College of Engineering and Computers
Um Al-Qura University

BOTANIXP LORER
Climate-Smart Agriculture

Team Members:
Ghadi Ahmed id: 444002696
Weaam Hassan id: 444010345

Supervised By:
Dr. Mona Alofi
Department of Computer Science

Contents

1 Abstract

Smart agriculture is a modern approach that uses advanced tech- nology to improve farming and sustainability. This method com- bines sensors, big data, and the Internet of Things to collect and analyze information about farming conditions. The goal is to man- age resources like water and soil better, helping farmers make de- cisions based on accurate data. Smart agri-

culture includes techniques like precision farming, which allows farmers to use water and fertilizers more accurately, reduc- ing waste and increasing yields. These applications also provide alerts to help farmers know the best times to water and harvest, improving crop health and reducing problems. Smarta griculture helps ensure food security by making production more effi-

cient and lowering costs. It also promotes sustainability by reducing the use of pesticides and chemical fertilizers. With the challenges facing traditional farming, smart agriculture offers innovative solutions for a more sustainable and efficient future, helping meet the growing needs of the world's population.

.

2 Introduction

Today, the Smart Agriculture App is a helpful tool for farmers. It allows them to easily access important information. This app combines new technology with useful data to help farmers grow healthy crops and get better results. One of its main features is the ability to choose the right seeds and care for them. This helps farmers pick the best types for their land and get practical advice to make sure their crops succeed.

In this research, we will look at how the Smart Agriculture App improves farming practices. We will discuss its features and the positive effects it can have on sustainable agriculture. By using technologies like the Internet of Things (IoT) and big data, the app can help farmers make better decisions about growing their crops. This can increase production and reduce waste, which helps to ensure food security.

We will also analyze how the app provides accurate information about soil, weather, and crop needs, making it easier to manage farming more effectively. Additionally, we will share success stories of farmers who have used the app to improve their farming practices, showing its positive impact on the agricultural sector.newpage

Chapter 1: Outline

3 Chapter 1

In this chapter, we will introduce a simple entrepreneur, where we will review the general idea and the most important basics. In addition, we will learn about the requirements of some functional and non-functional functions that must be met and the success and effectiveness of the program.

3.1 Application BOTANIXP LORER

- **App Idea:** The app provides a device for the garden that gives information about plants, soil, and temperature. It sends notifications to a mobile app, telling users when to harvest, water, and monitor plant growth. Users can also take pictures of plant issues, and the app will suggest solutions.
- **App Importance:** This app helps farmers and gardening enthusiasts care for their plants with accurate, data-based advice. It eliminates guesswork, allowing users to make informed decisions, which improves plant health and productivity.
- **Problems without the app:**
  - Difficulty knowing when to water or harvest, leading to potential damage.
  - Reliance on personal experience, which may not be accurate, especially for beginners.
  - Late detection of plant problems, making them harder to fix.
- **Examples of past challenges:** Before the app, gardeners would water their plants at the wrong times, which hurt them. The app made it easier by sending reminders for when to water.
- **How the app works:**
  - A sensor collects data on soil, plants, and temperature.
  - The data is sent to the mobile app, which notifies users about watering and harvesting times.
  - Users can take pictures of plant problems, and the app will suggest solutions.

This app makes plant care easier, more accurate, and less time-consuming.

3.2 Main tasks

- **Information Gathering:** BotaniXplorer checks the soil and plant growth, along with water needs, temperature, and humidity. It finds the best times for fertilizing and harvesting and spots problems with crops.
- **Sending Notifications:** The app sends reminders for watering, fertilizing, and harvesting. It also suggests suitable plants for each season and provides health reports for the plants.
- **Educational Information:** BotaniXplorer gives easy tips on plant care, like when to plant, how to trim sick plants, and how to fix common problems.
- **Monitoring Environmental Conditions:** The app tracks weather conditions and gives advice based on changes, helping users care for their plants better.

