PLANTIFY

CPIT 499 Final Report

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DECLARATION by AUTHORS

“I/we certify that this work has not been accepted in substance for any degree, and is not concurrently being submitted for any degree other than that of BS Information Technology being studied at King Abdulaziz University, Jeddah. I/we also declare that this work is the result of my/our own findings and investigations except where otherwise identified by references and that I/we have not plagiarized another’s work”.

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DECLARATION by SUPERVISOR

I, the undersigned hereby certify that I have read this project report and finally approve it with recommendation that this report may be submitted by the authors above to the final year project evaluation committee for final evaluation and presentation, in partial fulfillment of the requirements for the degree of BS Information Technology at the Department of Information Technology, Faculty of Computing and Information Technology, King Abdulaziz University, Jeddah.

[Signature]

Dr. Adil Khadidos

Acknowledgement

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Abstract

The Plantify project is a revolutionary initiative that aims to transform the way farmers and gardeners maintain their farms and gardens. The comprehensive system is designed to increase awareness of agriculture and the natural environment in the Kingdom of Saudi Arabia, while providing a centralized solution for maintaining farms and small gardens.

The proposed system includes a state-of-the-art centralized system that works together to provide a complete solution for maintaining farms and gardens. This all-in-one system is capable of performing a wide range of tasks, including identifying plants, learning about their characteristics, benefits, and potential harms, as well as automatic/manual watering, monitoring humidity, temperature, and moisture, and controlling ventilation and lighting. The system utilizes advanced machine learning algorithms, powered by TensorFlow software, Arduino hardware, and sensors, to give the farmer/user full control over their garden.

The Plantify project has the potential to benefit farmers, gardeners, and anyone interested in agriculture. The system can help farmers and gardeners save time and effort by automating many of the tasks involved in maintaining a farm or garden. This not only leads to increased productivity, but also promotes sustainability by reducing waste and conserving resources. Moreover, the project serves as a crucial step towards a more sustainable future and a better understanding of the natural environment.

With its comprehensive features and cutting-edge technology, the Plantify project represents a major breakthrough in the field of agriculture and has the potential to revolutionize the way we think about farming and gardening. This innovative solution is poised to make a significant impact on the Kingdom of Saudi Arabia's agricultural industry and contribute to a more sustainable and environmentally conscious future.

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

1.1 Project Background

The plants are the beauty of our earth. The importance of plants can never be denied. They are valuable and serve the important purpose with many benefits of planting trees. Every tree that we see around us was a tiny plant some years ago. The countless benefits of plants cannot be neglected. They are the main source of food for all living beings. They may not depend on us, but our lives depend on them for sure. There are more than 300 thousand species of plants on this planet.

The importance of plants in our life is inexhaustible. They are very important for survival of every specie living on Earth. They provide us food, shelter, habitat and medicines. Without plants, our water cycle will be disrupted, and our oxygen supply will be cut short because they improve oxygen level and reduce carbon dioxide level. In short, we will not be able to survive without plants. Plants maintain balance in ecosystem. They also help to purify the air that we breathe. They help to fight global warming by maintaining the global temperature to save us from scorching heat.

They also cool down the air as they lose moisture and reflect heat upward through their leaves. They maintain a balance in temperature by reflecting harmful radiations of sun. They play an important role to convert carbon dioxide to oxygen through a process called 'photosynthesizes'.
So, more trees mean more oxygen and less carbon dioxide in atmosphere. If there are less plants that means there will be more carbon dioxide in air and with more CO_2, more of sun’s radiations will be reflected to earth, instead of space. These radiations will cause our average temperature to rise. As a result, the oceans will be warmer and at some point, it will be a threat to humanity.

1.2 Problem Definition

The Saudi Vision 2030 is targeting the enhancement of the natural environment in the kingdom. by adopting a holistic vision of the precious ecosystem, and works to maintain water balance, restore biodiversity, and improve the ecosystem. The lack of awareness among the community regarding agriculture might lead to delay in achieving the goals of this vision. We need to raise the awareness of the community regarding this issue and present the solution in the clearest and smartest way possible using artificial technology.

This project aims to address the problem of inexperienced plant caregivers not having the knowledge or resources to properly care for their plants. This can lead to plants becoming unhealthy or dying, which can be frustrating and disappointing for the user. In addition, watering and caring for plants can be time-consuming and require frequent attention, which may not be feasible for people with busy schedules or physical limitations.

1.3 Project Objectives

This project helps users to get to know more about agriculture, their benefits and harms, the method of watering them, their growth environments, and their age, which makes it easier for them to maintain and grow them. also, the project will provide a complete system for maintaining farms and small gardens in terms of watering, maintaining temperature, lighting, and ventilation.

The proposed system will be consisting of:

-The centralized system will be capable of helping users as following:

- Watering the plant in your garden automatically/manually
- Helps you to monitor your garden's humidity, temperature, and moisture
- Control ventilation
- Control lighting

-The mobile application will be capable of helping the users as following:

- User can scan or upload a photo of a plant or tree and it will show:
- Agriculture name and characteristic
- plant benefits and harms

1.4 Project Stakeholders

- Project Supervisor: Dr. Adil Khadidos.
- Project owner: Faculty of Computing and Information Technology at King Abdul-Aziz university.
- End user: Farmer, Gardner, Individual, etc.
- Project team: Waleed Bamaqeen, Fahad Alsifri, Nawaf Alghamdi.

1.5 Proposed Solution

Our solution is targeting both farmers and normal people who's are interested in agriculture. By devolving centralized system and mobile application, the centralized system will focus on farmers and people who have green houses to help them control their gardens more easily and more efficiently. The mobile application will aim to target people interested in agriculture by It will make it easier for them to discover plants and their characteristics.

A centralized system installed in the garden or farm that automatically or manually controls all plants within the area, whether in terms of watering, temperature, lighting, ventilation, and soil moisture through sensors that will be installed inside the farm/garden, and it will be connected to the system through Arduino hardware.

A mobile application will be divided into two parts, the first part, agriculture can be identified by uploading or scanning the plant. using TensorFlow, which is going to use object detection, which is a computer vision technique for locating instances of objects in images or videos. To dedicate the agriculture and provide information about the agriculture like name, characteristic, harm, benefits, and method of watering this agriculture.

The other part of the application will enable the users to monitor the garden from the phone and control some features like lighting, control temperature and validation.

1.6 Tools and Software Used

Hardware Tools:

- Arduino (UNO)
  - Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices.
- Sensors
  - A sensor is a device, module, machine, or subsystem that detects events or changes in its environment and sends the information to other electronics, frequently a computer processor.
- Smartphone
  - Using Smartphone camera to dedicate plant/tree and running the application.

Software Tools:

- TensorFlow
  - TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks.
- Python
  - The Python programming language attracts a huge community of developers, which makes it a preferred programming language for machine learning and other projects, such as data analysis, regression, web development, etc.
- Java Script
  - JavaScript is a high-level, dynamic programming language that is commonly used for web development. It is known for its versatility and

ability to run on both the client-side and server-side of web applications. JavaScript is often used to create interactive user interfaces, dynamic web pages, and web-based games.

- Node-Red
    - Node-RED is a flow-based programming tool that allows users to easily create and deploy applications for the Internet of Things (IoT). It uses a visual programming interface to connect devices, APIs, and services, and can run on a wide range of platforms, including Arduino and cloud-based servers. With Node-RED, users can quickly build complex IoT applications without needing to write extensive amounts of code.
- PHP
    - PHP is an open-source, server-side scripting language that is widely used for web development. It is known for its simplicity, ease of use, and compatibility with a wide range of web servers and platforms. PHP is commonly used to create dynamic web pages, manage sessions and cookies, process and store form data, and interact with databases. It is also used in content management systems (CMS) such as WordPress and Drupal.
- phpMyadmin
    - phpMyAdmin is a free and open-source web-based application used for managing MySQL and MariaDB databases. It provides an easy-to-use graphical user interface (GUI) that allows users to create, modify, and delete databases, tables, fields, and indexes. With phpMyAdmin, users can also execute SQL queries, import and export data, and manage user accounts and permissions. It is a popular tool for web developers and database administrators due to its simplicity and wide range of features.

1.7 System Design

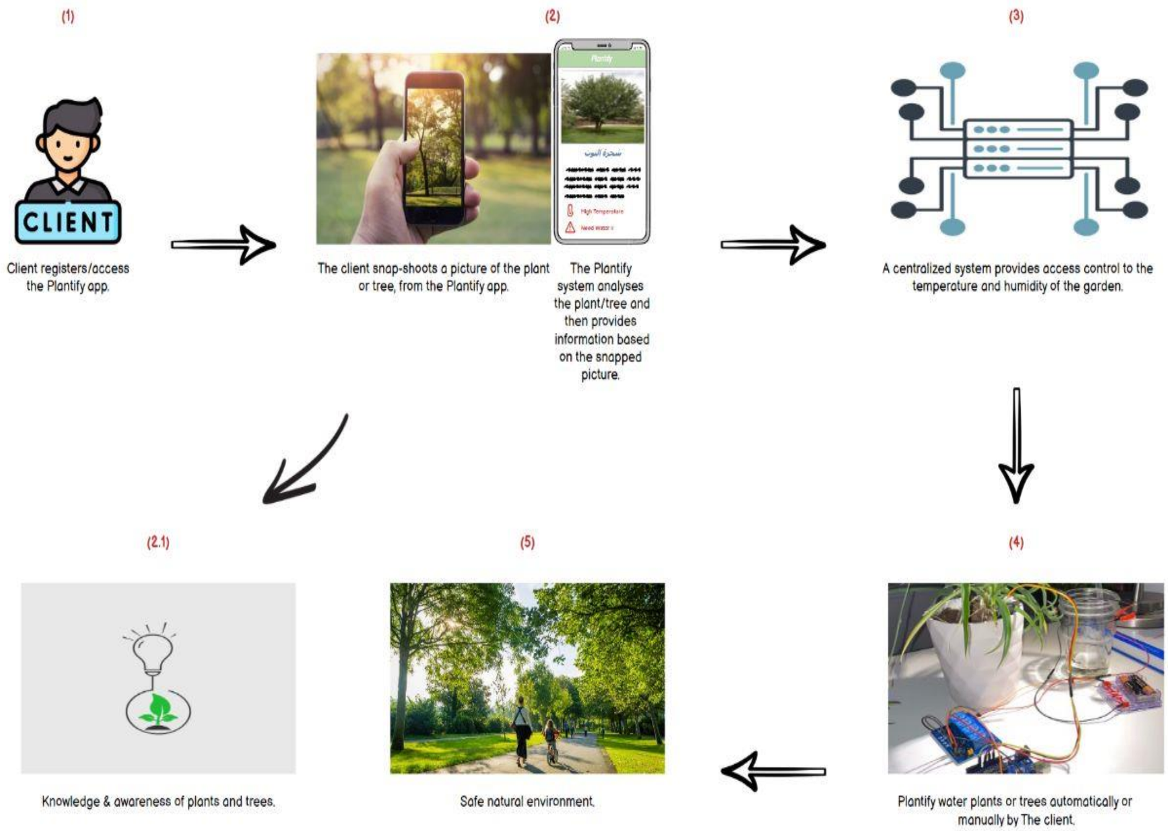


Figure 1 1.1 System Design

<u>Plantify System design:</u>

Figure 1 farmer access to Plantify, **figure 2** the app allows the user either to upload or snap-shoot a picture, then image detection is performed using the TensorFlow tool, and after identifying the plant, the user can read a short description about the specified plant or tree.

Figure 2.1 learn how to take care of plants: Plantify now teaches you how to grow and care for your plants and offers gardening tips and advice for different plant species.

Figure 3 plantify is a remote for the centralized system. The humidity and temperature of the garden are controlled by the centralized system.

Figure 4 automated wagering systems are exactly what the name suggests. Instead of using human intervention to take care of plants or crops, a system that runs on its own is put in place. Such a system monitors data (such as soil moisture and temperature) and controls water pumps to deliver a certain amount of water promptly

Figure 5 exploiting the project correctly and using it in public places, gardens, and in front of houses leads to beautiful nature and a safe environment. People might feel serene, peaceful, restful, and tranquil because of the trees' beauty. Additionally, Green spaces might aid in reducing criminal activity in a community.

1.8 Chapter Summary

In this chapter we been able to identify the problem which is enhancement of the natural environment in the kingdom by increase the awareness of the community regarding plant/tree. And helping farmers who are having problems managing their farms or gardens. After that we set the project objective and the solution, which is centralized system and mobile application using machine learning algorithm regarding object dedication by TensorFlow Software, also Arduino hardware and sensors to give the farmer/user full control to his garden in terms of identifying plants and their characteristics or watering the plant and controlling temperature, lighting, and ventilation. We provided a system design to show how the entire system works and decide the tools and software we going to work with in this project we are going to focus specially on TensorFlow to detect the plant/trees, Arduino, and sensor to connect the garden to be controlled by the centralized system or the mobile application.

Chapter 2: Background And Similar Applications

2.1 Plant Identification Using TensorFlow

The project aims to create a machine learning model that can classify different types of fruits. The model will be trained using a dataset of images of fruits collected from various sources such as Google Images and will be built using the TensorFlow library. The ultimate goal of this project is to design and optimize a neural network for use in fruit classification, and to develop a mobile application that allows users to classify fruits using their mobile device's camera. This can be useful for a wide range of users, such as farmers, food processors, grocery store managers, and even consumers who want to know more about the fruits they are eating. [1]

The project will start by researching different types of fruits and collecting a diverse dataset of images for each fruit. Next, the TensorFlow library will be used to design, train and test the neural network. Hyperparameter tuning will be used to optimize the model's performance. Finally, a mobile application will be developed, which will use the trained model to classify fruits in real-time using the device's camera. [1]

The potential users of this project include farmers, food processors, and grocery store managers who can use the model to classify and sort fruits in an automated way. this project is ideal for anyone who wants to learn more about machine learning and TensorFlow, and how it can be applied to real-world problems. [1]

The project goals include researching different types of fruits, collecting a diverse dataset of images, designing and training a neural network using TensorFlow, and developing a mobile application that allows users to classify fruits using their mobile device's camera. [1]

This project can be improved by using a larger dataset with more diverse images of fruits, and by using more advanced techniques such as transfer learning to improve the model's performance. Additionally, the mobile application can be further improved by adding more features such as a database of information about the fruits, or by integrating it with other services such as recipe suggestions based on the identified fruit. [1]

2.1.1 Advantages

- Simple and inexpensive way to identify plants by using a CNN camera only.
- Explained the Design Development phases in an excellent and simple way.
- Built a convolutional neural network which is capable to classifying images of plants with an average confidence level of 80% or more.

2.1.2 Disadvantages

- The language and wording is rather poor and it needs to be less wording with good summarization.
- The research is short and did not have any illustration or figure to explain the architecture. It needs to be well explained and have its space of explanation.

Table 2.1 The evaluation of Plant Identification Using TensorFlow research.

Criteria	Evaluation
Presentation	Poorly presented, the formatting of headers is confusing. There were some ambiguous words. The way of collecting the data wasn't clear. Only a few pictures of how the system is working.
Relevance	The similarities in this research with the senior project is that they both have focuses on running an efficient image object detection algorithm which is TensorFlow.
Difference	This research is run-on high-power devices such as CNN camera but in the senior project context, it will going to apply the object detection algorithms on middle power like computer.
Objectivity	The authors have demonstrated the most used image object detection algorithms and have applied it too small to medium image datasets, which prove that the high accuracy could CNN cameras provide. However, the authors did mention that dataset needs to be bigger to have better results.

