

Cotton Leaf Detection Application

Group: COMP2003-2023-7

Team Member	Role
David Penfold	Team Leader
Ben Keeping	Innovator
Edward Gaston	Architect
Morgan Hodge	Architect



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1. Introduction – Ben Keeping

As a group we were tasked with the project of implementing AI leaf curl detection code in a user-friendly android application by our client. We were given complete creative freedom and were outlined with a few key requirements.

Within this report we will discuss the solution we have created alongside the strategies we used to do so. Our sprint plans will be discussed in detail describing issues we faced which caused potential delays alongside the sprints we completed in time.

The application we created will also contain meaningful information about the leaf curl disease that will be used to educate users on the disease and what to do if an infected leaf is found. Other functionalities of our app will include maintaining a history of usage, so users can view their previous scans, and incorporating user feedback to continually improve the app's usability and features over time. The application will be Android native, therefore android studio will be the designated IDE.

As shown in the table on page 1, our team has four members within it; David Penfold, Ben Keeping, Edward Gaston and Morgan Hodge. Our client is Asiya Khan who tasked us with this project, alongside our sprint review tutor, Ali Golbaf, who has helped us try to tackle issues that we have had.

Our app caters to farmers in Pakistan who interact with cotton leaves on a recurring basis. Our app will allow them to efficiently distinguish diseased cotton leaves from the healthy ones. If a diseased leaf is detected, then our app provides insight as to what actions should be taken. A report feature is also available that allows the user to send off reports of any bugs they may have encountered.

Resource	URL
GitHub	Plymouth-University/comp2003-2023-7: comp2003-2023-7 created by GitHub Classroom
Trello	2003 Trello

2. Background – Ben Keeping

To allow farming to be both sustainable and productive, efficient crop monitoring must be used. Cotton is an essential crop for the world's economy; however, climate change is posing a risk to the production of cotton by increasing overall temperatures leading to scarcity in water and increasing the number of unwanted creatures taking habit on these cotton plants. The cotton leaf curl virus poses an issue as it reduces crop yield as well as harming the vital fiber quality of the cotton, due to the alterations in composition of key fiber components.

The Cotton Leaf Curl Virus Disease is a severe condition that affects plants in the Malvaceae family, including cotton. Recognizable symptoms include vein swelling, leaf cupping, and a distinct greening of infected leaves ([Cotton Leaf Research](#)). For farmers

to be able to suppress the impact of this disease, immediate removal and destruction of diseased leaves, followed by a thorough inspection of neighboring plants, is crucial. Infected plants should be either burned or buried deeply to prevent further spread. Additionally, the use of insecticides is essential to control whiteflies, which can transmit the disease to healthy plants.

Our client assigned us the task of creating a user-centric mobile application that identifies healthy and diseased cotton leaves. The application's functionality will allow a user to take a picture of a cotton leaf and the program will detect if it is diseased or healthy using the ai code provided by the client. Based on the result meaningful feedback will be returned, along with a confidence score.

Arguments could be taken against the production of the application as it will lead to a decrease in cotton lead curl virus identification jobs, however the development of our application will require constant monitoring offering up a lot more job opportunities to individuals.

Edward Gaston

Before starting development on the application, we did some market research on similar applications to see what we would be competing against. There are a few apps on the market which are similar to our idea, however, they are not the same. [PictureThis](#) is one of these applications, how it differs from our application is that picture this will scan the plants and tell the user what type of plant it is, which is different from ours as we scan the cotton plants to figure out the disease status of the plant.

3. System Requirements – David Penfold

The application has been developed for android users. This is due to the App being mostly utilized in Pakistan. Furthermore, android has the largest market share in Pakistan and is the most accessible phone. [Mobile Vender Market Share Pakistan](#). Additionally, Urdu has been implemented in the android app to allow language changing.

The system requirements on an android phone have been aimed to keep as low as possible. However, if the user wants to carry out all the apps functionality from their own device, they are required to have a working camera and an API minimum level of 24 alongside enough storage. Currently the application will have the AI leaf detection code built into the App, allowing scans to be completed without internet access. This has been estimated to require around 40MB. However, in the future to accommodate devices with

less processing power and storage, the app could store the AI leaf detection code in the cloud. Alternatively, this would require internet connectivity.

4. Budget – Morgan Hodge

When meeting with our client, one of the points we discussed was costs; our client was told there was not a budget for this project, meaning we could not spend any money. Fortunately, the project did not require any funding due to the developers already having access to all the software and hardware needed.

Cost Estimates:

Hardware:

- The Hardware used in this project will be PCs and Laptops, which fortunately all developers already own and have access to

Software:

- Android Studio – This software is free to download, no further cost required
- Trello – This software is free to download, no further cost required
- Figma – This software is free to download, no further cost required
- Git/GitHub – This software is free to download, no further cost required
- Communication: Teams and Discord - - This software is free to download, no further cost required

Testing:

- User Testing – This cost will be mitigated as we have already got several volunteers to conduct this testing without payment.

Developers:

- Due to this being a project for the university, the app developers will not require payment as this is all voluntary work

Human Resources Project Team Members:

Developers:

- David: Team Leader
- Ben: Innovator
- Ed: Architect
- Morgan: Architect

Client:

- Asiya Khan

Sprint Review Tutor:

- Ali Golbaf

Non-Human Resources:

- Software licenses
- Hardware
- Internet Connection

5. Project Management

5.1. Project Planning – Edward Gaston

There were many stages of project planning throughout the development of the application.

Stage one of the project planning included initial meetings with the client so the team could understand the wants and needs of the client for the application. This information was gathered throughout our biweekly meetings with the client and through various communication channels such as Zoom, Email and Microsoft teams. Online meetings with the client were held on zoom and Microsoft Teams, and this information was recorded in the minutes which is available in the minutes folder in the [GitHub repository](#).

We then used the information we got from the client to plan for the project, this included creating Gantt charts and [sprint plans](#) for the project so we could stay on track and get the project completed on time. We also had a [Trello](#) board which we created user stories on which are things we would like our users on the app to be able to do, this helped us plan the project as we knew what we needed to do and when for.

The team used many forms of communication to stay in contact and up to date with the project's development, the main form of communication would be the group discord channel. This is where we shared our plans and initial ideas, for example our wireframe project. This was our very first concept for the application which we then turned into a low-fidelity prototype on Figma and then from that a high-fidelity prototype on android studio.

5.2. Communication Plan – Ben Keeping

Our project communication plan consisted of biweekly client meetings, which allowed us to regularly update the application to tend to suggestions on improvements the client could see. This was extremely helpful for us as further ideas were made on how to create a better application that suits the clients' needs. These meetings followed a structured agenda, first covering the changes and improvements we had made since the previous meeting, after this we discussed the upcoming tasks that we were going to focus on before the next meeting. Finally, we would address any challenges we were encountering/will encounter in upcoming sprints.

Throughout the meetings, Ed also documented the minutes and shared them at the end to allow for transparency with the client. The documentation of the minutes provided a clear record of the project's evolution over time.

We also had biweekly meetings with the sprint review supervisor (Ali Golbaf) which allowed us to discuss the point at which we were at. We were also able to ask questions to further enhance our understanding of certain parts of the project such as providing a deeper insight as to how the AI code works.

Additionally, our group chose to maintain open communication with the client through frequent email exchanges, addressing detailed queries and clarifications.

Within the group, we used a discord server so that communication could be quick and informal, meaning we could update each other easily and have discussions where we clarify any issues that may have arisen.

This multi-channel approach, including scheduled meetings, documented minutes, email exchanges and real time chat, ensures that our communication plan is adaptive and tailored to the diverse needs of our project.

5.3. Methodologies Used – Ben Keeping

We will be using the Agile Development Methodology approach when creating this application as it is the best methodology to use when designing and creating such an application. It allows user feedback from the client in the application's development stages and feedback on any prototypes we may create. It also means the client can give feedback on the final product, this feedback allows us to be flexible with the client's needs and modify features where necessary. As this is part of the agile methodology it should not significantly impact on the project's timeline.

We also have constant meetings as a group through our discord server and biweekly meetings with our client to discuss any changes or additional information we may require. This communication allowed us to work as a high-level team whilst all having the same final goal. We continually integrated code into the main development branch and performed necessary tests to ensure our code works accordingly and would not cause any errors or crashes.

When developing our project we started with hand drawn prototypes, from this we then created a Figma design, to create our Figma we started off with designing a replica of all our hand drawn design pages. From this we created a color palette that we would use, over time this color palette changed as our original Figma design was altered drastically. Over time we started to change what our Figma looked like so that it would be more user friendly and would not use colors that were as harsh on the eye. The colors transitioned from bright and dark colors to pastille colors that would complement each other.

Throughout this design phase, we had total control as our client let us design the app how we felt appropriate. From this we then created our new android studio project which would be the basis for the rest of our app, we started off by adding the necessary xml pages and coded buttons to link between pages. Once we got the buttons linking, we designed the pages based on our Figma designs so that all features would be incorporated.

Once we had created all these pages in our android studio, we presented the product to the client in one of our meetings, this allowed us to adapt to the new color suggestions they had as well as adding additional changes and modifying current designs to better suit their needs.

5.4. Sprint Planning and Execution – Ben Keeping

The sprint plan we created has been developed to allow for good time-management and the ability to track the timings of certain events. This meant we could keep a record as to what must be done by certain dates that we had previously arranged in one of our group meetings. Our sprint plan first started with ensuring we had a safe, secure communication channel where all team members could communicate with one another. This included the creation of a Microsoft Teams channel, discord server and the ability to host zoom meetings. We then worked together as a team to take notes on the brief and shared these with one another. After this we decided to create user stories using Trello, this allowed us to have freedom when identifying features so that we could view what features should be like from a user perspective. We then aimed to identify how the AI leaf detection code

functioned, which would help us later in the project when it came to training and testing it. We then aimed at identifying the project framework which we established as being android due to the excessive number of android users in the country the app will be published. We then aimed at developing a low fidelity prototype so that we would be able to show our client a prototype which she could give feedback on. We then acted upon this feedback and provided our client with an updated version of the low fidelity prototype. This would allow us to create a high-fidelity prototype that is suited to the feedback the client gave. After this we focused on implementing logic behind each page, this included multiple sprints which included the logic behind the Login API, profile page logic, settings, camera and photo library.

Sprint Plan for Leaf Application	Date Started	Date to be Completed by	Status
Create Communication Channels	31/10/2023	01/11/2023	Pass
Review Brief and take notes	31/10/2023	09/11/2023	Pass
Create Trello User Stories	06/11/2023	20/11/2023	Pass
Familiarise ourselves with raw leaf detection code	15/11/2023	22/11/2023	Pass
Establish Project Framework	18/11/2023	02/12/2023	Pass
Create Figma Prototype Low-Fidelity	02/12/2023	15/12/2023	Pass
Create Android Studio Prototype High-Fidelity	15/12/2023	09/01/2024	Pass
Login Page API working	09/01/2024	16/01/2024	Pass
Discuss with Asiya Prototype changes	16/01/2024	23/01/2024	Pass
Improve the design of android studio	23/01/2024	30/01/2024	Pass
Add Java code to make settings work	30/01/2024	07/02/2023	Pass
Add java code to make the profile page work	30/01/2024	08/02/2023	Pass
Add camera functions	28/02/2023	03/03/2023	Pass
Add photo library storage functionality	03/03/2023	05/03/2023	Pass
Implement AI Code	05/03/2024	07/03/2024	Fail
Store the AI result	07/03/2024	10/03/2024	Fail
Display the AI result	10/03/2024	13/03/2024	Fail
User Testing	14/03/2024	14/04/2024	Pass

The beginning of our problems began at the sprint assigned to 05/03/2024 where we had to begin implementing the python code. For a couple of weeks, we had to get the code fixed as the code provided did not work with the photo files provided by the client. This took approximately 3 weeks to fix due to other deadlines being due within these time periods. The issue was within the folder organization, alongside this some of the code did not work as intended within the Clients AI (Artificial Intelligence) code. This meant we had to make certain changes to the client's code so that it would work. When it came to exporting the file to get it to work in android studio, we attempted to convert the file from a hdf5 to a TensorFlow lite file. This caused more problems because the model code itself was not compatible with TensorFlow lite.

At the end of our project our plan was to conduct a thorough final test plan so that every feature could be tested to make sure the project didn't contain any bugs before publishing the application.

5.5. Risk Assessment and Mitigation – Edward Gaston

Over the course of the project, we have encountered several risks that impacted on the project and the team's ability to work through the sprints we created.

The first possible risk is productivity. Demotivation in development can result in the team slowing down progress, as if one member gets demotivated and this hinders productivity it can result in other team members' work being slowed down while they wait for the work to be completed. There are other risks that lead to lower productivity, such as underestimating the difficulty of a task. We have done this during the implementation of the AI (Artificial Intelligence) model code in our application. We underestimated and took a lot longer than we expected, which led to lower productivity.

Other risks we faced would be internet connections during online client meetings. The team maintained an exceedingly high attendance rate, never missing a meeting with the client however there were some meetings where the internet was not stable enough for all members of the team to attend, this could result in some members not being up to date on the clients wishes for the project and could result in lower productivity.

To mitigate this risk of team members being unable to attend the meetings, we planned our meetings with our client bi-weekly, which gave them time to be in a location with reliable internet for the meetings. We also have stand ups within the development team on discord, one of our communication channels. This was so every team member would be up to date on the project including being aware of the tasks needing to be completed.

Another risk we faced was the storage of our user data. We had to make sure all data we store is stored securely so it isn't breaking any GDPR guidelines, to mitigate this we made sure that all user data is stored safely on googles firebase cloud service.

5.6. Project Schedule - Edward Gaston

From the start of the project, we have tried to stick to the schedule we created for the project. This meant all parts of the application would be functional and tested before the end of the project.

When we started, we created sprint plans, it served as a project schedule for the team as it provided dates of when we wanted certain parts of the application to be completed. This allowed us to track the dates of completion for each part of the project allowing us to put together a timeline.

Additionally, we utilized a team Trello board, this allowed the team to map out parts of the project which needed to be completed for a certain date, it also allowed us to effectively schedule the project, and dates of completion for aspects of the application.

We had biweekly meetings with our client and our supervisor, these meetings served as a schedule for the team as we would like to present the two weeks' worth of progress we have made on the project, this helped the team members stay productive and active while working on the project, and gave them a deadline to present new work which served as a schedule.

Another factor which contributed to the project schedule would be the deadlines created via the 30% submission deadline. This provided the team with a date by which we must have made considerable progress by. The first deadline was to create a low fidelity prototype and present it to the client, which we did, coupled with biweekly meetings, this deadline and our clients wishes for the application allowed us to schedule the project for the deadlines and our meetings.

