THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)

BY

LIM EN SIANG

A REPORT

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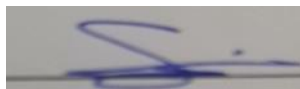**Academic Session**:____01/23_____

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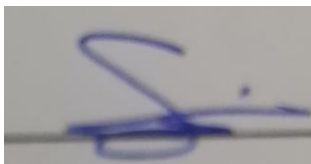**UNIVERSITI TUNKU ABDUL RAHMAN**

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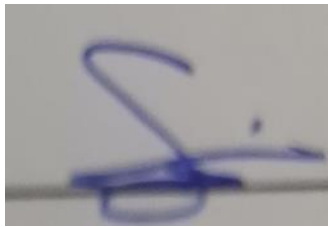
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I would like to express my sincere thanks and appreciation to my supervisor Ts Saw Seow Hui who has given me this bright opportunity to engage in an object recognitionmobile application development project. It is my first step to establishing a career in the machine learning field. A million thanks to you.

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ABSTRACT

This project is an object recognition mobile application development project. It will provide students with the methodology, concept, and design of object recognition mobile applications. The development of this project will be categorized into two partswhich are model training and mobile application development. In model training, a method used to train the model by using object detection software will be proposed. Another part of this project is mobile application development, the main function of theapplication will be object recognition function that can recognize object by using real-time camera or an image from the storage. Other extra function will add into the application as an additional service provide to the user. This project will provide method on mobile application development and model training with the software and hardware that needed to develop object recognition mobile application. Mobile application is a part of software development, this project will provide the mythology on software development. The software development model, system architecture and concept of system of the application defined will be stated in this project. The final outcome of this project will be an object recognition mobile application that serve an function that can recognize different electronic appliance as main function accompanywith extra function that can increase the user experience of user that try on this application.

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LIST OF ABBREVIATIONS

AR   Augmented Reality

API   Application Programming Interface

UI   User Interface

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Chapter 1

Introduction

In this chapter, the problem statement and motivation of the project, research objective, project scope and direction, project contribution, and project organization will be presented.

1.1   Problem Statement and Motivation

Nowadays, with the improvement of technology in the electronics sector, electronic industry was manufacturing the electronic products that implement high technology with specific design to meet the customer requirement. The electronic appliance nowadays was design to bring convenient to customer and it also make customer daily life become more comfortable. When the function of the electronic appliance has improved by high technology, the pattern design of the electronic appliance also had to improve to bring convenient to customer. However, when a pattern of electronic appliance was designed to be more convenient, the pattern of the modern electronic appliance may have different compared to the traditional electronic appliance. Some customers may have challenge to differentiate what is that electronic appliance because the pattern of electronic appliance may wholly be different with the traditional pattern in their memory. Hence, it is important to help customers differentiate what is the type of electronic appliance. By applying the object recognition technology, system will help user to recognize what is that electronic appliance and display the information of that electronic appliance to the customer.

Sometimes, there will have a scenario of an electronic appliance shop that the shop did not have sufficient worker to serve customer introduce to the information of electronic appliance. If the buyer can search the information of electronic appliance by themselves, needed of worker to serve the customer will be reduced. By applying object recognition technology, customer can use the system to help them recognized the electronic appliance and search the information of electronic appliance by themselves. Most of the time, customer need the worker to serve them is to introduce the information of electronic appliance because they did not know about the type and

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brands of the electronic appliance. By using object recognition technology, the key information of electronic appliance will be display on screen after the system recognized the object. This project will become an important tool to the electronic appliance shop to help them save human resource. By object recognition technology, customer can use the application to recognize the product that sell in shop, and they are able to find the information of the recognized electronic appliance through the application by themselves. This application was developed to bring convenient for both customer and electronic appliance shop workers.

Most of the time, when a person looking for an electronic appliance, they will do research based in the budget they have before they purchase the electronic appliance. To define what kind of specification of electronic appliance they can purchase based on their budget will be a challenge for the buyer. Thus, customer need a platform to discuss, ask and share their opinion and experience on purchasing electronic appliance. In this project, this application will provide a social media platform to the user, user can share their experience or ask question on social media platform. By sharing and searching on user experience about an electronic appliance, user can understand about the quality of electronic appliance and the suitable price of that electronic appliance belongs to. By using this application, user will be able to determine what quality of electronic appliance they can purchase based on their budget by collecting the user experience from different users.

1.2 Project Objectives

The main objective of the project is a development of object recognition mobile application that can recognize electronic appliances by applying machine learning skills. User can scan the object by using the camera of the device. When the application recognised the object successfully, system of application may link to other function that implement into the application. Some function such as add the recognized item into cart, display object information etc. Object recognition technology will be an important technology to develop an unmanned store by combining different function with object recognition technology to conduct a business procedure. In this project, the function that linked with object recognition technology is a function that will display the information of the object with AR frame surround the object on

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the screen on screen to tell user what the object is. The AR frame with information will appear on the screen of camera in the device.

Another objective of the project is to propose an application that function as an object information gallery. This application will collect and store different type of information of the object into the application and provide an object catalogue to the user. User can use this application to do research on the object that record in the system. Nowadays, most of the people will do research on the information of items such as price, function, and efficiency of the item before they purchase the product. This application will provide a nice platform to the user to search on the information of the object they wish to purchase. By providing the details and information of the object to the user, user will have better understand on the object. Therefore, it will reduce the probability of user deceived by the merchant due to lack of information about the product.

Last objective of this project is to provide a social media platform to the user of this application and allow them to share their user experience after using an electronic appliance. This application will provide a community function that allow all the user of this application connect with others user to communicate with each other by post and share their experience in the community. Asking the user experience of a product will be the simplest way to determine the quality of product. A product that has good user experience will recommended by a user when they are sharing their user experience. This application will be a good platform for user to communicate and share their user experience of a product.

1.3 Project Scope and Direction

The main project scope of this project is machine learning which need to develop an object recognition mobile application that can recognize electronic appliances by applying machine learning skills. This application will allow user to use their device real-time camera to scan different object in physical world then the application will recognize the object and display the information with an AR frame surrounding the object on screen to tell user what the object is. Except using camera to recognize the object, application will also provide another method to the user. User can upload an

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image from the storage of the device to application, then the application will recognize the item in the image,

Another project scope will be mobile application development which need to design and develop an application to function as an album that store different information of the electronic appliance. In this application, the electronic appliances information will be store into two main category which are electronic appliance type and manufacturer brands. User can search the information by select the category. An index page of electronic appliance will provide to the user. Hence, user can select the index of electronic appliance that they want to search. The information collected will include the price, specification, extra function of the electronic appliance etc. This application will be a good platform to let user understand the latest information of the electronic appliance.

Last project scope of this project is also involved in mobile application development which need to design and develop a social media platform to connect all the users of this application. In this application, there will have a community function that connect all the user of this application and act as a social media platform to the user, Users are able to share their experience by posting a post in community module. In their post, they can type in the message and upload the image they want to share.
After finish editing their post, user can post their post in the community and this post can view by others user, beside post a post, user also can interact with the post they saw by click on like button or share the post to others user or leave a comment on that post to communicate with another user. The community or social media function of this application will become a good platform for users to interact with each other.

1.4 Contributions

Nowadays, technology around the world have well development. With the improvement of technology, people are seeking for the life that have more convenient environment so they will have high demand towards the electronic appliances to improve their life quality. The development of high technology electronic appliance had changed the design pattern of electronic appliance to implement more function into it. Thus, it will have different on pattern

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design between traditional and modern electronic appliances. Due to the different design pattern of electronic appliances, some user did not keep up to date the information of modern electronic appliances, it will become a big challenge to customer to differentiate the type of electronic appliance. This project implements the object recognition technology that will help user to recognize the object and display information to tell user what the object is. Besides, this application will provide different function and different searching method to the user. They can search for electronic appliance information that available in electronic appliance store. Thus, this application will contribute a good application for public to do research on electronic appliance. Lastly, this project can contribute for [1] self- service area. Object recognition system will be a new revolution in self-service area. In a electronic appliance store, customers can scan the electronic appliance with a camera of device, the system will recognize the products. After system recognized the product, system can link to other process such as add them in to cart, displaying the price, payment process etc. Object recognition system make the process of shopping in a electronic appliance store become more convenience.

1.5 Project background

Object recognition is a computer vision technique for identifying objects in images or videos. Object recognition is the output of machine learning and deep learning algorithm. The goal of object recognition is to teach a computer identify an object like what human do. Object detection and object recognition are similar techniques for identifying objects, but they vary in their execution. Object detection is a process of finding instances of objects in images while object recognition is a process of not only identified but also located in an image. Object recognition allow to locate and recognize multiple objects in a same image.

Mobile object recognition [2] is categorized into two phases which are object detection and object identification. In object detection phase, an object detection method is used to define the area and the location of an object in an image. The algorithm developed will considers mobile devices limitations and makes some assumptions which are the camera is point towards the object they wish to detect, and the object will frequently appear on the image central area and another assumption is the image background has a homogeneous texture. The image will separate into two region which are interior region and exterior region. Interior region will perform object detection while exterior region is used for comparison. After the separation, those regions are divided into non-overlapping blocks then, the blocks assessment stage is

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performed to the interior block is belongs to an object or not. First, the variance of pixels grey level values is calculated for the exterior blocks separately, to obtain the maximum variance between these blocks, the variance is calculated for each interior block. Finally, the algorithm decides if one block belongs to an object by comparing the variance of each block with the maximum variance. This procedure is applied to all interior blocks and the area that includes the object is updated iteratively, according to the comparison results. In object identification phase, after the object detection method, a normalization technique is applied. Different objects can have very different shapes. The normalization phase consists of extracting the object area and set it to a default format then the algorithm will perform the process of object identification.

1.6 Report Organization

The details of this project will be organized into five chapter which are Introduction, Literature Review, Proposed Method/Approach, Preliminary Work and Conclusion.
First chapter is the introduction of the whole project. In this chapter, the content was separate into 6 part which are problem statement and motivation of this project, project objective, project scope, project contribution and project organization. Second chapter will be the literature review of existing object recognition mobile application. In this chapter, there are 3 object recognition application will be carried out, the strengths and weakness of each application will be evaluated.

Third chapter is to introduce the proposed method or approach on this project. In this chapter, design specification of the project will be discuss including the software process model, user requirement, hardware and software needed in development process. Besides, system design of this application will also discuss on this chapter such as the design flowchart of whole application system, flow chart of each function module and the design architecture of this application. Chapter 4 will discuss on the preliminary work of this project. The preliminary work in this project will be model training. This chapter will introduce on the software installation and method of how to train a model successfully by using TensorFlow. Last chapter of this project will be a conclusion that conclude the whole project.

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Chapter 2

Literature Review

In this chapter, some related works on object recognition application that develop by other developer will be presented. There are four object recognition application that use to recognized different object and one object recognition mobile application paper will be presented in this chapter.

2.1 Review on Journal Articles

2.1.1 Papers Reviewed on Glimpse: Continuous, Real-Time Object Recognition on Mobile Devices

In the past few years, many researchers about Augmented Reality based Object Recognition system have been done by researcher in different field. The research in Augmented Reality (AR) based Object Recognition on mobile device was done by [3] The authors propose Glimpse, which captures full-motion video, recognizes and labels objects of interest, and tracks them from frame to frame. The main contribution of this work is that Glimpse uses an active cache of video frames on the mobile device to regain accuracy when the latency between the server and mobile device is higher than a frame-time.

Glimpse system has been implemented for Android smartphones, Google Glass, and Linux, using the OpenCV library for computer vision tasks. The Android implementation uses C++ code for faster computation and separate threads for receiving camera frames and computation. Object tracking is performed using the Lucas-Kanade function, and frames are stored in grayscale format for efficient processing. The Glimpse server implements road sign and face recognition pipelines using convolutional neural networks and support vector machines. Viola-Jones object detector is used for face detection, and semantic facial landmarks are extracted for feature extraction. The system also supports retrying in case of network failures and local object recognition for disconnected operation. The active cache and trigger frames remain important for efficient processing. Overall, the Glimpse system offers a robust and efficient object recognition solution for mobile devices.