2.2 AgroAId: A Mobile App System for Visual Classification of Plant Species and Diseases Using Deep Learning and TensorFlow Lite

The researchers created a system intended to assist novice gardeners in identifying plant diseases to circumvent misdiagnosing their plants and increase general horticultural knowledge for better plant growth. In this paper, they develop a mobile plant care support system ("AgroAId"), which incorporates computer vision technology to classify a plant's [species–disease] combination from an input plant leaf image, recognizing 39 [species-and-disease] classes. their method comprises a comparative analysis to maximize their multi-label classification model's performance and determine the effects of varying the convolutional neural network (CNN) architectures, transfer learning approach, and hyper parameter optimizations. [2]

The researcher's methodology focused on using transfer learning with previously trained students' CNN models to investigate the effect of changing learning transfer scenarios on model performance and to determine which learning transfer scenario is most effective for their specific classification problem and domain. The authors mentioned that there are four main scenarios that can be considered for exploring the effects of transfer learning:

1. Scenario 1: Freezing all convolutional layers, while retraining only the classifier layers. This scenario is ideal for when the target dataset is small but is similar to the source dataset of the pre-trained model. Because the source dataset is similar to the new target dataset, the expectation is that the higher-level features that are already considered and extracted by the pre-trained model would still be relevant to the new dataset.

2. Scenario 2: Freezing 80% of the convolutional layers, while retraining the remaining layers. This scenario is more suited when there is a large target dataset that is similar to the pre-trained model's source dataset [20]. Because both datasets are similar, it is logical to freeze the feature extraction portion and only retrain the classifier portion (Top layers)

3. Scenario 3: Freezing the first 50% of the convolutional layers, while retraining the remaining 50% of the convolutional layers. In this scenario, a small target dataset that is relatively different from the pre-trained model's source dataset is being considered [20]. Because the target and source datasets are relatively different in their domains, it is probably best not to freeze the higher-level

features as they are likely more specific to the source dataset, which may not be fully in line with the new target dataset's domain [2].

4. Scenario 4: Retraining all layers. This scenario is suited for when there is a large target The dataset that is relatively different from the pre-trained source dataset [20]. Because the target dataset is large in relation to the size of the pre-trained dataset, it may not need to be dependent on a pre-trained transfer learning approach to develop a successful deep learning model.[2]

The authors talked about the problem of poor accuracy of the results when using a dataset. To avoid the risk of poor accuracy results when using their own incomplete dataset, they decided to use a well-known dataset which was the Plant-Village dataset. An augmented version of the dataset consists of 61,486 images belonging to 39 classes, to solve their chosen complex classification problem. The researcher's main conclusion is that CNNs are powerful tools that can suitably deal with plant pathology problems. However, the dataset must contain a large sample size per class to sufficiently differentiate between the minor leaf details for each species and disease.[2]

The paper has mentioned four base neural network architectures that were chosen to develop and compare for their project: MobileNet, MobileNetV2, NasNetMobile, and EfficientNetB0. Each neural network architecture was used to develop 8 models, based on the four transfer learning scenarios and 2 hyper-parameter permutations considered during development. In total, they developed 32 models for their comparative analysis.[2]

After choosing architecture models they divided their results into two stages: preliminary results and post-preliminary results. For preliminary results as in Figure, the accuracy scores vary across the base-network architectures, where the NasNetMobile models produced the worst accuracy scores, while the EfficientNetB0 models consistently perform the best in both hyperparameter variations. [2]

Post-preliminary results after comparing the various evaluation metrics between each of the best four models, the EfficientNetB0 model with transfer learning Scenario 4 and their proposed hyper-parameters were selected as the best-performing model. This is due to the EfficientNetB0 model obtaining the highest accuracy and F1-scores. The researcher's findings show that the

EfficientNetB0 network outperformed MobileNetV2, MobileNet, and NasNetMobile when considering average scores and confusion matrices. [2]

The model analysis results concluded that varying the percentage of convolutional layers retrained for the base networks does impact the model performance, indicating that, on average, there was a trend of Scenario 3 performing the best for the given Plant-Village dataset and solution domain. They have found that the model architecture, hyper-parameter optimization and the portion of the network retrained can all each have a significant effect on the model performance, and that understanding the most suitable portion of the network to retrain can save time and computational effort when training models using a transfer learning approach, especially for pre-trained models that have deep and complex architectures. [2]

2.2.1 Advantages

- The research has explained and compared the most well-known neural network methods to detect plant species-and-disease.
- The research applied several scenarios and tests on different neural network architectures and compared the accuracy and presented graphs of the accuracy of the results for all models
- The research evaluated and compared several articles similar to the project
- The research applied the detection on a smartphone with real-time plant species-and-disease detection.

2.2.2 Disadvantages

- The research used a pre-built dataset instead of creating a dataset from scratch to solve a problem that interests them.

Table 2.2 The evaluation of the AgroAId system research.

Criteria	Evaluation
Presentation	The article did a good job of representing the plant classification system by applying the test on different neural network architectures and showing the standards and the accuracy of the results on graphics. They have mentioned a brief overview of the problem. All techniques and tools used were explained in detail. In addition, many pictures were provided to show the system's mechanism to facilitate the project's understanding.
Relevance	The system accommodated two input sources for users: either taking a picture of the specified plant using the camera or uploading a pre-existing image from the mobile gallery, like our intended application input.
Difference	The difference is that they made a system that could detect and label a plant’s species-and-disease combination from a simple image of the plant using TensorFlow. While our system focuses on plant type identification and health care method with an irrigation monitoring system to water the plant automatically.
Objectivity	The research demonstrates the effectiveness of the methodology for detecting plant species and diseases and explains what the limitations and difficulties are in obtaining correct and accurate results by applying four scenarios with different dataset sizes then four neural network architectures were tested and compared the results of the accurate.

2.3 TensorFlow Based Image Classification using Advanced Convolutional Neural Network

This research study focuses on using advanced CNN (Convolutional Neural Networks) with the TensorFlow framework in Python to identify plants using their leaves. The study found that using CNN was the best approach for training and testing data as it produced accurate and continuously improving results on automated plant identification.[3]

Results were measured in terms of accuracy and time, with accuracy above 95% and faster than other methods. The study also highlights the importance and challenges of image identification in the field of machine vision and the need for efficient methods for identification in taxonomy. The article discusses the challenges of image-based taxonomy identification, specifically in plants. [3] It cites the large number of species available as one of the main challenges, as well as variations within species and issues with image capturing and resolution. The article then describes the use of Advanced CNN (Convolutional Neural Networks) with TensorFlow framework in Python as a solution to these challenges, as it is able to accurately identify plants using their images or parts of the plant. The advanced CNN is smaller in size and can handle larger sets of images, producing results faster than traditional CNNs. The article also mentions that the training process can be done using multiple GPU cards for further efficiency. [3]

2.3.1 Advantages

- The research has explained and compared different image classification models and results.
- The research applied several different image classification models and compared the accuracy rate, time consume, error rate, and validation loss, and presented in a table for all models

2.3.2 Disadvantages

- The author hasn't mentioned a problem description to allow the reader to quickly understand the purpose and intent of the research.

Table 2.3 Tensorflow Based Image Classification using Advanced Convolutional Neural Network.

Criteria	Evaluation
Presentation	The article is presented quite nicely. They performed classifications on leaves of plants by using CIFAR 10 dataset and checked the comparison result between multiple models with specified dataset.
Relevance	According to the author's research paper, the similarities between this research and our senior project is that they both have focused on plant identification with the help of Quantitative and Qualitative features.
Difference	This research was missing an application to simulate the work they did. The research is based on a study case. There is no system has been designed. While our project is based on a system and application that helps to identify plant species through the camera
Objectivity	The authors have demonstrated the effectiveness of the methodology for plant identification and explains the limitations by explaining the CNN limitations such as it is not better with very large sets of images or lack of explanatory power. However, the author did mention advanced CNN is small in size compared to CNN for image recognition. Since these models are small enough to train quickly, huge models can be simply scaled up

2.4 Agricultural Pest and Disease Detection in Banana Plant

The author discusses the importance of agriculture as the primary source of food for a nation, and how it contributes to employment and the economy. He specifically mentions the situation in India, where 58% of the population relies on agriculture as their main occupation, and 81.1% of agricultural production is produced by livestock farmers. [4]

The research also notes that pest and disease can cause significant losses in yield and that farmers may use unsuitable pesticides, which can have negative effects on soil and food quality, as well as human health. The author describes a methodology for detecting and identifying diseases in banana leaves using image processing techniques. [4]

The process involves collecting samples of healthy and diseased banana leaves, training a model using these samples, converting RGB images of banana leaves to grayscale using the luminosity method, using image filtering, and cropping to remove unnecessary parts of the leaf, and using image labelling to categorize pixels that belong to similar disease components. [4]

The author also mentions the use of TensorFlow Lite and a Raspberry Pi for running the model and displaying the results on a mobile app. The proposed model can accurately detect and identify three common banana leaf diseases, and also display the percentage of the leaf affected by the disease, the recommended pesticide treatment, and the quantity of pesticide required. The author also suggests that further improvements in the model can be made by training it with more sample images, and by using drones or servo motors for wireless detection and movement within fields. [4]

2.4.1 Advantages

- The author has described the problem in detail to allow the reader to quickly understand the purpose and intent of the research.
- The research applied the detection on a smartphone camera with real-time plant disease detection and provide some figures.

2.4.2 Disadvantages

- The research is short and did not have any illustration or figure to explain the architecture. It needs to be well explained and have its space of explanation.
- The research hasn't mentioned which TensorFlow model was used and hasn't compared different image classification models and results.

Table 2.4 Agricultural Pest and Disease Detection in Banana Plant

Criteria	Evaluation
Presentation	The author explained the problem and the aim of the project well but did not adequately explain the tools and their working methods. The method of data collection was not clear.
Relevance	The similarity between the author's research and our project is that we focus on helping farmers by creating a plant detection app using an efficient image object detection algorithm which is TensorFlow.
Difference	The difference is that they used TensorFlow to create an app that could identify and label a plant's disease combination from a simple picture of the plant. While our system concentrates on identifying the type of plant and the best way to take care of it, also it has an irrigation monitoring system that automatically waters the plant.
Objectivity	The author didn’t explain the project sufficiently that some important points are left ambiguous. The model of the camera was mentioned, but the accuracy result of the plant classification wasn’t mentioned in the research.

2.5 Plant Disease Detection using Deep Learning

This paper proposes a deep learning-based model called the "Plant Disease Detector" for identifying various diseases in plants using images of their leaves. The model is developed using a neural network, the PlantVillage dataset, and a convolutional neural network (CNN) with multiple convolution and pooling layers.

The model is trained and tested using 15% of the data from the PlantVillage dataset, achieving 98.3% testing accuracy. The study aims to create an automated system for detecting plant diseases using deep learning techniques, which can be integrated with drones or other systems in the future for live detection and reporting of diseased plant locations for timely treatment.

The study highlights the importance of taking care of plants, as they play a vital role in climate change, agriculture industry, and a country's economy. Plant diseases caused by bacteria, fungi, and viruses can lead to significant losses in food, fiber, and ornamental production systems. Identifying and treating these diseases in a timely manner is crucial to prevent the destruction of entire plants.

The proposed deep learning model, "Plant Disease Detector", aims to address this challenge by automating the process of disease detection in plants, which can save time, effort, and human resources. The study aims to make this technology available for farmers and other industries to help them take care of plants more efficiently and effectively.

2.5.1 Advantages

- The system has achieved an overall 98% testing accuracy on publicly accessible dataset. Implementing this project is affordable and efficient.

2.5.2 Disadvantages

- Language and wording is poor and it needs to be less wording with good summarization. The research is brief and lacks visual aids or figures to explain.

Table 5 2.5 Plant Desis Dedication using Deep Learning

Criteria	Evaluation
Presentation	The study presented various sample images to demonstrate how different object detection algorithm's function. However, the authors made heavy use of acronyms without providing sufficient explanation.
Relevance	The similarities in this research with the senior project is that they both use Convolution Neural Network (CNN).
Difference	The research was carried out using the publicly accessible collection of 70295 images, we will be using smaller dataset.
Objectivity	The authors have presented new and recent image object detection algorithms, which they have applied to large datasets and achieved high accuracy.

2.6 Chapter Summary

Identifying plants using machine learning got people intention for the past few years. There are a lot of research about identifying plants using TensorFlow with different techniques. Like, using centralized camera or using the smartphone's camera with TensorFlow Lite.

This chapter covered the studies that were relevant to the project and contrasted them in terms of benefits and drawbacks. To avoid reinventing the wheel and to avoid making the mistakes that other researchers have made in their projects, the key to improving this project is reading and summarizing other people's work. Finding the connections between the relevant works and this project will make it easier to complete it and will allow you to see how others have completed similar tasks more effectively.

Chapter 3: Analysis

3.1 Functional requirement

The functional requirements describe the core functionality of the system, which can be as following:

•**Image Capture**: The system should be able to capture high-resolution images of plants using a connected camera. The images should be stored in a centralized database for further processing.

•**Image Processing**: The system should be able to process the captured images using machine learning and TensorFlow to identify and classify the plants. The processed images should be stored in the centralized database for further analysis.

•**Micro-Controller Unit**: The system should be able to connect to a Arduino device to control the camera and process the captured images. The Arduino device should also be able to send the processed images to the centralized database for storage.

•**Mobile Application**: The system should have a mobile application that allows users to monitor the system remotely. The application should provide real-time updates on the status of the plants, including their health and growth progress.

•**Camera Stream**: Define the functionalities of video streaming in the mobile application such as obtain IP address, connect to the camera, and disconnect from the camera. This is an optional feature in the mobile application where allows user to video stream from the mobile application via the camera which is connected to the centralized system.

•**Watering Automation**: The system should have the capability to automatically water the plants based on the status of the plants as identified by the Arduino sensors. Users should be able to set the watering schedule and configure the system to water the plants at specific intervals, or to water them only when necessary.

•**<u>Notification</u>**: The mobile application should provide notifications to the user about the status of the plants, such as when they need to be watered or when a plant is in a poor health. Users should also be able to receive notifications about the status of the watering schedule and to receive alerts if the system detects any issues with the plants or the connected devices.

3.2 Non-Functional requirement

The Non-Functional requirements shows the properties of the system, which will be as follows:

● The system would be accurate in identifying Agriculture using TensorFlow technology.

● The system can identify agriculture from a live stream camera or phone which reflects the high performance of the system.

● The system will be able to identify more than one agriculture at a time.

● The system should be operational all the time.

3.3 Stakeholders

- <u>Project supervisor</u>: The project supervisor is Dr. Adil Khadidos. Who is fully experienced in networked robots and devices, swarm robotics, self-organization, self-distributed systems, and embedded Systems, such as Arduino and raspberry pi.

- <u>Project owner</u>: The project owner is the Faculty of Computing and Information Technology at King Abdul- Aziz university. One of the most important colleges within one of the best universities in the world. The graduates of this department played an important role in the national economic development in both the government and private sectors by participating in major information technology projects, and glory remains.

- End user: The user downloads the application to allow him/her to use the application's features of detecting plant/tree species by taking a picture or using a pre-photo of the plant to be detected. The system will help farmers monitor their plants and follow the stages of plant growth through a surveillance camera that can be viewed through a centralized system and the ability to control lighting, humidity, temperature, and soil moisture, as well as the possibility of watering plants/trees manually or automatically through the application.