5.7. Development Approach – Edward Gaston

The development approach of this project initially focused on integrating an AI model into an application the team has made, along with facing any problems in hand. Decisions were made within the team to address which problems should be dealt with first and the expected solution for the problems we are facing.

The project started with the development team making sprint plans and user stories to better understand the task and to guide them to completing the project. This allowed the team to break down the project into smaller sized pieces of work which are more manageable.

The team first created a low fidelity prototype on Figma with the purpose of designing the look of the application and testing basic functionality such as navigation of the application. The team created sprint plans for this section by breaking the prototype down into smaller goals to achieve, such as completing the home page design and keeping it consistent throughout the application.

We then moved forward with the design of the application after showing it to the client and receiving feedback, we decided to create a high-fidelity prototype on android studio. This would be a big task so yet again we used a similar development approach to what we used before. We broke down big tasks into smaller more manageable ones until we had a functional prototype. At this stage the application had not been refined, the look was not final. Meaning some functionality was only temporary as we needed the clients feedback

first, such as the login system. In the prototype it utilized shared preferences (local storage) to store users, this was for testing other aspects of the application.

After receiving feedback from the client about our prototype, we moved to the refining stage of the application, this is when the team started to fix bugs and implement the proper functionality of features on the application such as a correct and secure login system utilizing google firebase instead of local storage. We also underwent testing for the application in the hope to find and fix all potential problems in the application. When we were developing the camera for the application and our implementation of the AI model code we had a lot of bugs. Our development approach helped us fix these bugs as we broke them down, so they are more manageable and asked our supervisor for help when the team hit a brick wall in development. This approach helped us clear the application from bugs which will negatively affect the user experience.

To maintain version control, the team utilized GitHub as a code repository for all aspects of the project from minutes to the code, as it is easily integrated into the project.

5.8. Requirements – David Penfold

The system requirements were outlined to us within our first meeting with the client. These requirements were predefined and therefore met without our alterations. The original task was - 'Develop a user-centric mobile app with an intuitive interface for iOS/Android/both platforms.

Our client gave us complete creative freedom with the design. This helped us as we worked through multiple designs and then had the ability to agree on a design which we all agreed on. The requirements mentioned from the client was the following:

- Meaningful feedback to users 'diseased' or 'healthy'.
- Some information about the leaf curl disease to educate users.
- Give a confidence score.
- Maintain a history of usage.
- Incorporate user feedback to continually improve the app's usability and features.

These requirements helped us get started with further refinement. Alongside the use of user stories, UML diagrams and ERD diagrams we highlighted additional key requirements:

- User-friendly and quick navigation. The navigation bar was used to meet this goal.

- Account creation page, with enforced strong password security such as the use of capitals, numbers, and special characters.
- Account authentication- login.

The use of the product backlog which consists of the sprint planning, information from sprints, tasks to complete and tasks completed. This helped us identify further requirements and keep track of what has been completed.

6. Detailed System Design

The detailed design segment of this report highlights all the necessary steps that need to be taken to achieve user-friendly and efficient design. This includes the user stories, ERD diagrams, prototype screenshots, wireframes used to develop an initial design, HIPO charts, State Diagrams, DFD's, Sequence Diagrams Flowcharts, UML Diagrams and example of how code has been created to allow important features to work.

6.1. User stories – David Penfold

The user stories helped highlight crucial parts of the design which were needed to meet the desired requirements. Using user stories, we extracted key requirements needed for our application to function correctly.

User Story for Leaf Detection Mobile Android Application

Green Guardian Leaf Detection App:

1. As a user, I want to create a profile.
2. As a user, I want to use my details to login to my account.
3. As a user, I want to use my camera to scan leaf's.
4. As a user, I want to use my camera flash to improve image quality.
5. As a user, I want to import photos in from my camera library.
6. As a user, I want to see the results of the leaf I have scanned.
7. As a user, I want to easily navigate between any page.
8. As a user, I want to see the history of the leaves I've previously scanned.
9. As a user, I want to edit my profile information.
10. As a user, I want to change the language of the application.

Green Guardian Leaf Detection App Administrators:

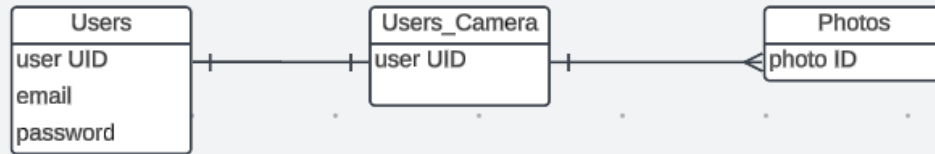
1. As an admin, I want to remove accounts.
2. As an admin, I want to view reports.

6.2. ERD Diagram – Edward Gaston

The following figure shows the Entity Relationship Diagram of the application.

It details how the User database (Firestore) connects to the user's camera and their photos in their device's storage.

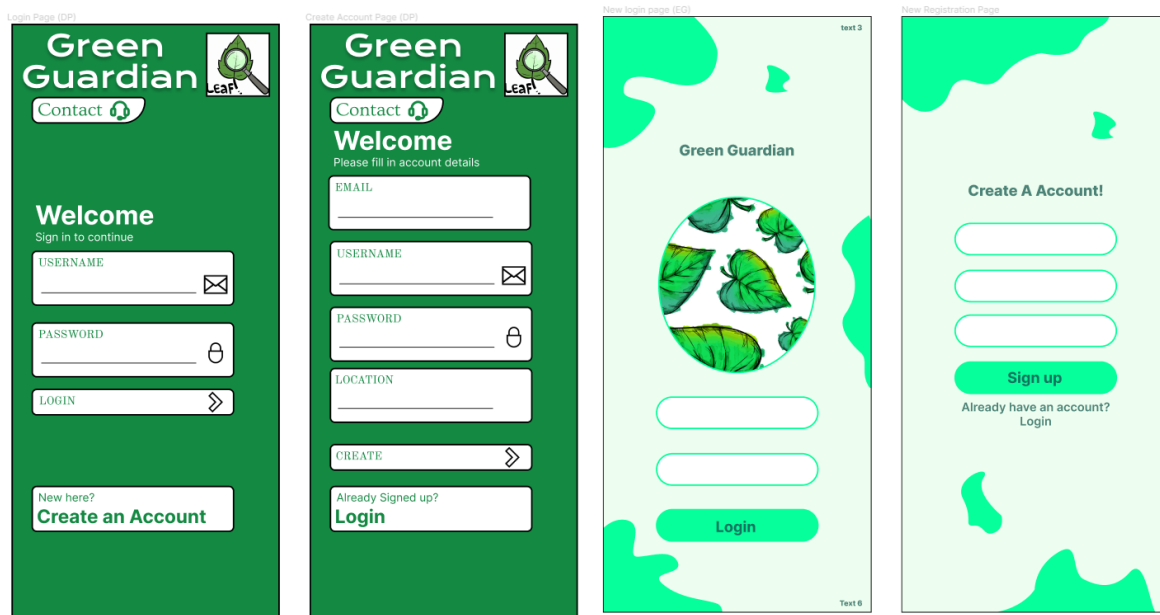
This entity relationship diagram shows how the users have a unique id named "user UID" and that as a one-to-one relationship with the user's camera. From there the user UID can have a one-to-many relationship with the Photo ID, this gives the user access to all the photos stored on the device they are using and their camera feature if they have one.



6.3. Prototype screenshots – David Penfold

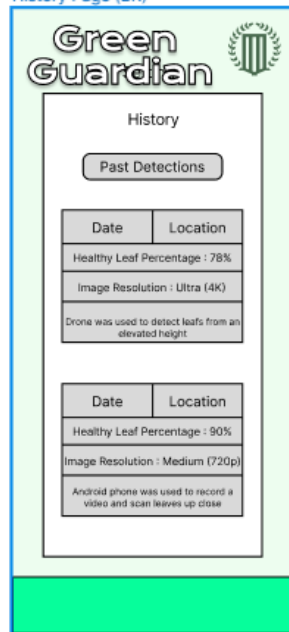
The application's design was first sketched on paper and then transitioned to a low-fidelity prototype carried out with Figma.

Multiple prototype designs were made on Figma, and each page was developed to improve the overall design. Below shows an example of how the login and account creation pages were improved.

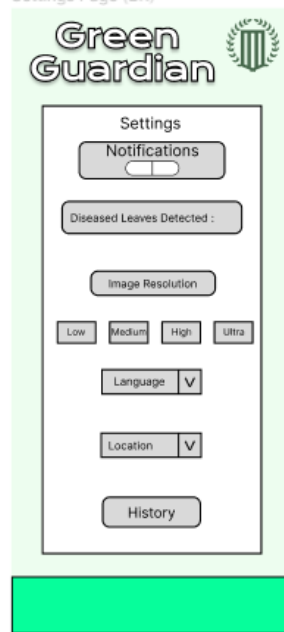


Other prototype pages created:

History Page (BK)



Settings Page (BK)



Home (MH)



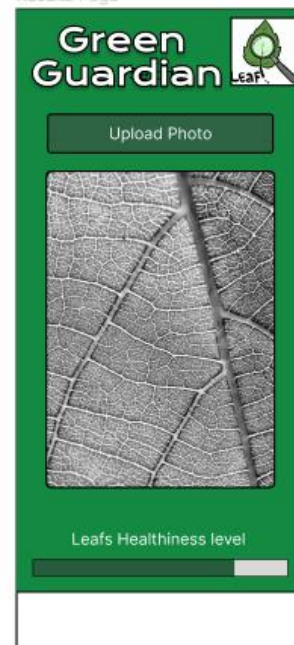
Information Page(MH)



Scanning Page (EG)



Results Page



6.4. Wireframes – Morgan Hodge

The wireframes were created during the first month of development, before the Initial Figma design. These wireframes served as a starting point for the overall design of the

application, they were used as a template for what we wanted the app to end up looking like. When creating the Figma prototype (See above) we used the wireframes heavily for inspiration on what we wanted the final product to eventually look like.

Figure 1.0 - Log-In Page

APP NAME LOGO

USER NAME

PASSWORD

Aa NEW?

CREATE ACCOUNT

Figure 2.0 - Register/create Account

APP NAME LOGO

PLEASE FILL:

Email

USERNAME

PASSWORD

LOCATION

CREATE

ALREADY HAVE

LOG-IN

Figure 3.0 - History Page

PAST DETECTION

SCAN: 1

DATE	LOCATION
HEALTH PERCENT	DESCRIPTION
Image	

SCAN: 2

DATE	LOCATION
HEALTH PERCENT	DESCRIPTION
Image	

Figure 4.0 - Settings

APP NAME LOGO

NOTIFICATION

ON OFF

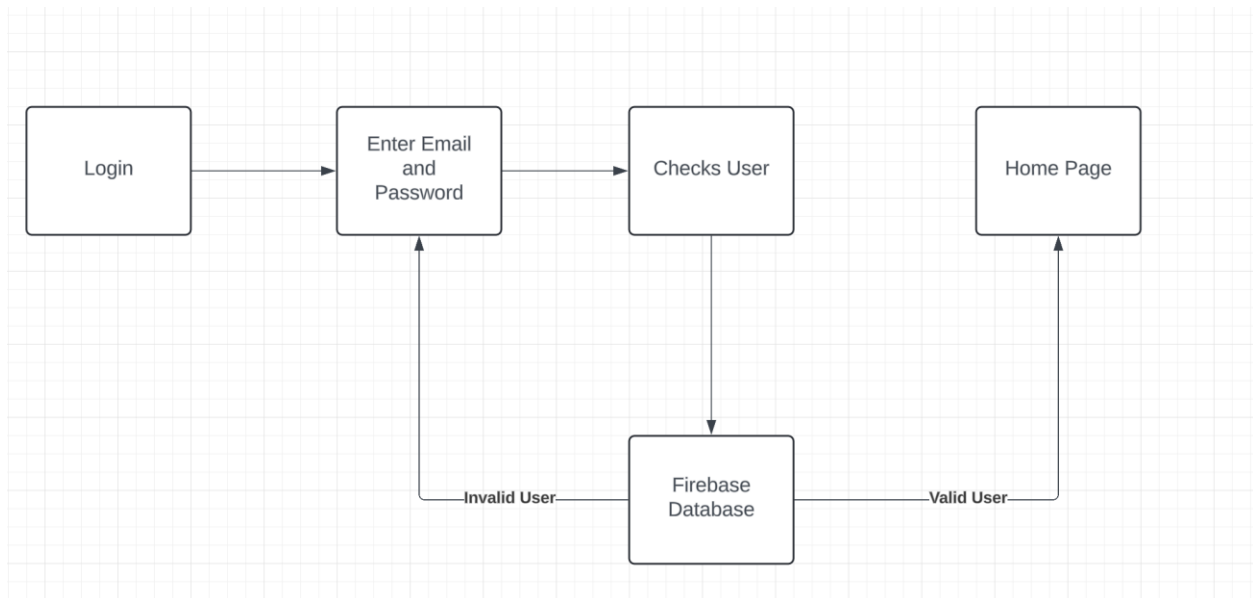
IMAGE QUALITY

Low MED HIGH

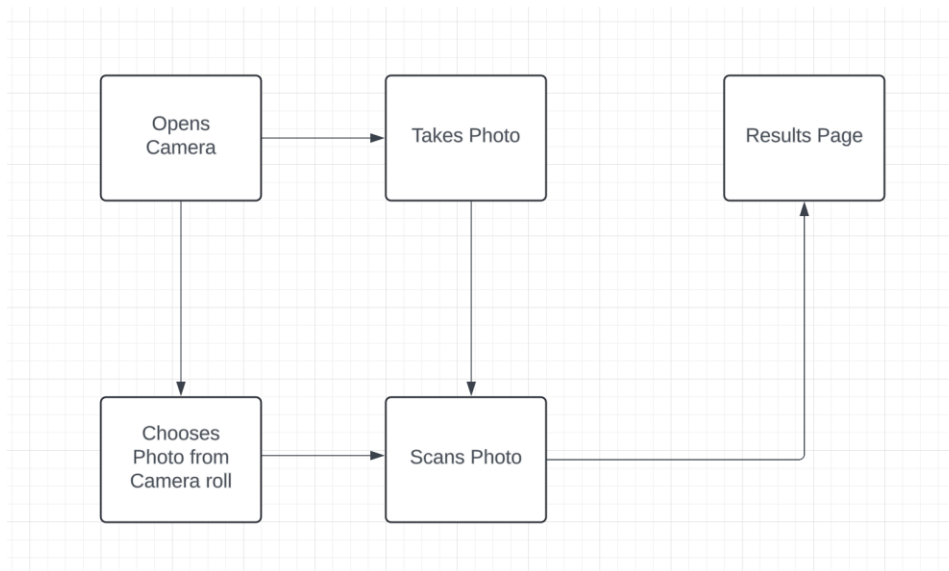
LANGUAGE

HISTORY

6.5. DFDs – Edward Gaston



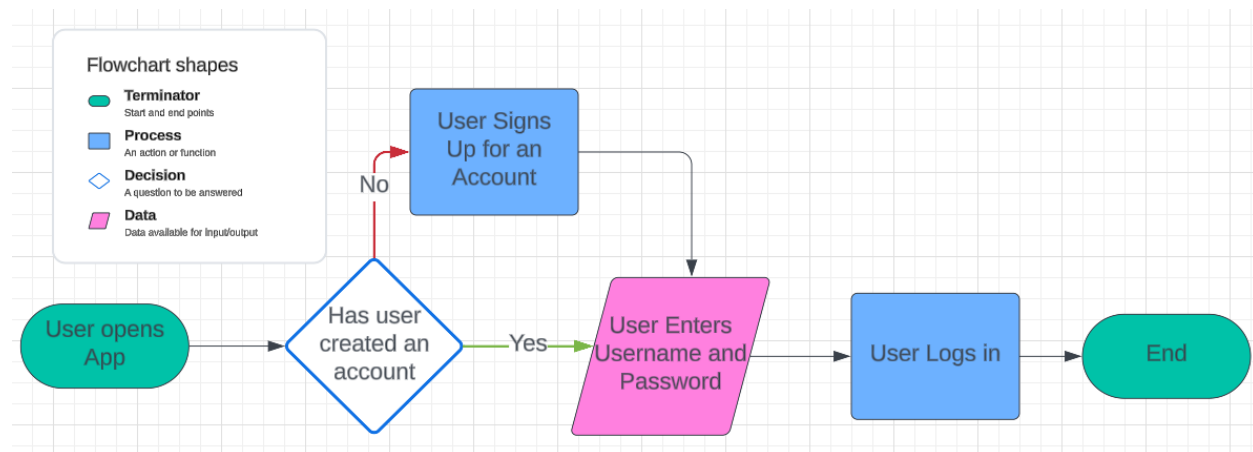
The dataflow diagram above shows how the data will flow when a user logs into the application. The user will first enter their email and password and then a check with the database to see if the credentials are valid or not, if they are not the user will have to reenter the correct user details, if the details are valid the user will be directed to the home page.



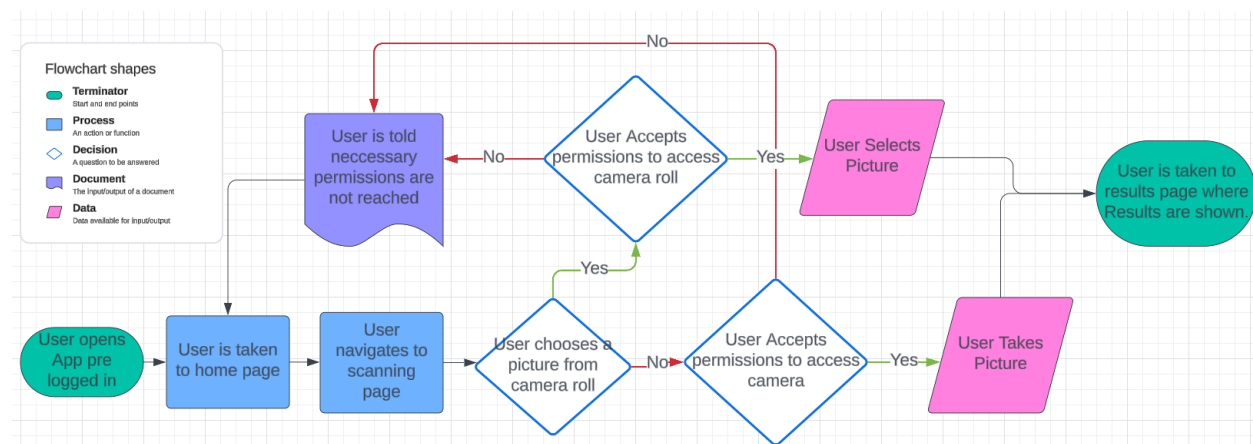
The DFD above shows how the data from the camera would flow, after the user chooses a photo from camera roll or takes the photo, it is scanned and then that data flows to the results page where it tells the user the results from the scan.

6.6. Sequence Diagrams Flowcharts – David Penfold

User Login and Sign-Up Process – This shows the process of how a user can login to the system. If the user has an account already created, then they can bypass the signup process and proceed straight to the app via login.



User Scanning a Leaf and viewing Results - this is where scanning a leaf is documented. The sequence diagram flowchart shows the route which can be taken for either using the camera or choosing a photo from library. Permissions must be accepted for the camera and photo library to work.

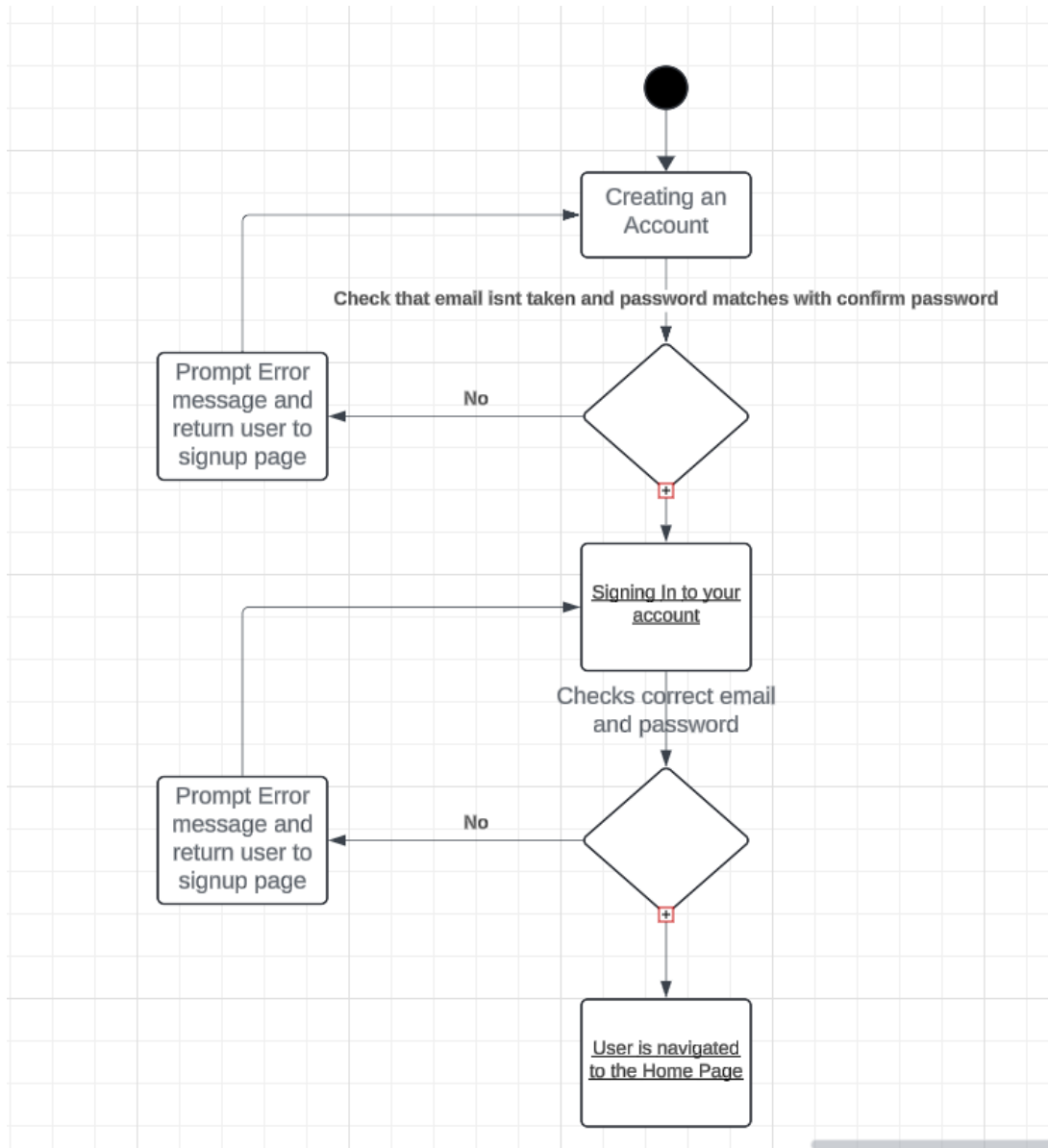


6.9. UML Diagrams – Edward Gaston

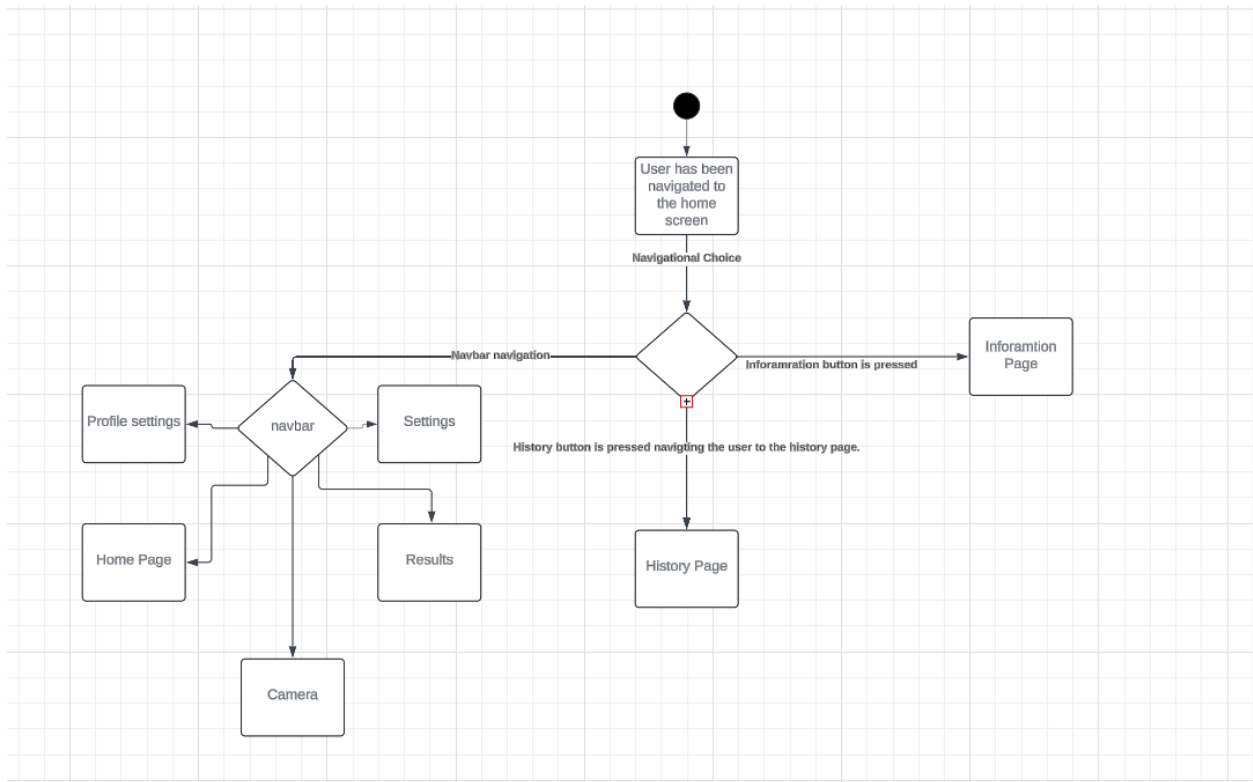
To help us in creating the application we created UML diagrams to tell the story of how the application works. Below shows the UML diagram created for the login and sign-up system on the application.

The user first creates an account and then is navigated to the login page if their email and password passes the sign-up criteria then the user will sign in and a similar email

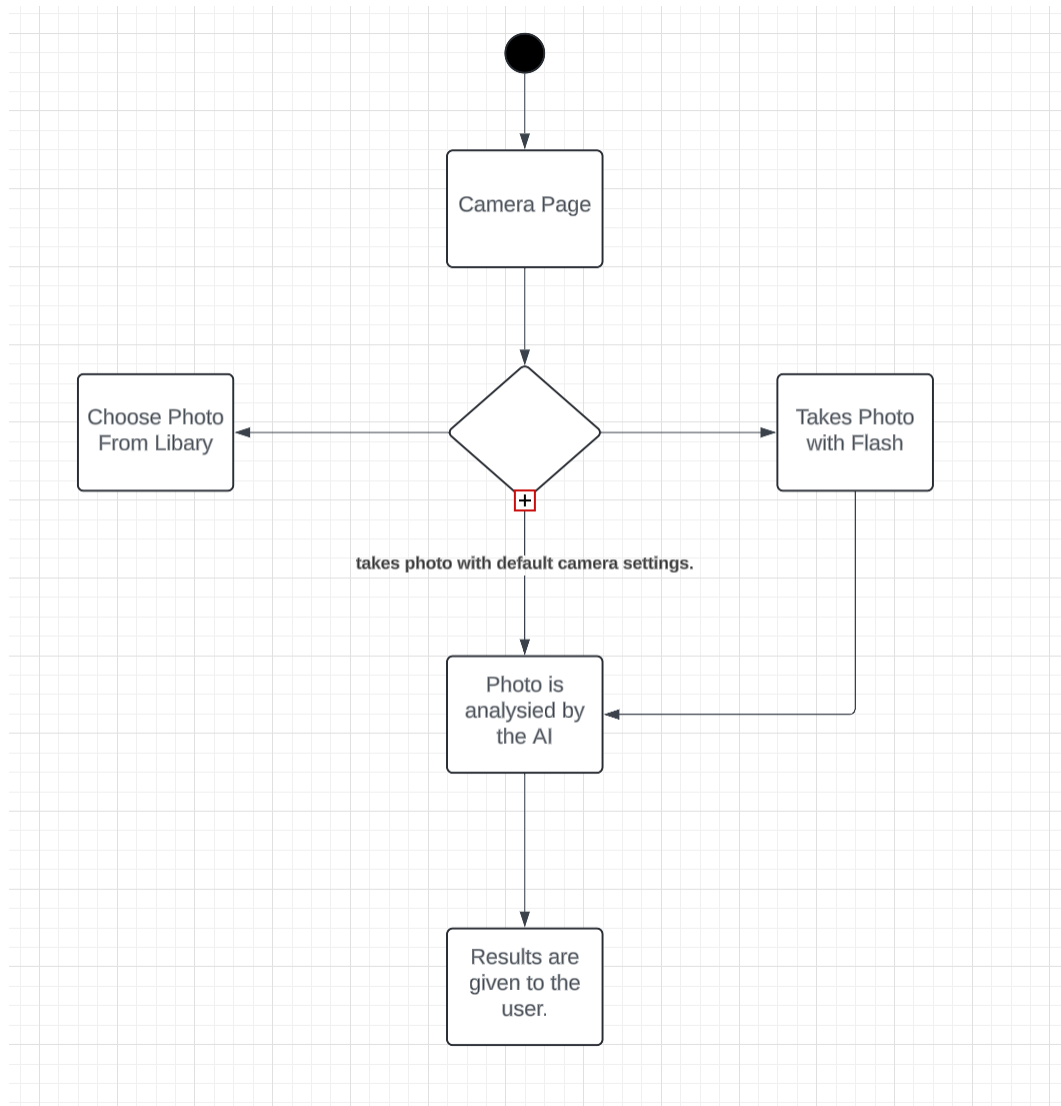
and password check to make sure its correct will then log them in and navigate the user to the home page of the application.