The challenges of developing continuous, real-time object recognition applications on mobile devices due to the required computationally intensive computer-vision algorithms that must run at the real-time rate of 30 frames per second. To achieve high trackability, object recognition tasks must be offloaded to more powerful servers, but offloading must be applied

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with care as wireless network latencies are too high. To address these challenges, the paper presents the design, implementation, and evaluation of Glimpse, a continuous, real-time object recognition system that achieves high trackability while reducing the amount of network bandwidth consumed relative to alternative designs. Glimpse achieves high trackability by maintaining an active cache of frames on the mobile device and computing over the cached frames using stale hints that arrive from the server to estimate an object's location in the current frame. Trigger frames are used to strategically send only certain frames to the server to obtain object recognition hints, reducing bandwidth consumption. The active cache and trigger frames are generic techniques that may be applied to a wide range of real-time, vision-based systems. The article evaluates two versions of Glimpse, software, and hardware, and presents experimental results that demonstrate significant improvements in precision for face and road sign recognition due to the active cache.

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2.2 Previous works on object recognition application

2.2.1   Plantsnap

Plant is a living organism in the world and according to researcher, there are about 435,000 species of plants on the earth. Same species of plant also have different plant and each plant has different and similar characteristic. Some species of plant was very rare and some of the species was very common. Due to huge amount of plant species, differentiate a plant will be a huge challenge for a human because human cannot remember all the plant species, even most popular plant species is also hard to differentiate accurately by non-professional human. Plantsnap is a plant identifier application that applying object recognition technique to recognized distinct species of plants. Plantsnap provide a platform to non-professional user to differentiate the plant correctly by snapping a photo of plant and then the application will display the result that stored in database and tell the user what the plant is. According to Plantsnap team [4], Plantsnap can identify almost 90% of known plants and tree, and they have more than 600,000 plants information been store in their database. Besides, Plantsnap also provide the accurate result in 37 language that's mean Plantsnap can works everywhere on the earth. The image below shows the user interface of Plantsnap.

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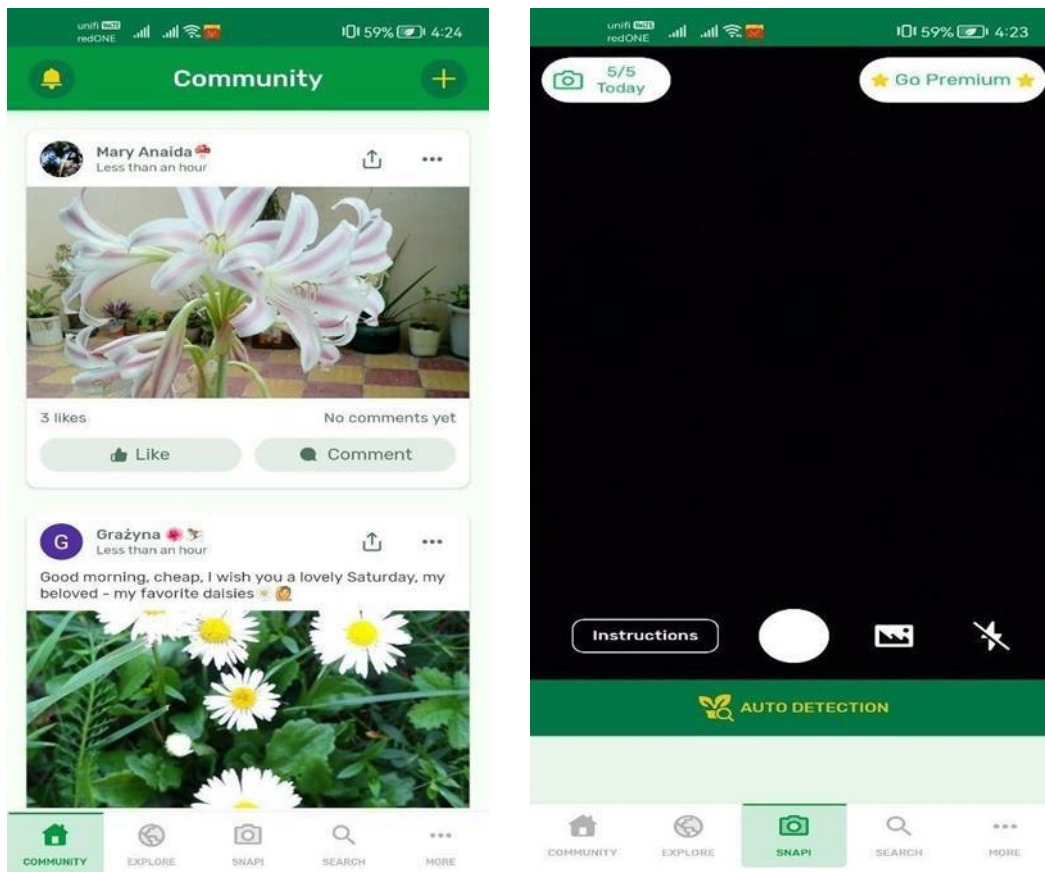
Figure 2.2.1 UI design of Plantsnap

Plantsnap allow the user to use their device's camara to recognize the plant, user only need to hold the camera on plant, Plantsnap will located the plant automatically. When user click on the circle that located the plant, it will show the most possible result to the user. To prevent user cannot use camera to recognize the plant, Plantsnap also allow to identify the plant through the image in the storage. When Plantsnap successfully identify the plant, it will display all the information of most plant to the user. One of the strengths of Plantsnap is user can drag the image of result to zoom in and out the image. Besides another strength of Plantsnap is Plantsnap will provide a video tutorial to guide user on how to operate the plant recognition function of the application. Last strengths of Plantsnap is user can directly find out the market or shop that sale the plant identify by the Plantsnap. When user get the result of plant, there is a button will display the nearby market and the price of the plant to the user so that user did not search for the market outside the application when they want to purchase the plant.

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Although Plantsnap have many strengthen, but it also has some weakness. First weakness will be the database of Plantsnap. Plantsnap only allow user to type in the key words to search on the information to store in database, if without the information of plant, user unable to search on the plant. Another weakness is the object recognition system of Plantsnap cannot locate the non-flowering plant automatically. Users need to manually locate the non-flowering plant to let Plantsnap identify the plant.

The first weakness of Plantsnap can solved by adding an interface that show a list of plant information attract from database. Plantsnap can categorize the plant in database by their species and show a list of plant in that function so that the user can click on the plant that they interest and search for the plant information. Second weakness of Plantsnap can be solved by improve the non-flowering plant model training. Increase the dataset of non-flowering plant when training the model will improve the accuracy of result and helps in locate the non-flowering plant accurately.

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2.2.2 Vivino

Vivino [5] is an online wine market application, and it was the world's largest wine marketplace. Although Vivino is an online wine market application, but Vivino had provide an object recognition function to the user. User can use camera to scan on the wine label, then Vivino will display the information of most possible wine result to the user. The images below are the user interface of Vivino.
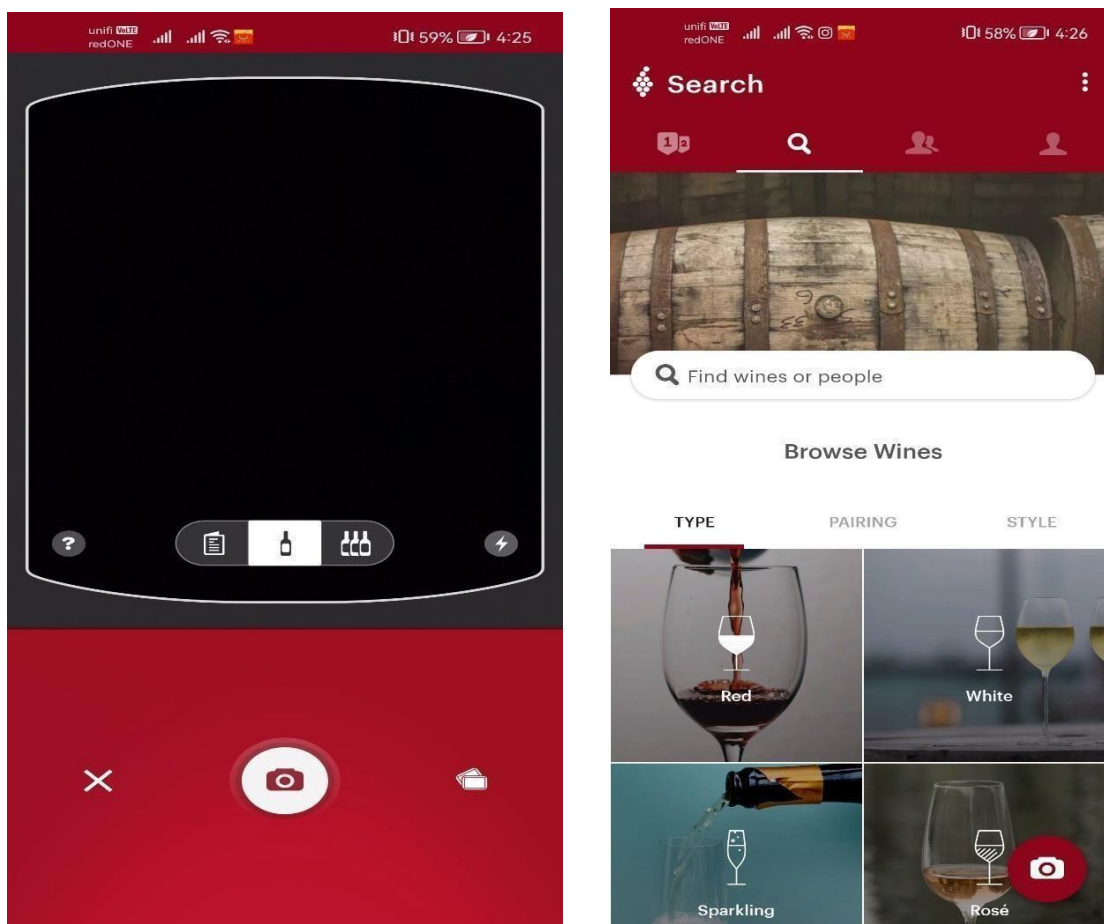
Figure 2.2.2 UI design of Vivino

Vivino can recognized the wine by scanning the wine label by different method. Beside using the real-time camera to scan and take an image of wine label, Vivino also allow user to scan the image of wine label from device storage. The strength of Vivino compared to similar application is Vivino provide a search list that store different wine information in the application and each wine information are categorized in their wine type and manufacture

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country. Besides, Vivino also categorized the wine by their best recommended meal such as beef, pasta, lamb etc. It is a good function that suitable for the user who are new to drink wine, Vivino will tell the user which wine is suitable to which type of meal by searching the wine in the wine list. Another strength of Vivino is it can connect to social media such as Facebook and Twitter. User of Vivino can connect to social media and looking for others wine lover in social media to share their wine experience. There is also a community function that can let user post a post to share their experience.

Although Vivino have much strengthen, but it also has a limitation Vivino is an online wine market application, but it did not provide any method ti user to purchase their favourite wine. User of Vivino only can add the favourite wine into wish list but did not have any method to purchase the wine via application. Vivino application only provide the function of wine label recognition, community, and a wine list to search on wine information. If user wish to purchase wine, they had to go to Vivino official website to purchase the wine,

This limitation can be solved by develop and implement a system into application to provide a purchase method for user. This system will show the nearest store that sell the wine search by user. Besides, Vivino also can develop a system and cooperate with wine retailer to conduct online business so that user of Vivino can purchase wine through the application.