- Project team: The project team members are responsible for developing and testing the system before releasing the mobile application. Project team members can confirm the new plant/tree species reported by the users by training a new dataset model of the new required species and updating the database. The project team developers are Waleed Bamaqeen, Fahad Alsifri, and Nawaf Alghamdi

3.4 Use Cases Diagram:

The use case diagrams describe the high-level functions and scope of the system. These diagrams also identify the interactions between the system and its actors. The use cases and actors in use case diagrams describe what the system does and how the actors use it, but not how the system operates internally. There are two use cases that represent the entire system one for the centralized system and one for the mobile application.

3.4.1 Centralized system use case

The first use case is about the centralized system as the Figure 3.1 below:

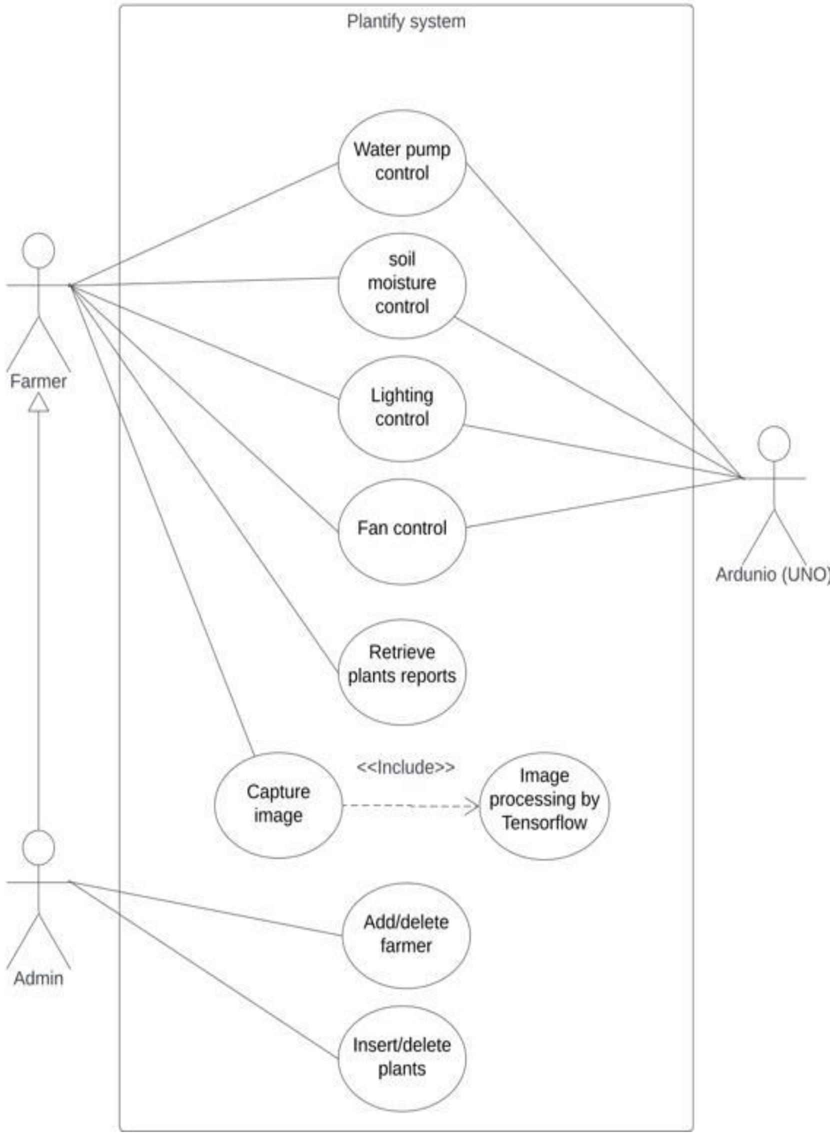


Figure 2 3.1 Use case diagram for the centralized system part

Actors and Description:

The use case diagram would illustrate the relationship between the actors: Farmer, admin and Arduino microcontroller and their functionalities and how they interact with each other.

Farmer and Arduino: The farmer and Arduino microcontroller is associated with the following use cases:

Water pump control: Arduino microcontroller measures the watering pump process, and the farmer can control the water pump and choose whether the process going to be manually or automatic.

Soil Moisture control: Arduino microcontroller measures the soil moisture process, and the farmer can choose whether the process going to be manually or automatic.

Lighting Control: Lighting will be installed and connected to Arduino and the farmer can control the intensity of lighting.

Fan Control: Fan will be installed and connected to Arduino and the farmer can control the power or speed of it and choose to set it manually or automatic.

All these use cases are associated between the farm and Arduino microcontroller, the two following use cases are for the farmer only:

Retrieve plant reports: the farmer will be able to see details of all plants in his farm like: When was the last time it was watered?

Capture image: The farmer captures high-resolution images of the plants through a camera which are then processed by the machine learning and TensorFlow model.

Admin: there is a generalization relation between the farmer and the admin, the admin will have all use cases that the farmer has plus the following:

Add/delete users: the admin can add/delete users to specific farm so they can be able to view the plant's status and control it.

Insert/delete plants: the admin will be able to insert/delete plants to his farm so he can keep tracking them.

3.4.2 Mobile application use case

Figure 3.2 represents the second use case in the system which is about the mobile a

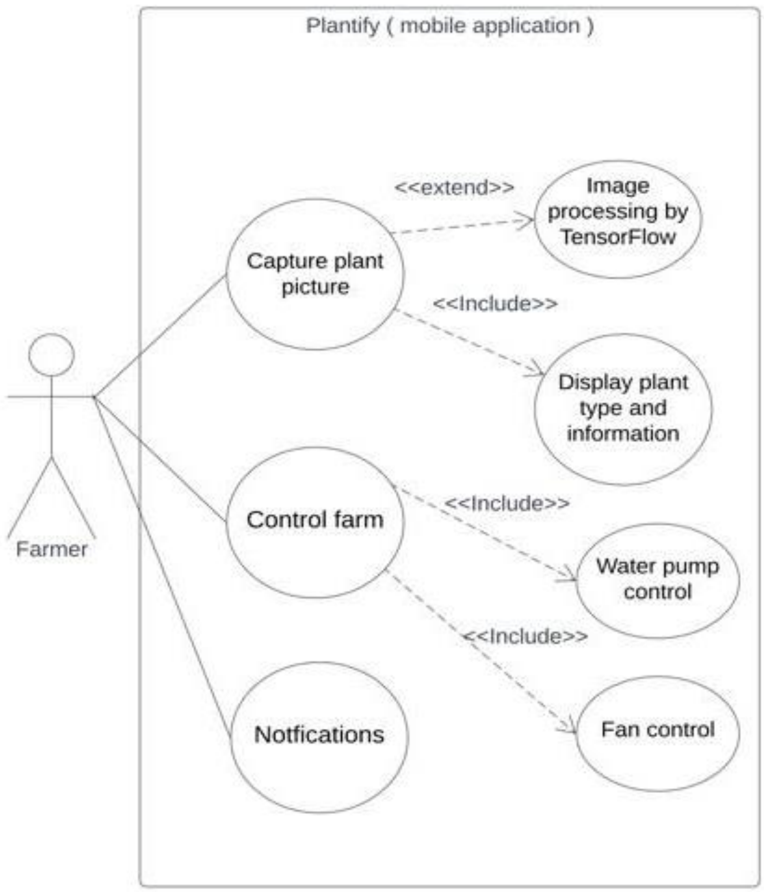


Figure 3 3.2 use case diagram for the mobile application part

Actors and Description:

The use case diagram would illustrate the relationship between the actor (Farmer) and the functionalities (capture plant image, Control farm, Notifications) and how they interact with each other.

Farmer

Capture plant image: This functionality allows the farmer to take a picture of their plants or upload an existing one to the centralized system.

Image processing by TensorFlow: this is an extend use case from capture plant image, which will take the picture and analysis it in the TensorFlow model.

Display plant type and information: this is an include use case in capture plant image, the system will return the name of the plant, its type, benefits, harms, and method of watering it.

Farm Control: which mean view the farm condition and control some of the feature in the centralized system not all of.

Water pump control: this is an include use case in Farm control, the farmer will be able to control the water pump and set it manually or automatic.

Fan control: this is an include use case in Farm control, the farmer will be able to view the fan state and control it and choose to set it manually or automatic.

Notifications: This functionality allows the farmer to receive notifications about the system's status, like plant (x) has been watered

3.5Traceability Matrix

Table 6 3.1 Tracebailty Matrix

Use case name	**Functional requirements**						
	Image Capture	Image Processing	Micro-Controller Unit	Mobile Application	Camera stream	Watering Automation	Notification
Water pump control			**X**	**X**		**X**	
Soil moisture control			**X**			**X**	
Lighting control			**X**				
Fan control			**X**	**X**			
Retrieve plants reports							**X**
Capture image	**X**	**X**			**X**		
Add/delete user							**X**
Add/delete plants			**X**				**X**
Capture plant image	**X**	**X**		**X**			
Display plant type and information		**X**		**X**			
Notification				**X**			**X**

Table 3.1 represents the traceability matrix which shows the many to many relations between the functional requirements and use cases of the system. It is useful to track the requirements with the current use cases that plan to be developed are met or there something missing. Two different sets of values are compared against each other by placing an identifier for one set in the top row, and the other set on the left column. If there is commonality or a relationship, a mark is placed where the column and row intersect.

3.6 Chapter Summary

Plantify system can be broken down into two main subsystems. The first one is related to identifying the plants using a machine learning. It also uses a micro-controller unit linked with sensors and camera.

The second subsystem is the plants identification and farm management system which is about a mobile application that help farmers to identify plants and control the farm. The mobile application will give the farmer the ability to upload pictures to and the application will retrieve plant characteristics, also the farmer will be able to control the farm like watering the plant automatically/manually and show the following information: soil moisture, temperature, and ventilation.

The use cases for the two subsystems were shown during the analysis and design process, which also identified the primary and supporting actors for each system. The traceability matrix also demonstrates how the functional requirements and use cases of the two subsystems relate to one another.

Chapter 4: Methodology

4.1 Methodology Description

The approach for implementing this project will be using Extreme Programming, a significant software development methodology within the Agile models. This methodology is preferred due to the following reasons:

- Clear and Transparent: Regular communication within the team ensures that everyone stays informed about the progress of the project. Although each team member works on their own specific tasks, regular meetings help track the overall progress. This visibility in Extreme Programming projects helps to minimize failures and reduce the occurrence of bugs.
- Emphasis on Testing: Extreme Programming places a high importance on testing and considers it to be the primary factor in creating error-free software.
- Focus on Simplicity: The objective is to develop a straightforward system that will perform well in the present. As a result, Extreme Programming aims for quick and prompt results, making it a fitting approach for the project's short timeline during the third semester.

4.2 Diagram Designing Tool

Diagrams have been designed using Lucidchart. It’s an online tool that provides a free subscription with a limited number of an object can be used. One of the advantages that Lucidchat has is that it supports multiple users can edit the same diagram at the same time and you can edit your diagrams from your phone from. one of its limitation that you can only work on three diagrams at a time if you want to work in more you need to buy premium subscription.

4.3 Class Diagram

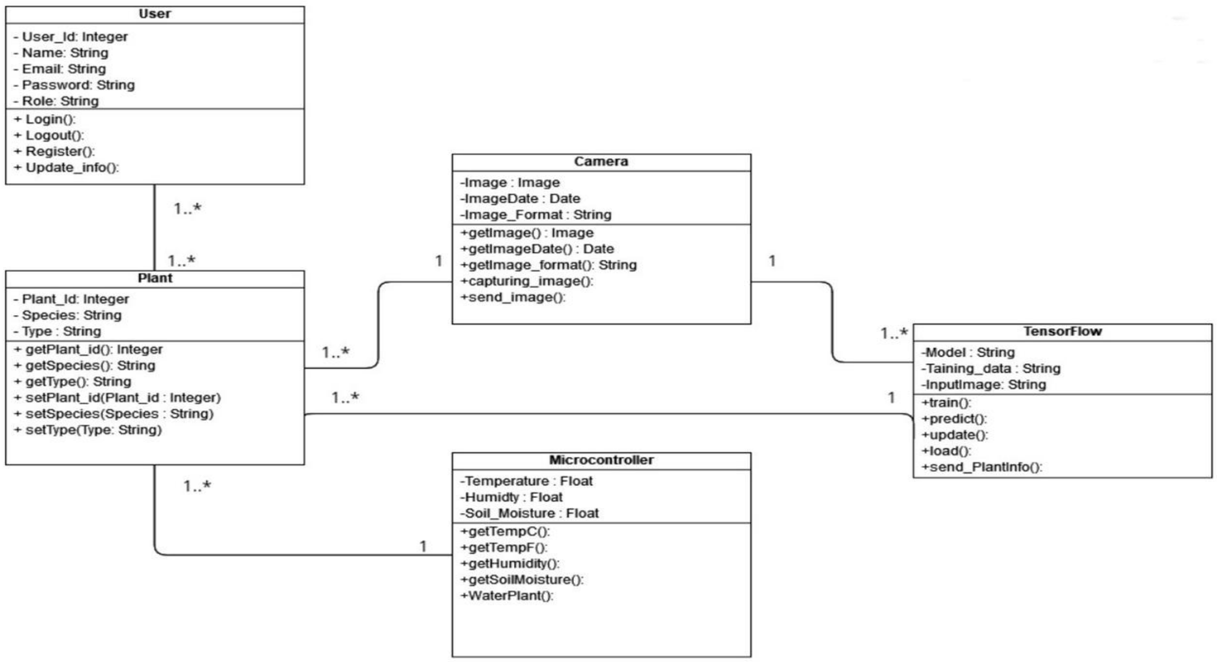


Figure 4 4.1 Class Diagram

Description:

The class "User" in the class diagram represents the users who interact with the centralized system for identifying plants using machine learning and TensorFlow. The attributes of this class include "User ID", "Name", "Email", "Password", and "Role". The User ID is a unique identifier for each user. The "Name" attribute stores the name of the user, "Email" stores the email address, and "Password" stores the password for the user's account. The "Role" attribute specifies the role of the user, such as an administrator or a regular user.

The class "User" also includes the operations "Login", "Logout", "Register", and "Update Info". The "Login" operation allows the user to log into the system, "Logout" allows the user to log out, "Register" allows the user to create a new account, and "Update Info" allows the user to update their information.

The class "User" has a relationship with the class "Plant" to retrieve information about the plants. This allows the user to view information about specific plants and to receive updates about changes to the plants, such as changes in soil moisture, temperature, and humidity.

The class "Plant" in the class diagram represents the plants that are monitored by the centralized system. The attributes of this class include "Plant ID", "Species", and "Type". The "Plant ID" is a unique identifier for each plant and is represented as an integer. The "Species" attribute stores the species of the plant, and the "Type" attribute stores the type of the plant, such as a tree, shrub, or flower.

The class "Plant" also includes the operations "get" and "setters" for the attributes. The "get" operation allows the user to retrieve the values of the attributes, while the "setters" allow the user to update the values of the attributes.

The class "Plant" has information about soil moisture, temperature, and humidity, which can be retrieved by the class "User" through their relationship. This allows the user to view information about the current state of the plants and to receive updates about changes to the plants over time. The class "Camera" in the class diagram represents the camera that is connected to the centralized system for identifying plants using machine learning and TensorFlow.