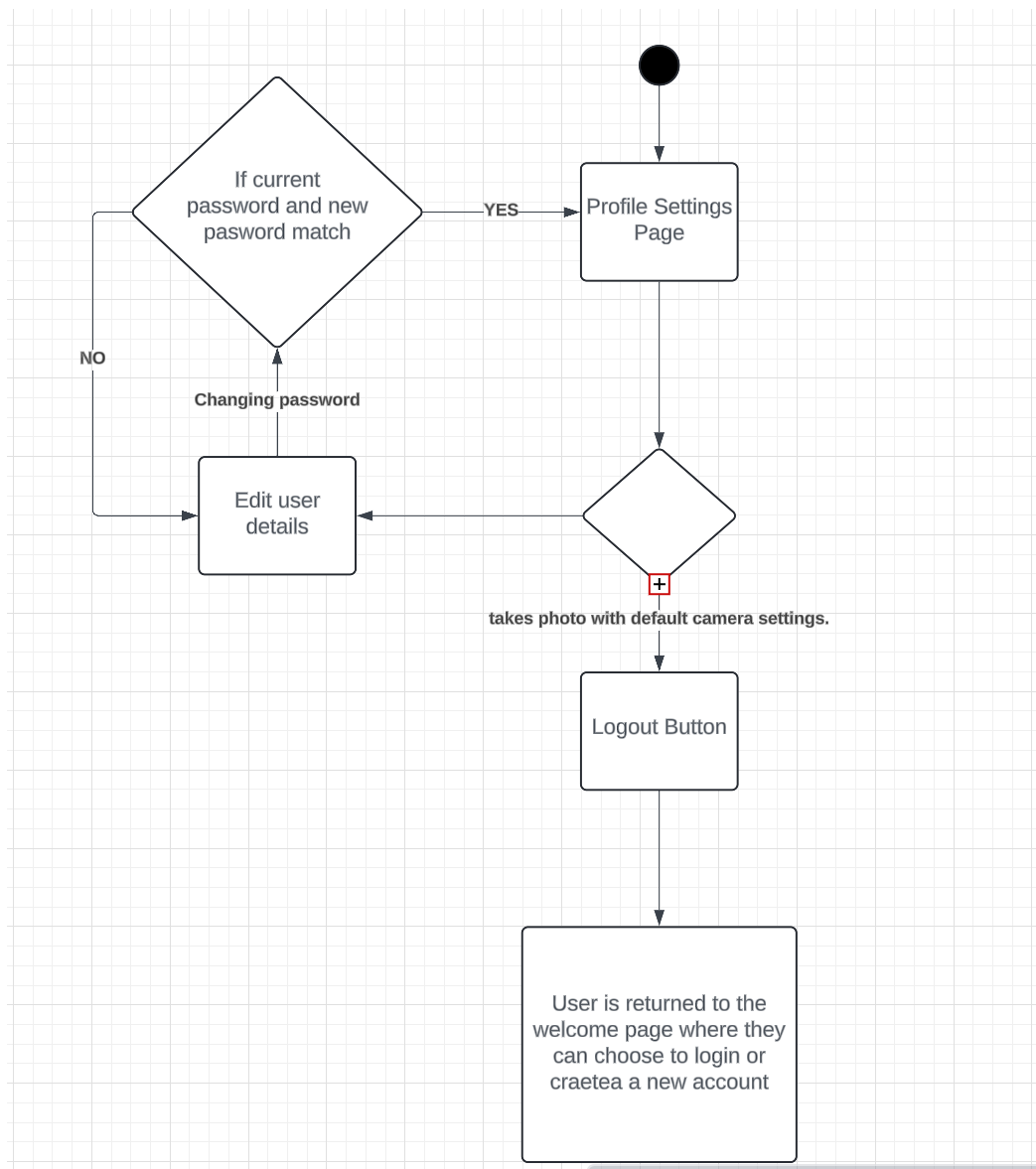
Below shows a UML diagram of how a user would navigate around the home page of the application, it details what buttons from the navbar and on the page might help navigate the user too.



Below shows a UML diagram of how the user would use the camera system in the application. It shows the default route of opening the camera and taking a photo without changing any settings, it also shows the user routes such as changing the front and back camera and flash settings. Instead of taking a photo from the camera it takes one from the device's camera roll.



Below shows a UML diagram of how a user will navigate and use the profile settings page to either logout or edit their user details such as their password for their account. For the user to be able to change their password, their current password and their current email must match otherwise it will not change. If incorrect the user will be given a prompt that the edit was unsuccessful, and the passwords must match.



7. Code Examples

7.1. Load Up Animation – Ben Keeping

A user-friendly application was one of the requirements that our client set to us. For this reason, I decided to create a load up animation that included the logo sliding across onto the page whilst the app was loading. Implementing this meant that we could give the app longer to load up the login page which could be essential for some devices.

The following code sets up an animation including a logo image and a text view. A handler is then created to add a delay to the openLogin logic, this means there is a 4 second delay until the login page is opened. This gives the user enough time to view the animation adding a cleaner flow to the load up of the application.


```

bottomAnimation = AnimationUtils.loadAnimation( context: this,R.anim.bottomsplash_animation);
logoImage = findViewById(R.id.logo);
logoImage.setAnimation(bottomAnimation);
Text = findViewById(R.id.GreenGuardian);
Text.setAnimation(bottomAnimation);

Handler handler = new Handler();
Ben Keeping
handler.postDelayed(new Runnable() {
    Ben Keeping
    @Override
    public void run() {
        openLogin();
    }
}, delayMillis: 4000);
}

```

The openLogin() code is as follows:

```

public void openLogin() {
    Intent intent = new Intent( packageContext: this, MainActivity.class);

    Pair<View, String> pairLogo = Pair.create((View) logoImage, b: "centerImage");

    Pair[] pairs = new Pair[]{pairLogo};

    ActivityOptions options = ActivityOptions.makeSceneTransitionAnimation( activity: this, pairs);
    startActivity(intent, options.toBundle());
}

```

This creates an animation pair so that the logo Image can be mapped onto the logo image on the login page which is a fade away animation.

7.2. Log in System – Edward Gaston

The Login system serves as the first page users enter upon opening the app. This is why the login system for the Green Guardian App must be designed well and work seamlessly.

When I first approached making the Login and sign-up system, I made a temporary login system for testing while I researched a different approach to making the Login system. This is where I stored users created within shared preferences (local storage) which was not ideal as it can only store one user at a time.

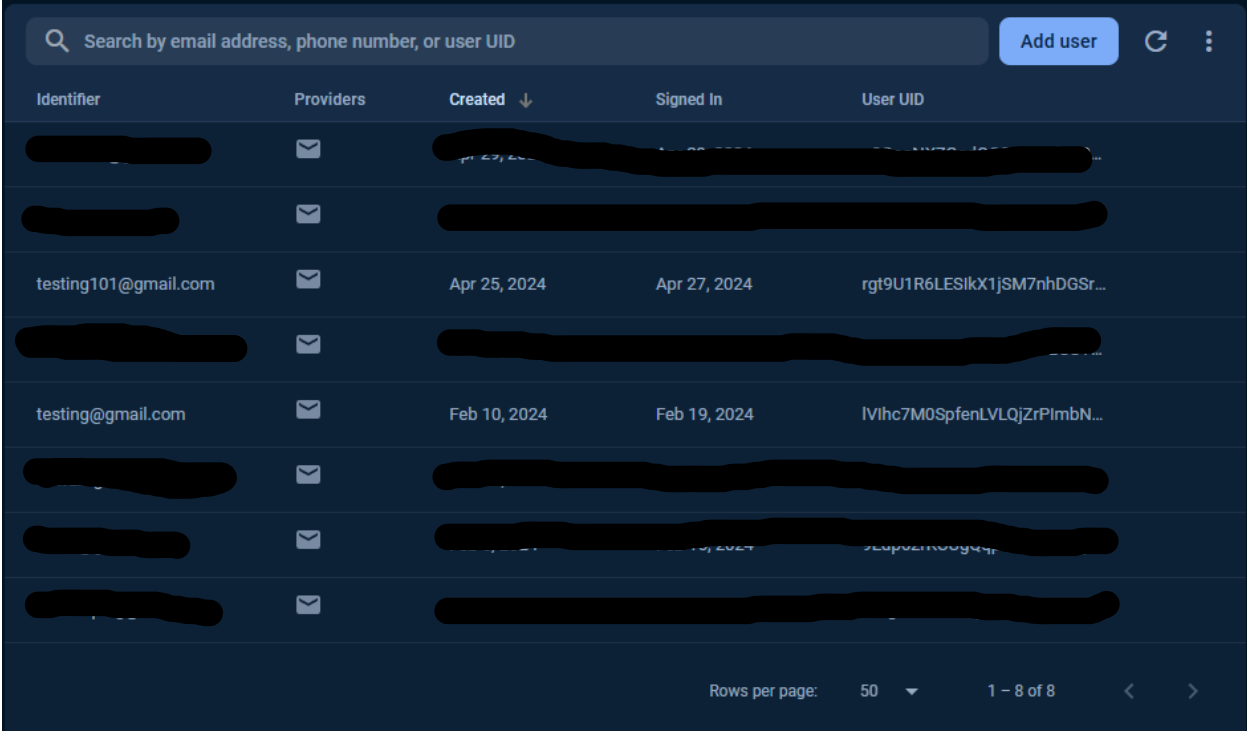
After email communication with our client, I was given the go ahead to utilize Google's firebase cloud service within my login system. After synchronizing the firebase with the application, it allowed for users to be stored in a secure location along with keeping their

confidential information secure such as passwords and emails used in the account creation.

For a user to create an account for the application they would have to meet a couple of requirements. First being that they would have to confirm their password by typing it in twice, and that Passwords creation must meet a specific criterion to accept a valid password. (e.g. including a number and capital in the password).

The Login system also has a profile settings page in the application, so users can go to the page and edit their settings like their password. This page also contains a logout button which will return the user to the login page.

Below shows the Firebase dashboard, this contains all the users who have made an account on the application. It displays their emails, the date they last signed in and the date they created their account. This dashboard is only available to admins with password to access the dashboard, and all personal details such as passwords are hidden from the admins who have access. This dashboard provides admins with a way users can delete users accounts from the application.



Identifier	Providers	Created ↓	Signed In	User UID
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
testing101@gmail.com	[REDACTED]	Apr 25, 2024	Apr 27, 2024	rgt9U1R6LESikX1jSM7nhDGSr...
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
testing@gmail.com	[REDACTED]	Feb 10, 2024	Feb 19, 2024	IVlhc7M0SpfenLVLQjZrPImbN...
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Below shows the code from the welcome page, this is the page the user enters the app onto, it can direct them to the login page or the signup page.

```

Ben Keeping +1
signInButton.setOnClickListener(new View.OnClickListener() {
    Edward-gaston +1
    @Override
    public void onClick(View v) {
        // Navigate to login page
        Intent loginIntent = new Intent( packageContext MainActivity.this, LoginPage.class);
        startActivity(loginIntent);
    }
});

```

```

Edward-gaston
signUpButton.setOnClickListener(new View.OnClickListener() {
    Edward-gaston
    @Override
    public void onClick(View v) {
        // Navigate to registration page
        Intent registrationIntent = new Intent( packageContext MainActivity.this, RegistrationPage.class);
        startActivity(registrationIntent);
    }
});
}

```

Below shows a section of code from the login page, this section of code will sign in the user with firebase authentication. If successful it signs in to the user and navigates them to the home page. If unsuccessful the user will be shown an error message and will try again, or they must create an account if they haven't already.

```

// Sign in user with Firebase Authentication
firebaseAuth.signInWithEmailAndPassword(email, password)
Edward-gaston *
.addOnCompleteListener( activity: this, new OnCompleteListener<AuthResult>() {
    Edward-gaston *
    @Override
    public void onComplete(@NonNull Task<AuthResult> task) {
        if (task.isSuccessful()) {
            // Sign in success, navigate to home page
            startActivity(new Intent( packageContext LoginPage.this, HomePage.class));
            finish();
        } else {
            // Sign in failed, display a message to the user.
            Toast.makeText( context LoginPage.this, text "Authentication failed.", Toast.LENGTH_SHORT).show();
        }
    }
});

```

Below shows the code from the sign-up page, The user will create an account which will then be added to the firebase system. The user will then be able to sign into the application with the account they have just created.

```
// Method to create a user account with email and password using Firebase Authentication
1 usage  ⚡️ edward-gaston
private void createUserWithEmailAndPassword(String email, String password) {
    FirebaseAuth.getInstance().createUserWithEmailAndPassword(email, password)
        .addOnCompleteListener( activity: this, new OnCompleteListener<AuthResult>() {
            ⚡️ edward-gaston
            @Override
            public void onComplete(@NonNull Task<AuthResult> task) {
                if (task.isSuccessful()) {
                    // User account created successfully
                    showToast("Account Created");
                    openMainActivity();
                } else {
                    // If account creation fails, display a message to the user.
                    showToast("Failed to create account: " + task.getException().getMessage());
                }
            }
        });
}
```

7.3. Camera – Permissions David Penfold

An important aspect regarding the camera is how the application must first ask the user to gain access to their camera. The same goes for access to the photo library. This is appropriate to follow the LSEP standards:

```
// Request camera permission
if (ContextCompat.checkSelfPermission(context: CameraPage.this, Manifest.permission.CAMERA) != PackageManager.PERMISSION_GRANTED){
    activityResultLauncher.launch(Manifest.permission.CAMERA);
} else {
    startCamera(cameraFacing);
}
```

```
1 usage  ⚡️ DPenfold
private final ActivityResultLauncher<String> photoLibraryPermissionLauncher = registerForActivityResult(new ActivityResultContracts.RequestPermission(), new ActivityResultCallback<Boolean>() {
    ⚡️ DPenfold
    @Override
    public void onActivityResult(Boolean isGranted) {
        if (isGranted) {
            openGallery();
        } else {
            Toast.makeText(context: CameraPage.this, text: "Permission denied. Cannot access the photo library.", Toast.LENGTH_SHORT).show();
        }
    }
});
```

7.3.1 Camera – Camera usage and Photo Library– David Penfold

The use of the photo library and camera usage is essential to get the pictures of the leaves which can then be passed into the AI model, which will return the leaf's health. The camera access will be used in all aspects of the App. The App cannot function correctly without this. This part was one of the most difficult parts of the project but was essential for the success.