3.3 Functional and Non-Functional Requirements

3.3.1 Functional Requirements

- Change Language: The app should let you choose the language you prefer, making it easier to use and understand the information.
- Create Account and Login: You should be able to create a new account using your email or phone number. Then, you can log in using the same details.
- Buy Seeds: You should be able to buy seeds and plants through the app, where you can browse different options and choose what you like.
- Make Payments: The app should offer safe and easy payment options when you buy seeds and farm products, either online with credit cards or using digital wallets, or cash on delivery.
- Monitor Crops: You should be able to check the health and growth of the plants you bought, including their needs for water and fertilizers, so you know how to take care of them.
- Set Reminders: You should be able to set reminders for watering, fertilizing, and harvesting your plants, so you can stay organized and not miss important dates.
- Access Useful Information: You should have access to helpful information about taking care of plants, including tips and guides on planting, fertilizing, and pest control.
- Track Performance: You should be able to track how your plants are growing over time. This means keeping notes on their condition, like changes in color or size, so you understand how your care affects their health.

3.3.2 Non-Functional Requirements

- Performance: The system should be fast and efficient, able to handle requests quickly so that users don't have to wait long.
- Security: User data must be protected from unauthorized access. We will use methods like data encryption and strong passwords to keep information safe.

- Availability: The system should be available almost all the time, meaning it should work 99.9% of the time so that users can access it whenever they need.
- Scalability: The system must be able to handle more users or data without affecting its performance.
- Usability: The system should be easy and simple to use, so new users can quickly learn how to navigate it.
- Compatibility: The system must work well on all devices and operating systems, so everyone can benefit from the application.
- Maintainability: The system should be easy to maintain, allowing for quick updates and fixes to any problems that arise.

3.4 Summary

• Smart Agriculture Technology: Using sensors to collect data on soil, temperature, and plants.
• Notifications and Reminders: Sending alerts for watering, harvesting, and fertilizing times.
•Problem Diagnosis: Capturing photos of plant problems and getting suggested solutions. Improved Decision Making: Basing decisions on accurate data, which reduces errors.
• Increased Productivity: Improving plant health and productivity through data-driven care.
Continuing Education: Providing information and guidance to users on plant care.

Chapter 2: Outline

2.1 Programs Purpose
2.2 Survey
2.3 Comparison
2.4 Optimization App
2.5 Summary

4 Chapter 2

In this chapter, the purpose of developing the *BotaniXplorer* app was discussed, which aims to simplify plant care by collecting accurate data and providing effective agricultural recommendations. A survey was conducted to gather user feedback about the app and to identify improvements that could be made based on their opinions. Additionally, a comparison was made with similar apps, highlighting the challenges they faced and how these were addressed in *BotaniXplorer*, making it superior in offering smart and innovative solutions for plant care.

4.1 Programs Purpose

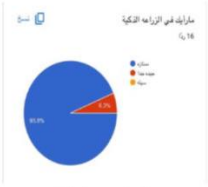
BotaniXplorer is an advanced plant tracking software designed to help users take care of their plants effectively.
The program provides detailed information about different plant types, including their care needs, best growing conditions, and possible problems.
BotaniXplorer continuously monitors plants to find signs of pests, diseases, or damage using sensors and image recognition technology.
When a problem is detected, the software alerts the user with notifications and messages, offering practical solutions to fix the issue.
Additionally, the program tracks plant growth and progress, helping users know when to water, fertilize, or repot their plants.With BotaniXplorer, users receive valuable insights and support to keep their plants healthy, ensuring a thriving garden or beautiful indoor space.

4.2 Survey

We conducted a survey and shared it with a group of people to understand their opinions about our smart farming app. After analyzing the results, we found common ideas and differences among them. These results show the importance of surveys in helping us make better decisions for improving the app.

Figure 1: Figure 1,2

Note that in the question "Have you tried agriculture before?" in the figure (1,1), 31.3% of users have not tried it, while 68.8% said yes. Users who said yes answered the question with what type of plant they grew in the figure (1,2).

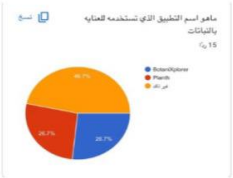


Picture 1,3

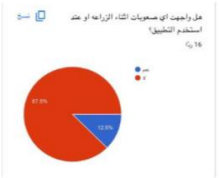
Picture (1,4)

Figure 2: Figure 3,4

When asked about smart agriculture and how users see it, 93.8% said it was excellent, while 6.3% said it was very good (figure 1,3). The figure (1,4) shows people's opinions about how difficult it is to monitor plants and compare it with the use of technology. According to the knowledge survey of 16 people, 75% of them think that growing plants manually is powerful, while 25% do not think so.