The attributes of this class include "Image", "Image Date", and "Image Format". The "Image" attribute stores the captured image of the plant, "Image Date" stores the date and time when the image was captured, and "Image Format" specifies the format of the image, such as JPEG or PNG.

The class "Camera" also includes the operations "getImage", "getImageDate", "getImageFormat", "captureImage", and "sendImage". The "getImage" operation retrieves the captured image, "getImageDate" retrieves the date and time when the image was captured, "getImageFormat" retrieves the format of the image, "captureImage" captures a new image of the plant, and "sendImage" sends the captured image to the TensorFlow class for processing.
The class "Camera" has a relationship with the class "Plant" because it captures images of the plants, and it also has a relationship with the class "TensorFlow" because it sends the captured images to the TensorFlow class for processing.

The class "Microcontroller" in the class diagram represents the device responsible for measuring the environmental conditions of the plants, such as soil moisture, temperature, and humidity. The attributes of this class include "Temperature", "Humidity", and "Soil Moisture".
The "Temperature" attribute stores the current temperature of the environment, which can be returned in either Celsius or Fahrenheit using the operations "getTempC()" and "getTempF()", respectively. The "Humidity" attribute stores the current humidity, which can be returned using the operation "getHumidity()". The "Soil Moisture" attribute stores the current soil moisture, which can be returned using the operation "getSoilMoisture()".

The class "Microcontroller" also includes the operation "WaterPlant()", which allows the device to water the plant. This operation is crucial for maintaining the health and growth of the plants. The class "Microcontroller" has a relationship with the class "Plant", as it measures the environmental conditions of the plant. This allows the microcontroller to monitor the conditions of the plant and to water it as needed, ensuring its health and growth.

The class "Tensorflow" in the class diagram represents the machine learning model used for identifying plants. The attributes of this class include "Model", "Training Data", and "Input Image". The "Model" attribute stores the type of model used for plant identification, "Training Data" stores the data used for training the model, and "Input Image" is where the captured image from the camera is stored.

The class "Tensorflow" also includes the operations "Train", "Predict", "Update", "Load", and "Send Plant Info". The "Train" operation allows the model to be trained using the training data, "Predict" allows the model to make predictions about the plant based on the input image, "Update" allows the model to be updated with new data, "Load" allows the model to be loaded with a previously trained model, and "Send Plant Info" allows the model to send the information about the plant to the central system.

The class "Tensorflow" has a relationship with the class "Camera" as it receives the image from the camera and with the class "Plant" as it sends the information about the plant to the central system.

4.4 Sequence Diagram

The sequence diagram of the system will be divided into two systems. The first subsystem is the centralized system. Second subsystem is the mobile application system.

4.4.1 Centralized system sequence diagram

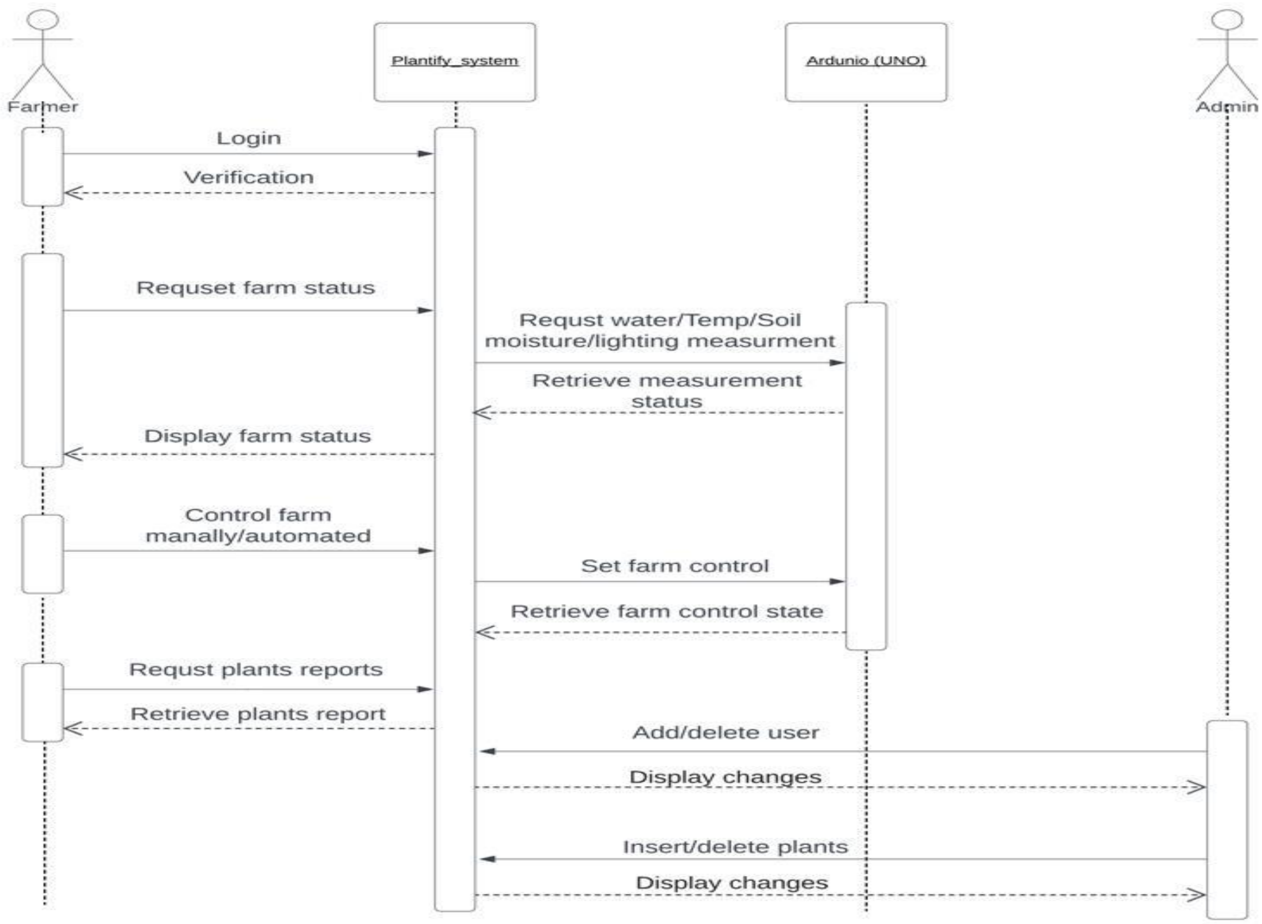


Figure 5 **4.2 Plantify System Sequence diagram**

Description:

First the farmer will login into the system, after that he will request the farm status and the system will retrieve the measurement from Arduino microcontroller and then the farm status will be displayed to the farmer. After that farmer can choose whether the farm be controlled manually or automatic, whatever the farmer chooses the system will send it to Arduino microcontroller and then the state will be displayed to the farmer and he can control the water pump, soil moisture, lighting, and fan. After that farmer can request plants report and the system will display it to him. Also, as an admin the farmer can add/delete farmers to his farm and add/delete plants to his farm.

4.4.2 Plantify Mobile Application Sequence Diagram

Figure 4.3 shows the sequence diagram for the second subsystem which is the mobile application

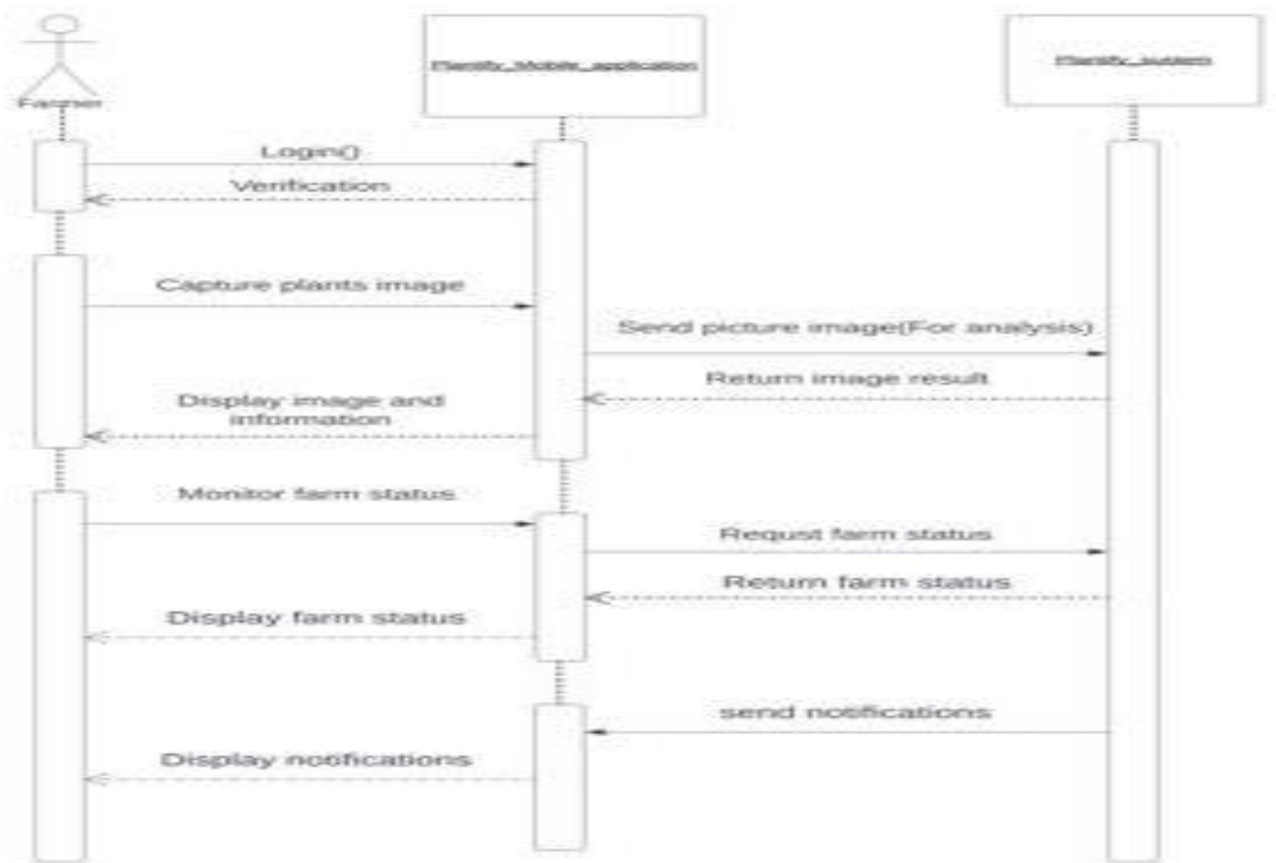


Figure 6 4.3 Plantify mobile Application Sequence diagram

Description:

Farmer will login into the application, after that he will capture plant image, the application will send the image to the system and it will be analyzed by TensorFlow model after that the system will return the result to the application, name of plant, type, benefits, harms, and method of watering it will be displayed to the farmer. Also, the farmer can monitor the farm from his mobile the application will request the farm status from the system, and it will be displayed to the farmer in the application. And at any times, the farmer can receive notification from the system related to the condition of the plants.

4.5 ER Diagram

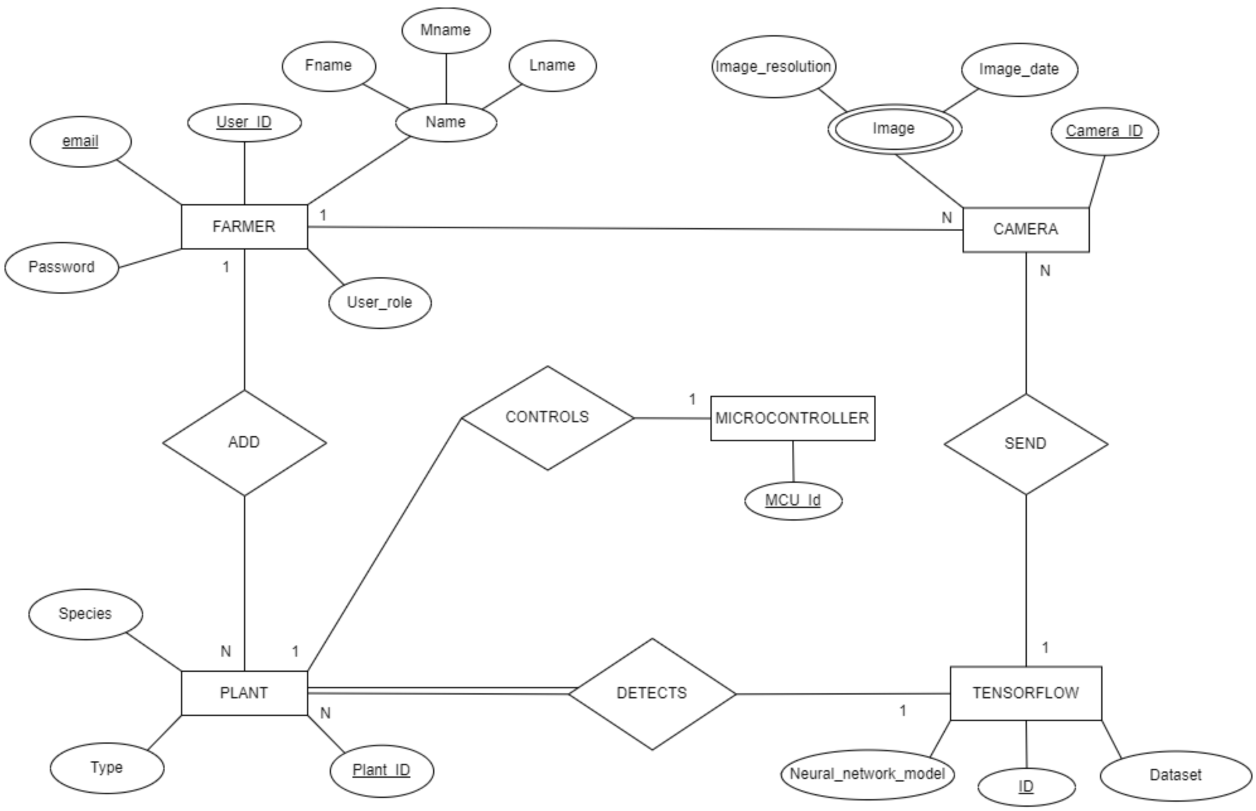


Figure 7 4.4 Plantify System ER diagream

Description:

ER diagram has 5 main tables, as the following:

<u>Farmer:</u>

This table defines all the users in general including the 2 different types of users and we can separate them by the user role attribute. Also, the farmer will have basic user information such as username and password and name, etc.

Cardinality:

• Each farmer can add many plants or there could be a user that didn’t add any plants.

• Each farmer can have more than one camera.

<u>Plant:</u>

The plant table has all the related information about the plant. Each plant has a unique ID, and type, information of plant species. The plant table has three relationships. Frist relationship with the farmer, the farmer can add plants. The second relationship is with TensorFlow, which that TensorFlow can detect an image of the plant and its type. The third relationship is with the microcontroller, which that microcontroller can control plants.

Cardinality:

• The plant with the farmer is a many-to-one relationship which is that many plants can be added by a farmer.

• The plant with the TensorFlow is a many-to-one relationship which is that many plants can be detected by one TensorFlow tool.

• The plant with the microcontroller is a one-to-one relationship which is that each microcontroller can control one plant.

<u>Camera:</u>

This table will have the information on the camera which is responsible for capturing plants. The camera has a unique id, and the image format is listed on the database to know if the image is valid for the detection process.