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2.2.3 Pinterest

Pinterest [6] is a visual searching engine application that use to search for idea such as home living style, receipt and others. Pinterest provide a special searching method to the user which is user provide an image to Pinterest and it will recognize the object on the image. Once the object on the image was recognized, Pinterest will display the similar image or photo to the user. The images below are the user interface of Pinterest.
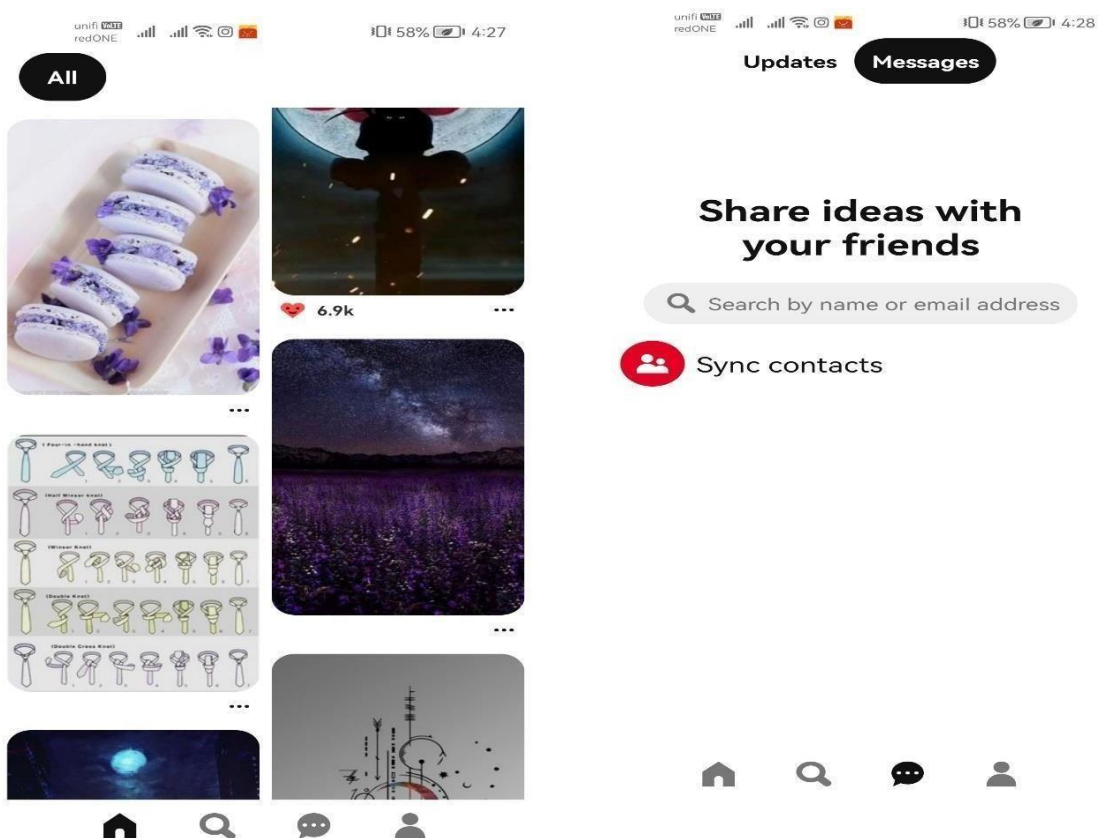
Figure 2.2.3 UI design of Pinterest

The strength of Pinterest is it allow to user to select on the theme that they interest when they first time login to their account. After user select the theme, it will display the image that related to the theme selected on the main page. Another strength of Pinterest is it can connect to social media and search on the friend who have use Pinterest. After connecting to social media, user are allow to communicate with others user in Pinterest. There is a chat function in Pinterest and this chat function allow user to send message and chat directly with another user.

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Besides connect to social media, Pinterest also allow user to synchronize the contact list of user device so that user can search for the other Pinterest user in their contact list.

The limitation of Pinterest is the themes selection that provide to the user is only once which is the first-time login of the user. User cannot change their interest theme in application after first-time login to Pinterest. User had to think carefully before they select the theme that interest due to the interest themes cannot be change easily. Another limitation is the function implement in Pinterest is too little. Pinterest only provide chat function, search function and social media function. It did not have a community for user to share their post, did not have an image list provide to user to do research.

The limitation of Pinterest can be solved by develop and implement more function into Pinterest to diversification the application. An image list that categorized with different themes can provide to the user since they cannot change their interest theme so that they can search on the image in image list. Besides, adding a community function to allow user to share their experience by post a post and other user can share or comment on that post. This function will help user to have better interaction with other social media user who have connected with Pinterest.

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2.2.4 Google Lens

Google Lens [7] is an advanced image recognition technology developed by Google that allows users to use their smartphone camera to copy or translate text, identify plants and animals, explore locales or menus, discover products, find visually similar images, and take other useful actions. It uses computer vision and machine learning algorithms to identify objects and provide relevant information and actions based on what it sees. Google Lens can recognize various types of objects, such as landmarks, plants, animals, books, products, and more. It can extract text from images and translate it into different languages, scan QR codes and barcodes, and even help users find similar items to what they have captured. Google Lens is integrated into various Google products, including Google Photos, Google Assistant, and Google Search, allowing users to access its features directly from these applications. With its powerful visual search capabilities, Google Lens has transformed the way we search for information, making it more intuitive and seamless than ever before.
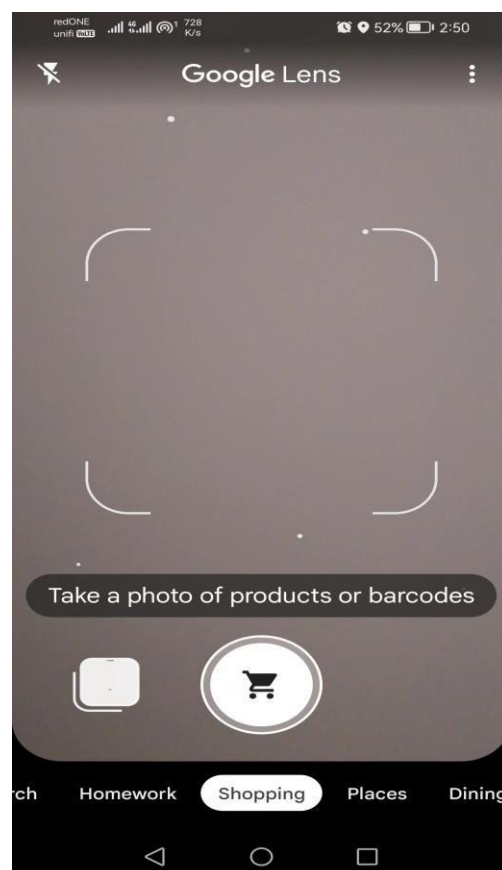
Figure 2.2.4 UI design of Google Lens

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The greatest strengths of Google Lens is its advanced image recognition capabilities, which are powered by Google's machine learning and computer vision technologies. It can identify a wide range of objects, from plants and animals to products and landmarks, and provide relevant information and actions based on what it sees. Additionally, Google Lens is seamlessly integrated into several Google products, such as Google Photos, Google Assistant, and Google Search, making it easy for users to access its features directly from these applications. Furthermore, Google Lens can extract text from images and translate it into different languages, making it an excellent tool for travelers and students who need to quickly translate foreign text. Finally, Google Lens also supports augmented reality, allowing users to view additional information and interact with virtual objects superimposed on the real world.

The limitation of Google Lens is firstly, it may not be available in all regions, limiting its accessibility. Secondly, Google Lens requires an internet connection to work, which can be an issue in areas with poor connectivity or when traveling abroad. Moreover, while Google Lens is generally accurate, it may not always provide accurate results, particularly when identifying obscure objects or in low light conditions. Finally, Google Lens relies on image recognition and analysis, which raises privacy concerns around data collection and usage. Overall, Google Lens is a powerful tool that offers many benefits but also has some limitations that users should be aware of.

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2.3 Summarize and Comparison Between previous works on object recognition application and proposed application.

Application	Plantsnap	Vivino	Pinterest	Google Lens	Proposed application
Platform	Android	Android	Android	Android	Android
Recognized object by real-time camera	False	False	False	True	True
Take an image by camera	True	True	True	True	True
Recognized object through image taken	True	True	True	True	True
Upload image from device storage	True	True	False	True	True
Connect to social media	False	True	True	False	True
Community function	True	True	False	False	True
Post a post	True	True	False	False	True
Like, share and comment on post	True	True	False	False	True
Object information list	False	True	False	False	True
Connect to database	True	False	True	True	True
Offline	False	True	False	True	True
Locate user location	True	False	False	False	False

Table 2.3 Summarize and Comparison Between previous works and proposed application.

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Chapter 3

Proposed Method/Approach

In this chapter the design specification, system architecture, use case diagram and description and activity diagram of this project will be presented.

3.1   Design Specifications

The software process model that selected to use in this project is agile development. Agile development [8] approach is use in this project because it is suitable for small and medium scale system, and it can deliver a software in short period and the system is able to change frequently based on the requirement. It only needs minimal documentation so that the development of this project will more focus on coding to make sure all the objectives can be achieved and develop completely. The agile methos that focus on this project is scrum method. Scrum method [9] is focuses on managing iterative development rather than specific agile practices. There are 3 phases in scrum methos which are initial phase, project sprint cycle and project closure phases. First phase will be including the project initiation, planning and estimation. Project sprint cycle will be the system or module implementation of the project and last phases is reviewing and releasing the module that implement before.

Figure 3.1 Scrum Method

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Initial phase

The initial phase is an outline of initial planning phase that establish the general objective of the project. In this phase, system architecture and software architecture will be design completely. Time estimation to complete each sprint will be determine in this phase.

Sprint cycle

Each sprint cycle will develop the increment of the system. Each print cycle has fixed length normally are 2 – 4 weeks for a sprint. In each sprint cycle, the product backlog which is a list of work to done will be planned and complete. Once a sprint cycle had complete, next sprint cycle will start follow by the other sprint.

Project closure phases

project closure phases complete the required documentation and wrap up the project. In this phase, feedback from the user will be collected and discuss on the improvement of result from each completed sprint. After reviewing the result, the final product which is the outcome of the project will deliver and release

3.1.1 User requirement (user story)

Sprint 1

Sprint Goal

To implement "login" module of the user account to manage the account used by user to access the application.

Sprint Backlog

1. As a user, I can create my own account
2. As a user, I can fill up my personal information
3. As a user, I can key in the account that I want to log in
4. As a user, I can type my account password
5. As a user, I can retry my account password when I key in wrong password
6. As a user, I can change my account password if I forget my password

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Sprint 2

Sprint Goal

To implement "Community" module to propose a community area let user to share their experience with other users.

Sprint Backlog

1. As a user, I can create a post.
2. As a user, I can type my message on my post.
3. As a user, I can upload a picture on my post.
4. As a user, I can post my post and show to other users.
5. As a user, I can view other user's post.
6. As a user, I can like the post I like.
7. As a user, I can share the post I like.
8. As a user, I can comment on other user's post.

Sprint 3

Sprint Goal

To implement "Object recognition" module to let users can on the object they want to recognize.

Sprint Backlog

1. As a user, I can recognize the object through application.
2. As a user, I can recognize the object with my device camera.
3. As a user, I can recognize the object in the image.
4. As a user, I can upload the image from device storage.
5. As a user, I can know what the object is that application recognized.

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Sprint 4

Sprint Goal

To implement "Search" module to propose a object list to the user and user can search for the object information that recorded in application after select the object card view

Sprint Backlog

1. As a user, I can search for the object information.
2. As a user, I can search for the object categories by different type or brand.
3. As a user, I can view a list of objects.
4. As a user, I can select the object I want to view.
5. As a user, I can view the object information in object list.

Sprint   5

Sprint Goal

To implement "Information" module to display the account information and application information to the user and user is able to edit and change their personal information in their account.

Sprint Backlog

1. As a user, I can view my personal information in my account.
2. As a user, I can view my account information.
3. As a user, I can edit my personal information.
4. As a user, I can upload an image as my profile picture.
5. As a user, I can log out my current account.