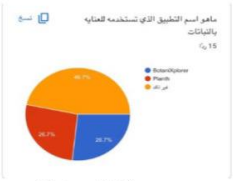
Picture (1,5)



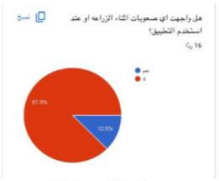
Picture (1,6)

Figure 3: figure 5,6

In the figure (1,5) What apps do you use to care for your plants? According to the survey of 15 people. The figure (1,6) shows the difficulties users faced while planting or using the application. According to the survey of 16 people, 87.5of them did not face any difficulties, while 12.5 faced difficulties.



Picture (1,5)



Picture (1,6)

Figure 4:

The figure (1,7) shows that 68.8of participants found all functions of the plant care app useful. 12.5found both "plant growth tracking" and "information about plant species" useful, while 6.3 chose "plant care tips." The figure (1,8) reveals that 57.1 had no additional suggestions, 14.3said "No thanks," and another 14.3suggested a seed store with information.

4.3 Comparison and explanation:

Plantify: is an app that helps users take care of their plants by providing information on how to care for them. However, the app has some downsides, such as not including some types of plants in its database and having a confusing interface that makes it hard to navigate.
Plantln: is another app that focuses on helping users manage their plants, but it also has some drawbacks. The app may have inaccurate information about plant care, and users can experience issues with its performance, like slow loading times or crashing sometimes.

Table 1: Figure 4,3,1

tybe	Disadvantages:	Advantages:
Plantify	Language: The app doesn't have many languages, so a lot of users might have trouble if their language isn't available. Cost: The app is expensive and there's no free trial, plus there are annoying ads	. Interactive activities: There are farming challenges and competitions you can join with other users. . Product marketing: The app can help you find local markets to buy or sell farm products
Plantln	Lack of information: Information about plant diseases is missing, not all diseases are included. Basic factors: The app doesn't support important information like temperature, humidity, and how much water each plant needs. Communication: It's hard to contact support, and if you message them, replies are slow and problems might not get solved	User reviews: There's a special section for reviews and comments about each plant, which helps you make better choices. Sharing on social media: You can easily share your achievements and pictures of your plants on social media platforms

4.4 Optimization BotanixpLoren App:

In the Botanixp LORER app, we maintain features like user interaction, product marketing, user ratings, and social media engagement. We have also improved our app by addressing issues found in other apps, including:
- Language: Supports multiple languages, including Arabic, English, French, and more.
- Cost: The average cost allows all users to purchase and enjoy a good experience with the app.
- Information Availability: Features various algorithms and regular updates on plant diseases and information, providing clear and accurate solutions and tracking treatments.- Key Factors: The app includes a feature for measuring temperature and sending it to the app. It also tracks humidity, harvest time, irrigation, water amounts, issues, and soil type.
- Updates: We have a strategy for regular updates to improve performance and ensure smooth operations. This includes regular updates on app requirements, daily reports on crop status, weekly routine updates, significant monthly updates, and annual comprehensive updates summarizing achievements and future plans.
- Communication: Communication is easy through a dedicated section in the app, an email for quick customer service, a specific number for issues and inquiries, and fast chat support to quickly resolve problems and answer questions.

4.5 Summary

1.Plantify: Helps users with plant care but lacks some plant types and has a confusing interface.
2.Plantln: Provides plant management but hasinaccurate information and performance issues.
3.BotaniXplorer:
- Supports multiple languages and offers affordable pricing.
- Provides accurate plant disease info and tracks treatments.
- Key features: Temperature, humidity, harvest time, irrigatio tracking.
- Regular updates for improved performance.
- Easy communication through email, phone, and live chat support.

Chapter 3: Outline

3.1 Introduction
3.2 Applications Interface
3.3 Data model
3.3.1 UML Digram Sequence
3.3.2 UML Digram Class
3.3.3 UML Digram Activity
3.4 System Architecture
3.5 Summary

5 Chapter 3

In this chapter, the analysis of the application such as user interfaces, application and system architecture, database and data model graphics are studied.

