveraging technology to support and enhance gardening practices. The project's comprehensive approach, encompassing the System Requirements Specification, social, legal, ethical, and professional issues, and the system architecture and design, ensures a robust and user-centric mobile application.

Acknowledgement

It is my pleasure to thank Mr. Banuka Athuraliya, our Module Leader for providing significant guidance, constant support and constructive feedback throughout the project. This work has greatly benefited from his ideas and input.

To all the stakeholders who assisted in this study offering their opinions and ideas which I deemed important as I worked on this project, I would like to take this opportunity to thank them. This made their input very practical to help Agro-Lanka to address the real life gardening requirements.

My group members deserve a big thanks because they have been very devoted, cooperative, and encouraging throughout this project. The different views and contributions from all have been invaluable to this project.

Last but not least, my friends and family are owed special thanks for their support, time, and encouragement during the course of this project. I am grateful for their constant belief in me during this academic journey.

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List of abbreviations

Abbreviation	Full Form
AR	Augmented Reality
API	Application Programming Interface
SRS	System Requirements Specification
SLEP	Social, Legal, Ethical, and Professional
UI	User Interface
GDPR	General Data Protection Regulation
FR	Functional Requirements
NFR	Non-Functional Requirements
DFD	Data Flow Diagram

Chapter 4: System Requirements Specification (SRS)

4.1 Chapter Overview

In this chapter, all of the system requirements and the foundations of Agro-Lanka the gardening application are described. This details the analysis of core functionalities, system boundary and technical specification for the implementation to be successful. The chapter is structured in a way to provide a clear presentation of the user and the technical aspects of the system.

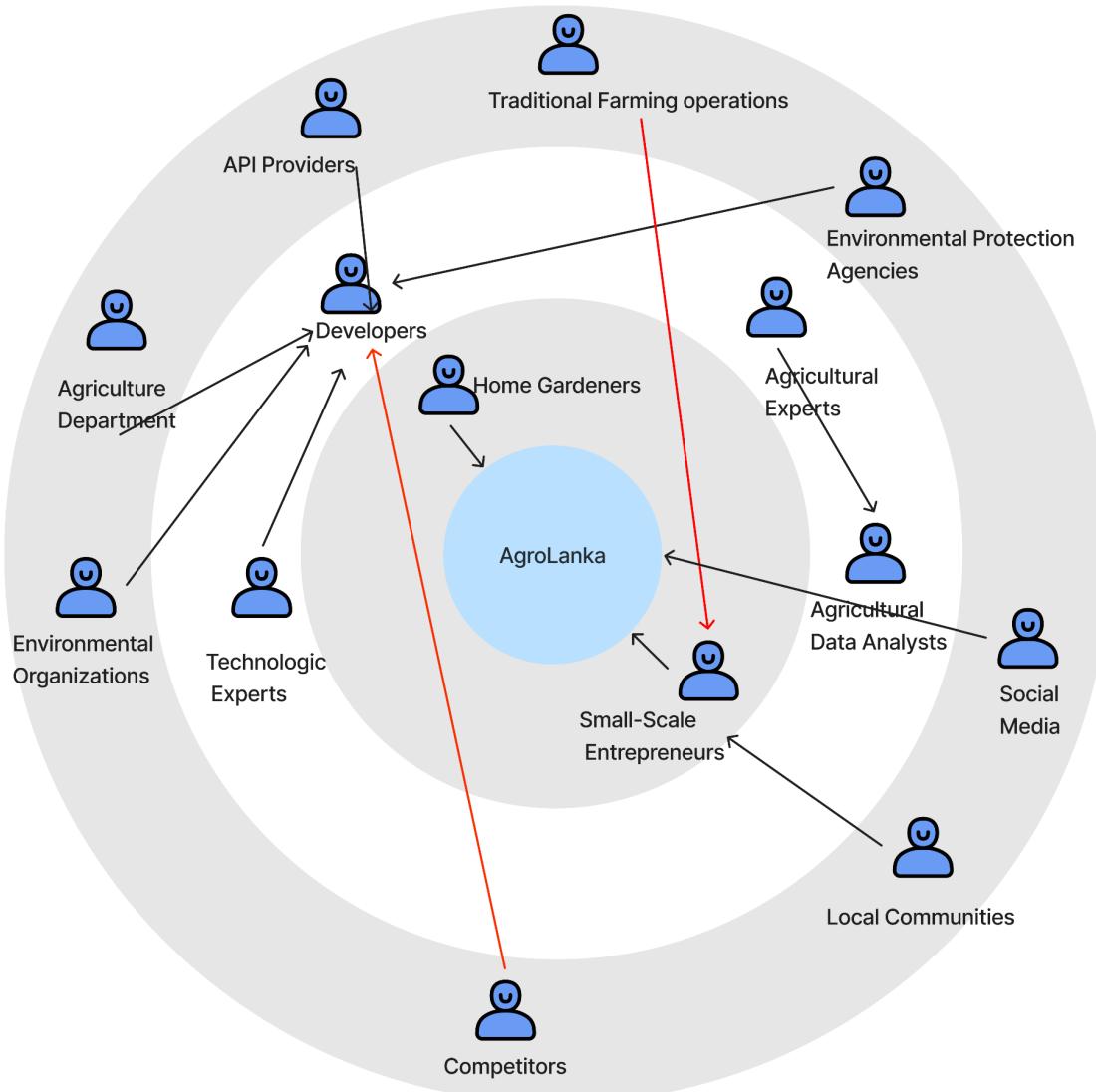
4.2. Stakeholder Analysis

The stakeholder analysis employs an onion model that presents hierarchical relationships among different stakeholders and their interactions with the system. The stakeholder analysis is a process of identifying these people before the project begins; grouping them according to their levels of participation, interest, and influence in the project; and determining how best to involve and communicate each of these stakeholder groups throughout.(Product Plan, 2018)

This stakeholder structure ensures:

- Clear communication channels
- Well-defined responsibilities
- Efficient decision-making processes
- Balanced consideration of all stakeholder interests
- Proper resource allocation
- Effective risk management

4.2.1.Onion Model



4.2.2.Stakeholder Descriptions

Stakeholder	Viewpoint
Functional beneficiary	
Home gardeners	For those who want to start or maintain a home garden but don't have any knowledge of it. Yet, they require easy to understand advice, effective cultivation planning tools and immediate guidance to grow successfully.
Financial beneficiary	
Developer	Design and develop the AR application with enhanced functional and optimal system performance and security of data.
Small-scale Entrepreneurs	Local garden-related business owners, who aim to increase their clients' base and extend the range of services or products offered both online and offline.
Social beneficiary	
Social media	Building community connection, creating engaging content and knowledge sharing among gardeners.
Local communities	Groups that share gardening interests and spaces, want to share facilities, tools for sharing resources and promotion of local food sustainability initiatives.
Environmental Organizations	Organizations that promote sustainable practice and conservation, and a resource and guidelines for earth friendly gardening technique.