Alongside the Camera implementation, I have added the ability for users to use both their front and back camera. The flash ability has also been implemented, all to ensure the best image quality. This will ultimately lead to better scans and therefore more precise results.

This code shows how the camera flash is turned on and off:

```
1 usage  ▲ DPenfold
private void setFlashIcon(Camera camera) {
    if (camera.getCameraInfo().hasFlashUnit()) {
        if (camera.getCameraInfo().getTorchState().getValue() == 0){
            camera.getCameraControl().enableTorch(true);
            toggleFlash.setImageResource(R.drawable.baseline_flash_off_24);
        } else {
            camera.getCameraControl().enableTorch(false);
            toggleFlash.setImageResource(R.drawable.baseline_flash_on_24);
        }
    } else {
        ▲ DPenfold
        runOnUiThread(new Runnable() {
            ▲ DPenfold
            @Override
            public void run() {
                Toast.makeText(context: CameraPage.this, text: "Flash is not available currently", Toast.LENGTH_SHORT).show();
            }
        });
    }
}
```

This code shows the process of taking a picture and storing it. This is necessary so it can pass into the AI and that the image can be displayed on the results and history page:

```
1 usage  ▲ DPenfold
public void takePicture(ImageCapture imageCapture) {
    File file = new File(getFilesDir(), child: "captured_image.jpg");

    ImageCapture.OutputFileOptions outputFileOptions = new ImageCapture.OutputFileOptions.Builder(file).build();

    ▲ DPenfold
    imageCapture.takePicture(outputFileOptions, Executors.newCachedThreadPool(), new ImageCapture.OnImageSavedCallback() {
        1 usage  ▲ DPenfold
        @Override
        public void onImageSaved(@NonNull ImageCapture.OutputFileResults outputFileResults) {
            // Pass the file path to the next activity for display
            Intent intent = new Intent(packageContext: CameraPage.this, ResultsPage.class);
            intent.putExtra(name: "imagePath", file.getAbsolutePath());
            startActivity(intent);
        }
    });

    ▲ DPenfold
    @Override
    public void onError(@NonNull ImageCaptureException exception) {
        Toast.makeText(context: CameraPage.this, text: "Failed to save image: " + exception.getMessage(), Toast.LENGTH_SHORT).show();
    }
}
};
}
```

This is the code which is ran to show a preview of the camera. This is essential so that the user knows what picture they're taking. It calls other functions such as takePicture when the capture button is pressed and setFlashicon when the flash is turned on and off:

3 usages DPenfold

```
public void startCamera(int cameraFacing) {

    int aspectRatio = aspectRatio(previewView.getWidth(), previewView.getHeight());
    ListenableFuture<ProcessCameraProvider> listenableFuture = ProcessCameraProvider.getInstance(context: this);

    listenableFuture.addListener(() -> {
        try {
            ProcessCameraProvider cameraProvider = (ProcessCameraProvider) listenableFuture.get();

            Preview preview = new Preview.Builder().setTargetAspectRatio(aspectRatio).build();

            ImageCapture imageCapture = new ImageCapture.Builder()
                .setCaptureMode(ImageCapture.CAPTURE_MODE_MINIMIZE_LATENCY)
                .setTargetRotation(getWindowManager().getDefaultDisplay().getRotation())
                .build();

            CameraSelector cameraSelector = new CameraSelector.Builder().requireLensFacing(cameraFacing).build();

            cameraProvider.unbindAll();

            Camera camera = cameraProvider.bindToLifecycle(lifecycleOwner: this, cameraSelector, preview, imageCapture);

            DPenfold
            capture.setOnClickListener(new View.OnClickListener() {
                DPenfold
                @Override
                public void onClick(View v) { takePicture(imageCapture); }
            });
        }
    });
}
```

```
DPenfold
toggleflash.setOnClickListener(new View.OnClickListener() {
    DPenfold
    @Override
    public void onClick(View v) { setFlashIcon(camera); }
});

preview.setSurfaceProvider(previewView.getSurfaceProvider());
} catch (ExecutionException | InterruptedException e) {
    e.printStackTrace();
}
}, ContextCompat.getMainExecutor(context: this));
}
```

Here is the code which is activated when the camera is switched between the front and back camera:

```
DPenfold
flipcamera.setOnClickListener(new View.OnClickListener() {
    DPenfold
    @Override
    public void onClick(View v) {
        if (cameraFacing == CameraSelector.LENS_FACING_BACK){
            cameraFacing = CameraSelector.LENS_FACING_FRONT;
        } else {
            cameraFacing = CameraSelector.LENS_FACING_BACK;
        }
        startCamera(cameraFacing);
    }
});
```

7.4. Language Changer – Ben Keeping

To allow the user to change the language of the application I used spinners on the settings page, this meant once the spinner was clicked all languages would be shown and the user could select either English or Urdu.

```
LanguageSpinner = findViewById(R.id.LanguageSpinner);
Languages = Arrays.asList("English", "Urdu");

adapter = new ArrayAdapter<>( context: this, android.R.layout.simple_spinner_item, Languages);
adapter.setDropDownViewResource(android.R.layout.simple_spinner_dropdown_item);
LanguageSpinner.setAdapter(adapter);
```

Urdu was the secondary language the app was coded in; the choice of Urdu was down to our client as that is the language that is spoken in Pakistan which is where the app is being developed. I then used an 'OnItemSelectedListener' on the spinner to perform actions when a language is selected. Upon selection the selected language is compared to the language that is being stored within SharedPreferences. If the selected language is different to that of what is stored in the shared preferences, then the locale is updated using the setLocale() method. It creates a new locale object with the language code that is specific to the language selected and sets it as the default locale. For English, an empty string is used and for Urdu the language code is 'ur'. Once the locale needed has been set to default, the configuration of the app is updated accordingly. Once the

language has been updated, I continued to update the SharedPreferences by saving the language so that upon an app restart the language choice will be upheld. Additionally, I added a toast message to notify the user as to the change in language settings.

```

Ben Keeping
LanguageSpinner.setOnItemSelectedListener(new AdapterView.OnItemSelectedListener() {
    Ben Keeping
    @Override
    public void onItemSelected(AdapterView<?> parent, View view, int position, long id) {
        String selectedLanguage = (String) parent.getItemAtPosition(position);
        SharedPreferences Language_prefs = PreferenceManager.getDefaultSharedPreferences(getApplicationContext());
        String savedLanguage = Language_prefs.getString( key: "language", defValue: "");

        // Check if the selected language is different from the saved language
        if (!selectedLanguage.equals(savedLanguage)) {
            if (selectedLanguage.equals("Urdu")) {
                setLocale("ur"); // "ur" is the language code for Urdu
            } else {
                setLocale(""); // Default to English
            }

            // Update the saved language in SharedPreferences
            Language_prefs.edit().putString("language", selectedLanguage).apply();

            // Display toast message for language change
            Toast.makeText( context: Settings.this, |text: "Language changed to " + selectedLanguage, Toast.LENGTH_SHORT).show();
        }
    }

    Ben Keeping
    @Override
    public void onNothingSelected(AdapterView<?> parent) {
    }
});

```

To be able to implement the language selector properly, I had to translate the entire app into Urdu and use two different string files, one of which had English translations, the other, Urdu. An example of how this was done is shown below:

<string name="Login">LOGIN</string>	<string name="Login">لگن</string>
<string name="SignUp">SIGN UP</string>	<string name="SignUp">سائن اپ کریں</string>
<string name="SignUp2">Sign Up!</string>	<string name="SignUp2">سائن اپ کریں!</string>
<string name="Email">Email</string>	<string name="Email">ای میل</string>
<string name="Password">Password</string>	<string name="Password">پاس ورڈ</string>
<string name="ForgotPassword">Forgot Password?</string>	<string name="ForgotPassword">فگٹ پسا ورڈ کیلے؟</string>
<string name="ProfileSettings">Profile Settings</string>	<string name="ProfileSettings">پروفائل کی ترتیبات</string>
<string name="ConfirmChanges">CONFIRM CHANGES</string>	<string name="ConfirmChanges">تصدیق کیے جانے والے تبدیلیوں کی تصدیق کریں</string>
<string name="LanguageSelect">This button is used to select the language</string>	<string name="LanguageSelect">یہ بٹن زبان منتخب کرنے کے لیے استعمال کیا جاتا ہے</string>
<string name="Logout">LOG OUT</string>	<string name="Logout">لگن آؤٹ کریں</string>
<string name="Welcome">Welcome!</string>	<string name="Welcome">خوش آمدید!</string>
<string name="SignIn">Sign In</string>	<string name="SignIn">سائن اپ کریں</string>
<string name="ResultsTitle">Results</string>	<string name="ResultsTitle">نتائج</string>
<string name="SettingsTitle">Settings</string>	<string name="SettingsTitle">سینٹنگز</string>
<string name="Notifications">Notifications</string>	<string name="Notifications">اطلاعات</string>
<string name="AllowDeny">Allow/Deny</string>	<string name="AllowDeny">اجازت دیں / انکار کریں</string>
<string name="DetectedLeaves">Diseased Leaves Detected :</string>	<string name="DetectedLeaves">بیمار پتوں کا پتہ چلا</string>
<string name="ImageResolution">Image Resolution</string>	<string name="ImageResolution">تصویر کی ریزولوشن</string>
<string name="LowRes">Low</string>	<string name="LowRes">کم پھیلا</string>
<string name="MediumRes">Medium</string>	<string name="MediumRes">درمیانہ</string>
<string name="HighRes">High</string>	<string name="HighRes">اونچا</string>
<string name="UltraRes">Ultra</string>	<string name="UltraRes">اثری</string>
<string name="Report">Report</string>	<string name="Report">رپورٹ</string>

One issue that was run into when creating the translation ability was the format of the application, this was due to Urdu being a right-to-left language meaning that positioning

attributes would flip if a “Start” or “End” Positioning attribute were used to position an object within the application.

7.5. AI Code Analysis – Ben Keeping

The following code is the code provided by the client to create and train a CNN (Convolutional Neural Network) model based on the dataset provided by the client.

This code is used to print the folder's contents that the dataset can be found within. This was helpful in ensuring all images were in the location we needed them to be.

```
import os
for dirname, _, filenames in os.walk("C:\\Users\\benke\\OneDrive\\Documents\\Year 2 Uni\\Comp2003\\Data"):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

✓ 0.1s

After this the code defines the image constraints including the width, height, batch size and channels. The dataset is then loaded from the folder containing all leaf images. It prints the number of photos found within the two folders ('Healthy' and 'Virus'). This means we could check if images had been added to the folder.

```
# Define image constraints (width and height, dataset batch size and channels )
IMAGE_SIZE = 224
BATCH_SIZE = 32
CHANNELS = 3

# LOAD DATASET
dataset = tf.keras.preprocessing.image_dataset_from_directory(
    "C:\\Users\\benke\\OneDrive\\Documents\\Year 2 Uni\\Comp2003\\comp2003-2023-7\\Data",
    shuffle=True,
    image_size = (IMAGE_SIZE, IMAGE_SIZE),
    batch_size = BATCH_SIZE
)
```

✓ 0.0s

✓ 1.3s

Found 1069 files belonging to 2 classes.

The dataset was split into 3 subsets using the following code. To allow for reproducibility of this dataset a shuffle size of 1000 was used, this allowed for reproducibility. The sizes of the 3 respective subsets are then calculated. And using the take and skip operations, the dataset is split into 3 datasets; train_ds, val_ds and test_ds. The train dataset would be 70% of the initial dataset, the validation dataset 20% and finally the test dataset being 10% of the total dataset.

```
def split_dataset(ds, train_sp=0.7, val_sp=0.2, test_sp=0.1, shuffle=True, shuffle_size=1000):
    ds_size = len(ds)

    if shuffle:
        ds = ds.shuffle(shuffle_size, seed=12)

    train_size = int(train_sp * ds_size)
    val_size = int(val_sp * ds_size)

    train_ds = ds.take(train_size)

    val_ds = ds.skip(train_size).take(val_size)
    test_ds = ds.skip(train_size).skip(val_size)