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3.2 System Architecture

3.2.1   System Architecture Design
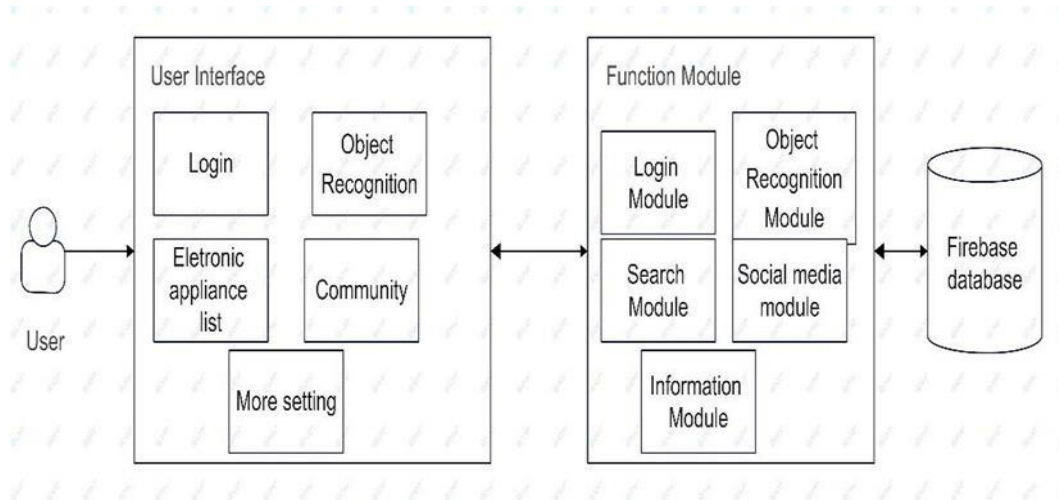
Figure 3.2.1 System Architecture diagram

Figure 3.2.1 is the system architecture of the project, users will interact with application user interface, the user interface will display data of service provided andthe button allow users to control the services. The control button will connect to function module and function module will connect to database, every change that done by user will stored in database. Besides, the function module can access to database and retrieved the data from database. The data retrieved will display on userinterface and show to users.

3.2.2   Login System Architecture
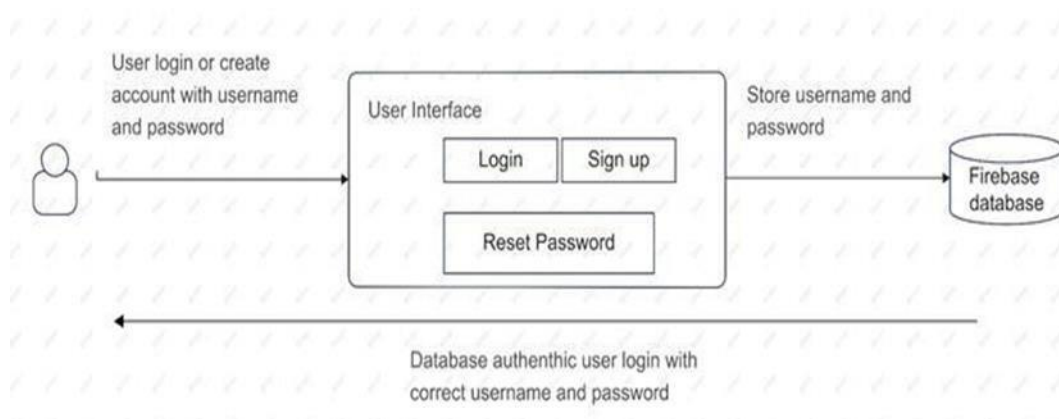
Figure 3.2.2 Login System Architecture Diagram

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Figure 3.2.2 is the login module architecture diagram, when user login their accountin user interface, the username and password that entered by users will send to database, database will do authentication after user click on login button, an error message will display to user when username or password was incorrect. When user create a new account or reset their password, the information data will save in database.

3.2.3 Mobile Application Network Architecture
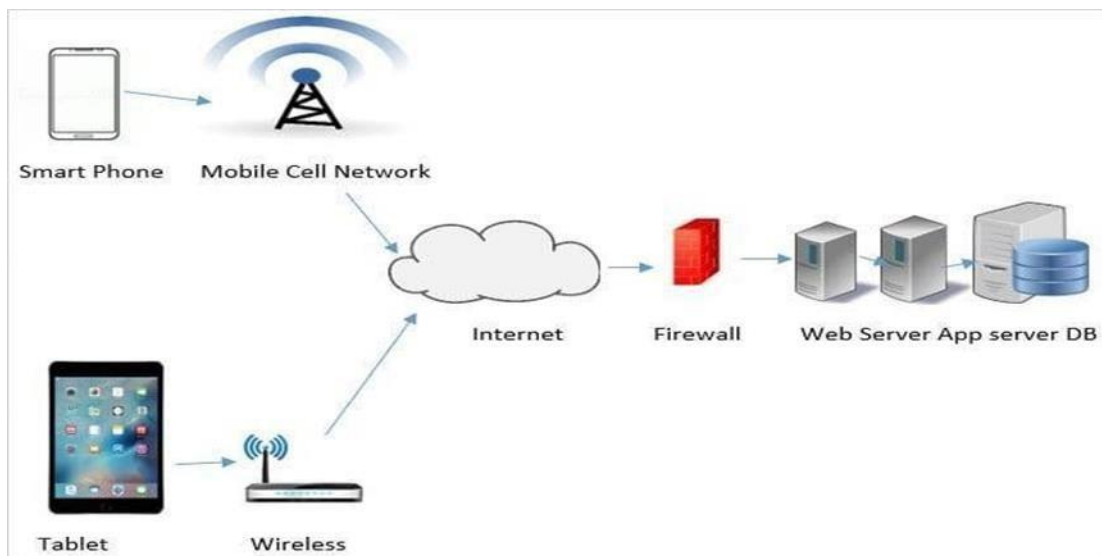
Figure 3.2.3 Mobile application network Architecture Diagram

Figure 3.2.3 shows the mobile application network architecture of this project. In this project, the application is a native mobile application [10] which is an application that run on the operating system of mobile devices. Figure 3.2.3 shows the devices such as mobile phone and tablet was connect to Wi-Fi or cellular network such as 3G,4G to connect to the internet. After connecting to internet, mobile devices can access to the server that protected by the firewall. In this project, users of this application will use their mobile device connect to internet to get the service that provide by the application such as community function.

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3.3   Use Case Diagram and Description
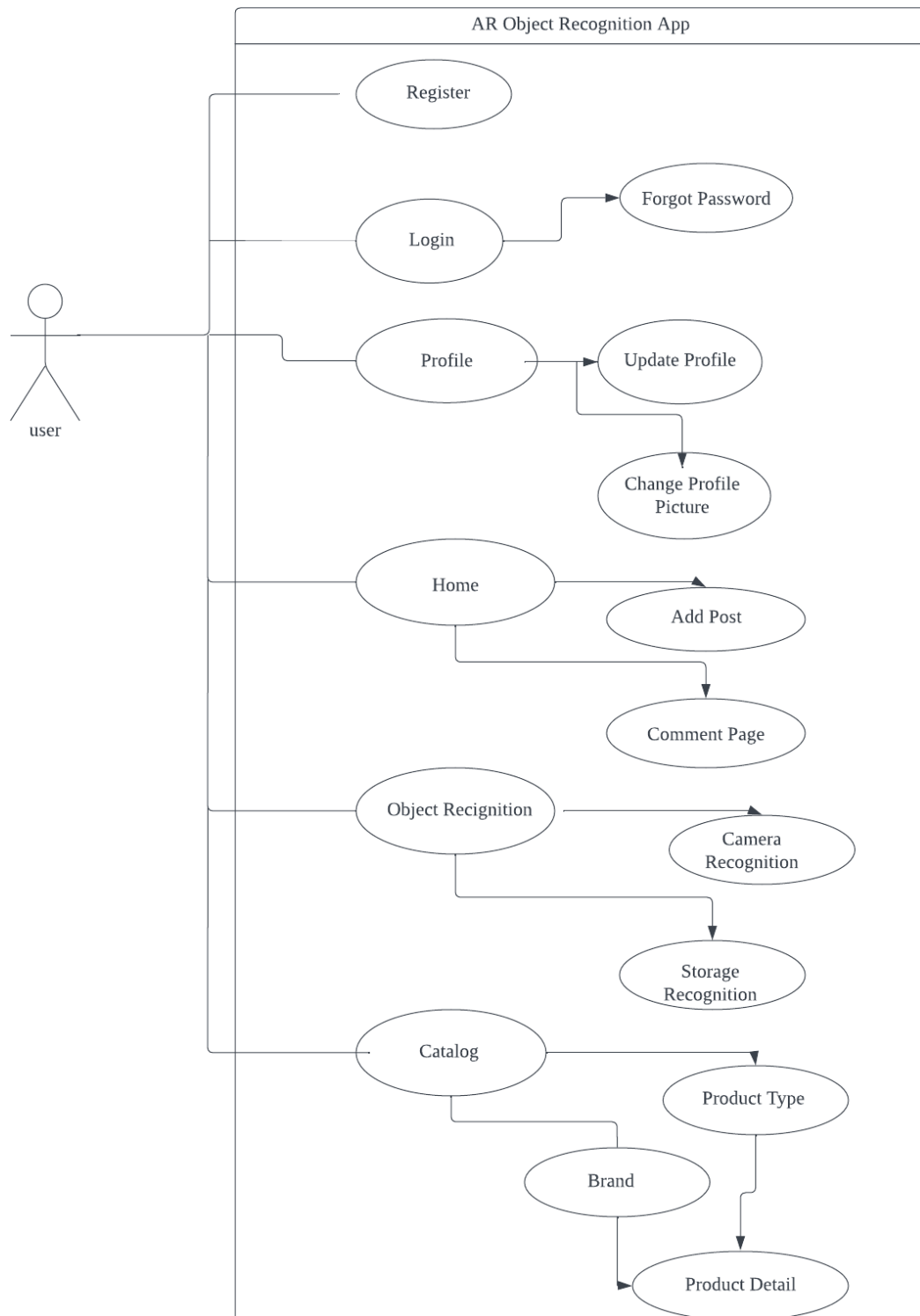
Figure 3.3 Use Case Diagram

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3.3.1 Use Case Description

Use Case	User Registeration
Actor	User
Description	User will create his first account by key in an valid email address and a valid format of password. Once the system checked the email and password key in by user is in valid format, an account will be created when user click on register button
Assumption	1. User enter a valid email address. 2. User enter a valid format of password. 3. User click on register button.
Success Scenario	1. An account was created. 2. A message will display to users when the account created successfully.
Alternative Scenario	1. Email address invalid format. 2. Email address is empty or none. 3. Password is invalid format. **4.** Password is empty or none**.**

Table3.3.1   Register Use Case Description

Use Case	User Login
Actor	User
Description	User login into a registered account by entering correct email address and password. When the email address and password is correct user will be able to login into their account
Assumption	1. User registered an account. 2. User enter a correct email address of an account. 3. User enter a correct password.
Success Scenario	1. User Login into account successfully. 2. User can access the function or service of the application.

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Alternative Scenario	1. Account is not registered.
	2. User enter a wrong email address.
	3. User enter a wrong password.

Table3.3.2   Login Use Case Description

Use Case	Reset Password
Actor	User
Description	User forgot their account password and wish to reset account password. Users are required to key in an email address, an email with a link will send to the email address, user can reset their password in firebase pages by clicking on the link.
Assumption	1. User key in a valid account.
	2. User are available to view the email.
	3. User received the email and click on the link.
Success Scenario	1. User Login into account successfully.
	2. User can access the function or service of the application.
Alternative Scenario	1. Account is not registered.
	2. User enter a wrong email address.
	3. User enter a wrong password.