Operational beneficiary	
Agricultural analysts	Data Growing pattern analysis and user behavior analysis to predictive models and data driven recommendations in improving gardening success.
Developers	Platform infrastructure technical teams managing and controlling system scalability and security, and data processing operations smoothly.
Negative Stakeholders	
Competitors	Gardening service providers monitor market changes and react to the change in the business model so as to maintain its market relevance.
Traditional farming operations	Large scale ag businesses adjusting to the uptick that home gardening is seeing, as a complement, not competitor to home grower.
Regulatory	
Agricultural department	organization in charge of supporting the compliance with the agricultural regulation and rural and urban agriculture standards.
Environmental protection agencies	Monitoring the impact of urban gardening practices and what the compliance looks like from a sustainability aspect and that type of stuff, under the regulatory bodies that are then, enforcing that kind of environmental compliance.
Experts	

Agricultural Experts	Specialized knowledge, validation of recommendations, and the development of best practice guidelines from professionals.
Technology Experts	Technical excellence, keeping it in mind, optimizing your experience, offering you innovative features — AR and mobile development specialists.
Neighboring systems	
API providers	External services that offer essential data integrations such as weather, soil analysis, plant databases.

4.3. Selection of Requirement Elicitation Techniques/Methods

- Interviews

Purpose: deep insights into potential user & stakeholders expectations and requirements.

Conducted an Expert Interview to learn what the technical advice and best practices are.

- Questionnaire

A questionnaire is a list of questions or items used to gather data from respondents about their attitudes, experiences, or opinions. can be used to collect quantitative and/or qualitative information. (Bhandari p, 2021).

4.4. Discussion/ Analysis of Results

- Interview - 29/10/2024

Key Insights:

On our visit to Govijana Madura, we met Mr. Anura, the Agri Technology IT department Director, who had some insights in terms of activities and the technologies deployed in order to promote agriculture in Sri Lanka.

The key takeaway from the interview :

Adoption of Modern Agri-Tech Solutions:

Mr.Anura provided insights into the importance of sustainable practice and modern agricultural technologies in Sri Lanka. Sustainable agriculture is the main focus of Govijana Madura to improve agricultural productivity and environmental sustainability. These insights will be a great source when designing and shaping our own AR based gardening app, as it should work well for the needs and practices of urban gardeners as well as promote sustainable agricultural practice.

Summary

Mr.Anura provided insights into the importance of sustainable practice and modern agricultural technologies in Sri Lanka. Sustainable agriculture is the main focus of Govijana Madura to improve agricultural productivity and environmental sustainability. These insights will be a great source when designing and shaping our own AR based gardening app, as it should work well for the needs and practices of urban gardeners as well as promote sustainable agricultural practice.

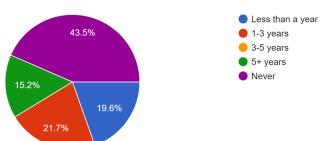


- Questionnaire -

https://docs.google.com/forms/u/1/d/1Ad5YgM1y_vOgiRqAOyBThWoGtSPuOJ4cCwnUy_VEBtk/edit?ts=673da753#responses

Question 01

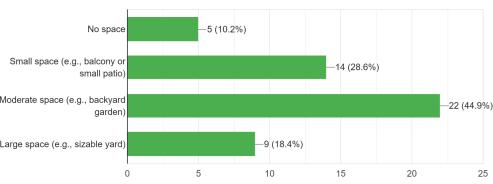
How long have you been gardening?
46 responses



Majority (43.5%) have **never engaged in gardening** before, indicating a high potential for onboarding beginners.

Question 02

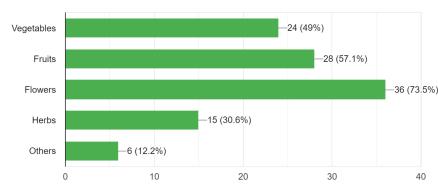
How much space do you have available for framing a garden?
49 responses



Most respondents (44.9%) have **moderate space** (e.g., backyard gardens), suggesting the application should prioritize features catering to mid-sized gardening setups.

Question 03

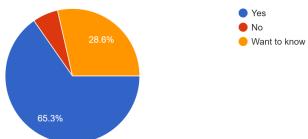
What types of plants do you grow in your garden? (Check all that apply)
49 responses



Fruits (57.1%) and **Vegetables** (49%) are popular, highlighting high interest in edible gardening.

Question 04

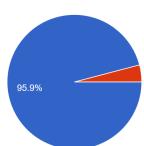
Are users aware of any potential health or economic benefits of home gardening?
49 responses



The majority (65.3%) are **aware of the health or economic benefits**, showing an engaged user base.

Question 05

Are you interested in learning about sustainable gardening techniques or advanced gardening tools?
49 responses

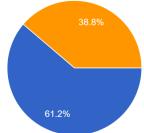


● Yes
● No

A remarkable majority (95.9%) are interested in sustainable gardening techniques and advanced tools. This highlights a strong inclination towards learning and adopting eco-friendly and innovative gardening practices.