5.1 Introduction

The Smart Farming app is a new tool that helps farmers do their jobs better. It connects farmers to sensors and smart devices to make their work more efficient and productive. To work well, the app needs a good setup, easy-to-use data models, and clear technical information. It's also important to use version control to manage updates. This study will explain how the Smart Farming app is designed, what data it uses, the technical details, and how it keeps everything up to date.

5.2 Application Interface:

Smart Agriculture App Interfaces The Smart Agriculture app has several main interfaces designed for different users: farmers, agricultural experts, and farm managers. Below is a simple explanation of the interfaces as shown in the provided images:

1. Sign Up and Login Interface

First Screen: (Figure 5)

Sign Up Options:

- Sign up with email
- Continue as a guest

Figure 5: App Logo: Includes an image of a plant.

1. Sign Up and Login Interface

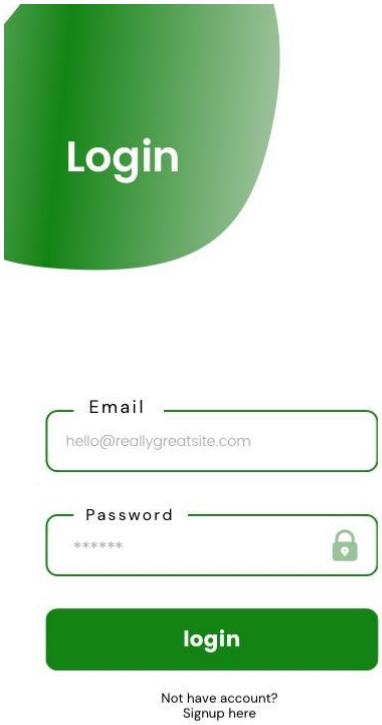
Sign Up Screen: (Figure 6)

Input Fields: Includes fields for name, email, and password.
Sign Up Button: A big and clear button for signing up.
Link for Existing Users: Option for already registered users to log in.

Figure 6: Sign Up Screen: Includes input fields and buttons.

2. Sign Up and Login Interface

Login Screen: (Figure 7)



Input Fields: Includes fields for email and password.
Login Button: A big and clear button for logging in.
Link for New Users: Option for new users to sign up.

Figure 7: Login Screen: Includes input fields and buttons.

1. Agricultural Tools Interface

Cara Tools: (Figure 8)

Figure 8: Agricultural Tools: Cara Tools and Plantum Tools.

Cara Tools:
Diagnose: Check your plant's health.
Identify: Recognize a plant using pictures.
Water Calculator: Optimize watering for your plants.
Reminders: Stay on top of your plant care.

Plantum Tools:
Light Meter: Measure light intensity.
Pot Meter: Calculate the size of your pot.
Filters: Find the plants you need.

These tools help users manage plant care more effectively by providing accurate information and important reminders.

3. Plant Management (Figure 9)

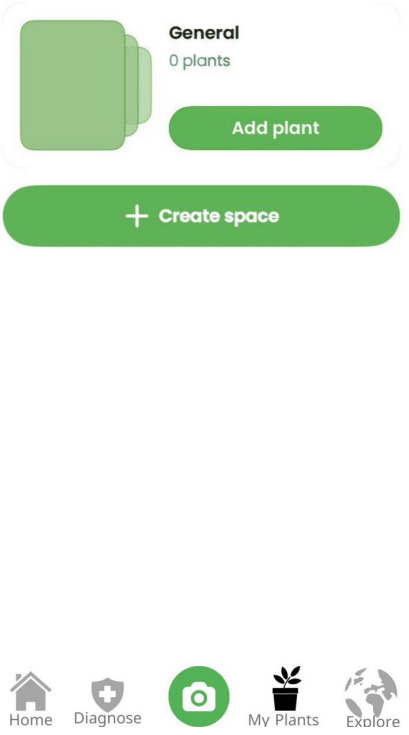


Figure 9: Plant Management Interface.

General Section:
This part is for managing your plants. It shows how many plants are currently added. In this case, there are no plants added yet ("0 plants").

Add Plant Button:
This big green button lets you add a new plant to the list. When you click it, a form will likely open to enter the plant's details.

Create Space Button:
The big green button at the bottom is for creating a new space or area for plants. This helps organize your plants into different spaces or zones within the app.

5.3 Data Model

Data Model in Smart Agriculture System

In the smart agriculture system, the data model is very important. It helps organize and manage information about crops and the farming environment.