Table3.3.3   Reset Password Use Case Description

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Use Case	Profile
Actor	User
Description	User can view on their profile page that display their information in profile page. If the profile information did not updated, the information is default or empty, once the information updated, the updated information will display on profile page
Assumption	1. User updated profile information successfully. 2. User updated profile picture successfully.
Success Scenario	1. Updated user profile information will be displayed. 2. Updated profile picture will be displayed
Alternative Scenario	1. User did not updated profile information. 2. User fail to update their profile information. 3. User fail to update profile picture

Table3.3.4   Profile Use Case Description

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Use Case	Object Recognition
Actor	User
Description	User can select to recognized an object by using their device camera or select an image in device storage to recognize the object in image
Assumption	1. User give camera permission to the application. 2. User give storage permission to the application. 3. User use their device camera and point to an object. 4. User successfully pick an image from device storage.
Success Scenario	1. An AR frame will bounded the object that appear on the camera and the name of object will display on the AR frame. 2. A green color frame will bound the object in the image and the name of object will write on the frame.
Alternative Scenario	1. Camera permission or storage permission is not granted. 2. System fails to detect an object in device camera or image

Table3.3.5   Object Recognition Use Case Description

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Use Case	Home
Actor	User
Description	User can see the post that post by other users of this application and interact with the post by click on like, comment or share button of the post. In this page, user is able to share their user experience by publishing a post to the application
Assumption	1. User give internet access permission to the application.
Success Scenario	1. User can view the post publish by other user of the application 2. User can interact with the post by clicking on like, comment and share button of the post. 3. User can like the post. 4. User can leaving a comment under the post. 5. User can share the post. 6. User can publish new post to the application
Alternative Scenario	1. Internet access permission is not granted. 2. User fail to publish a post to application

Table3.3.6 Home Use Case Description

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Use Case	Catalog
Actor	User
Description	User select and view on the product information that record in the application
Assumption	1. User click on the button and select the card view on the list.
Success Scenario	1. A list of products will display to the user after user click on the button. 2. More details or product information will display to the user when user select the product in the product list.
Alternative Scenario	1. User did not click on the button or the product on the list

Table3.3.7 Catalog Use Case Description

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3.4 Activity Diagram

3.4.1 Register Activity Diagram
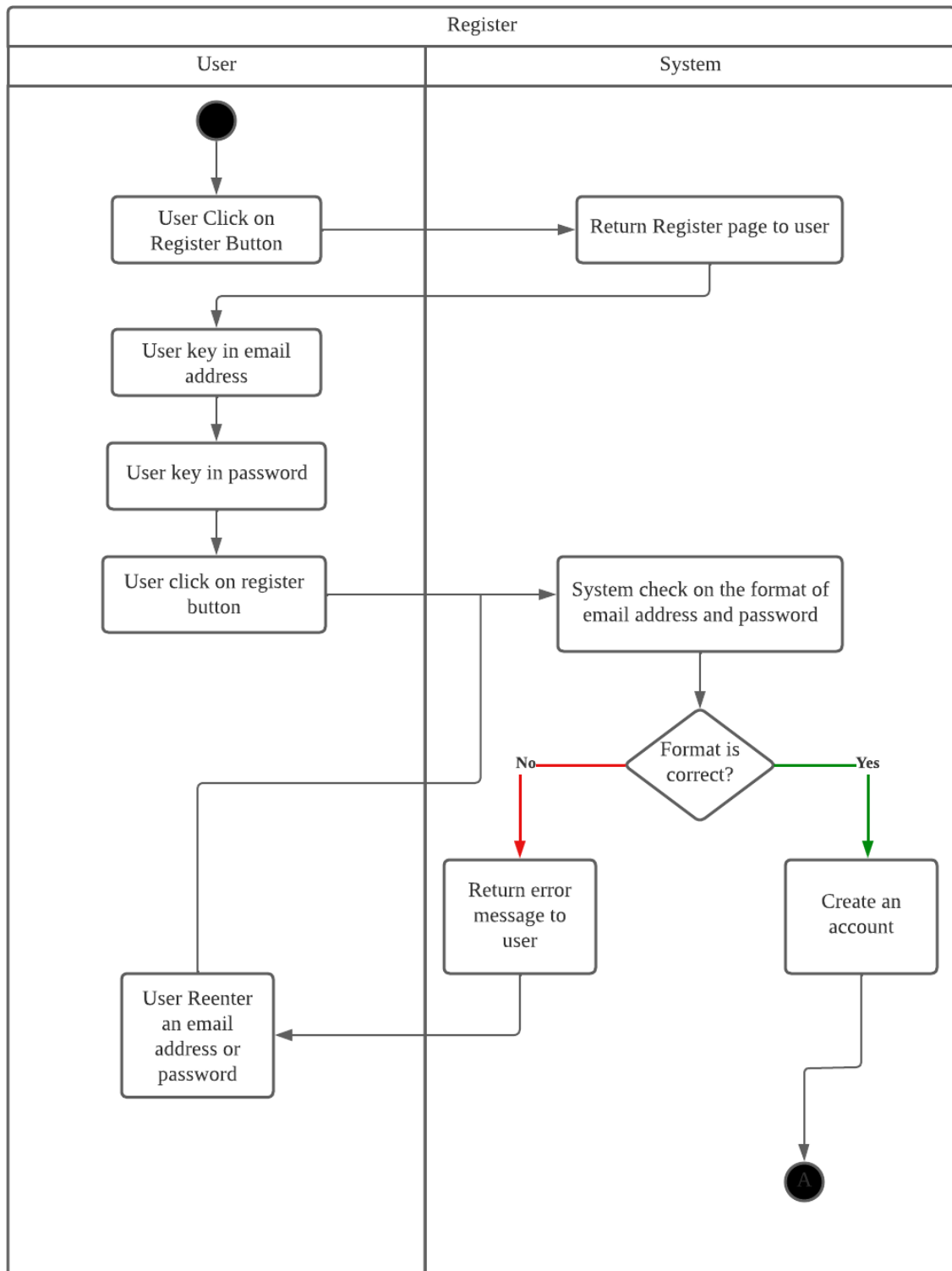
Figure 3.4.1 Register Activity Diagram

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3.4.2 Login Activity Diagram
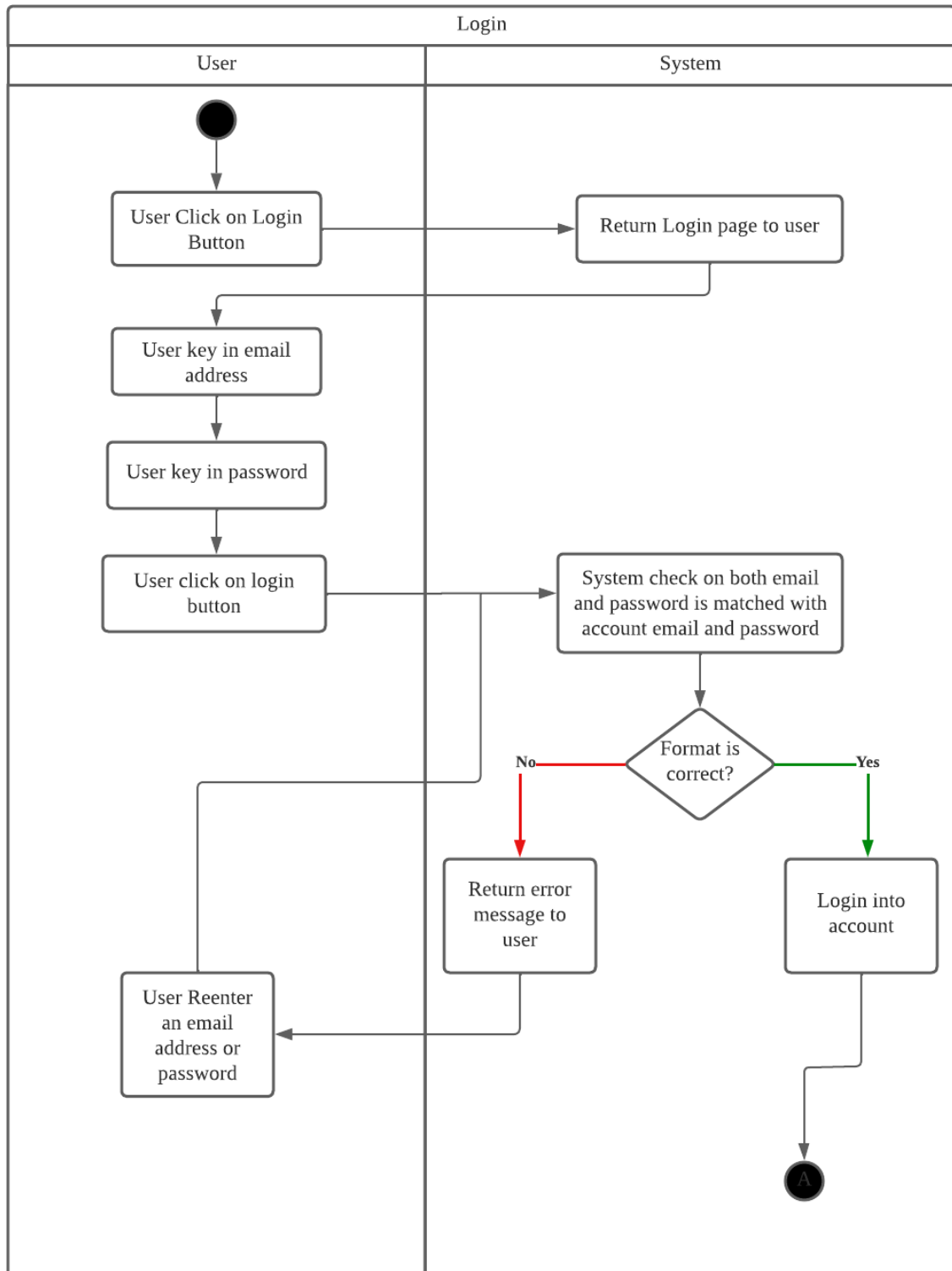
Figure 3.4.2 Login Activity Diagram

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3.4.3 Reset Password Activity Diagram

Figure 3.4.3 Reset Password Activity Diagram

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3.4.4 Profile Activity Diagram
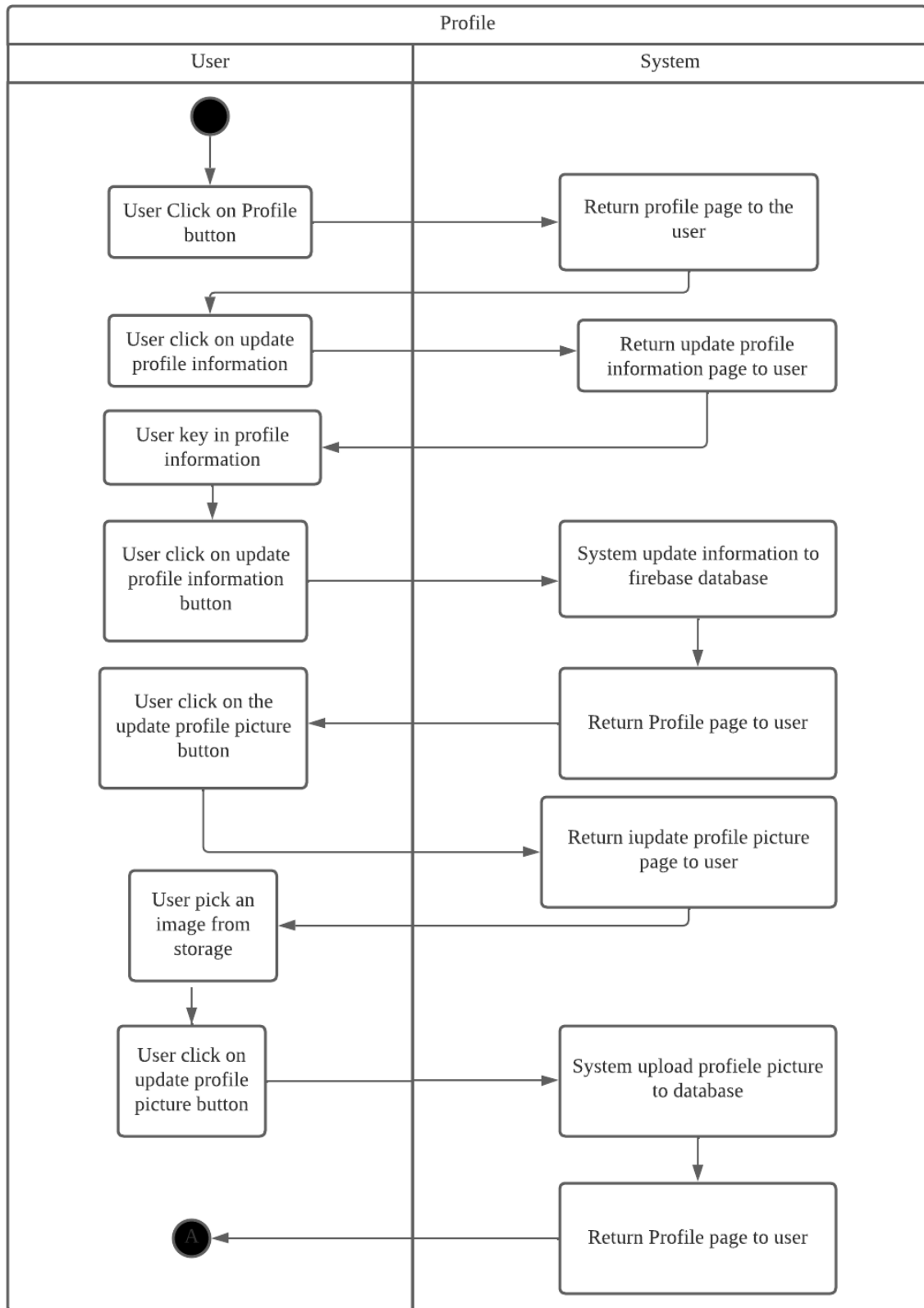
Figure 3.4.4 Profile Activity Diagram