Question 06

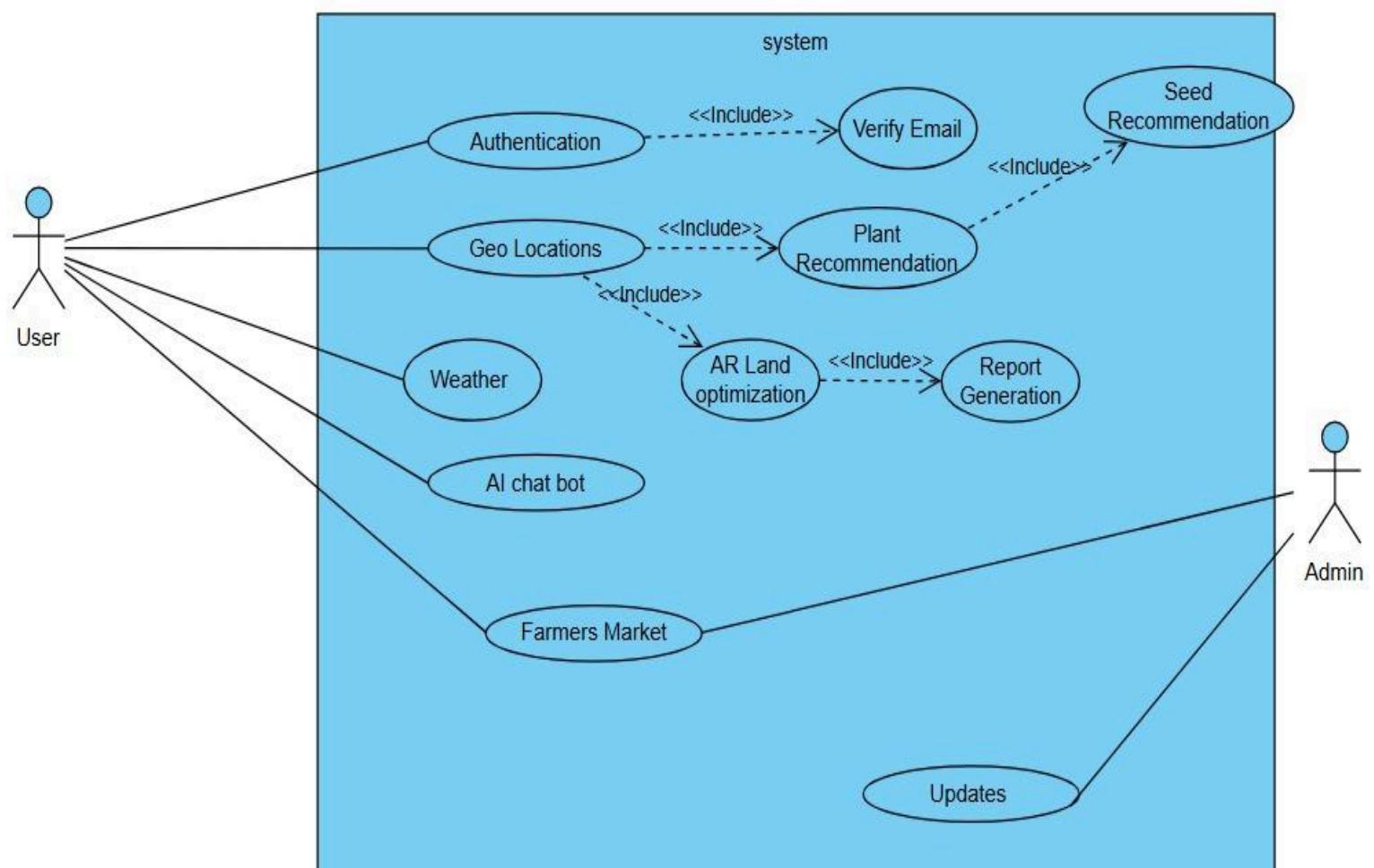
Do you prefer fresh produce over store-bought options?
49 responses



● Yes, I prefer fresh produce.
● No, I don't have a preference.
● I'm open to both options.

61.2% prefer fresh produce over store-bought options, showcasing a significant interest in growing their own food.

4.5. Use Case Diagram



4.6. Use Case Descriptions

1. LOGIN

Use Case Name	User Authentication	
Use Case ID	UC-001	
Description	A user should authenticate their credentials to access the AR gardening application	
Priority	High	
Primary Actor	User	
Supporting Actors	Authentication System	
Pre-Conditions	User has downloaded the app	
Trigger	User attempts to access the application (Press "Login" button)	
Main flow	Actors	System
	User enters credentials	enters email/username and password taps login button
Exception flow	Actors	System
	User enters invalid credentials	System displays error message and prompts retry
Alternate flow	Actors	System
	User selects social login	System processes third-party authentication
Exclusions	Guest access features	

Post Conditions	User successfully logged into the system
------------------------	--

2. Geo Location

Use Case Name	Location Detection	
Use Case ID	UC-002	
Description	System must detect user's geographical location for garden planning	
Priority	High	
Primary Actor	User	
Supporting Actors	GPS System	
Pre-Conditions	Location permissions enabled	
Trigger	Press "Enable Location"	
Main flow	Actors	System
	User allows location access	System detects coordinates and loads zone data
Exception flow	Actors	System
	User denies location access	System prompts for manual location entry
Alternate flow	Actors	System
	User enters manual location	System validates and updates location
Exclusions	Offline location services	
Post Conditions	Location successfully configured in system	

3. Weather API

Use Case Name	Weather Integration	
Use Case ID	UC-003	
Description	System must fetch and display current weather information	
Priority	Medium	
Primary Actor	Weather Service	
Supporting Actors	User	
Pre-Conditions	Valid location data and internet connection	
Trigger	App launch or manual refresh	
Main flow	Actors	System
	Weather service sends data	System processes and displays weather info
Exception flow	Actors	System
	Service unavailable	System shows cached data and error message
Alternate flow	Actors	System
	User requests detailed view	System fetches extended forecast
Exclusions	Historical weather data	
Post Conditions	Updated weather data displayed	

4. AI chatbot

Use Case Name	Garden Assistant	
Use Case ID	UC-004	
Description	AI chatbot provides gardening advice and answers queries	
Priority	High	
Primary Actor	User	
Supporting Actors	AI Engine	
Pre-Conditions	Active internet connection	
Trigger	Press "Chat with Assistant"	
Main flow	Actors	System
	User sends query	System processes and provides response
Exception flow	Actors	System
	User sends unclear query	System requests clarification
Alternate flow	Actors	System
	User uploads image	System analyzes and provides specific advice
Exclusions	Non-gardening queries	
Post Conditions	User receives relevant assistance	

5. Farmers Market

Use Case Name	Market Finder	
Use Case ID	UC-005	
Description	System locates and displays local farmers markets	
Priority	Medium	
Primary Actor	User	
Supporting Actors	Market Database	
Pre-Conditions	Location services enabled	
Trigger	Press "Find Markets"	
Main flow	Actors	System
	User searches products	System displays nearby options
Exception flow	Actors	System
	No products found	System suggests alternatives
Alternate flow	Actors	System
	User applies filters	System updates results
Exclusions	Online purchasing	
Post Conditions	Market information displayed	

6. Updates

Use Case Name	System Updates	
Use Case ID	UC-006	
Description	System manages application updates and notifications	
Priority	Low	
Primary Actor	System	
Supporting Actors	User	
Pre-Conditions	App installed and running	
Trigger	New update available	
Main flow	Actors	System
	System detects update	System downloads and installs
Exception flow	Actors	System
	Installation fails	System retries and logs error
Alternate flow	Actors	System
	User postpones	System schedules reminder
Exclusions	Beta updates	
Post Conditions	System successfully updated	