Cardinality:

• The camera with the farmer is a many-to-one relationship. Each farmer can use many cameras.

• The camera with TensorFlow is a many-to-one relationship which is that many cameras can send images to a TensorFlow for the detection process.

TensorFlow:

The TensorFlow table has all the related information about TensorFlow. TensorFlow has a unique ID, and trained dataset. The TensorFlow table also has a neural network model attribute which finds out the algorithm used.

Cardinality:

- The TensorFlow with the plant is a one-to-many which is that many plants can be detected by one TensorFlow.
- The TensorFlow with the camera is a one-to-many relationship which is that many cameras can send images to a TensorFlow for the detection process.

Microcontroller:

This table will have one attribute about the microcontroller. Each microcontroller has a unique id.

Cardinality:

- The detection device with the plant is a one-to-one relationship. Each plant can be controlled by one microcontroller.

4.6 Chapter Summary

This chapter of a project explains the methodology used for implementing the project. The Extreme Programming methodology is used for this project due to its benefits of clear and transparent communication, emphasis on testing, and focus on simplicity. The diagrams are created using the Lucidchart online tool.

The class diagram for the Plantify system includes classes for Users, Plants, Camera, Microcontroller, and Tensorflow. The User class includes attributes such as User ID, Name, Email, Password, and Role, as well as operations such as Login, Logout, Register, and Update Info. The Plant class includes attributes such as Plant ID, Species, and Type, as well as operations to retrieve and update the attributes.

The Camera class includes attributes such as Image, Image Date, and Image Format, and operations to capture images and send them to TensorFlow for processing. The Microcontroller class includes attributes such as Temperature, Humidity, and Soil Moisture, and operations to measure the environmental conditions of the plants and water them. The TensorFlow class includes attributes such as Model, Training Data, and Input Image, and operations to train, predict, update, load, and send plant information. The classes are connected by relationships that allow information to be shared and updated between them.

The system described in the 4.4 Sequence Diagram has two subsystems, the centralized system, and the mobile application system. The centralized system allows farmers to log in, request farm status, control the water pump, soil moisture, lighting, and fan, request plant reports, and add or delete farmers and plants as an admin. The mobile application system allows farmers to log in, capture plant images and receive information on the name, type, benefits, harms, and method of watering the plant. The application also allows farmers to monitor the farm status and receive notifications related to the plant's condition.

Chapter 5: Interfaces

5.1 Admin interfaces

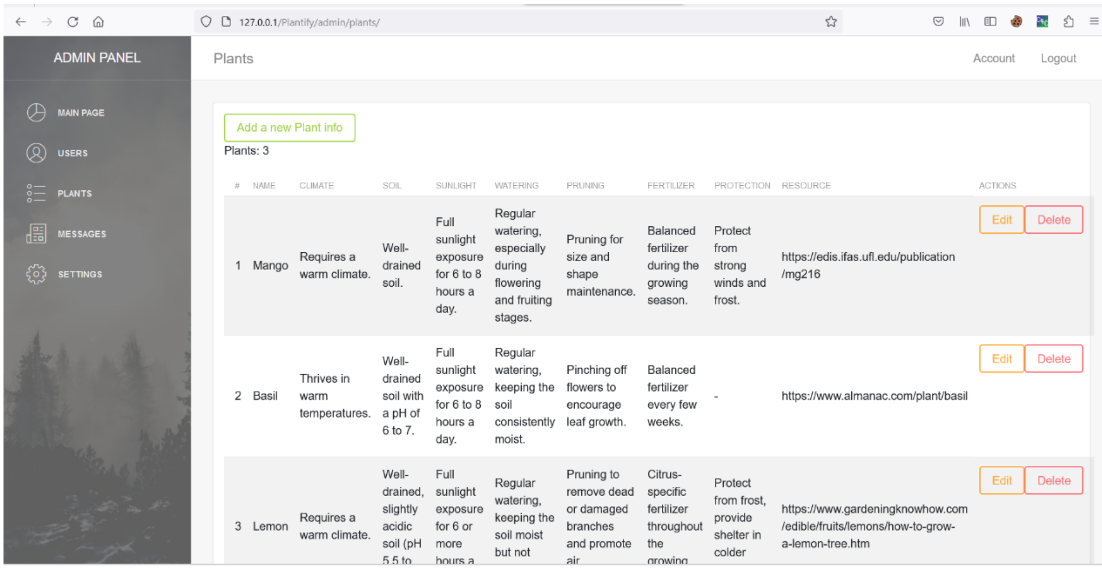


Figure 8 5.1 Admin interface

Description*:*

These interfaces contain several windows for the admin, for example displaying admin dashboard to manage users, plant care information and messages.

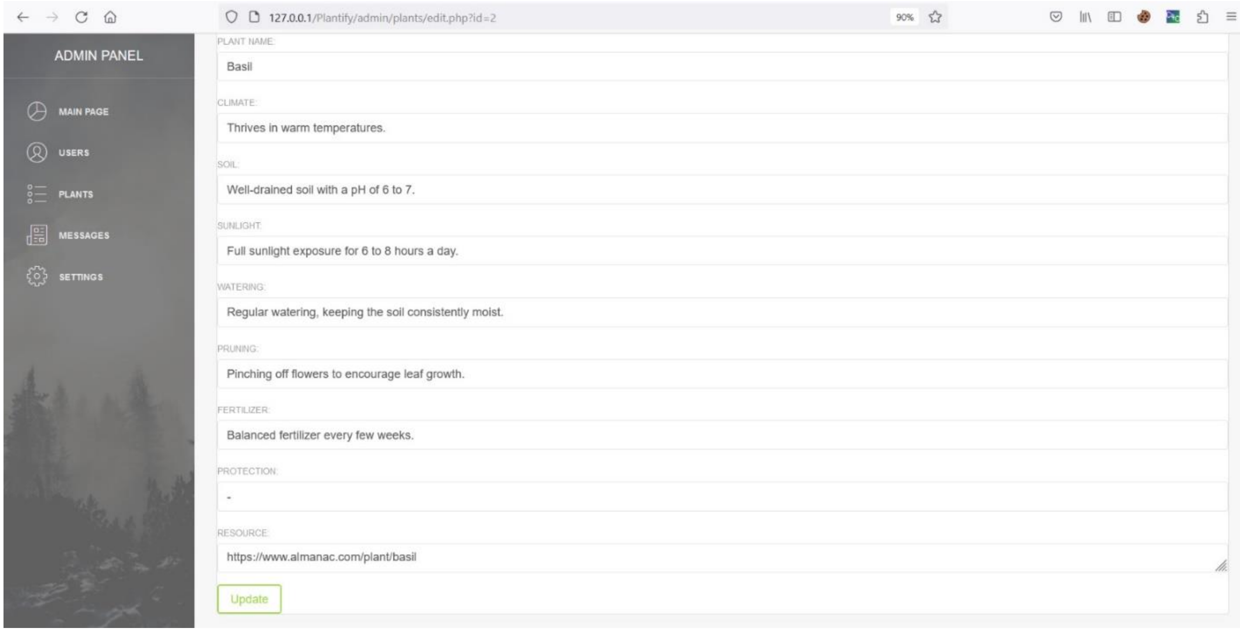


Figure 9 5.2 Plant Info Page

Description*:*

The Plant Info page enables the admin to retrieve and modify crucial information about different plants recommended on the website. This includes details like climate requirements, soil moisture levels, sunlight exposure, and other relevant factors affecting plant growth. By editing this information, the admin ensures accurate and up-to-date recommendations for optimal plant cultivation.

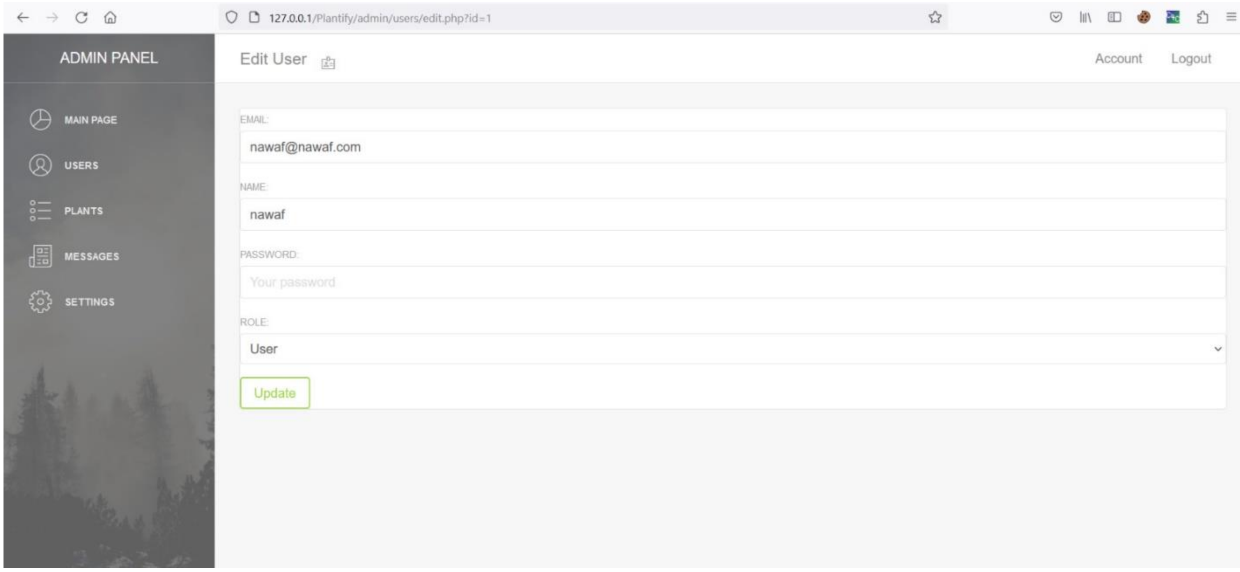


Figure 10 5.3 Edit User page

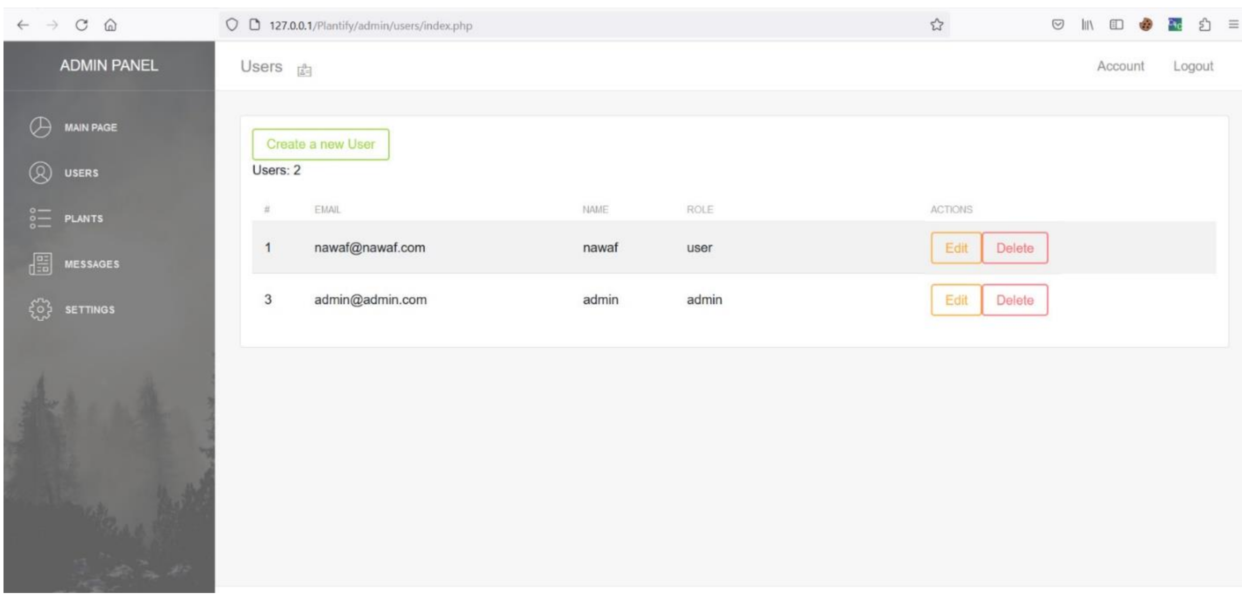


Figure 11 5.4 Users page

Description:

This page allows the admin to view and manage user accounts on the website. A list of all registered users will be displayed and their associated information, such as name, email address, and role. The admin will also have the ability to edit user information, such as updating their profile details or resetting passwords if necessary.

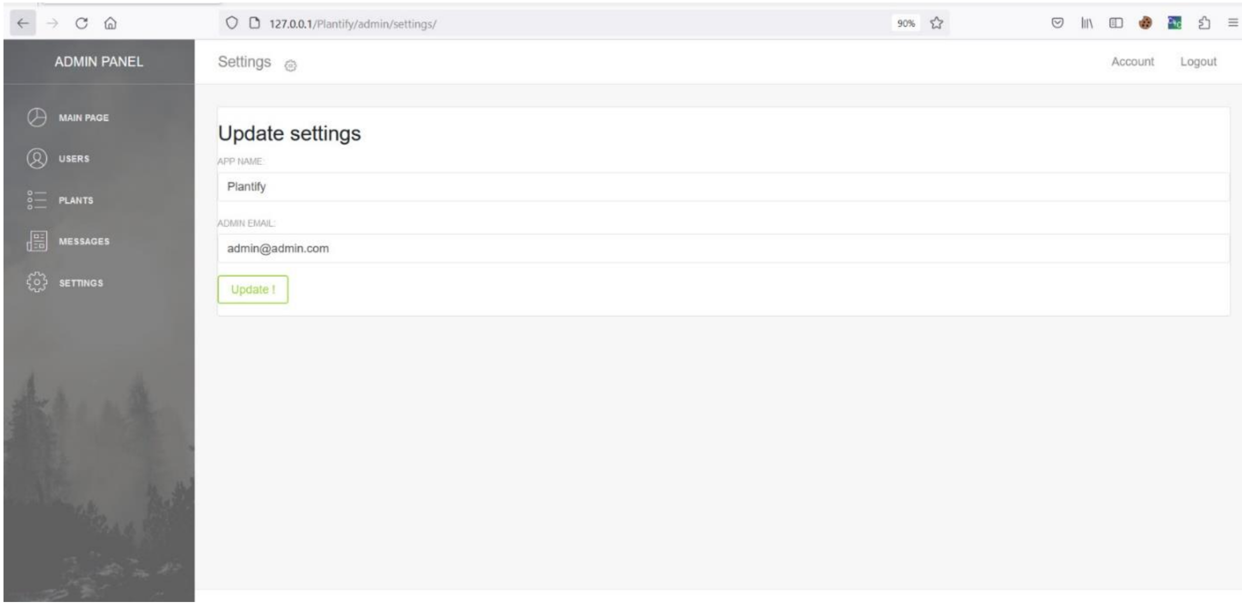


Figure 12 5.5 Settings Page

Description*:*

The Settings page empowers the admin to personalize essential aspects of the website and the admin panel itself. It offers the flexibility to modify settings such as the website name or title, as well as the admin's email.