Class Diagram

The class diagram shows the main parts of the system, like crops, farmers, and environmental sensors. It also shows how these parts are connected, which makes it easier to store and use data.

Sequence Diagram

The sequence diagram shows how these parts work together over time. This helps improve how things are done and allows for better decisions based on the data available.

Activity Diagram

The activity diagram shows the steps in the smart agriculture system. It displays how farmers or the system collect data, analyze it, and make conclusions. This helps everyone understand the process better and make good decisions based on the information they have.

5.3.1 UML Diagram Sequence

This diagram represents a sequence diagram for a user interacting with a system that involves a plant management system and a seed store. Here's a breakdown of the process:

- **User Interaction:**
  - The user starts by entering their login credentials in the UI (User Interface).
- **Authentication:**
  - The UI sends the credentials to the Authentication Service for verification.
  - The Authentication Service checks these credentials against the Database.
- **Login Confirmation:**
  - If the credentials are valid, the Authentication Service sends a confirmation back to the UI, allowing the user to access the dashboard.
- **Plant Data:**
  - The user can enter plant data, which is stored or managed by the plant management system.
- **Accessing Seed Store:**
  - The user accesses the seed store and requests a seed list.
  - The seed store responds with the available seeds.
- **Seed Selection:**
  - The user selects seeds for purchase from the displayed seed list.
- **Purchase Confirmation:**
  - After selecting, the user confirms the purchase.
  - The system processes this confirmation, likely interacting with the database to finalize the transaction.

This sequence illustrates the flow of actions and interactions between the user and the different components of the system, emphasizing the steps involved in logging in, managing plants, and purchasing seeds.You can see the picture 5.3.1.1.

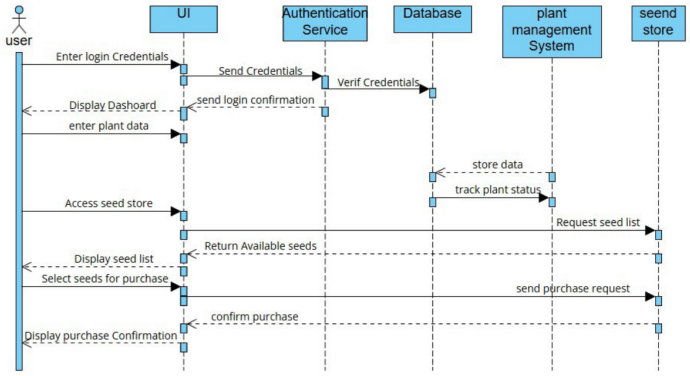


Figure 10: figure 5.3.1.1

5.3.2 UML Diagram Class

- Class diagram for BotaniX Lorer:
Relationships:

- The diagram shows relationships between these classes. For instance:
  - The **User** class can interact with **Plant** and **Garden** classes, suggesting that users can manage their plants and gardens.
  - The **Garden** class has methods to add or remove plants, indicating that gardens can contain multiple plants.
  - The **SeedStore** class provides seeds that can be purchased, likely to be added to a garden.

The UML diagram outlines a system where users can manage their gardens by adding and updating plants, while also allowing them to purchase seeds from a seed store. It illustrates the relationships between users, plants, gardens, and seed stores, emphasizing how these entities interact within the application.

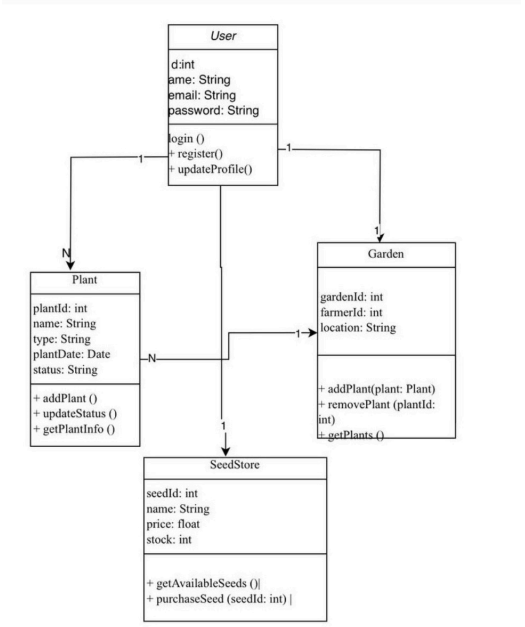


Figure 11: figure 5.3.1.2

5.3.3 UML Activity Diagram

An Activity Diagram is a type of behavioral diagram used in the Unified Modeling Language (UML) to describe workflows or activities within a system. It helps in visualizing processes, actions, and decision paths that users or systems follow. The diagram you provided matches the purpose of an activity diagram, showing the flow of data and interactions between different entities. Here's a simplified explanation:
What is an Activity Diagram?