AR Land Optimization

Use Case Name	AR Land Optimization	
Use Case ID	UC-007	
Description	Helps users optimize their land for planting using augmented reality.	
Priority	High	
Primary Actor	User	
Supporting Actors	System	
Pre-Conditions	The user must provide location and enable AR service	
Trigger	The user selects the AR Land Optimization feature.	
Main flow	Actors	System
	User activates the augmented reality	The system analyzes the geographic and topographic data on the user's land. The system delivers recommendations for land optimization through AR visualization.
Exception flow	Actors	System

	AR fails	System will offer textual suggestions and utilize satellite imagery to obtain the map.
Alternate flow	Actors	System
	Users upload image	The system subsequently delivers optimization recommendations informed by the uploaded images for detailed analysis.
Exclusions	The augmented reality feature requires access to the camera and location services to function properly.	
Post Conditions	The recipient is provided with recommendations for optimizing land use.	

8. Plant recommendation

Use Case Name	Plant recommendation	
Use Case ID	UC-008	
Description	Suggests the best plants to grow based on the user's location and preferences.	
Priority	High	
Primary Actor	User	
Supporting Actors	System	
Pre-Conditions	The user must provide location and crop preferences	
Trigger	The user selects the Plant Recommendations feature	
Main flow	Actors	System
	system evaluates the user's geographical location along with soil conditions.	It then provides recommendations for suitable plant varieties based on this analysis.
Exception flow	Actors	System
	If data is unavailable.	System will alert the user and offer generalized recommendations to assist in decision-making.
Alternate flow	Actors	System

Exclusions	
Post Conditions	The user is provided with personalized plant recommendations that align with their specific requirements.

9. Report Generation

Use Case Name	Report Generation	
Use Case ID	UC-009	
Description	Generates reports based on user inputs and system data	
Priority	Medium	
Primary Actor	User	
Supporting Actors	System	
Pre-Conditions	The user must have completed at least one task or data	
Trigger	The user requests a report	
Main flow	Actors	System
	User commences the report generation	The system systematically compiles the required data into an organized report format. Upon completion, the report is presented for viewing or made available for download.

Exception flow	Actors	System
	Data is missing or incomplete,	System will promptly notify the user and offer guidance for resolution.
Alternate flow	Actors	System
Exclusions		
Post Conditions	The recipient will receive a comprehensive report summarizing their data.	

10. Verify Email

Use Case Name	Verify Email	
Use Case ID	UC-0010	
Description	Allow the user to verify their email for account activation or updates	
Priority	High	
Primary Actor	User	
Supporting Actors	System	
Pre-Conditions	The user must have a valid email address	
Trigger	The user submits an email for verification	
Main flow	Actors	System

	<p>The system generates and dispatches a verification email containing a unique link or code to the user.</p>	<p>The user then clicks the link or inputs the code into the system to finalize the verification process.</p> <p>The system subsequently validates the code and confirms the successful completion of the verification.</p>
Exception flow	Actors	System
	An email is unsuccessful in being sent,	<p>System will either initiate a retry or notify the user accordingly.</p> <p>system will prompt them to re-enter the information for accuracy.</p>
Alternate flow	Actors	System
	user requests a re-issuance of the verification email.	<p>System generates and dispatches a new verification link or code. link or code.</p>
Exclusions	The system is unable to verify email addresses if the user does not have access to their inbox.	
Post Conditions	The email has been successfully verified, granting access to features that require this verification.	

11. Seed Recommendation

Use Case Name	Seed Recommendation	
Use Case ID	UC-0011	
Description	Recommends seed based on location, soil, and weather conditions	
Priority	High	
Primary Actor	User	
Supporting Actors	System	
Pre-Conditions	The user provides location and soil information	
Trigger	The user selects the “Seed Recommendation” feature	
Main flow	Actors	System
	user inputs relevant location and soil information	System analyzes the data and generates appropriate seed recommendations and presented to user
Exception flow	Actors	System
	location or soil data is unavailable	System will prompt the user for manual input.
Alternate flow	Actors	System
	User adjusts their preferences	The system subsequently recalibrates and refreshes its

		recommendations based on these updated preferences.
Exclusions	Recommendations cannot be generated without at least fundamental location data.	
Post Conditions	The individual is provided with a curated selection of seed recommendations tailored to their specific needs and preferences.	

4.7. Functional Requirements (with prioritization)

Requirements list		Priority Level	Description
FR1	Plot Measurements and Analysis	Critical	<p>Using AR to scan and measure area Of land.</p> <p>Suggest optimal crop planning methods and intercropping techniques to user.</p>
FR2	Crop Recommendations	Critical	<p>Provide crop suggestions based on soil types,location and weather conditions.</p>
FR3	Seed Recommendation	Critical	<p>Allow users to select the type of seeds based on area,soil type,location and weather conditions.</p>

FR4	Cost and Revenue Calculator	Critical	Estimate costs,potential yields and profits for the given area and selected crops.
F45	Weather Integration	Desirable	Fetch real-time weather updates using a weather API.
FR6	Offline Recommendation	Desirable	Allow users to access essential functions without internet access.
FR7	Visual Representation	Luxury	Display a virtual map of the garden with recommended crop placements.
FR8	AI ChatBot	Luxury	Provide gardening advice through AI-powered chatbot.
FR9	Marketplace Integration	Luxury	Enable users to sell surplus produce through the app.
FR10	Reminders and Notifications	Luxury	Give reminders for watering,planting and other gardening activities

4.8. Non-Functional Requirements

Requirements list		Priority Level	Description
NFR1	Performance	Critical	No extreme delays should occur in the app. A smooth performance experience when the hardware requirements are met.
NFR2	Scalability	Critical	Perform without performance degradation in support of up to a few thousand users. This makes it easy for updates for new features and APIs to be integrated, without hassle.
NFR3	Usability	Desirable	Provide a user-friendly interface without too much complexity. Ensure symbols and language are familiar and easily understandable.
NFR4	Localization	Desirable	Restrict usage to just certain geographic regions.
NFR5	Security	Critical	Encrypt sensitive data. Authentication of user accounts must be done via secure methods.

4.9. Chapter Summary

In this chapter, we identified who are some appropriate stakeholders for our project and what perspective they hold on our project. The second discussed requirement elicitation techniques, prioritization of functional and nonfunctional requirements as well as use case diagram and description creation.