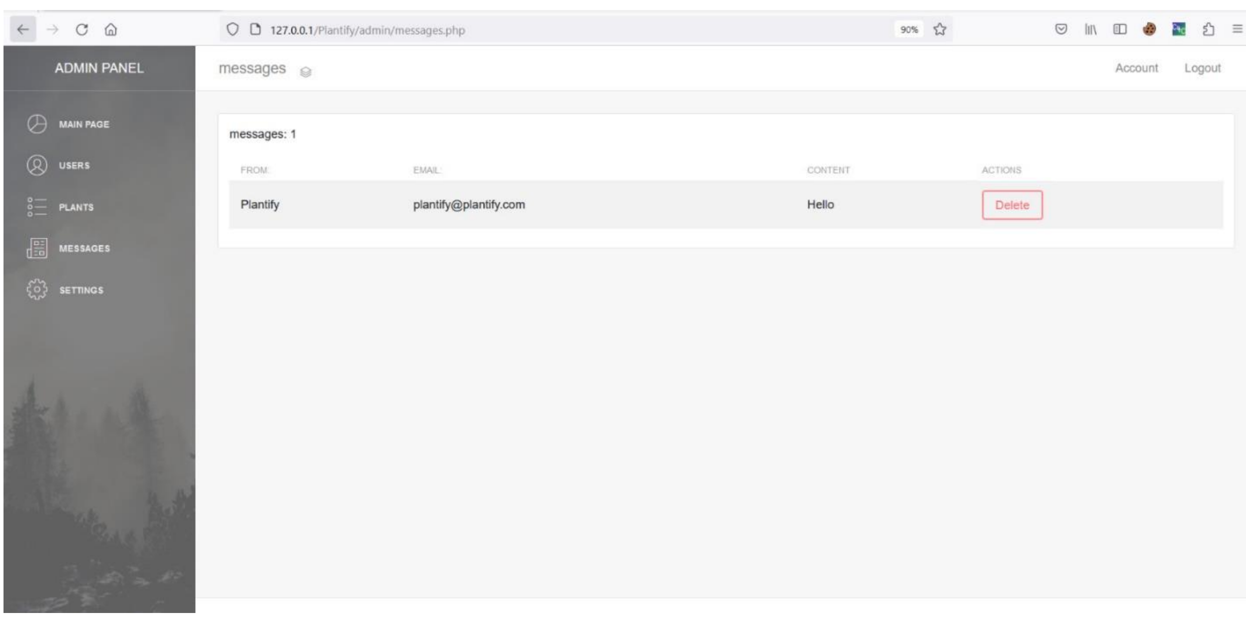
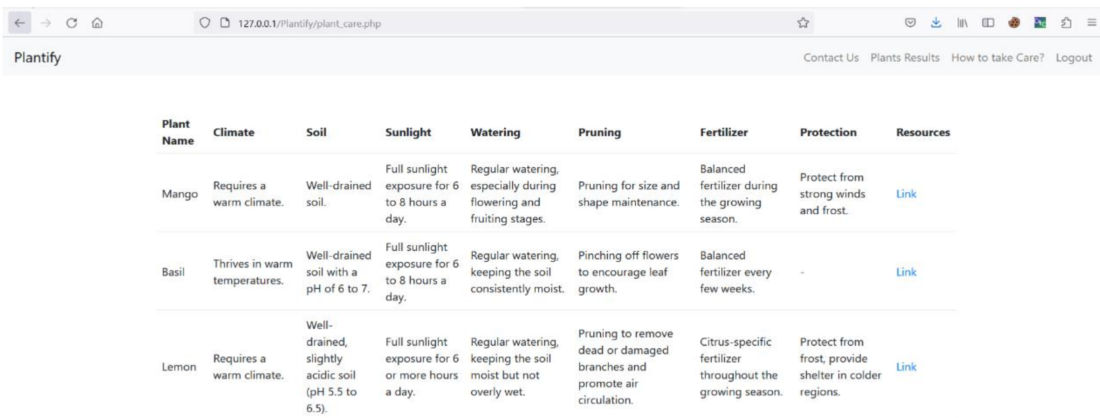


Figure 13 5.6 Message Page

Description:

The admin can efficiently manage and respond to user inquiries sent via the contact us page. It provides a comprehensive view of received messages, including sender details such as name, email address, and the content of their messages.

5.2 User interfaces



Plant Name	Climate	Soil	Sunlight	Watering	Pruning	Fertilizer	Protection	Resources
Mango	Requires a warm climate.	Well-drained soil.	Full sunlight exposure for 6 to 8 hours a day.	Regular watering, especially during flowering and fruiting stages.	Pruning for size and shape maintenance.	Balanced fertilizer during the growing season.	Protect from strong winds and frost.	Link
Basil	Thrives in warm temperatures.	Well-drained soil with a pH of 6 to 7.	Full sunlight exposure for 6 to 8 hours a day.	Regular watering, keeping the soil consistently moist.	Pinching off flowers to encourage leaf growth.	Balanced fertilizer every few weeks.	-	Link
Lemon	Requires a warm climate.	Well-drained, slightly acidic soil (pH 5.5 to 6.5).	Full sunlight exposure for 6 or more hours a day.	Regular watering, keeping the soil moist but not overly wet.	Pruning to remove dead or damaged branches and promote air circulation.	Citrus-specific fertilizer throughout the growing season.	Protect from frost, provide shelter in colder regions.	Link

Figure 14 5.7 User Interfaces

Description:

These interfaces contain several windows for the users, for example displaying how to provide the best environment for your plants.

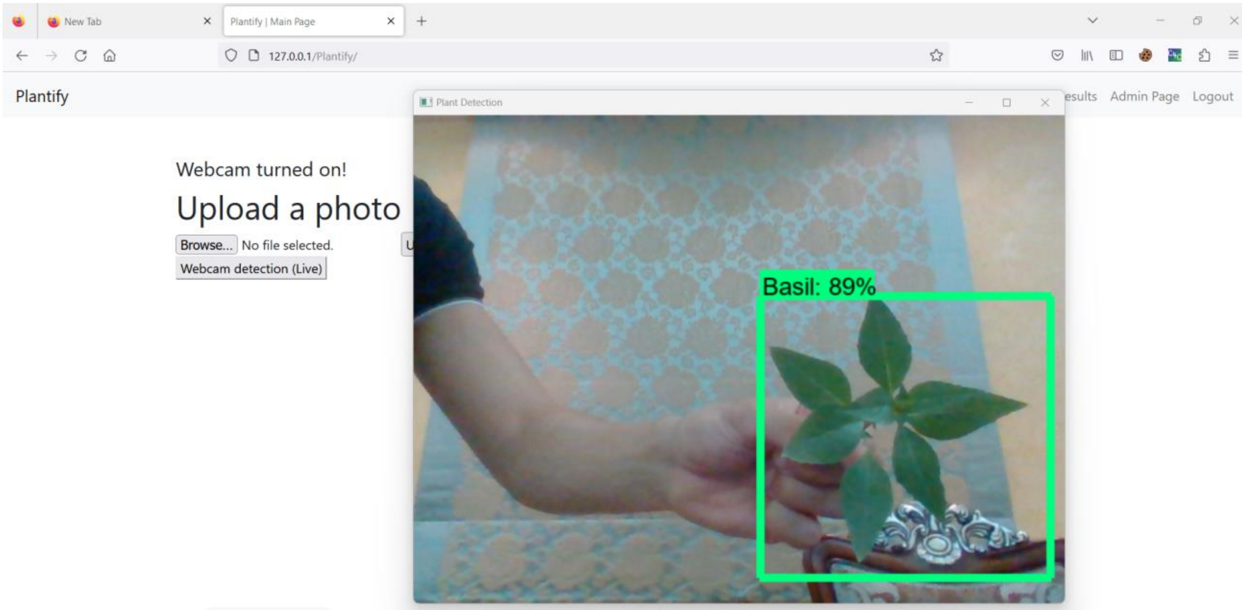


Figure 15 5.8 Dedication Process

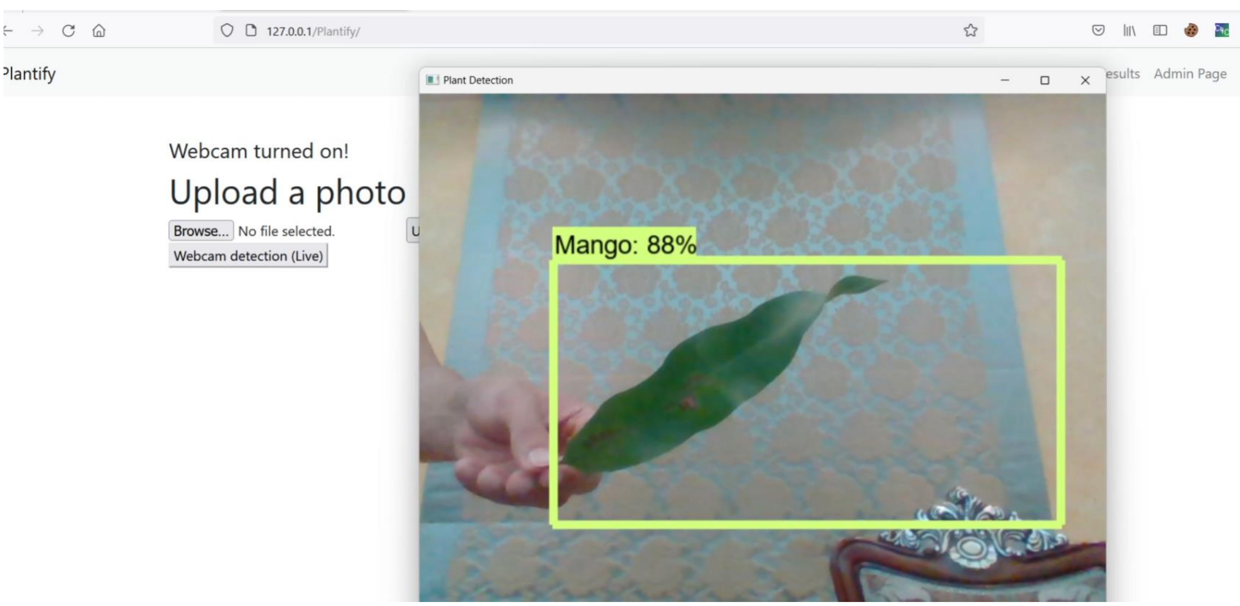


Figure 16 5.9 Dedication Process 2

Description:

Figure 5.7 and 5.8 shows dedication process using live stream camera and showing the accuracy for each one of them.

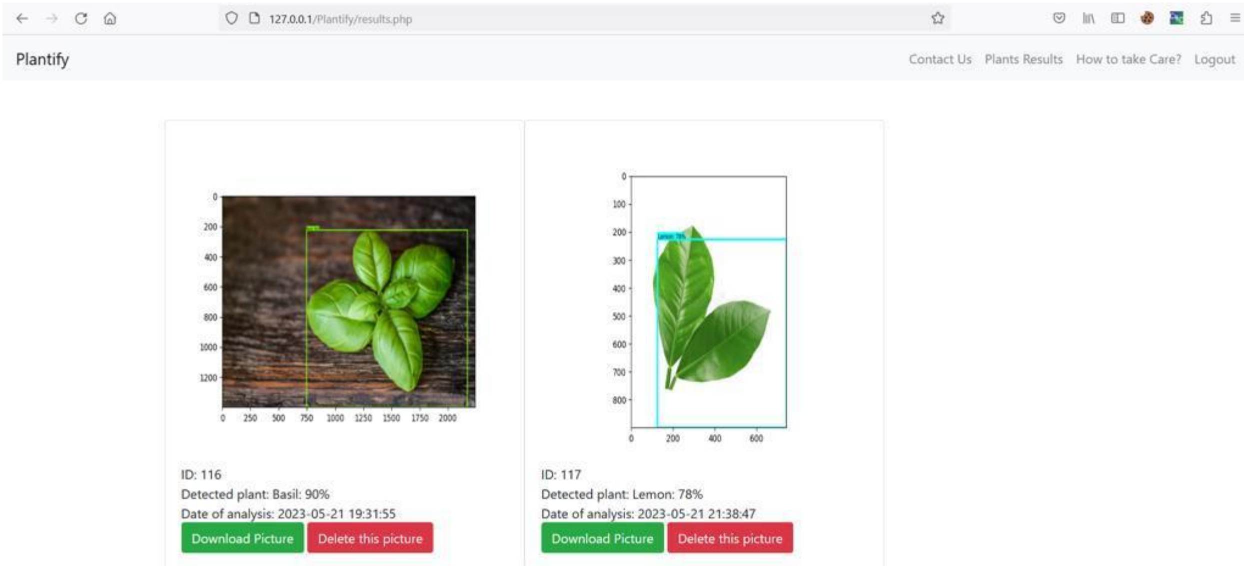


Figure 17 5.10 Dedication Result

Description:

This page for displaying results after TensorFlow analyzes the images and you can choose whether you want to download it to your device or delete it.

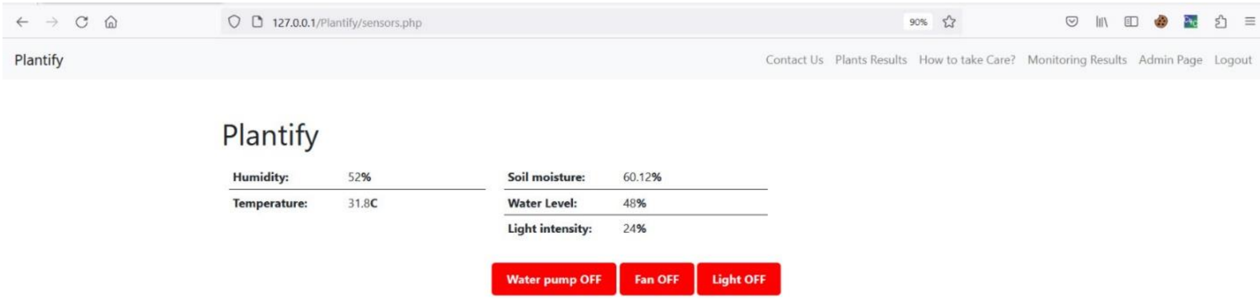


Figure 18 5.11 Controllng and Montiring page

Description:

This page is for controlling the farm, it shows the sensors data and the buttons for turning the water pump, fan and light on and off.