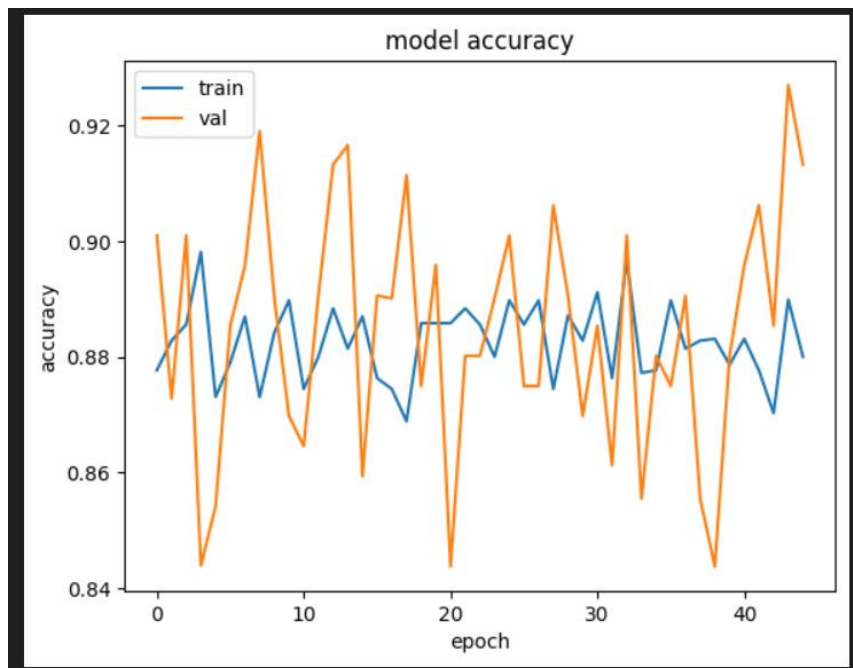
    return train_ds, val_ds, test_ds
```

✓ 0.0s

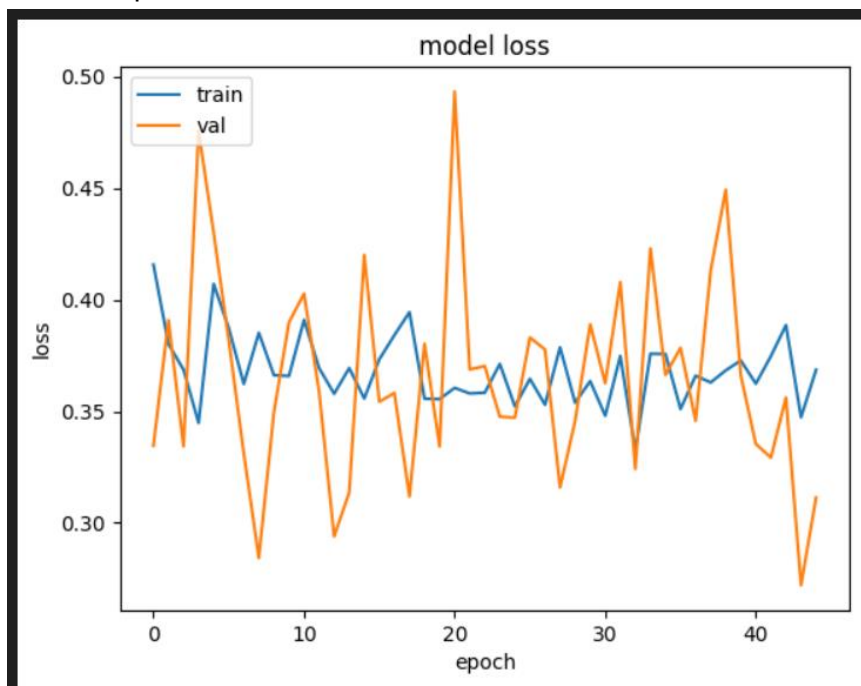
The model is then built, and a summary of the model is provided so that we can view the model's architecture. This included the layers of the models as well as listing both the number of parameters and the output shape of each layer

Layer (type)	Output Shape	Param #
sequential (Sequential)	(32, 224, 224, 3)	0
conv2d (Conv2D)	(32, 222, 222, 32)	896
max_pooling2d (MaxPooling2D)	(32, 111, 111, 32)	0
conv2d_1 (Conv2D)	(32, 109, 109, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(32, 54, 54, 64)	0
conv2d_2 (Conv2D)	(32, 52, 52, 64)	36,928
max_pooling2d_2 (MaxPooling2D)	(32, 26, 26, 64)	0
conv2d_3 (Conv2D)	(32, 24, 24, 64)	36,928
max_pooling2d_3 (MaxPooling2D)	(32, 12, 12, 64)	0
conv2d_4 (Conv2D)	(32, 10, 10, 64)	36,928
max_pooling2d_4 (MaxPooling2D)	(32, 5, 5, 64)	0
conv2d_5 (Conv2D)	(32, 3, 3, 64)	36,928
max_pooling2d_5 (MaxPooling2D)	(32, 1, 1, 64)	0
flatten (Flatten)	(32, 64)	0
dense (Dense)	(32, 64)	4,160
dense_1 (Dense)	(32, 2)	130

A graph of the model's accuracy is shown below, it uses the accuracy at each epoch of which 45 were run. The model's accuracy is extremely high providing an average accuracy of around 88.4%.



A graph showing the loss per epoch is then shown below, this shows the measure of loss between predicted values and actual values.



This image shows how data will be shown, including the accuracy, disease status and the leaf's actual status. This allows us to see where leaves may be predicted wrong and visualize how accurate the prediction is.

Actual: Healthy,
Predicted: Healthy.
Confidence: 85.34%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.14%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.34%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.38%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.3%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.28%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.21%



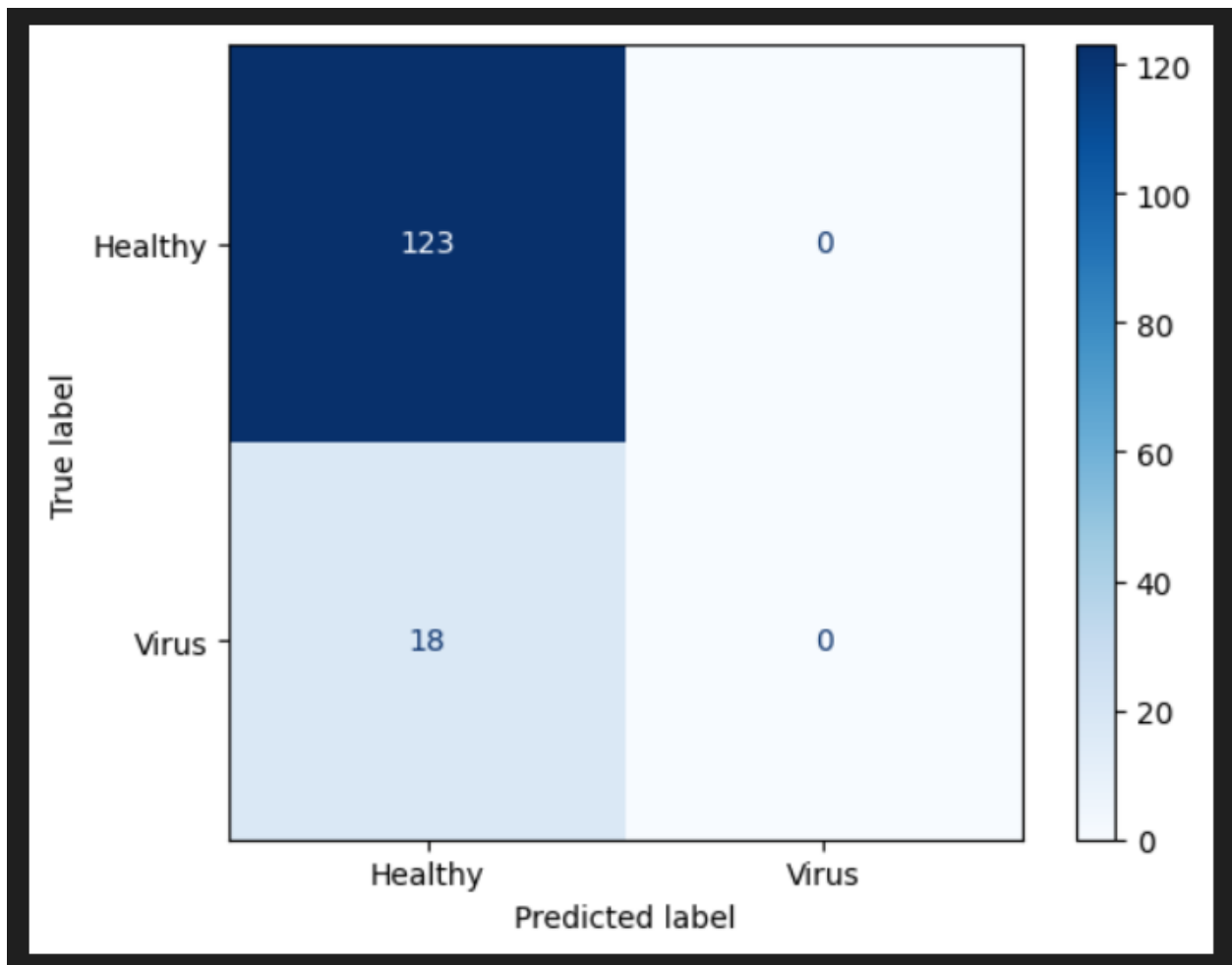
Actual: Healthy,
Predicted: Healthy.
Confidence: 85.37%



Actual: Healthy,
Predicted: Healthy.
Confidence: 85.29%



This graph shows the confusion matrix of the model, as you can see the model always predicts the leaf as being healthy. This is because of the bias in the dataset which we have spoken to the client about and she is aware of this.



7.5.1 AI Code For Predictions – Ben Keeping

The following code shows that we successfully trained the model so that it could give a prediction as to the status of a leaf that has been assigned to the image path variable

```
# Loads the image
img_path = "C:\\Users\\benke\\OneDrive\\Documents\\Year 2 Uni\\Comp2003\\bad leaf.jpg" # Path to the leaf image
img = cv2.imread(img_path) # Load the image
```

This is the if statement that surrounds the entire code block of the following code, it ensures there is an image within the file path and eventually returns either a disease status or a statement informing the user that the image failed to load.

```
if img is not None:
```

This code is used to resize the image to 200x200 pixels, ensuring it can be used within the model.

```
img = cv2.resize(img, (200, 200))
```

The following code converts the resized image from the BGR color space to the RGB color space so that it can be used in the model.

```
rgb_img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
```

A PIL image is then created from the NumPy array.

```
img_pil = Image.fromarray(rgb_img)
```

The image is then resized again to fit the models input size.

```
resized_img = img_pil.resize((IMAGE_SIZE, IMAGE_SIZE))
```

The resized image is then turned into a NumPy array, and a batch dimension is added.

```
# Convert the resized image to a numpy array and add a batch dimension
img_array = image.img_to_array(resized_img)

img_array = tf.expand_dims(img_array, 0)
```

The image is then normalized so that pixel values lie between 0 and 1.

```
normalized_img = img_array / 255.0
```

The image is then passed into the model and a prediction is made as to the disease status.

```
predictions = model.predict(normalized_img)
```

The index containing the highest probability status is then located and can be mapped to the class it is related to. After this the predicted class is then printed. In this example it predicted the leaf as being healthy.

```
# Interpret predictions
# Get the index of the class with the highest probability
predicted_class_index = np.argmax(predictions[0])
# Map the index to the corresponding class name
predicted_class = class_names[predicted_class_index]