Chapter 5 : Social, Legal, Ethical and Professional Issues

5.1 Chapter Overview

In the context of home gardening, several social, legal, ethical, and professional issues arise that can impact the success and sustainability of such initiatives. Addressing these issues is crucial for promoting a healthier, more sustainable approach to food production. The Agro-Lanka addresses the critical issues of food safety and also the small plot cultivation allowing users to maximize their available space for gardening. The app is intended for effective usage in a limited space, which is typical for modern cities and suburban areas. Therefore this can impact the success of the idea considering the social, legal and ethical issues of such initiatives, addressing these issues will promote a healthier sustainable approach for the development process of this application.

5.2 Dataset Ethical Clearance

The App uses datasets for determining AR-based plant placement, compatible soil type, and weather conditions as well. These datasets were cleared through ethical means by using open repositories such as Kaggle where data is given under creative common practice licenses.

- **Source:** The land images data was retrieved from Kaggle's dataset,
- **License Details:** licensed under Creative Commons License (CC BY 4.0), permitting adaptation with proper attribution, which permits use and modifications as long as proper credit is given.
-

5.3 SLEP Issues and Mitigation

Social Issues

Accessibility: Making sure that all the users of the app can easily use it and those with cognitive problems like the inability to use interfaces or remember what they have gardened.

Mitigation: Reducing the number of options available to users by having clean, uncluttered design and offering prompts, tips, and instruction on how to garden.

Digital Divide: The application may inadvertently bias itself towards users from better-endowed areas, with better devices and better technology than, for example, users from lower income backgrounds or rural areas.

Mitigation: Therefore, respecting the principles of equity and inclusion, the application was developed based on the feedback provided by the users of different age, gender, and technological literacy.

Legal Issues

Data Protection: Gardening recommendations based on user location and environmental information collection affected data privacy.

Mitigation: In accordance with GDPR, the users' consent was obtained to collect data; all data were anonymized, and data storage was secured (European Commission, 2016).

Content Licensing: AR models and dataset content protection from violating intellectual property rights.

Mitigation: Exclusive 3D models and datasets with royalty-free or suitable licenses were used only (Creative Commons, n.d.).

Ethical Issues

Algorithm Bias: Possible biases in suggestions on gardening based on datasets that contain only information from certain climate or soil conditions.

Mitigation: Various data sets were used and they included data from different parts of the world to make recommendations universal.

Environmental Impact: Suggesting people apply more of fertilizers or water by applications can be very detrimental to the ecosystem.

Mitigation: Environmental protection was encouraged through the provision of information regarding organic and water wise gardening.

Professional Issues

Transparency: Making sure that users know how their information is utilized and how app suggestions are made.

Mitigation: A comprehensive policy on Privacy was included and prototypes of the recommendation methodology were incorporated as a sign of enhanced transparency (BCS, n.d.).

Continuous Improvement: A practicing approach to learning relevant to the BCS Code was adopted in incorporating feedback channels through which users could report concerns, or make recommendations on the best way the app could be improved since its usage was ongoing.

5.4 Chapter Summary

Concerning the SLEP, this chapter discussed the creation of the mobile gardening app and possible mitigation approaches to maintaining ethical, legal, and professional compliance. Focusing on accessibility, data protection and sustainability, the project meets the general objectives of social responsibility and professionalism stated in the BCS Code of Conduct.

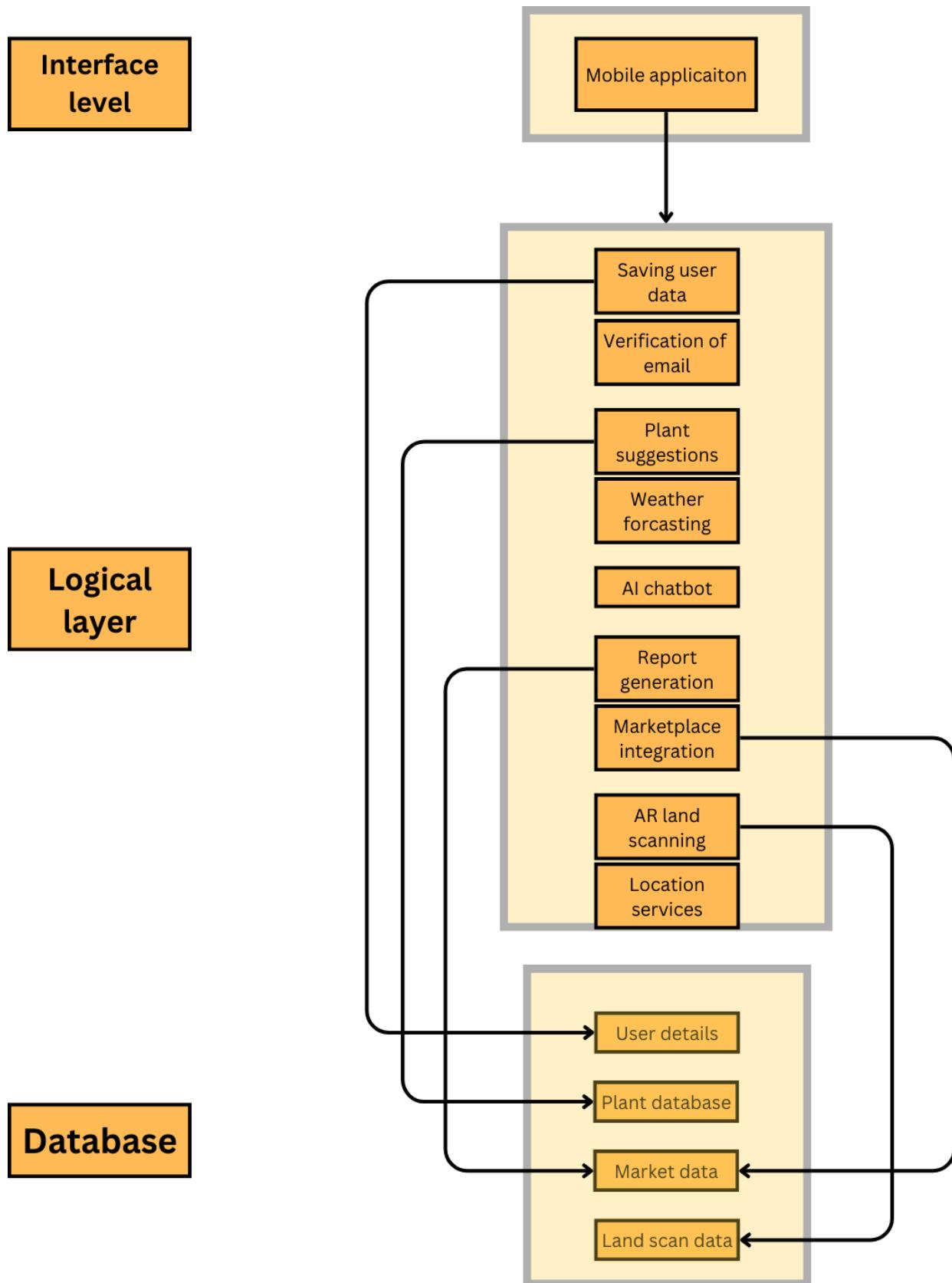
In conclusion, while gardening APP offers a promising solution to the challenges of food safety and sustainability, addressing the social, legal, ethical, and professional issues is essential for its success. By fostering community engagement, ensuring legal clarity, promoting ethical practices, and providing professional support, urban home gardening can become a viable and beneficial practice for many.