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3.4.5 Object Recognition Activity Diagram
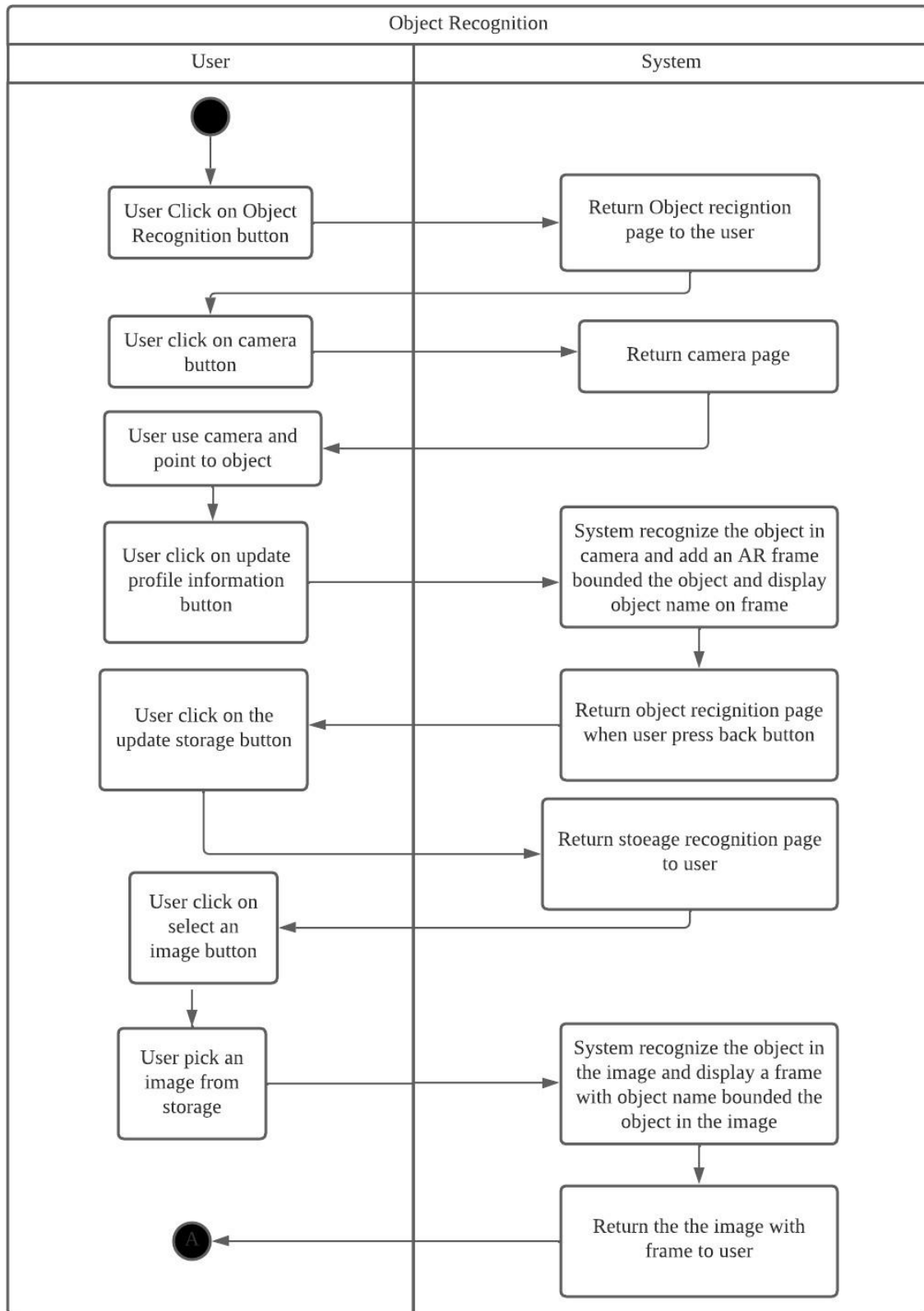
Figure 3.4.5 Object Recognition Activity Diagram

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3.4.6 Home Activity Diagram
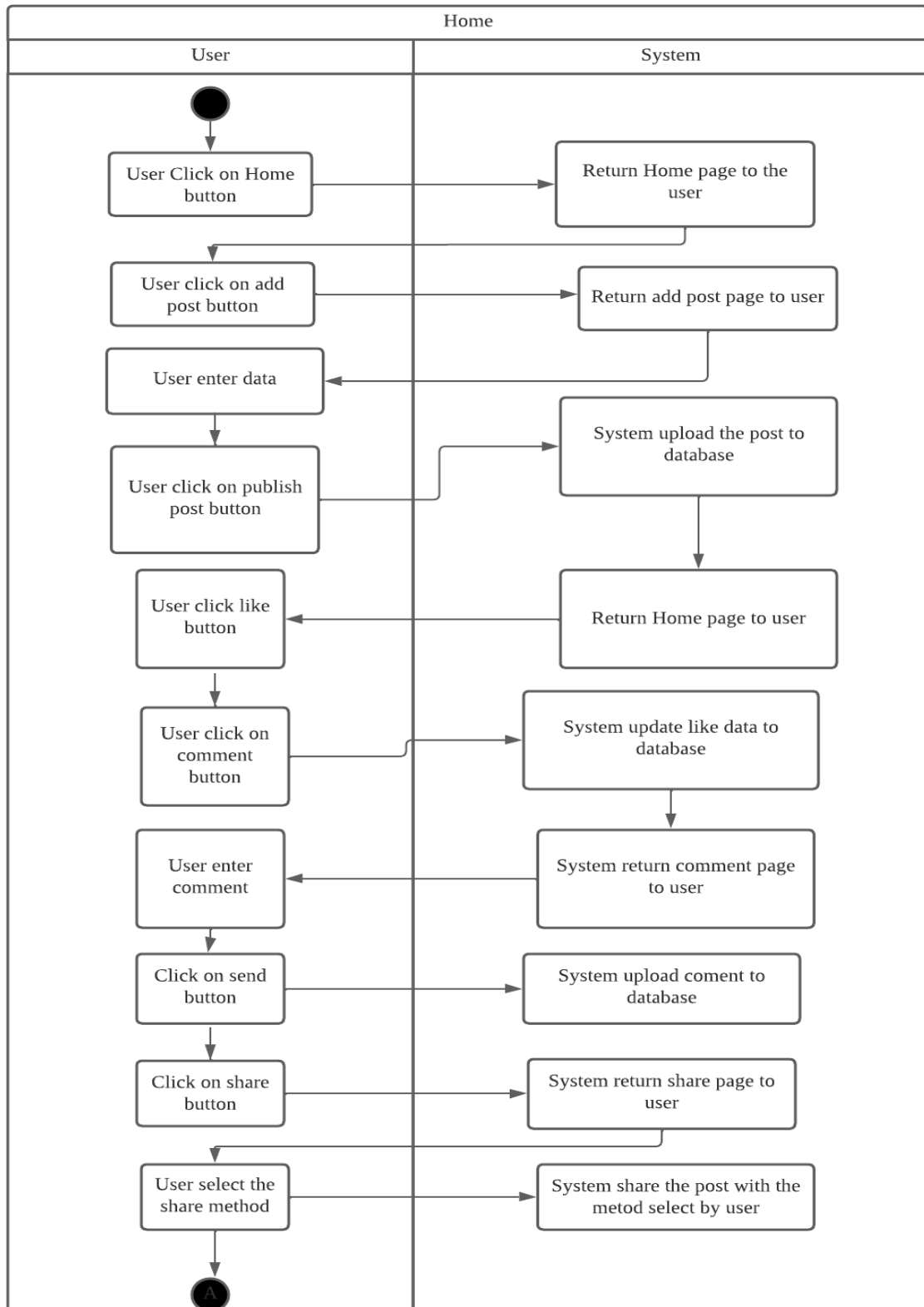
Figure 3.4.5 Home Activity Diagram

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3.4.7 Catalog Activity Diagram
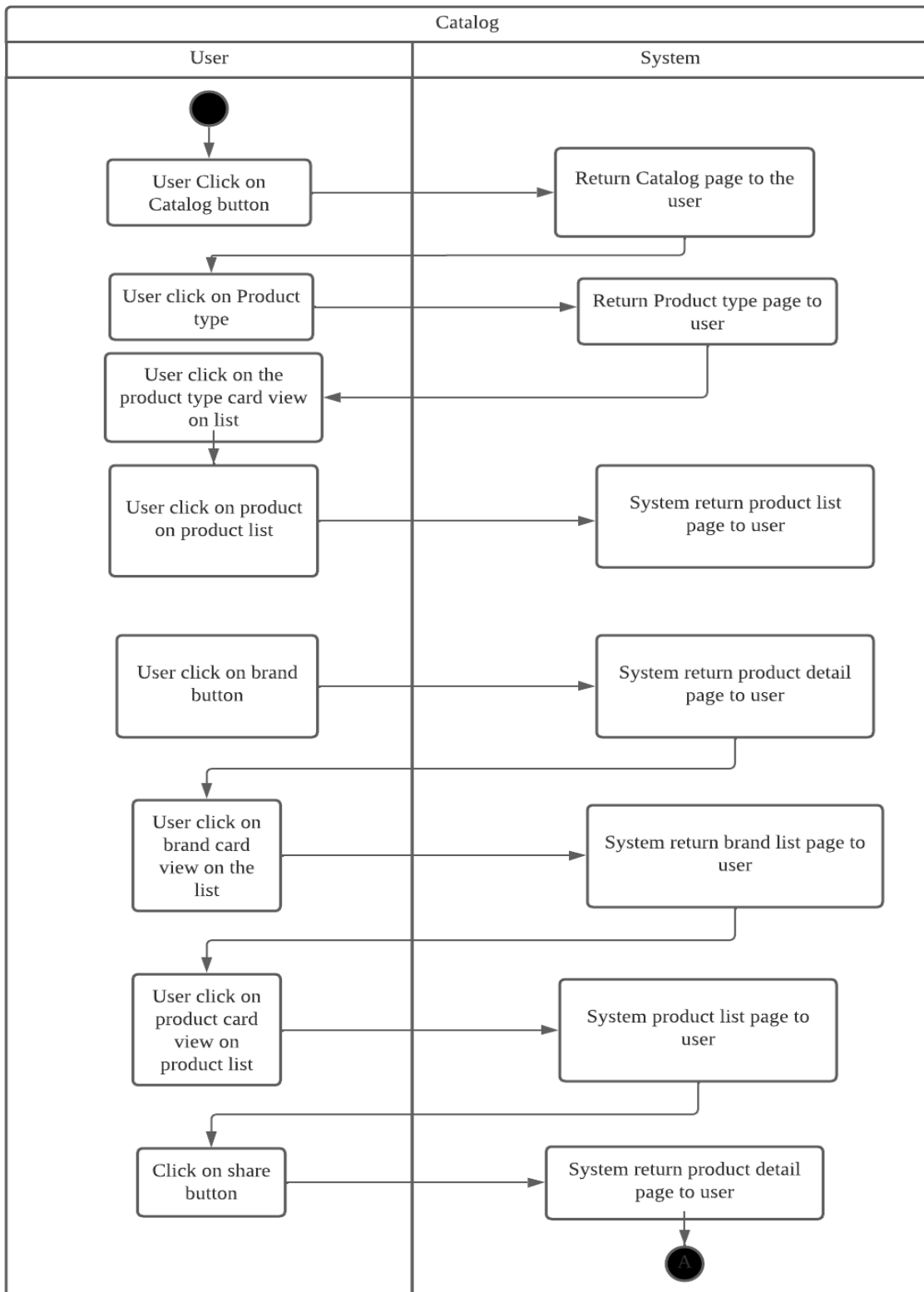
Figure 3.4.6 Catalog Activity Diagram

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Chapter 4

System Design

In this chapter system block diagram, system module and Description will be presented.