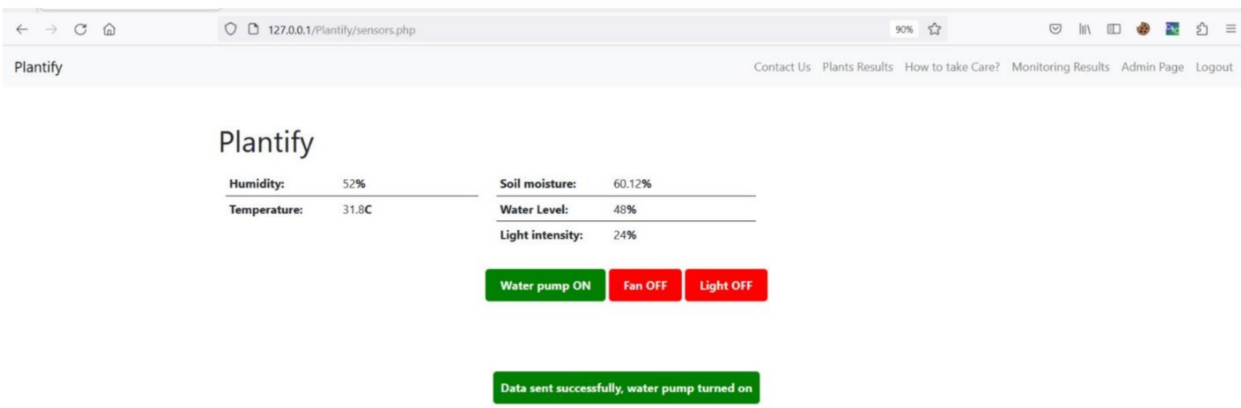


Figure 19 5.12 Controlling and montring page

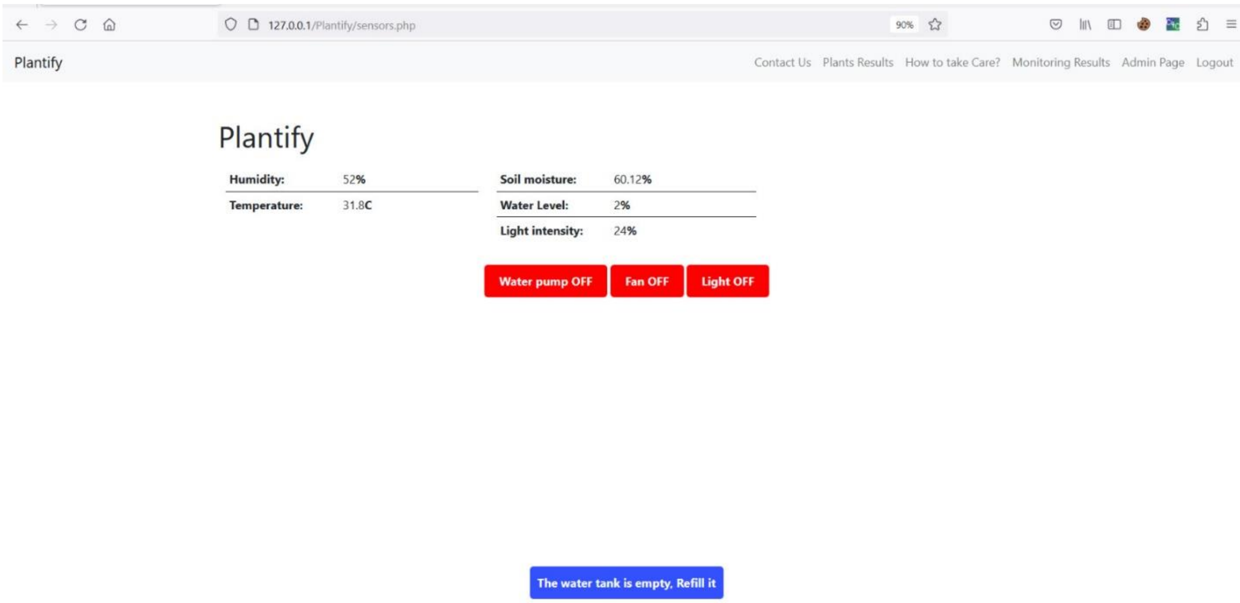


Figure 20 5.13 Controlling and Monitoring page

Description:

In Figure 5.12 the user will get popup message when he turns on or off one of the buttons to notice wither the button turned on successful or not. In figure 5.13 the user will get popup message if the water tank is empty and it won't vanish until you fill the tank.

Chapter 6: Conclusion & Future work

6.1 Conclusion

In conclusion, the Plantify project is a comprehensive system designed to help farmers and gardeners maintain their farms and gardens. The proposed system includes a centralized system that provide a complete solution for maintaining farms and small gardens. The centralized system is capable of identifying plants, learning about their characteristics, benefits, and harms, automatic/manual watering, monitoring humidity, temperature, and moisture, controlling ventilation and lighting.

The Plantify project has the potential to benefit farmers, gardeners, and anyone interested in agriculture. The system can help farmers and gardeners save time and effort by automating many of the tasks involved in maintaining a farm or garden. The project is a step towards a more sustainable future and a better understanding of the natural environment.

6.2 Limitation

- Building accurate and robust model requires a significant amount of training data. Collecting diverse and representative images of plants, along with their corresponding labels, can be a time-consuming.
- Dependence on technology: The Plantify system is dependent on technology, which may be subject to malfunctions or failures. If the system fails, users may not be able to water their plants or monitor their growth effectively.

6.3 Future Work

Some of the improvements that can be applied to enhance the system as the following:

- Mobile Application Development: Enhance system usability with a user-friendly mobile app for plant monitoring, watering control, and remote access.
- Expand the database of plants: The system could be expanded to include more information about different plants and their uses. This could include adding more plants to the database, as well as more detailed information about each plant.
- Add more sensors: The system could be expanded to include more sensors for monitoring soil quality and plant growth. This could include sensors for measuring pH levels, nutrient levels, and other factors that affect plant growth.
- Improve the machine learning algorithms: The system uses machine learning algorithms for object detection by TensorFlow software. Future work could focus on improving these algorithms to make them more accurate and efficient.

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Appendix A: Project Questionnaire

This section shows the conducted questionnaire where the observation of potential use of the system such as farmers and any person who has interest in farming and express their opinion on the current situation and the idea of the project.

The following are all the questions from the questionnaire:

هل لديك اهتمام بالزراعة؟ *

نعم

لا

هل تفضل استخدام تطبيق يسهل عليك التعرف على النباتات ومراقبة درجة الحرارة, رطوبة الجو ورطوبة التربة ؟ *

	1	2	3	4	5	
غير مهم على الإطلاق	○	○	○	○	○	مهم جدا

ما رأيك بإستخدام نظام يساعدك على التعرف على النباتات الخاصة بك والعناية بها عن طريق كاميرا مركزية؟ *

	1	2	3	4	5	
غير مهم على الإطلاق	○	○	○	○	○	مهم جدا

ما مدى أهمية التعرف على النباتات الخاصة بك والعناية بها عن طريق كاميرا هاتفك المحمول؟ *

	1	2	3	4	5	
غير مهم على الإطلاق	○	○	○	○	○	مهم جدا

Figure 21 A.1 First Figure in Appendix A

هل سبق و واجهتك مشكلة في تحديد كمية المياه المناسبة لنباتاتك؟ *

	1	2	3	4	5	
غير مهم على الإطلاق	○	○	○	○	○	مهم جدا

هل سبق وذبلت نباتات لديك أو أصبحت غير صحية بسبب سوء الرعاية وعدم مراقبة درجة الحرارة, رطوبة الجو ورطوبة التربة؟ *

○ نعم

○ لا

هل تعتقد ان الزراعة فالمملكة غير مناسبة بسبب الظروف البيئية ؟ *

	1	2	3	4	5	
أعارض بشدة	○	○	○	○	○	أتفق بشدة

هل تسقي نباتاتك أكثر من مرة يوميًا؟ *

○ نعم

○ لا

ما مدى أهمية مراقبة درجة الحرارة, رطوبة الجو ورطوبة التربة لنباتاتك؟ *

	1	2	3	4	5	
غير مهم	○	○	○	○	○	مهم جدا

للإقتراحات

نص الإجابة الطويلة

Figure 22 A.2 Second Figure in Appendix A

The following are the responses and ideas about the project questionnaire:

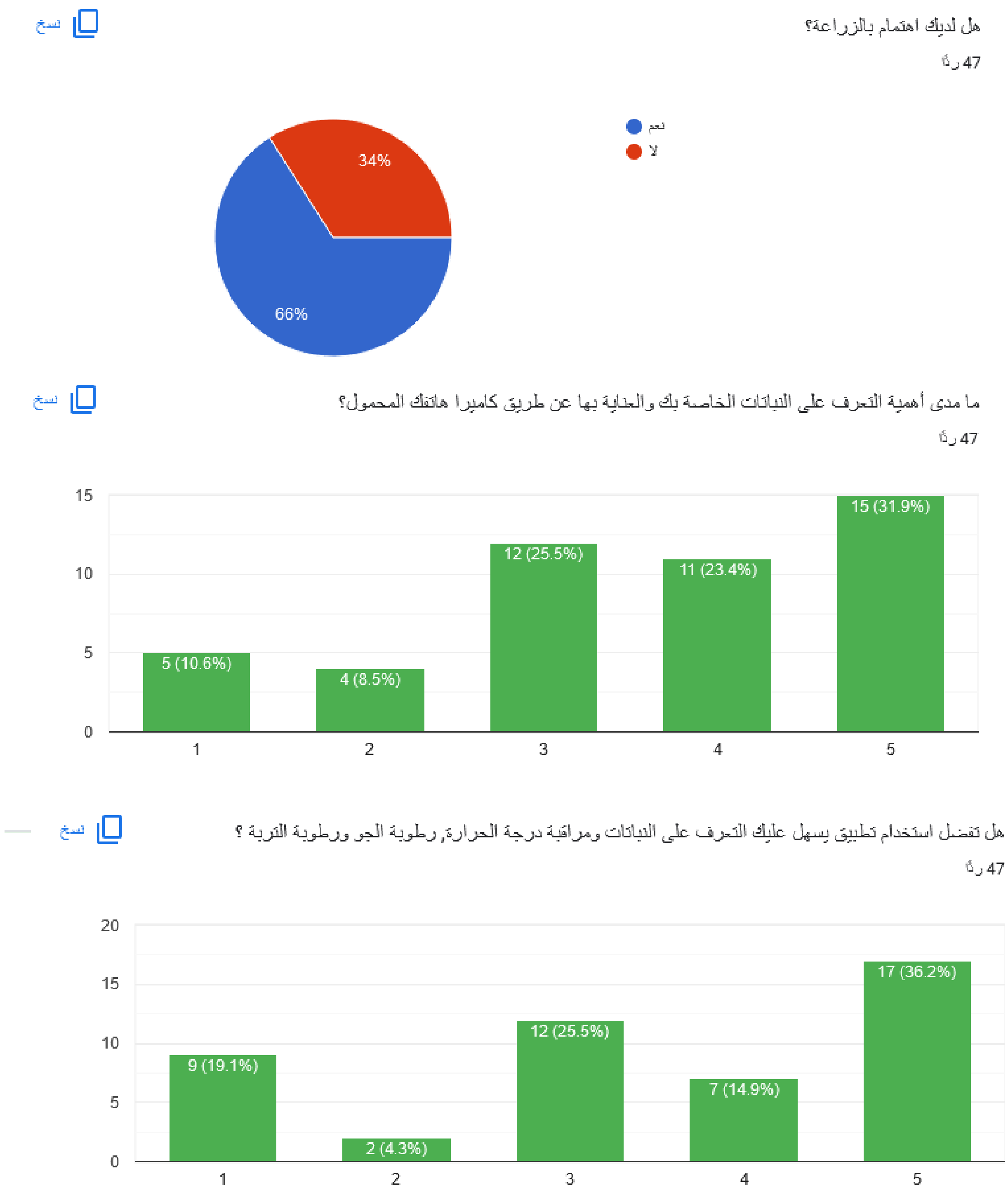
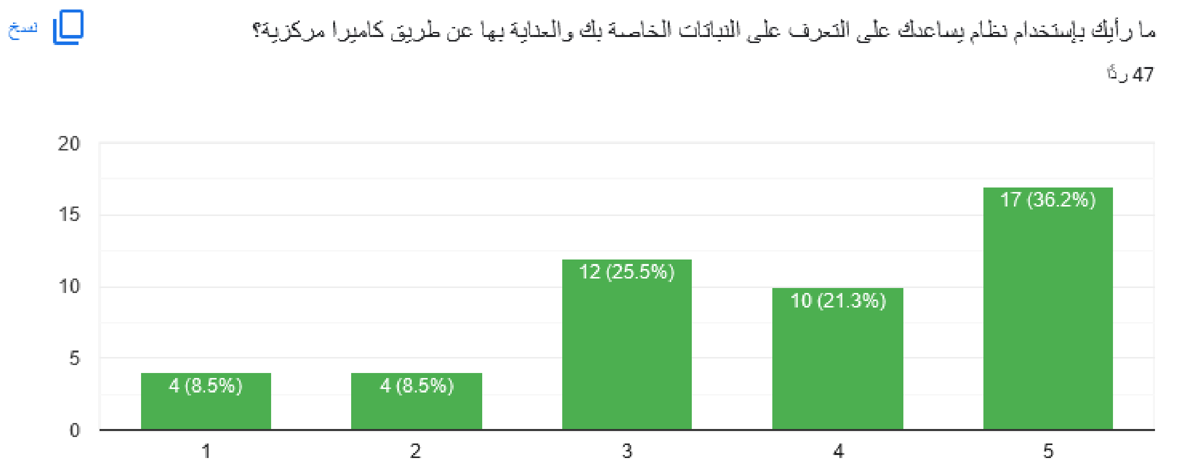
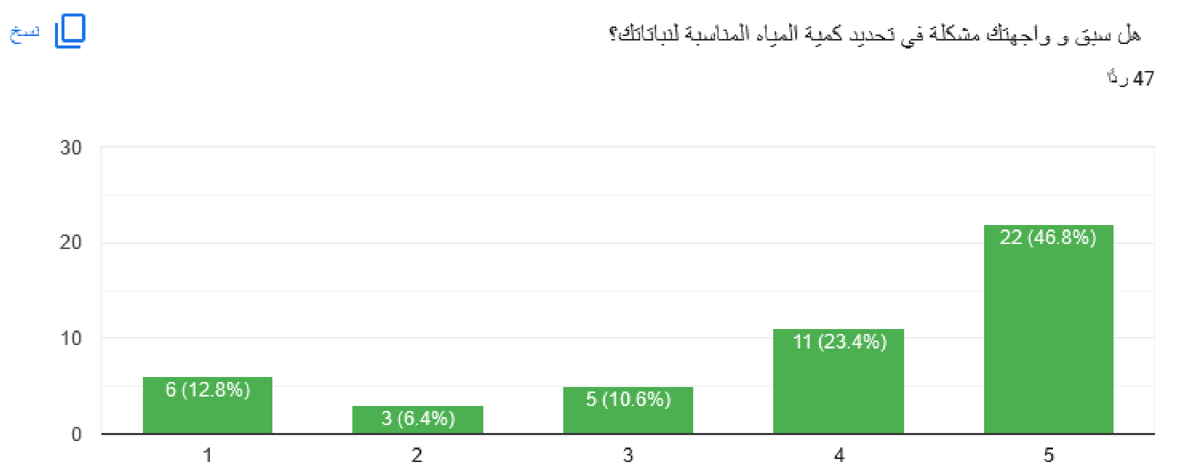