Chapter 6: System Architecture & Design

6.1. Chapter Overview

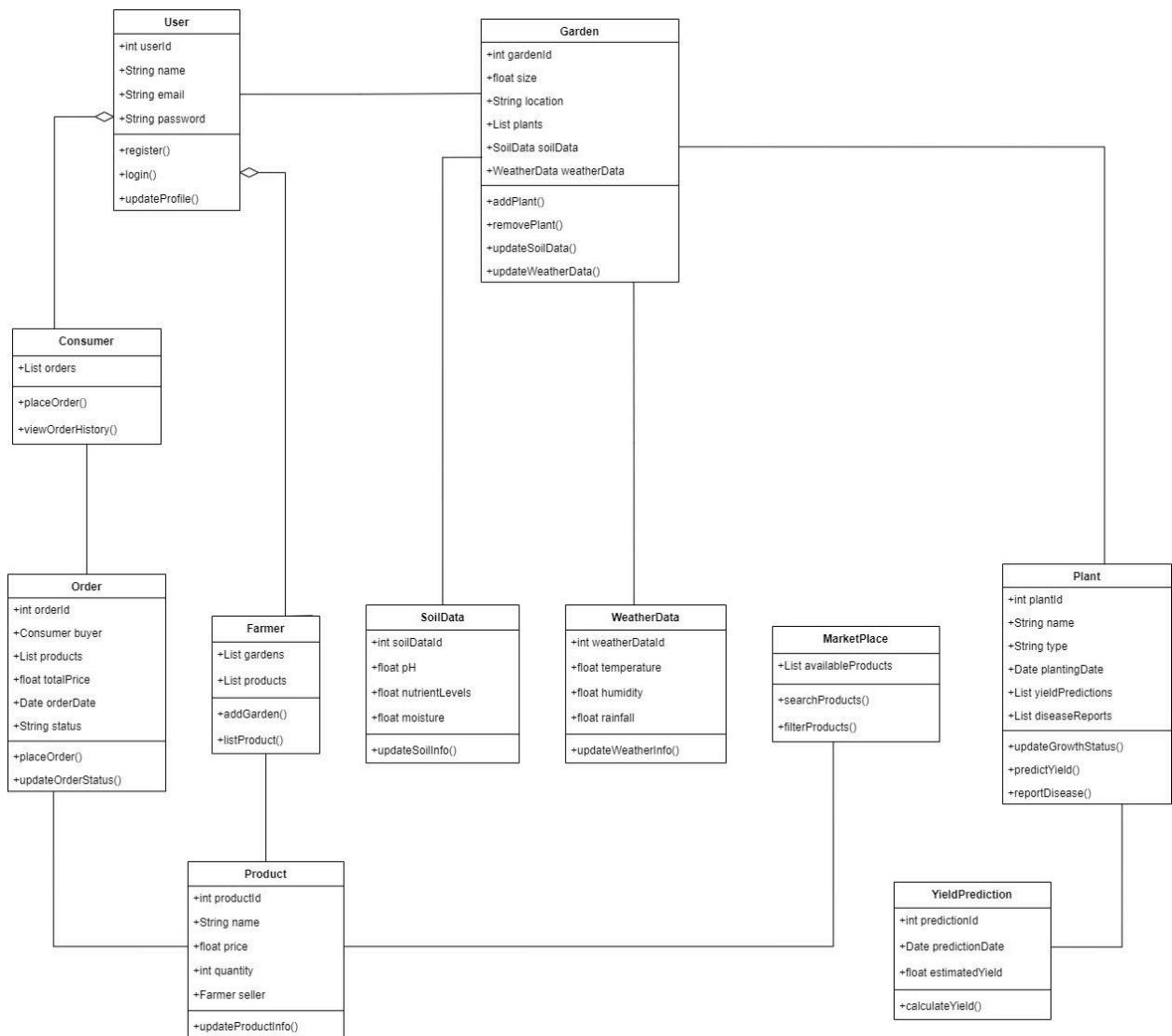
System architecture and design of the AGRO LANKA mobile application is discussed in this chapter for defining the technical aspects as well as the development approach for the small-scale gardening systems. The following viewing guide is perhaps the most significant aspect of the design, providing detailed diagrams of activity flows and interaction models to show the relationships between home gardeners, plant care systems, and application ecosystems. The architecture encompasses the key features of the app by providing necessary functions for garden space scheduling, plant care and harvest management, and community involvement; at the same time, more fundamental needs of the app include offline modality, the synching of the data, and user confidentiality. The chapter describes further methodologies for managing data and integrating with outside services and parts of systems for eminent garden management and enhancement of the customers' experience on mobile interfaces. Additional emphasis is placed on one-garden growing, inventive use of space, planning by seasons, and localized information on cultivation practices suitable for Sri Lanka. The design framework implies that both the new members and the experienced persons in gardening will easily incorporate the use of different features on the platform to manage and conduct urban and small-scale farming ventures.