- **Purpose:** An activity diagram is used to visualize the process a system goes through from start to finish. It shows the sequence of actions and decisions made along the way, as well as any exceptions or errors that may occur.

Key Elements:

- **Activities:** These represent tasks or steps that are performed, such as "Language settings," "Create an account," and "Pay."
- **Decisions:** At certain points, decisions are made, like whether the account was created successfully or if the payment was processed. Based on these decisions, the user either proceeds to the next step or encounters an error.
- **Start and End Points:** The diagram begins with an initial action, like setting the language or logging in, and ends when the final goal is reached, such as "Report on the status of your crop."
- **Flows:** These are lines connecting the activities, representing the transition from one step to another in the process.
- **Decision Nodes:** These show where decisions are made, like whether the language change or account creation was successful.

Main Activities in the Diagram:

1. **Start Activity:** The process starts with an action, such as selecting language settings.
2. **Executing Actions:** The activities progress through various steps, including:
    - Changing language

- Creating an account
- Logging in
- Buying a product
- Making a payment
- Tracking the order status

3. **Decision Points:** At each major step, decisions are made:
   - Did the language change successfully?
   - Was the account created successfully?
   - Was the payment processed?

   Based on these decisions, users either move forward or are shown an error message.

4. **Handling Errors:** If a step fails, the system shows an error message, like "Error, try again," indicating that the user needs to retry the action.

5. **End Activity:** The process finishes at the "Report on the status of your crop," marking the end of the workflow.

Importance of Activity Diagrams:

- **Detailing the Process:** They help in breaking down complex workflows into simple, easy-to-understand steps, making it clear how a system or user moves through different actions.
- **Showing Decisions:** Activity diagrams highlight key decision points, where different paths can be taken based on certain conditions.
- **Error Handling:** These diagrams are useful for showing how errors or failures are managed, ensuring the user knows what to do if something goes wrong.

An activity diagram is an effective tool for representing the steps and actions a user or system goes through. In the case of the diagram you provided, it shows the flow from setting language preferences and creating an account to purchasing products and tracking orders, with clear paths for handling errors along the way.

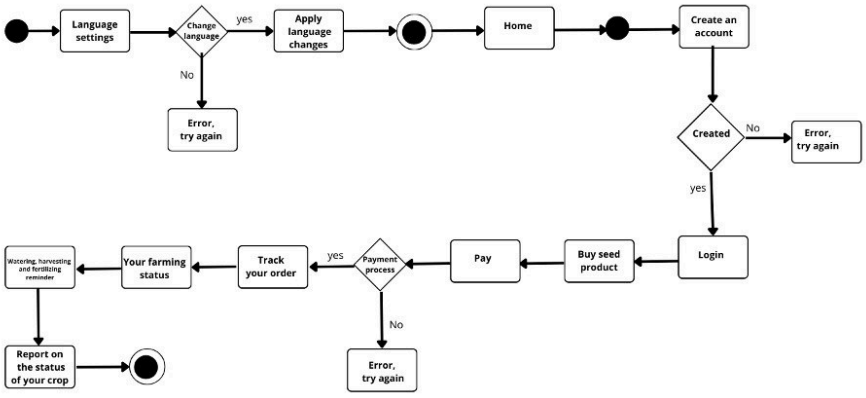


Figure 12: figure 5.3.1.3

5.4 System architectures

Supported Operating Systems

The Smart Agriculture app is available on the following systems:

iOS: Users can download the app for iPhone and iPad from the App Store, ensuring compatibility with Apple devices and taking advantage of the unique features of the iOS platform.

Android: The app is available for a variety of Android devices and can be downloaded from Google Play, catering to different specifications to ensure wider user accessibility.