# Print the predicted class
print("Predicted class:", predicted_class)
else:
    print("Failed to load the image.")
```

✓ 3.0s

1/1 ————— 0s 409ms/step

Predicted class: Healthy

8. Quality Assurance - Morgan Hodge

As a group, we formed together to create a plan for maintaining the project's quality to the highest standard. This was achieved by firstly dividing the workload between the team members and allocating roles based on each team member's skills. The roles were crucial to ensuring quality throughout the app as the quality would lower if a team member who was not particularly skilled in a section had to then work on said section. These roles were allocated within the first meeting that was conducted, this provided us with an understanding of which members would be working on specific sections.

Once the project was underway, we had bi-weekly meetings with our client in person and online. These meetings allowed us to present to the client the latest changes and

updates we had made to the app. This was done in a variety of ways such as screensharing via zoom and showing the changes in real time, downloading a copy of the most recent version, and presenting it during the face-to-face meetings. As well as taking notes of changes that our client wanted, or features that we had to implement, and going home and creating said changes.

Another way we ensured that an elevated level of quality was maintained throughout the project was by reviewing each member's work after a work session. After each session we would join a call on zoom and take turns reviewing the changes made that day. This allowed us to make a group decision on what standard we consider good quality as we all agreed upon the new changes then it would satisfy our belief that it was of a good quality.

8.1. Quality Testing – Morgan Hodge

To maintain high quality throughout the project's creation, we created a testing table that we referred to after every major change. This table (see below) contains basic functionalities, and the purpose of this testing was to ensure that these functions still work after major changes have been made. This was put in place after one incident that occurred where a minor change was made to the log-in system that caused the button on another page to be faulty. After this incident we came up with the idea of the testing table as it would remind us to test basic functions that we may otherwise have looked over and just assumed would work.

9. LSEP Considerations

9.1. Legal – Ben Keeping

To avoid the risks associated with copyright laws we made sure that all images we used, whether they be used as buttons or sections of a background, were images that had a Creative Commons license. For many of our assets we have created them ourselves using photoshop to avoid any laws that might put us at risk. There was one image we used on the home page which included 3 pictures of diseased leaves so that users would be able to identify leaves themselves if necessary. We made sure this photo complied with copyright laws by ensuring they had a creative commons license. To comply with GDPR rules we hashed all passwords to maintain data privacy. We also only collected and processed necessary information that was kept accurate and up to date. We also taken the Disability Discrimination Act 1995 into account when designing the application. We did this by ensuring color-blind friendly colors were used that wouldn't clash with one another to allow for a user-friendly feel to be present within the application.

9.2. Social – Ben Keeping

Our application complies with the social issues that may arise by having the ability to change language between both English and Urdu as these are the two primary languages in the country of origin that our application will be used in (Pakistan). To allow consistency the androids language is considered when loading up the application, this means that social issues will be tackled with ease in terms of language swapping ability. Another social issue that may have arisen is the economic status of users. To tackle this issue, we made sure to allow the app to be run on android devices of 2016 or newer with an android API level of 24. This means the geographical location also doesn't affect the ability to access the application. Additionally, farmers within the areas the application is being developed may not trust the new application and prefer their traditional methods of identification.

9.3. Ethical – Ben Keeping

The disabilities act is also an ethical problem that we have addressed as we have considered all disabilities that may affect a user's experience when using the application as we want to ensure all users have an enjoyable experience and experiences are kept consistent throughout user bases. For users who struggle with sight and so need screen readers, we have added content descriptions to all buttons and text views. When a screen reader is used, if a button is hovered over then a description of the action that will occur is read out loud. We made sure that all content descriptions are translated between both English and Urdu in case there were to be an Urdu user requiring a screen reader.

The AI model itself is biased towards healthy leaves; this is due to the photos it being trained on predominantly being healthy leaves. Going forward we would need to obtain more images from the client to allow for a better trained model, this would not be difficult to implement into the ai code training as all it would require on the client's side would be the addition of images to relevant folders.

As well as these issues, agricultural workers whose job was to identify diseased leaves could lose their jobs; however, the application will broaden the range of opportunities for new jobs.

9.4. Professional – David Penfold

Professional standards have been carefully considered during the development of our android application. This is crucial for ensuring the app meets industry standards, follows best practices, and upholds professional integrity. We have made sure throughout the development process that these standards have been met.

User Support:

User support and feedback has been kept as a key focus in our project. A report page has been implemented which allows users to report on any bugs and/or any concerns. These reports are stored in a firebase cloud which is linked to the user's email. This allows us to handle reports efficiently and even reach out to the user when needed in appropriate situations. User feedback and reports will be acted upon immediately allowing the app to stay up to standards and deal with any concerns. This can help with continuous improvements and innovation to enhance the app's functionality and performance in the future. The use of this feature should lead to greater user satisfaction.

Before the App has gone live, we conducted questionnaires and surveys to ensure we deal with any concerns before the app reaches the public. This allows us to correct any potential problems within a controlled environment. The advantage of this is that the app cannot be exploited in any way before being released.

Professional Security Standards:

Security is another key aspect that has been considered during the development process. An example of this is on the account creation page. Users must create an account which meets a certain criteria such as a valid email address and a password which contains a number and a capital. This will strengthen the security of the user's information and the security of the system.

Additionally, where the user's data is stored has been kept in mind. To comply with professional standards, we will store the user's information in a secure firebase cloud system. This allows for multiple features such as:

- **Security and Encryption** due to the data being protected in rest and transit.
- **Scalability and Reliability** which will be useful in the long term of the App. Other features of the
- **Real-time Database and Synchronization** ensures that users have access to the most up-to-date information.
- **Authentication and Authorization** to control access to user data and resources.

Firebase also complies with industry standards and certifications, such as [GDPR](#) standards, showing its commitment to data privacy and professional standards.

Quality Assurance and Testing:

The implementation of rigorous quality assurance processes to thoroughly test the app for functionality, performance, and security vulnerabilities has been completed before deployment. This has been done with user testing and is highlighted in the user acceptance testing document. The tests vary from beta testing to final questionnaire results. Additionally, feedback from surveys has been taken on board.

Professional Communication:

Throughout the development process we have kept professional communication. This includes creating clear communication channels between our team and the client. We managed this with teams and allowing the client access to our Figma prototype and Trello board to track progress. Timely responses to queries, feedback, and support requests to ensure a positive client- team relationship.

Professional Development and Code of Conduct:

As a team as a whole we have kept professional team development by learning appropriate skills to complete the project, keep up to date in our respective areas of expertise, ethical behaviour, professional communication, efficient use of time and planning. This has led to the team taking on board multiple new skills and valuable experiences, leading to a well-established and professional group.

By incorporating these professional considerations into our project, it will help lead to successful development and deployment. This will help maintain our Android application in a manner that promotes trust, reliability, and professionalism among users and stakeholders.

10. Usability Heuristics Evaluation

10.1. Surveys and Results – Morgan Hodge

A survey was created during the starting stage of the app's development as a method of gathering data from our target audience. The data from the survey was used to gain an insight into what the users want to get from our application. The benefits of conducting a survey included gathering feedback on what features could be implemented/improved, Identifying existing issues within the application and engagement with the customers.

The Questions asked in the survey were specific to our application, we asked questions such as if the user can create an account, and if the user can log into said account. These questions were necessary for us to ensure that the registry system worked universally across a range of different android phones. A link to the survey can be found [here](#), photos will also be attached below (to view the full survey please follow link):

Cotton Leaf Detection App Forum



This is a Survey for the Cotton Leaf Detection Application. All results will stay anonymous if the users wishes, data will be used from this to innovate changes to the App. Please answer every Question with honesty. Thank you - Cotton Leaf Team

Survey

How much would you be willing to pay for a reliable disease detection mobile application?

- ☐ £0
☐ Less than £5
☐ More than £5

Can you create an account

- ☐ Yes ☐ No

Can you Log into an account

- ☐ Yes ☐ No

- ☐ Yes ☐ No

Does your camera allow you access to use our app?

- ☐ Yes ☐ No

What features would you like to see in a mobile application for detecting diseases in cotton plants?

How likely are you to recommend the Cotton Leaf Detection mobile application to other cotton farmers?

- ☐ Likely ☐ Unlikely

Feedback (What would you like to see changed to the app)

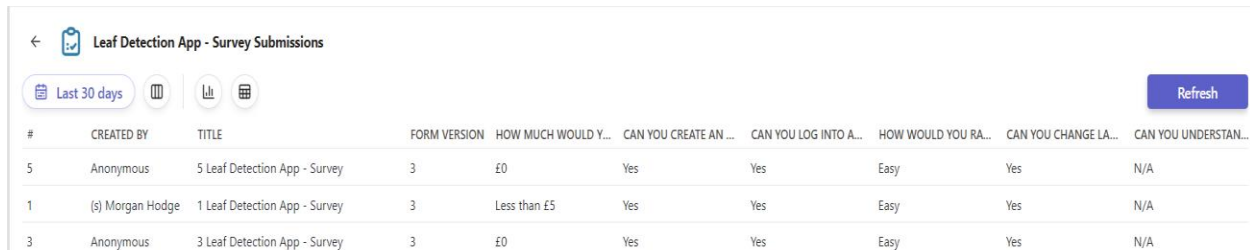
Questions For The Developers (Optional)

Contact Details

- Morgan.hodge@students.plymouth.ac.uk
- David.Penfold@students.plymouth.ac.uk
- Edward.Gaston@students.plymouth.ac.uk
- Ben.Keeping@students.plymouth.ac.uk

Submit

The results from this survey are stored in a table on teams, we took all the useful feedback from the survey results and put them in a word document. The feedback had to be addressed as some were direct questions to us developers. We planned to create an email with the issues/questions that were raised, and mass send this email to all users that took the survey so they could be updated with the changes made.



The screenshot shows a Microsoft Teams interface for a survey titled 'Leaf Detection App - Survey Submissions'. At the top, there is a back arrow, a checkmark icon, and the title. Below the title are filters for 'Last 30 days' and icons for list, grid, and chart views. A 'Refresh' button is on the right. The table below has 10 columns: #, CREATED BY, TITLE, FORM VERSION, HOW MUCH WOULD Y..., CAN YOU CREATE AN ..., CAN YOU LOG INTO A..., HOW WOULD YOU RA..., CAN YOU CHANGE LA..., and CAN YOU UNDERSTAN... The table contains three rows of data.

#	CREATED BY	TITLE	FORM VERSION	HOW MUCH WOULD Y...	CAN YOU CREATE AN ...	CAN YOU LOG INTO A...	HOW WOULD YOU RA...	CAN YOU CHANGE LA...	CAN YOU UNDERSTAN...
5	Anonymous	5 Leaf Detection App - Survey	3	£0	Yes	Yes	Easy	Yes	N/A
1	(s) Morgan Hodge	1 Leaf Detection App - Survey	3	Less than £5	Yes	Yes	Easy	Yes	N/A
3	Anonymous	3 Leaf Detection App - Survey	3	£0	Yes	Yes	Easy	Yes	N/A

10.2. Unit Test Plan – Ben Keeping

To allow our team to produce a successful product that meets all requirements needed, we created multiple test plans, these included test plans ranging from Requirement testing plans to action testing plans. These plans were established at an early stage and would be regularly rerun to ensure all tests were still producing the required output. The following images display the test plans we created including their actions and the actual outcome. This would constantly be checked after every 10 git commits. This meant we could identify any possible errors that lay within the application before publishing it.

Test Number	Test Type	Action	Expected Outcome	Actual Outcome	Pass/Fail
1	Sign Up	Sign up with both fields filled and validation met	Successful Sign Up	Successful Sign Up	Pass
2	Sign Up	Sign up with username filled but no password	Unsuccessful Sign Up	Unsuccessful Sign Up	Pass
3	Sign Up	Sign up with password filled but no username	Unsuccessful Sign Up	Unsuccessful Sign Up	Pass
4	Login	Login with correct credentials	Successful Login	Successful Login	Pass
5	Login	Login with 1 correct credential	Unsuccessful Login	Unsuccessful Login	Pass
6	Login	Login with a combination of different users correct credentials	Unsuccessful Login	Unsuccessful Login	Pass
7	Login	Login with 0 inputs	Unsuccessful Login	Unsuccessful Login	Pass
8	Login	Login with only username field filled	Unsuccessful Login	Unsuccessful Login	Pass
9	Login	Login with only password field filled	Unsuccessful Login	Unsuccessful Login	Pass
10	Navigation Bar	Navigate to the home page via every pages navigation bar	Successfully reached the home page via all pages	Successfully reached the home page via all pages	Pass
11	Navigation Bar	Navigate to the results page via every pages navigation bar	Successfully reached the results page via all pages	Successfully reached the results page via all pages	Pass
12	Navigation Bar	Navigate to the settings page via every pages navigation bar	Successfully reached the settings page via all pages	Successfully reached the settings page via all pages	Pass
13	Navigation Bar	Navigate to the profile settings page via every pages navigation bar	Successfully reached the profile settings page via all pages	Successfully reached the profile settings page via all pages	Pass
14	Navigation Bar	Navigate to the camera page via every pages navigation bar	Successfully reached the camera page via all pages	Successfully reached the camera page via all pages	Pass
15	Navigation	Navigate to the information page via home page	Home page is opened and displayed	Home page is opened and displayed	Pass
16	Navigation	Navigate to the history page via home page	History page is opened and displayed	History page is opened and displayed	Pass
17	Navigation	Navigate to the report page via settings page	Report page is opened and displayed	Report page is opened and displayed	Pass
18	Navigation	Navigate to the Results information page via results	Results information page is opened and displayed	Results information page is opened and displayed	Pass
19	Camera	Click the photo button when on the front camera	A photo is taken using the front camera	A photo is taken using the front camera	Pass
20	Camera	Click the camera flip button	The camera is flipped	The camera is flipped	Pass
21	Camera	Click the photo button when on the back camera	A photo is taken using the back camera	A photo is taken using the back camera	Pass
22	Camera	Click the flash button then click the photo button	The flash works when a photo is taken	The flash works when a photo is taken	Pass
23	Settings	Select a new language	Language is changed throughout the app	Language is changed throughout the app	Pass
24	Settings	Select a new location	Location is changed to the selected location	Location is changed to the selected location	Pass
25	Profile Settings	Type a new password in the text view with incorrect current password	Password isn't changed	Password isn't changed	Pass
26	Profile Settings	Type a new password with current password entered	Password is successfully changed	Password is successfully changed	Pass
27	Profile Settings	Click the logout button	The user is logged out	The user is logged out	Pass

10.3. UAT on methodology – David Penfold

The UAT was key for helping and improving our methodology of our final project. Firstly, it helped us validate requirements. During the UAT we confirmed that the software met the specific requirements and did not need any further change. This ensured the software fulfilled the intended purpose and delivered the expected functionality.

We were able to gather user satisfaction feedback and use this to further improve the app. This is because the UAT allowed users to interact with the software and provide feedback based on their experience. The feedback helped us identify any usability issues and any potential bugs.

Finally, the use of the UAT serves as a final quality assurance checkpoint to minimize any risks with the software deployment. This confirmed if the app was ready for deployment.

10.4. Post-project support – David Penfold

Although the project will be handed over to the client at the end of development, it is important we have the right measures in place for post project support. An example of this

is implementing the report button which stores reports in the firebase which will be linked to the user's email. This is essential to allow users to give feedback and identify any bugs they have experienced. Furthermore, this will let future developers identify problems and roll out appropriate updates to keep the app functioning and up to date.

We will also hand over the firebase logins for administrators to access the database and make changes appropriately. This is essential for managing users such as in situations where a user needs to be removed from the app or perhaps a login criterion needs to be updated.

11. Conclusion – Ben Keeping, Edward Gaston and David Penfold

During the development of the project, we had multiple stages of improvement. The first being the improvement as we refined the low fidelity Figma prototype. Following this would be the improvement to android studio and having a high-fidelity prototype which we would refine.

Throughout the development of our project, we focused on continuous improvement at various stages. We began by refining our low fidelity Figma prototype, addressing both design and user experience elements to ensure it met our requirements. This process involved multiple iterations, allowing us to identify and resolve potential issues early on.

From the conception to the project to the competition the project has been through many stages in pursuit of completing all the goals we set at the start of the project. We created wireframes, low-fidelity prototype on Figma and our high-fidelity prototype on android studio, with each phase we fixed bugs and improved the app by fixing bugs and making it more a user-friendly experience making the design cleaner.

Early on in our development process we identified that our main programming languages would be Python (to work with the ai code), Java (to provide functionality to pages) and XML (to create better looking, more consistent screen designs), we will be using these languages within Android Studio in a mobile development environment.

During this project multiple achievements have been reached. As a team we have come such a long way in multiple aspects. We have gained real world experience through working with a client. We have improved on how we present ourselves in a professional manner. This is shown in the way we communicate, manage tasks, and solve problems. Multiple achievements have been met on the technical side. Each member has greatly improved their coding skills, especially in java. Additionally, each member now has a