6.2. System Architecture Design

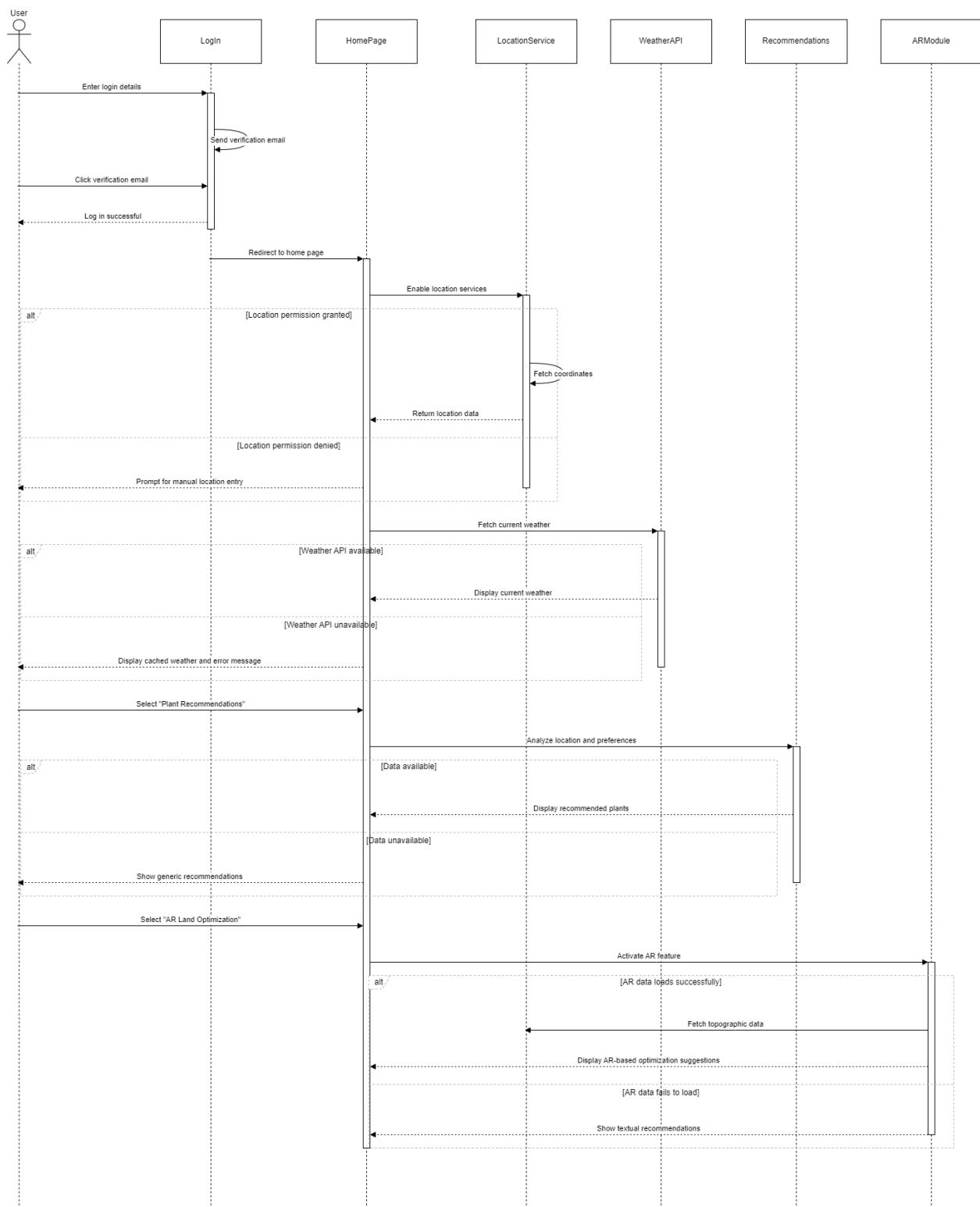


6.3. System Design

6.3.1. Class Diagram

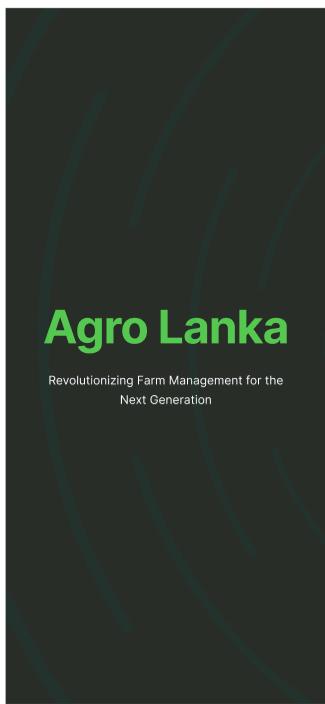


6.3.2 Sequence Diagram

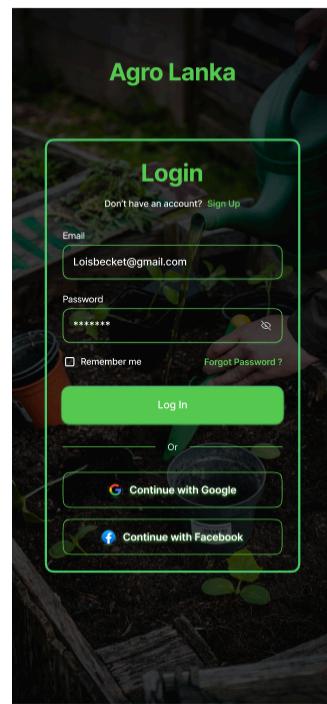


6.3.3 UI Design

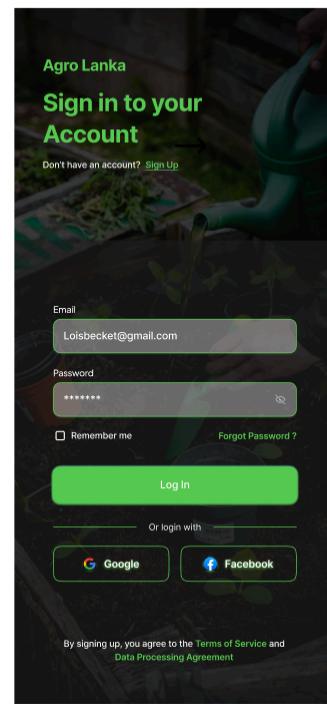
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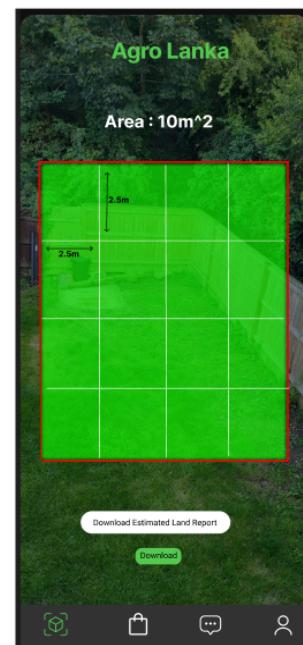
AR Page 1