Database

The Smart Agriculture app needs to manage large amounts of information, including:

- User data
- Crop details

- Weather information
- Resource usage
- Alerts

Therefore, it is crucial to have a reliable and scalable database to ensure the app runs smoothly. A relational database like MySQL or PostgreSQL is preferred because they are open-source databases that support advanced features like transactions and geographic data, making it easier to manage and retrieve data effectively. SQL is used to interact with the database, allowing for easy data storage, searching, and updating.

Server

The server in the Smart Agriculture app is responsible for handling operations between user interfaces and the database. The app may use a server framework such as:

- **Node.js**: A JavaScript-based runtime environment that allows for building fast and scalable applications.
- **Django**: A Python-based framework known for its security, ease of use, and rapid development.

Cloud Hosting

The application can be hosted on reliable cloud services like:

- **AWS (Amazon Web Services)**: Offers a comprehensive suite of cloud computing services, providing flexibility and reliability.
- **Google Cloud**: Provides powerful tools to support AI and machine learning applications, enhancing the app's capabilities in smart agriculture.

Programming Languages

- **Frontend (User Interface)**: The mobile apps for both iOS and Android are likely built using:
  - **JavaScript**: Used for developing web and mobile applications, enabling rich user interactions.

  - **Dart**: A programming language commonly used with Flutter, a framework that allows for efficient cross-platform app development.

- **Backend (Server)**:
  - **JavaScript**: Used with Node.js to develop scalable servers.
  - **Python**: Used with Django to develop secure and fast web applications.

- **Database**:
  - **SQL**: Used for managing and storing data, making it easier to handle complex data.

5.5 Summary

This chapter focuses on the design and development of the Smart Agriculture app, highlighting several key points:

- The user interface includes sign-up and login screens, along with various farming tools to help users manage their crops effectively.
- The data model organizes agricultural information and uses UML diagrams to show the interactions and relationships between different parts of the system.
- The app supports various operating systems, including iOS and Android, which increases its usability for a broader audience.
- The importance of databases like MySQL and PostgreSQL is emphasized for efficiently managing large amounts of information.
- The chapter also discusses the use of server environments like Node.js and Django, along with details about cloud hosting and the programming languages used in the app's development, showcasing essential technical aspects.

6 Conclusion

In conclusion, the BotaniXplorer app is an important step towards improving smart farming. By combining modern technology with the needs of farmers and gardening enthusiasts, the app provides an effective way to care for plants and offers accurate information. The features of the app, like monitoring soil condition, temperature, and humidity, make it easy for users to make informed decisions, which helps improve plant health and productivity.

BotaniXplorer has a user-friendly interface that supports multiple languages, making it accessible to a wide audience. These aspects allow users to quickly and easily access the necessary information, improving their overall experience. The image recognition feature for plant problems helps users identify issues and fix them quickly, contributing to better plant health.

Looking to the future, BotaniXplorer has great potential for growth and improvement. Adding new features based on user feedback and expanding the plant database can enhance the app's effectiveness and relevance in the evolving farming landscape. It is also important to create a community for users to share knowledge and experiences, which helps promote a culture of smart farming.

In short, BotaniXplorer is an essential tool for anyone looking to improve their plant care and farming skills. With its innovative features and ongoing improvements, the app empowers users and helps them achieve greater success in agriculture. Relying on modern technology in farming is not just an option; it is a necessity for moving towards a more sustainable and effective agricultural future.

7 References

[1] A. M. Guercio et al. “Plant Tracer: A Program to Track and Quantify Plant Movement from Cellphone Captured Time-Lapse Movies”. In: *Bioscene: Journal of College Biology Teaching* 45.3 (2019), pp. 14–21. URL: https://eric.ed.gov/?id=EJ1244760.

[2] L. Pinzani and S. Ceschin. “Smart(phone)-Monitoring (SPM): An Efficient and Accessible Method for Tracking Alien Plant Species”. In: *Sustainability* 15.12 (2023), p. 9814. DOI: 10.3390/su15129814.

[3] A. Wong and C. Johnson. “Advances in Smart Plant Tracking Technologies”. In: *Agricultural Technology Review* 5.1 (2024), pp. 1–15. DOI: 10.1000/atr.2024.56789.

[4] A. Wong and B. Smith. “Innovative Techniques in Plant Monitoring”. In: *Journal of Plant Studies* 12.2 (2024), pp. 34–45. DOI: 10.1000/jps.2024.12345.