greater understanding of the stages needed to develop a finished project. From prototyping to managing correct LSEP standards.

This project has been valuable in developing each of our learning experiences. The opportunity to work with a client has been much appreciated and we are thankful for the journey we've been on. We look forward to taking on further challenges in the future.

12. References

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StackOverFlow:

StackOverFlow: A community of developers where you can ask questions related to programming and find related answers Available at:

<https://stackoverflow.com/>

OpenCV:

Open-Source Computer Vision and machine learning library

<https://opencv.org/>

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13. Appendix - 1000-word CW Submission Evidence and Evaluation file for each member as appendix.

13.1. David Penfold Personal Evaluation

I have learnt many skills during this project and gained valuable experience. Throughout this feedback, I aim to delve into the technical and soft skills learnt during the project. Many reflections show I find myself not only learning many technical skills but also gaining valuable team skills that are essential in professional environments.

My technical skills have been improved greatly. I am now very confident in coding in java and xml. My experience with implementing a camera is now up to a standard which I believe cannot be improved, all functionality works correctly. I have coded features such as the front camera and back camera switching, additionally the usage of a flash.

Alongside the code to choose pictures from camera roll and ask the user for appropriate permissions to oblige with LSEP standards.

My prototyping skills have come along way. With the use of Figma I have learnt to correct low-fidelity prototypes, based off user stories, which are very valuable for future development.

Over the course of our project, I have picked up many soft skills which I'm sure will prove valuable in the future. By far the most important skill I have improved upon is my communication. This can be split up into many categories. For example, Client communication has been worked upon and I make sure that when we have our meetings that I convey information clearly and effectively. This is not only in person but also over email, I make sure to keep a clear and professional manner. I make sure to actively listen with both the client and during any questions asked at presentations. This makes sure they're aware that I'm taking all the information aboard. Alongside I have kept the client up to date with what is happening with the project yet not overwhelming them.

Communication can also be related to my teammates. As group leader it is essential that I keep information concise and easy to understand, I have made this a clear point to do. This has been done with the correct use of communication channels.

Another soft skill which I've improved on is teamwork. As a team I believe we have finished this journey much stronger than when we started. We have worked evenly and solved any problems independently. We have all become much closer, which I think has helped by meeting up outside of work and spending time together. As a team I've learnt valuable skills from each member and shared many skills of my own to the team.

A big challenge when creating the application was dealing with LSEP. In particular gaining access to the camera and camera roll. The LSEP standards was a very key topic we had to keep in mind when developing our application. In order to follow correct standards, I needed to implement appropriate code which will ask the user for permission to gain access to the camera and/or camera roll.

Another challenge was accidentally getting the camera functioning. I had a high quality which I wanted to follow, this included the front and back camera working, as well as the flash. This took up a large amount of my time and resources online were sparse.

Fortunately, through self-learning and improvement I did manage to get all functions fully working.

If we did this project again, I would not hesitate to choose the same team. Each member has demonstrated their skills and commitment to the project. We started the year not knowing each other too well and have ended with not only great teammates, but friends too. Each member can disgust between group mates and friends, when we're sat down to work everyone plays their role appropriately in a professional manner.

The overall learning experience with the client has been very interesting. My main takeaway is that we are dealing with a real-life situation and problems do occur. An example of this is when we were working on implementing the AI leaf detection code into android studios. The only problem was that the AI was written in python and a certain file type being used was not compatible. From this I learnt how a real-life situation does not follow a mark scheme or criteria and there will always be new and unexpected problems which we must work around.

Regarding the client, I learned how to maintain a positive client relationship management. This includes the importance of keeping the client in the loop when development and how the client wants to do what is best for you. Therefore, it is important to be honest and say any problems we are currently trying to solve.

The camera implementation proved to have many incidents. With a lack of online resources, the implementation was a hard challenge. I had no previous experience and found it hard to make a meaningful start. However, with much research I found the CameraX plugin. This was just the start. After much time spent and understanding the logic I was able to further develop the code and allow for complete access. This gave me valuable experience and I am now confident in implementing a camera without taking much time in the future.

I think I've learnt such a range of skills from this module, that when I'm put into a similar situation or just a real-world situation, I'm going to be much more prepared. A way I'm going to keep the growth is by applying professionalism to my everyday life, such as talking to lectures, meetings with my tutor and of course in my job. Alongside this I'm going to keep my email writing to a high standard, this should maintain the habit of concise and efficient communication.

13.2. Ben Keeping Personal Evaluation

The Cotton Leaf project has allowed me to improve upon many of my technical skills including coding areas such as Python, Java and XML. The Clients AI code allowed me to improve my current knowledge of python code used to create CNN models such as

TensorFlow. As well as this it allowed me to apply my current knowledge as to how AI models can be both trained and tested. Testing the code was where I had to write the code myself, this included coding different forms of pre-processing data techniques so that it would fit into the model correctly. The preprocessing data techniques I used were resizing the image to 200x200 pixels as the input data into the model had to be this size, converting the colour space to RGB from BGR so the python imaging library can successfully read the image and then normalizing the data so that machine learning could be undergone on the image. To modify and evaluate this code I used VS Code as I am extremely confident with it due to my history within other modules. Android studio allowed me to add functionality to objects within the app such as buttons, locales, and notification permissions, this further enhanced my knowledge of Java code as I had to undergo research as to how certain code would be used to allow actions to be taken. The use of GitHub allowed me to further understand how version control could be used included using rollbacks if work had errors as well as the ability to merge branches when needed.

Throughout the project I have developed my soft skills including my ability to communicate with clients, team members and important personal within the university such as sprint review tutors and module leaders. My ability to work as a team has also significantly increased as at some stages I have had to take charge and display leadership traits to ensure we get jobs done on time. This was shown within the last couple weeks of our project due in date, where I gave out specific tasks to team members to ensure both the project and final report were completed to a high standard within the required time frame. I also ensured we were all on the same page to allow for a reduction in stress that deadlines typically cause.

Whilst developing the project our group encountered a couple of issues, one of these issues was to do with the Clients AI code, initially the ai code was unable to read from the file path where our data was located for healthy and diseased leaves. To overcome this, I identified how the AI code loaded the dataset and quickly realised that I would have to create two separate folders within the folder being read, with all images being in one location instead of folders within folders. Another issue I quickly identified was the processing power on my laptop, the lack of a pc for me meant it took a very long time to test features I may have implemented in android studio due to the lag caused by creating a virtual device.

The experience with my other group members was definitely positive, we managed to function as a working team and throughout this year I have learnt to know them as people, and they've become some of my closest friends. I am glad I chose to work with all 3 of my group members as we have been able to help each other with tasks within the project

where it was needed. The strengths and weaknesses of our group worked hand in hand to form a well-balanced team who cover a wide range of programming languages essential for project development. Whether that be python, Java, XML or any others that we may have encountered.

Our client experience provided me with an extremely helpful insight as to how real-world projects are created with a clientele. Alongside this it has allowed me to gain an even more in-depth view as to how the agile methodology would be used in industry. Our biweekly client meetings allowed for the management of client expectations as well as allowing us to discuss how we would tender to any of these needs. It also provided me with insight as to how minutes can be taken to track discussion points in case a team member isn't available due to unforeseen circumstances. Minute documentation also allowed us to log any recommendations the client may have had allowing for a clear communication strategy through past conversations.

The AI code problem mentioned earlier, provided me with valuable experience as it allowed me to identify where problems may lie within pre-written code and how you shouldn't just look at code once and assume it works even if it is written by professionals.

After this module I will continue to explore how AI can be used to fix real world problems and how accuracy can be improved within prediction models. This is fascinating to me as the ability to predict solutions to real world problems will continue to be used within the future and utilized on even larger scales. I will continue to develop my knowledge in languages such as python and java and would even like to venture down the JavaScript route due to it being the most widely used programming language. I have set myself a goal over summer of developing an AI model from scratch that can be used to predict the expected profit a store can make in 1 day, 1 month and 1 year based on a wide range of inputs like opening hours, customer volume, products, and the average profit margin per product. This project has provided me with crucial knowledge needed to grow in the future and become successful in many different areas.

13.3. Edward Gaston Personal Evaluation

During this project, I developed several key technical skills. I gained proficiency in Android Studio and learned how to effectively manage large volumes of files within a project. My java programming skills improved significantly, and I also become more comfortable with XML code. Additionally my skills in python has improved from helping the team with errors they faced during implementation of the AI Model into the application.

Through this group project, I've noticed significant growth in my soft skills. My communication skills have become more effective, both within my team and in meetings with the client. This has also enhanced my interpersonal skills, enabling me to build a strong friendship with my team members. I also have seen improvements in my problem-solving capabilities allowing me to approach challenges in a more effective way. Overall these experiences boosted my confidence but have also fostered a more collaborative approach to achieving goals.

Throughout this project, I encountered several challenges that required perseverance and problem solving. Technically, I faced multiple complex bugs that needed careful debugging and troubleshooting. One of the significant hurdles was designing the login system, which required approach before I could implement my preferred solution. This back and forth added an extra layer of complexity to the process.

In terms of non technical challenges,. Time management was a key issue. Balancing project work with other responsibilities was initially difficult, but through this experience, I've learned how to better manage my time. As a result my ability to prioritize tasks and meet deadlines has improved. Overall these challenges have been valuable learning experiences that have strengthened my technical skills and personal discipline.

Working with my group mates was a highly positive experience. Everyone contributed equally to the project, and our team structure was well-defined, with each role functioning as intended. Beyond their technical capabilities, my team members were kind and supportive, always willing to help each other out. This cooperative spirit made our collaboration smooth and enjoyable. Overall, I couldn't have asked for a better group for this project.

From my experience dealing with the client, I learned a great deal about professional development communication and meeting protocols. I became familiar with the structure of meetings, including stand-ups, and understood the importance of preparing agendas beforehand. Additionally, I gained experience in taking meeting minutes, ensuring clear communication and follow up. Email communication with the client taught me how to maintain a professional tone and convey information effectively. Overall these experiences have equipped me with valuable skills for interacting with clients and managing project communications.

One incident that provided me with valuable experience occurred while I was implementing Google Firebase for the login system. This process required setting up a dedicated google account for the project which in turn, needed client approval. This situation taught me the importance of client communication and proper authorization before making technical changes.

After completing this module, I plan to leverage the experience I've gained to take on more significant roles in future group projects, potentially as a lead developer or project leader. This module has boosted my confidence, and I'm ready to embrace more responsibility and leadership positions. Additionally, I intend to continue improving my technical and programming skills. By expanding my knowledge and stepping into more challenging roles, I aim to build a stronger foundation for my career and contribute more effectively to team projects.

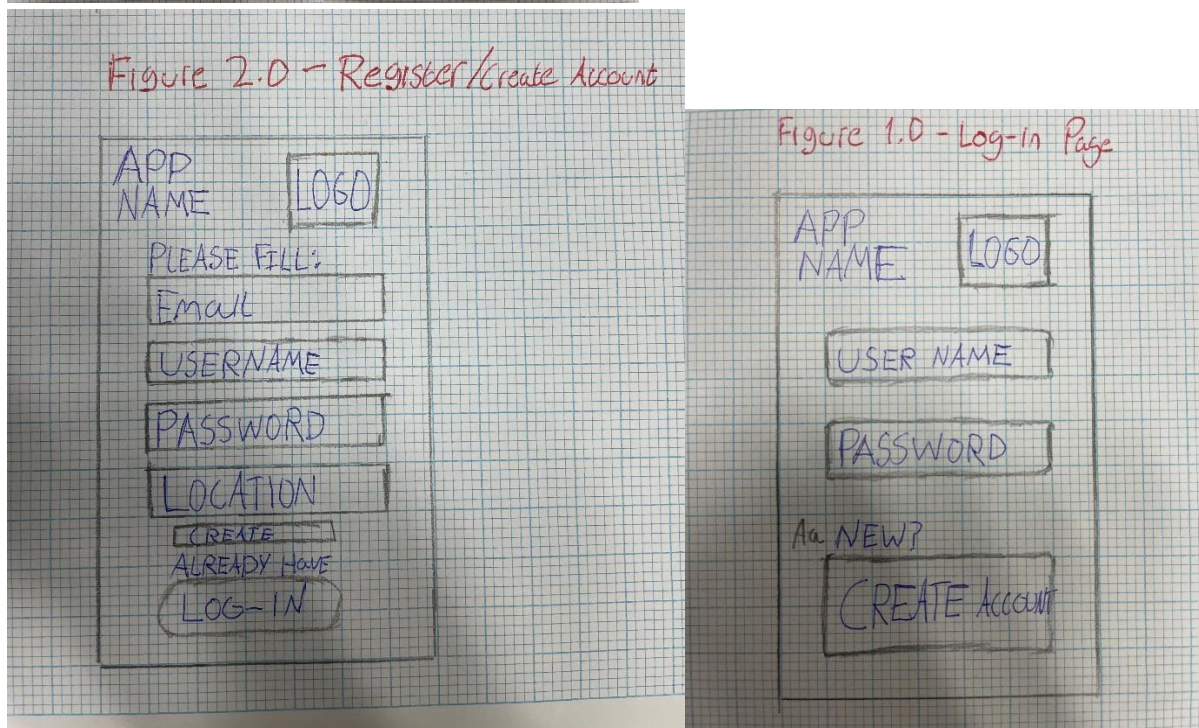
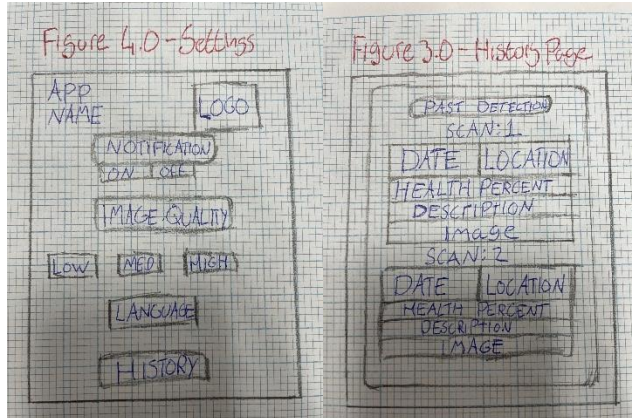
13.4. Morgan Hodge Personal Evaluation

During this project I have developed many of my coding skills such as my ability to write XML code. This was the language used to create the look/design of the pages on android studio. To be specific I learnt a lot on the constraints and how to structure a page to look professional and well laid out. My prior knowledge about XML helped me with this as in one of my previous modules I studied this language a lot as I had to use android studio to create some basic pages. This background knowledge helped me significantly as I didn't have to start from knowing nothing.

I also used java for a vast majority of this project and prior to this I had minimal experience with the language. Java was the language used to create the logic of the pages and to control the behaviour of certain functions within the app. Some example instances of where I applied this logic was to create functional buttons that took users to certain pages, and to load up previous leaf images from the user's camera history. I believe these skills were crucial to strengthen as they could be used in future projects.

I strengthened my soft skills within this project such as communication and teamwork skills. My communication was strong throughout the entirety of the project, I communicated frequently through channels such as discord, teams and email. Many nights were spent in discord calls, working on new changes to the app and discussing what we could do to fix/improve certain aspects within it. This also strengthened my teamworking skills as these calls included all members of the team. On some occasions we would screenshare and help each other out with work and provide constructive feedback on what could be done to improve. I believe this was one of the key things that strengthened my teamworking skills as I learnt to take constructive criticism and turn it into positive working improvements.

I feel like I contributed a lot of crucial work to this project, such as the frameworks and base design ideas. Being an Architect for this project, I was designated a lot of design work. As all apps need a framework to get a basic idea of what the app will end up looking like, I got straight to work with creating the initial designs. I created the framework for our application using pen paper and a pencil, the outcome of this proved to be effective as this was used as the design for our app. The framework designs were then built upon to create a Figma design, this was then used as the basis for the final android studio application. This proves that my frameworks had a significant impact on the applications overall design and look.



I also created the Microsoft teams survey, using the team's forum. This was a crucial piece of work as this was used to obtain user opinions alongside the retrieval of real user feedback on our application.

This survey was emailed to multiple testers so we could gather feedback that was used to improve features within the application. A link to view the forum is [here](#).

Creating the logic for the view history page became an issue, this is because I had troubles with creating a method of displaying the image from the user's photo history onto the image view within the history page. This was a big problem for me as one of the main pages I was working on was the history page, and viewing the leaf image was a crucial part of this page. I fixed this problem and overcame it with help from my teammate David, he figured

out a method to get this to work as he also had to do this on a page he was working on. Together we fixed this problem and got the image view working.

My experience working with the group was excellent, the groups dynamic worked perfectly. Me and the member David knew of each other before this project started and working on this together allowed us to form a stronger bond and I would now consider him one of my very good friends. The other two members Ben and Edward, I did not know at all before this project. I now consider both extremely good friends. One of my favourite team memories from this project was after our pitch for our interim meeting that we had with our client and module leader, we all went straight to the Student Union dressed still in our suits and played a few games of pool. I believe this moment strengthened our bond as a team and I think one of the reasons this project was successful was due to the fact we all had a good relationship with each other and we all got along.

My experience with the client was very professional and pleasant, I was very punctual to every meeting, only being absent for one due to reasons beyond my control. These meetings were beneficial to me as it created and developed my understanding on what the client wanted the app to do and how she wanted the app to function. The client helped me with any questions I had to do with the app and the apps logic. There was a meeting early on within the development of the project where I had to present to the client the Figma Low Fidelity design, the client was very happy with the design and provided feedback that was then applied to the design.

After this module I believe that I will continue to strengthen my skills within app development. This is a path I can see myself going down for a future job as I enjoy the creative freedom of designing an app with given set objectives. I have found that this project specifically has given me the confidence to potentially go down this path in the future.