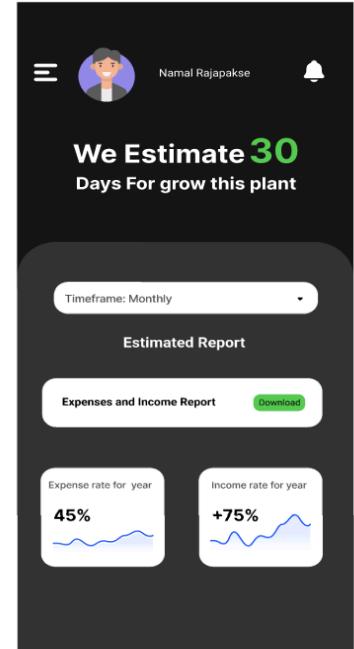
AR Page 2



AR Page 3



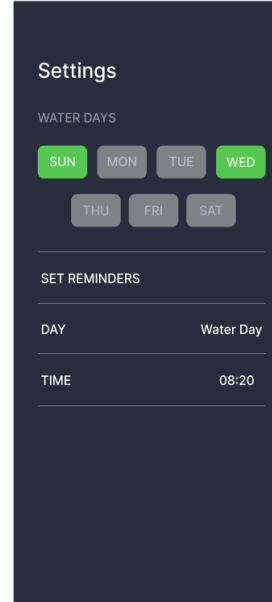
Report Generate 1



Weather_2



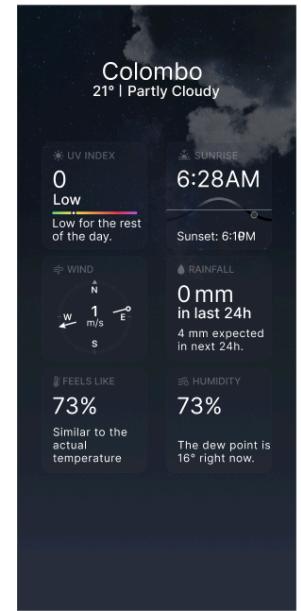
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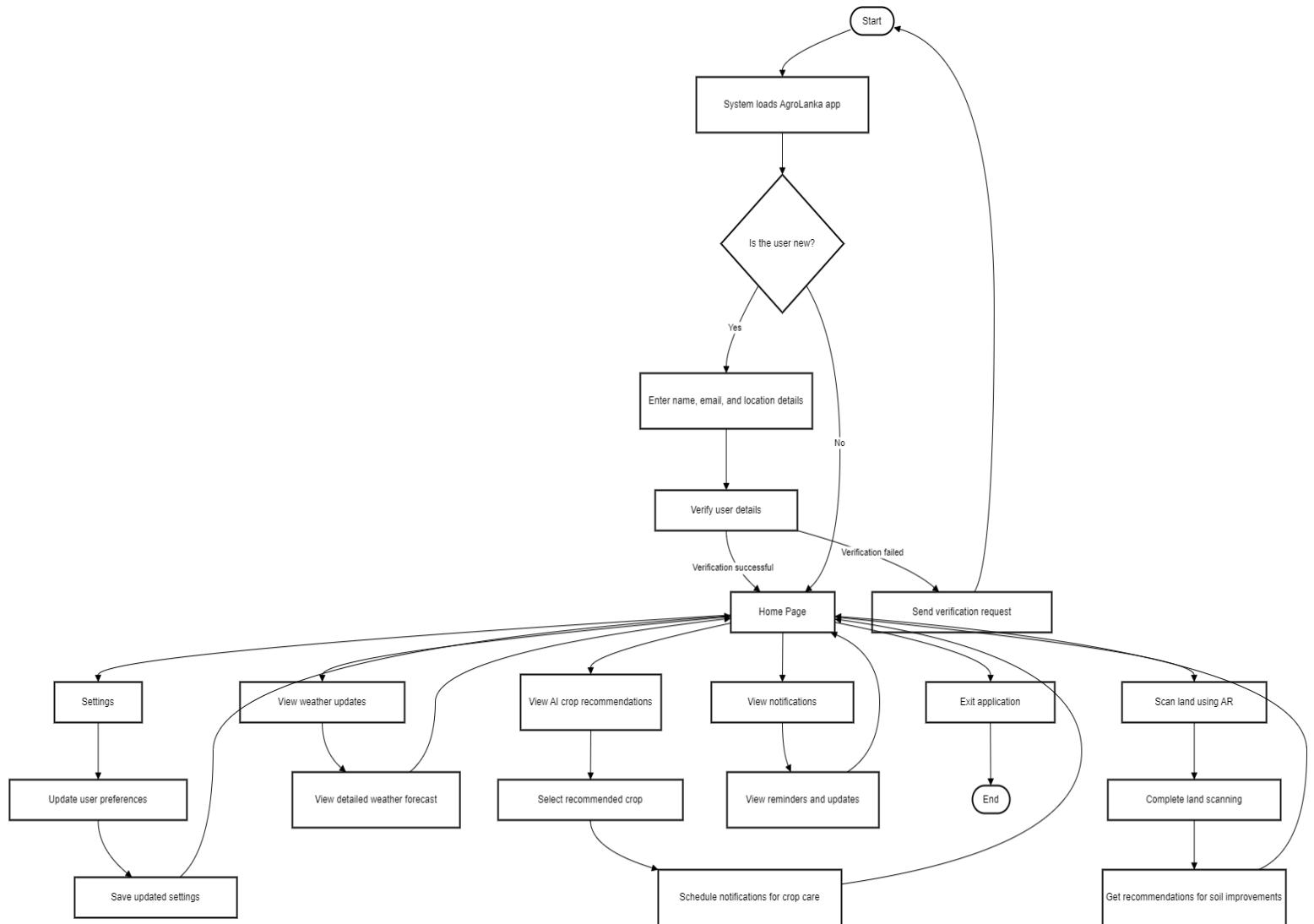
Weather_2



Weather_2



6.3.4. Activity Diagram



6.4. Chapter Summary

This chapter offered a detailed analysis of the system design and technology infrastructure of AGRO LANKA to build a strong framework of a mobile-first gardening application. The integration of online and offline functions is realized through a layered architecture pattern so that the system is maintainable and scalable. Several UML diagrams explained technical aspects of the system; how the significant features such as the garden space allocation, plant care, and community aspects are addressed. The UI/UX design specifications focused on the accessibility of the site; the layouts of the site also are responsive; special attention to the offline options guarantees the constant availability of the necessary data on gardening. By this architectural and user perspective design implementation, AGRO LANKA successfully offers functional gardening solutions to users with restricted yard spaces in Sri Lanka, while enabling them for future additions and modification on the app.

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