4.1 System Block Diagram
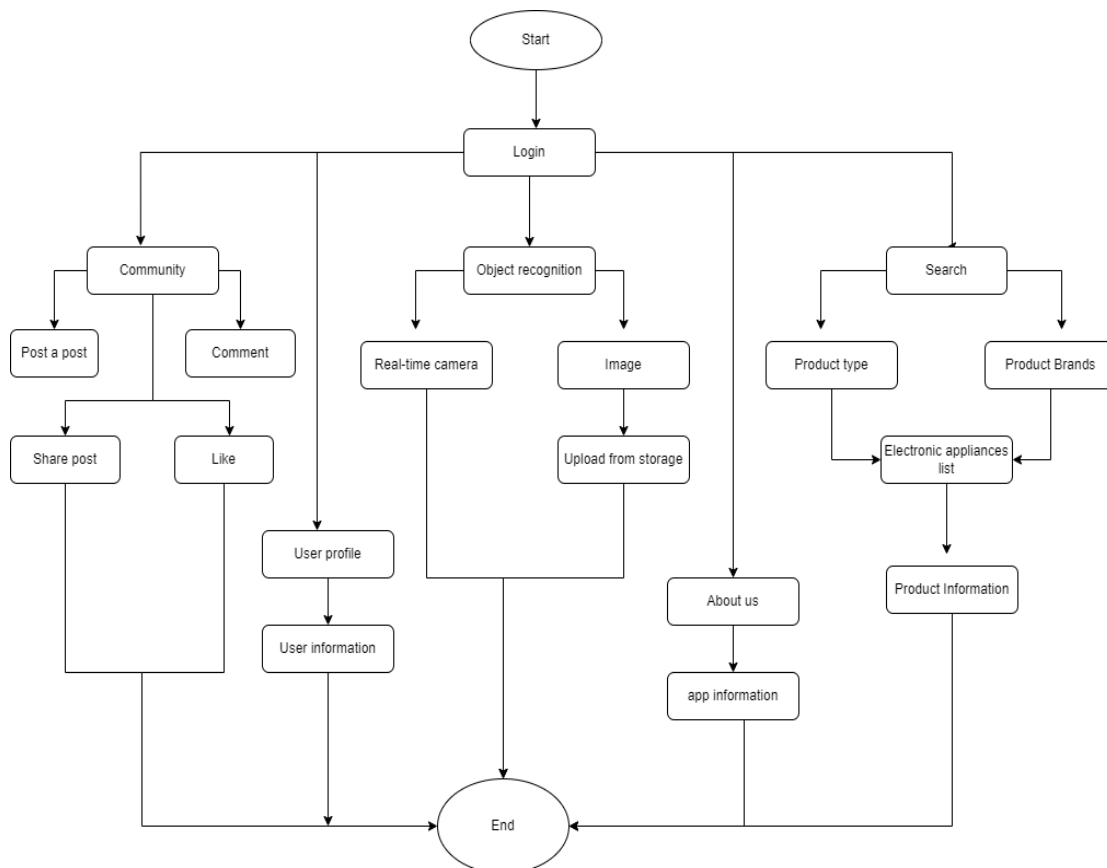
Figure 4.1 System Block Diagram

Figure 3.3.1 shows the system block diagram of the project, In this project there will have total 5 module in the system which are login module, object recognition module, search module, community module and information module. The operating process ofsystem will start with login module, in login module, users can create their own accountand set their own account password. After users owns an account, they can login into their account by key in correct username and password. If user forgot their password, they may reset their password by click on "forgot password?" button.

Once user login to their account successfully, they will enter to the main page of thesystem which is object recognition module, in this module, users can recognize

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an electronic appliance by using their device's camera or using an image upload from storage. Users can switch to others function that provide by the system by clicking on the button at the bottom of the main page. In community module, users can post a postand share, like or comment on other users post. In catalogue module, users can search for electronic appliances information, in catalogue module page will provide an electronic appliance catalogue to users. Last module will beinformation module, in this module, users can edit their account information and find more information about this application.

4.2 System module and Description

4.2.1 Login module
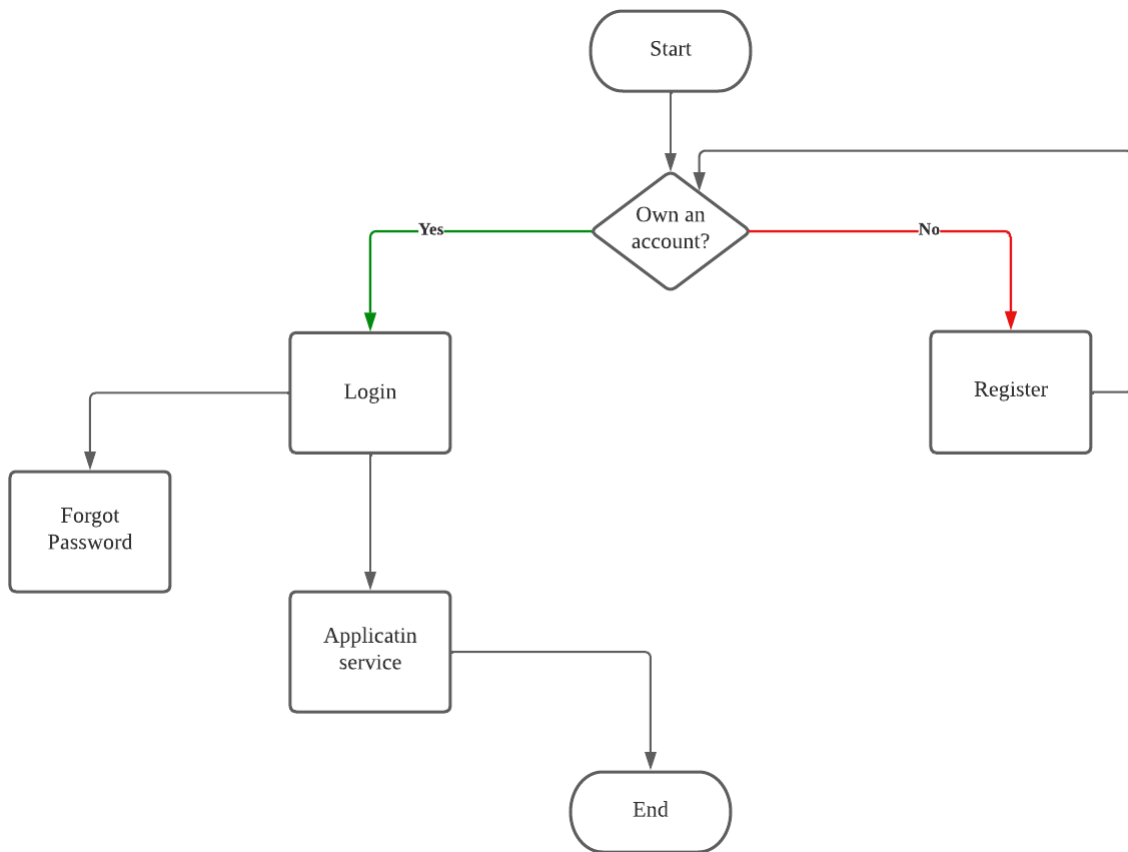
Figure 4.2.1 Flowchart of Login Module

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Figure 4.2.1 show the flowchart of login module. This application is connect to firebase database, all the user will need to register an firebase account of this application before accessing the service. In main page of the application, user will definite themselves whether they own an account or not. If the user is new user, they will click on register button to register an account. Once the register button clicked, the application will forward user to register page. In register page, user will asked to key in an email address and their account password.

```
registerbutton.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        // get user email and password
        String email = emailaddress.getText().toString().trim();
        String password = loginpassword.getText().toString().trim();
        // check the email address pattern is correct or not
        if (!Patterns.EMAIL_ADDRESS.matcher(email).matches()){
            emailaddress.setError("Invalid email address");
            emailaddress.setFocusable(true);
        }
        // check the password length is at least 8 or not
        else if (password.length()<8) {
            loginpassword.setError("Password should at least 8 character");
            loginpassword.setFocusable(true);

        }
        // register an account
        else {
            registeruser(email,password);
        }
```

Figure 4.2.1.1 Account and Password Format Code

In figure 4.2.1.1 String email and password is created and get the input from user by using input text. The input email and password were checked whether it match with the format or not, if not match it will display error message to user. If the email and password match the format, it will call the function registeruser to register a firebase account.

```
private void registeruser(String email, String password){
    progessDialog.show();
    mAuth.createUserWithEmailAndPassword(email, password)
            .addOnCompleteListener( activity: this, new OnCompleteListener<AuthResult>() {
                @Override
                public void onComplete(@NonNull Task<AuthResult> task) {
                    if (task.isSuccessful()) {
                        // User account creation was successful
                        Log.d(TAG,  msg: "Successfully create an account");
                        progessDialog.dismiss();
```

Figure 4.2.1.2 Register Account Code

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In figure 4.2.1.2, an account is created in firebase authentication by using the email and password that collect from user. All the user account will be stored in firebase database with data user uid, sign in date and created date.

Figure 4.2.1.3 Registered Account In Firebase Database

Figure 4.2.1.4 Login Code

Figure 4.2.1.4 is the code that call the function signInWithEmailAndPassword in firebase library, this function will authentic the account with email and password of the account. If authentication fail, an error message will display to user, if authentication success, it will forward the user to profile service of the application. If user forgot their password and wish to recover their password, they can click on forgot password? button, system will alert a window ask user to key in the email. An recover password email will send to the email address, user can recover their account password through that email.Figure 4.2.1.5 is the code of reset password. Function mAuth.sendPasswordResetEmail(email) is to send recover email to email address.

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```
1 usage
private void beginRecovery(String email){
    progessDialog.setMessage("Sending email, please wait...");
    progessDialog.show();
    mAuth.sendPasswordResetEmail(email).addOnCompleteListener(new OnCompleteListener<Void>() {
        @Override
        public void onComplete(@NonNull Task<Void> task) {
            if(task.isSuccessful()){
                Toast.makeText( context: login.this, text: "Email Sent", Toast.LENGTH_SHORT).show();;
                progessDialog.dismiss();
            }
            else {
                Toast.makeText( context: login.this, text: "Error", Toast.LENGTH_SHORT).show();;
                progessDialog.dismiss();
            }

        }
    }
```

Figure 4.2.1.5 Recover Password Code

4.2.2 Profile Module
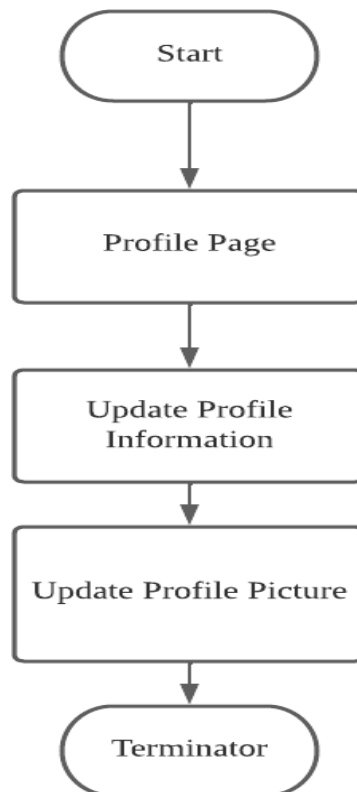
Figure 4.2.2 Flowchart of Profile Module

Figure 4.2.2 is the flowchart of profile module, when user enter the profile page, the

profile information profile picture, name, email, date of birth, gender and phone number will

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display on the profile page. If user did not update the information, the profile information will only display the email address that use to register this account and others information will be default or none. User can update their profile information and profile picture by clicking the update button on profile page.