Figure 23 A.3 Thrid Figure in Appendix A





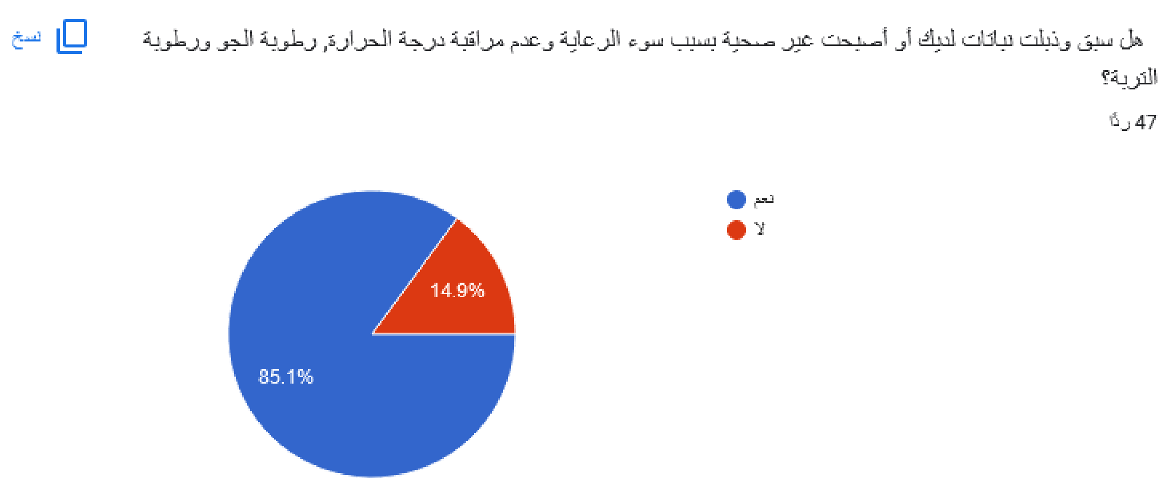
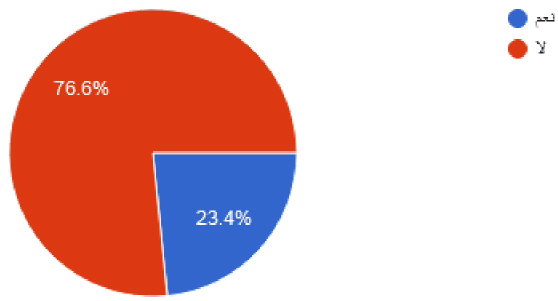


Figure 24 A.4 Fourth Figure in Appendix A

نسخ

هل تسقي نباتاتك أكثر من مرة يوميًا؟

47 ردًا



نسخ

هل تعتقد ان الزراعة فالمملكة غير مناسبة بسبب الظروف البيئية ؟

47 ردًا

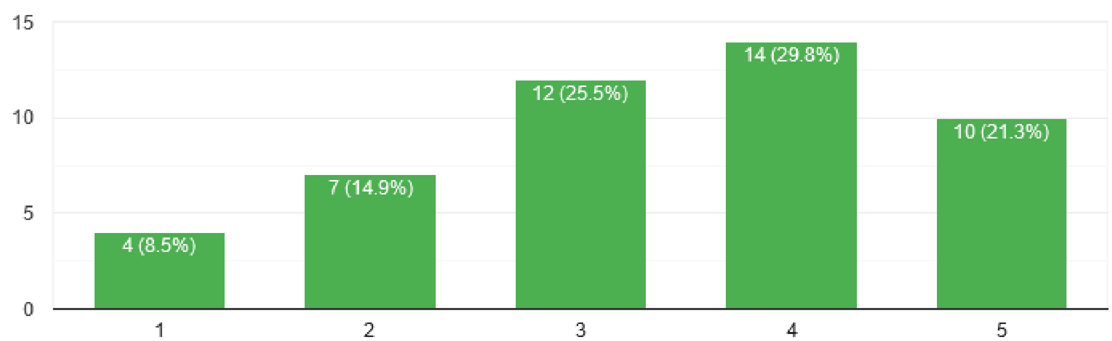
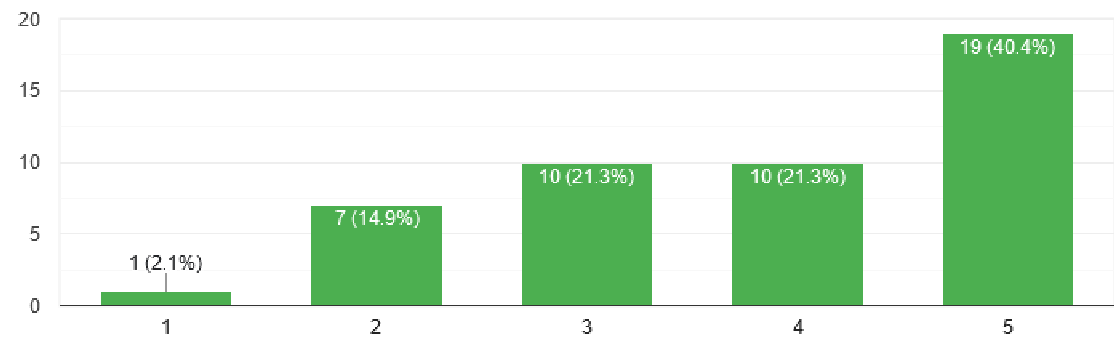


Figure 25 A.5 Fifith Figure in Appendix A

نسخ

ما مدى أهمية مراقبة درجة الحرارة, رطوبة الجو ورطوبة التربة لنباتاتك؟

47 ردًا



للإقتراحات

4 ردود

اريد ان ازرع شجرة برشومي كم مرة اسقيها

نشر التوعية في كيفية المحافظة على النباتات في وطني

تواجهني مشكلة عدم معرفة الطريقة المناسبة للتعامل الصحيح مع انواع النباتات المختلفة

نتمنى انه يكون في كتاب يفصل كل نبته وطريقة العناية بها لكي يطلع الناس ويصبح هنالك شغف في الزراعة وشكرا

Figure 26 A.6 Sixth Figure in Appendix A

Analysis of Surveys on the Importance of Plant Monitoring and Care using Machine Learning and Microcontroller Technology

Based on the survey responses, most of the respondents have expressed interest in farming and have faced challenges in providing proper care to their plants, such as determining the right amount of water and monitoring temperature, air humidity, and soil moisture. These findings support the need for the original work of the project, which is to develop a system that can help identify and care for plants and make it easier for people to monitor the environment of their plants.

About 66% of the respondents have shown interest in farming, which indicates that there is a significant portion of the population that might benefit from the system. Over 46% of the respondents have reported having trouble determining the right amount of water for their plants, while 85% of them reported that their plants have wilted or become unhealthy due to poor care and lack of monitoring. This highlights the importance of monitoring the environment of plants and the need for a system that can provide proper guidance.

Most of the respondents (36.2% and 31.9%) have also shown high interest in using an application or system that can help them identify and care for their plants. This is further supported by the fact that over 40% of the respondents have considered monitoring temperature, air humidity, and soil moisture as very important for their plants.

In conclusion, the survey results indicate that there is a significant need for a system that can help people identify and care for their plants, and that most of the population would be interested in using such a system. The results support the original work of the project, which is to develop a centralized system that can identify plant conditions and its type and automatically water the plants based on its condition.

Appendix B: Mobile Application

In terms of future work, one area of focus could be the further development and enhancement of the mobile application within the Plantify project. The mobile application has already proven to be a valuable tool for users, allowing them to identify plants, learn about their characteristics, and monitor various features of the centralized system. However, there is still room for improvement and expansion. For instance, the mobile application could be enhanced to include a larger and more comprehensive database of plants, encompassing a wider range of species. Additionally, the application could incorporate more advanced features such as real-time notifications and alerts for plant care, personalized recommendations for plant maintenance based on user preferences and location, and the ability to connect and share information with other users in a community-driven platform.

By continuously improving and expanding the mobile application, the Plantify project can provide an even more comprehensive and user-friendly experience for farmers, gardeners, and plant enthusiasts, ultimately contributing to the advancement of agriculture and environmental awareness.

Images form the mobile application:

Figure 27 B.1 First Figure in Appendix B

Description:

The first page of the app features a single button labeled "Get Started." Once the user clicks this button, they are taken to the second page, which is the sign-in page. The sign-in page prompts the user to enter their email address and password to access their account. Additionally, there is a clickable message that reads "Do not have an account? Sign up," which redirects the user to the sign-up page.

The third page is the sign-up page, which is similar in design to the sign-in page. The user is prompted to enter their email address and password to create a new account. There is also a clickable message that reads "Already have an account? Sign in," which takes the user back to the sign-in page.

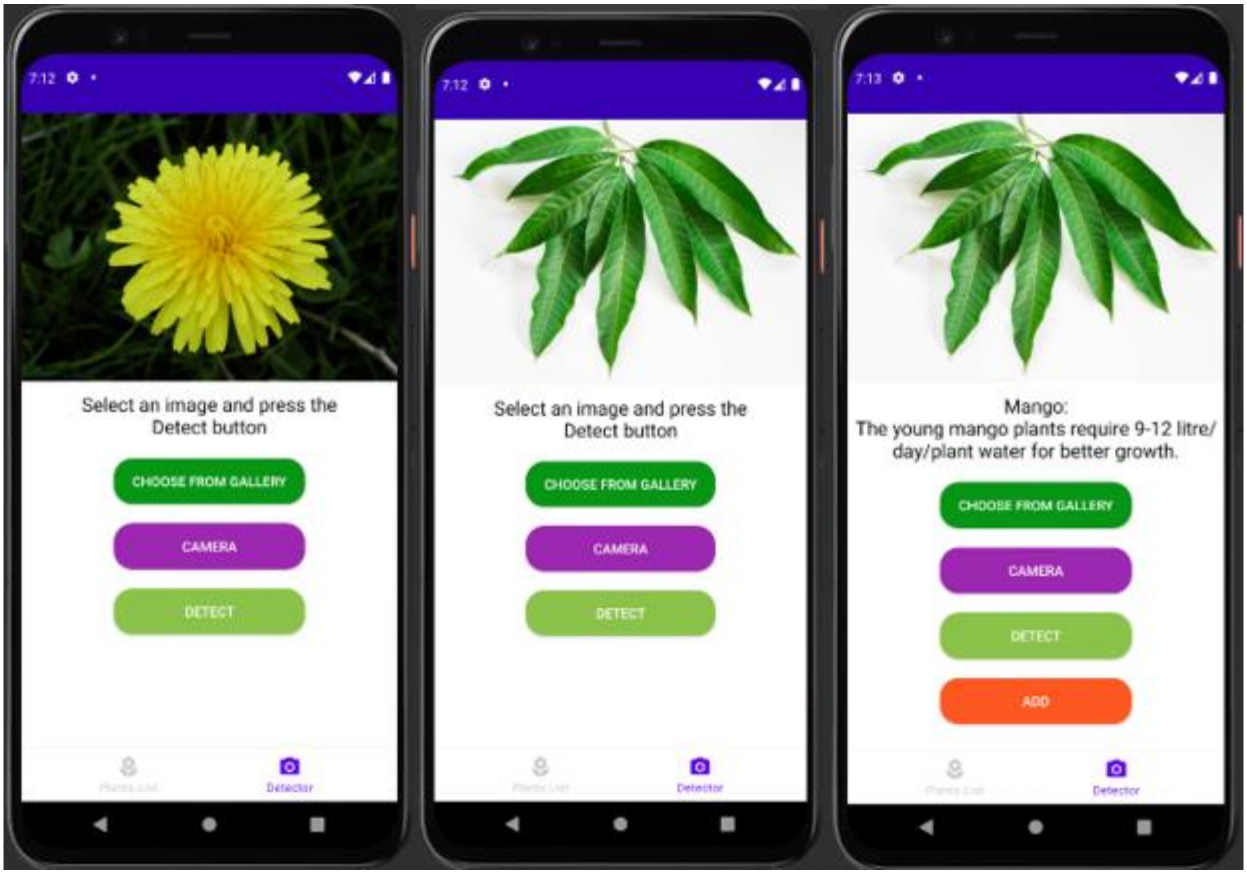


Figure 28 B.2 Second Fiugre in Appendix B

Description:

The “Detector” page has a picture frame at the top and three buttons: "Choose from gallery" lets the user select an image from their device; "Camera" allows the user to capture images of plants; "Detect" identifies the plant from the selected or captured image.

On the second image, when the user selects an image from the gallery, it appears in the picture frame, and the page layout is the same as the first image.

On the third image, after selecting an image on the second image, the user can click the "Detect" button to identify the plant. The detected plant's name and watering growth information are displayed below the picture frame. Additionally, an "Add" button appears next to the other three buttons, allowing the user to save the plant to their "Plant List" page.

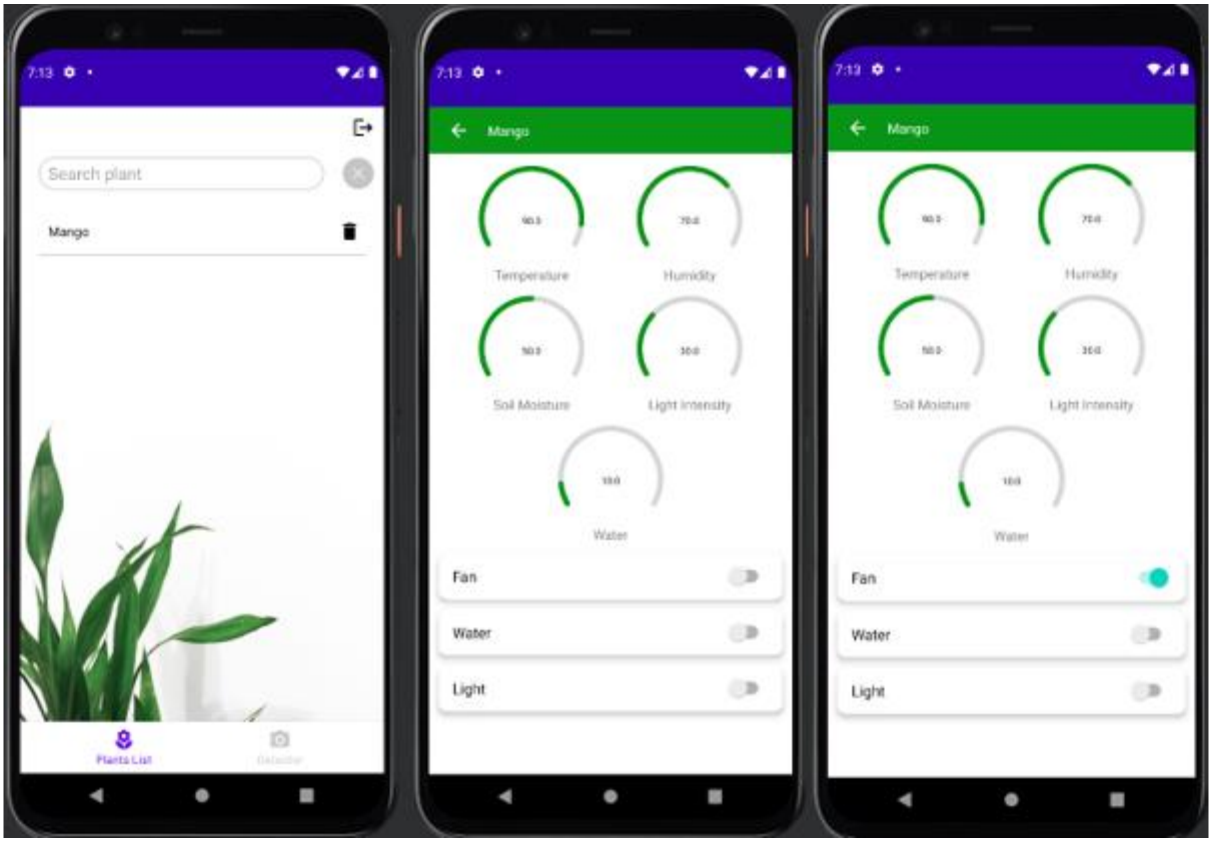


Figure 29 B.3 Third Figure in Appendix B

Description:

The first image displays the initial page of the app, the "Plant List" page, which is accessible upon logging in. On this page, the user can view a list of all the plants they have added through the detection process. Additionally, users can also delete any plants from their list.

The second and third image shows the "Plant Information" page, which displays a range of measurements for the plant, including temperature, humidity, soil moisture, light intensity, and the amount of water. Users can also control the water pump, fan, and light, in addition to monitoring these aspects of the plant's environment.