```java
else {
    Query query = databaseReference.orderByChild( path: "email").equalTo(firebaseUser.getEmail());
    query.addValueEventListener(new ValueEventListener() {
        @Override
        public void onDataChange(@NonNull DataSnapshot snapshot) {

            for (DataSnapshot ds : snapshot.getChildren()){

                String name = "" + ds.child( path: "name").getValue();
                String email = "" + ds.child( path: "email").getValue();
                String gender = "" + ds.child( path: "gender").getValue();
                String Dob = "" + ds.child( path: "dob").getValue();
                String phone = "" + ds.child( path: "phone").getValue();
                String photoUrl = ds.child( path: "image").getValue().toString();
                full_name.setText(name);
                mail.setText(email);
                birthday.setText(Dob);
                sex.setText(gender);
                mobile.setText(phone);

                try {
                    Picasso.get().load(photoUrl).into(profile_pic);
                }
                catch (Exception e){
                    Picasso.get().load(R.drawable.ic_default_img).into(profile_pic);
                }
```

Figure 4.2.2.1 Code To Retrieve Profile Information.

Figure 4.2.2.1 is the code to retrieve all the profile information such as name, email, gender, date of birth, phone and profile picture that store in user account from firebase database. The setText code is to set the data to the text view that display to user, profile picture was loaded by using Picasso. When user click on update profile information button, system will forward user to update page, user will enter their profile information and update to firebase. Figure 4.2.2.2 is the code that put user profile information into HashMap and figure 4.2.2.3 is the code to update and store the data.

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```java
private void UpdateProfileInfo(FirebaseUser firebaseUser){
    radioGroupUpdateGender = findViewById(R.id.RadioGroupUpdateGender);
    int radioButtonID = radioGroupUpdateGender.getCheckedRadioButtonId();
    GenderSelected = findViewById(radioButtonID);
    textName = editTextUpdateName.getText().toString().trim();
    textPhone = editTextUpdatePhone.getText().toString().trim();
    textGender = GenderSelected.getText().toString().trim();
    textDob = editTextUpdateDob.getText().toString().trim();
    FirebaseUser user1 = firebaseAuth.getCurrentUser();
    String uid = user1.getUid();
    String email = user1.getEmail();

    FirebaseDatabase database = FirebaseDatabase.getInstance();
    //path to store data
    DatabaseReference reference = database.getReference( path: "Users");
    HashMap<Object, String> hashMap = new HashMap<>();
    hashMap.put("uid",uid);
    hashMap.put("email",email);
    hashMap.put("name",textName);
    hashMap.put("phone",textPhone);
    hashMap.put("dob",textDob);
    hashMap.put("gender",textGender);
    hashMap.put("image","");
```

Figure 4.2.2.2 Put Data into HashMap

```java
// put data in databasewithout hashmap
reference.child(uid).setValue(hashMap).addOnCompleteListener(new OnCompleteListener<Void>() {
```

Figure 4.2.2.3 store data into firebase database

When user click on choose your picture button, system will forward to their device storage, user can pick an image from their device storage and upload to firebase database as their profile picture.

```java
private String getFileExtension(Uri uri){
    ContentResolver cR = getContentResolver();
    MimeTypeMap mime = MimeTypeMap.getSingleton();
    return mime.getExtensionFromMimeType(cR.getType(uri));
}
1 usage
private void openFileChooser(){
    Intent intent = new Intent(Intent.ACTION_GET_CONTENT);
    intent.setType("image/*");
    Intent chooser = Intent.createChooser(intent,  title: "Select Image");
    startActivityForResult(chooser, PICK_IMAGE_REQUEST);
}

@Override
protected void onActivityResult(int requestCode, int resultCode, @Nullable Intent data) {
    super.onActivityResult(requestCode, resultCode, data);

    if (requestCode == PICK_IMAGE_REQUEST && resultCode == RESULT_OK && data.getData() != null){
        uri = data.getData();
        upload_pic.setImageURI(uri);
    }
}
```

Figure 4.2.2.3 Code to Open Device Storage and Pick Image.

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Figure 4.2.2.4 show the code to open device storage and pick an image then put into file extension. Function openFileChooser() is to forward user to their device storage. Function onActivityResult is set the image that picked by user into uri, function getFileExtension is to get the file extension from the uri. The file extension is upload and store in firebase storage.

4.2.3 Object Recognition Module
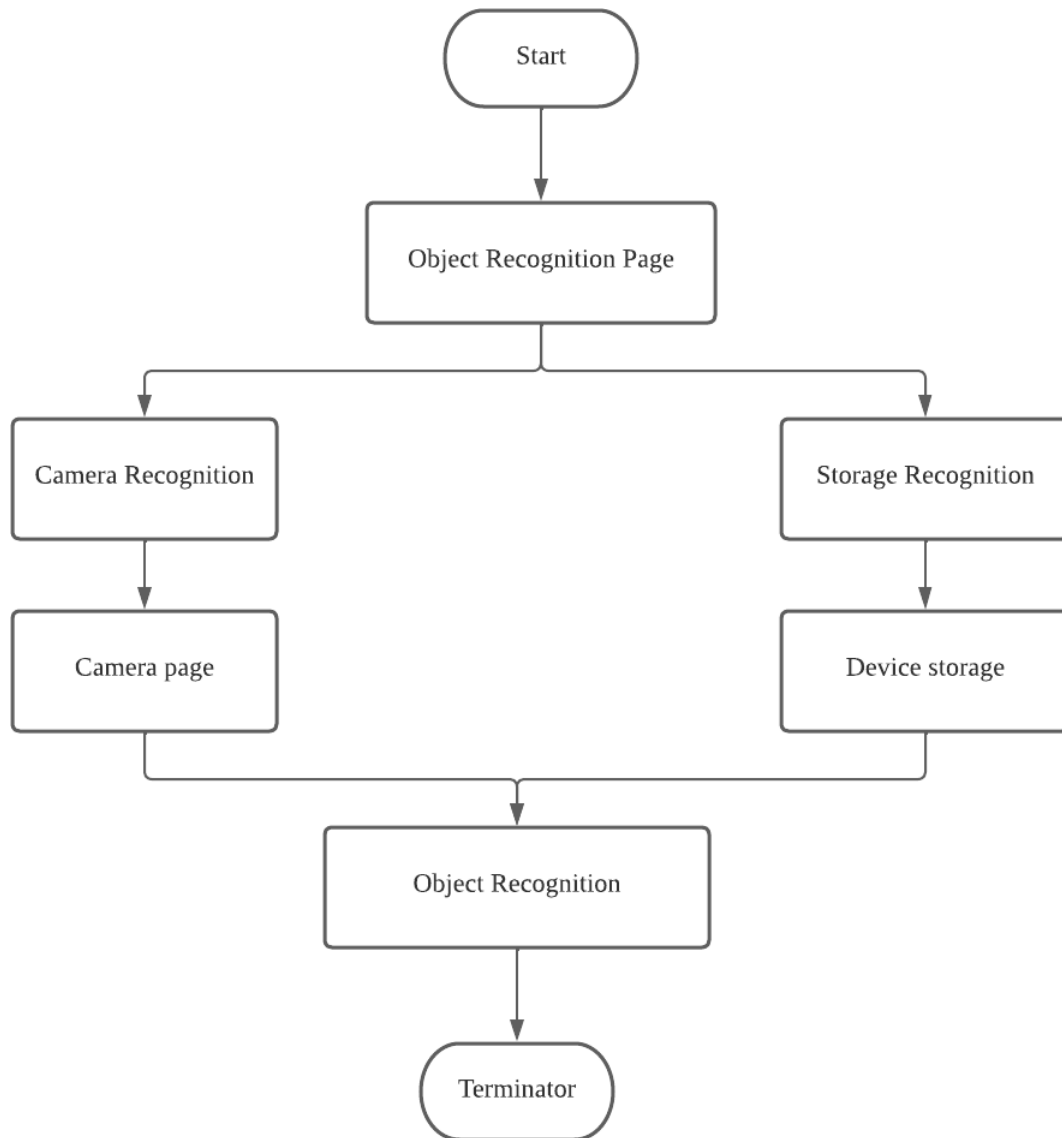
Figure 4.2.3 Flowchart of Object Recognition Module

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Figure 4.2.3 shows the flowchart of object recognition module. In this module, user can select to recognize object by clicking on camera button or storage button. When camera button is clicked, system will forward user to device camera .When user point their camera to the object and that object is able to recognize by the system, an AR frame that display the name of object will bounded the object in camera. If user click on storage button, system will forward user to a page, user can pick an image from device storage to recognize the object. When user click on select an image button, user can pick an image, the image will pass to the system, if the object in the image can recognize by system, a frame with object name will add into the picture and display to user.

```
// assetmanager provide access to application asset that contain model and labelmap
2 usages
objectDetecterClass(AssetManager assetManager, String modelPath, String labelPath, int inputSize) throws IOException {
    INPUT_SIZE=inputSize;
    //define gpu and thread
    Interpreter.Options options=new Interpreter.Options();
    gpuDelegate=new GpuDelegate();
    options.addDelegate(gpuDelegate);
    options.setNumThreads(4);
    // load model and labelmap
    interpreter=new Interpreter(loadModelFile(assetManager,modelPath),options);
    labelList=loadLabelList(assetManager,labelPath);
```

Figure 4.2.3.1 Define Object Detector Code

Figure 4.2.3.1 is the code to define a class foe object detection using a deep learning model, Variable gpuDelegate is created and added inyo option.addDelegate, number of thread is set into 4. Interpreter is created and load the model by calling loadModelFile. Labelmap was loaded into label list. Figure 4.2.3.2 is the function code that used to load model and labelmap from asset folder.LoadModelFile function load the model and loadLabelList load the label map and store in label list.

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```java
private List<String> loadLabelList(AssetManager assetManager, String labelPath) throws IOException {
    // load the label from labelmap and save into array list//
    List<String> labelList=new ArrayList<>();
    BufferedReader reader=new BufferedReader(new InputStreamReader(assetManager.open(labelPath)));
    String line;
    while ((line = reader.readLine())!=null){
        labelList.add(line);
    }
    reader.close();
    return labelList;
}


// load mechine learning model file that store in asset folder
1 usage
private ByteBuffer loadModelFile(AssetManager assetManager, String modelPath) throws IOException {

    AssetFileDescriptor fileDescriptor = assetManager.openFd(modelPath);
    FileInputStream inputStream=new FileInputStream(fileDescriptor.getFileDescriptor());
    FileChannel fileChannel = inputStream.getChannel();
    long startOffset =fileDescriptor.getStartOffset();
    long declaredLength=fileDescriptor.getDeclaredLength();

    return fileChannel.map(FileChannel.MapMode.READ_ONLY,startOffset,declaredLength);
}
```

Figure 4.2.3.2 Load Model and Label Map Function

```java
// convert image into bitmap and scale into input size of the model
Bitmap bitmap = null;
bitmap=Bitmap.createBitmap(rotated_mat_image.cols(),rotated_mat_image.rows(),Bitmap.Config.ARGB_8888);
Utils.matToBitmap(rotated_mat_image,bitmap);
height=bitmap.getHeight();
width=bitmap.getWidth();
Bitmap scaledBitmap=Bitmap.createScaledBitmap(bitmap,INPUT_SIZE,INPUT_SIZE, filter: false);
```

Figure 4.2.3.3 Function Convert Image into Bitmap

Figure 4.2.3.3 is the function to convert the image of camera into bitmap and scale into input size of the model. Figure 4.2.3.4 is the code to convert bitmap into byte buffer. This step is important due to the input to model must be a byte buffer object

```java
// this is important because input to the model must be a ByteBuffer object.
ByteBuffer byteBuffer=convertBitmapToByteBuffer(scaledBitmap);
Object[] input=new Object[1];
input[0]=byteBuffer;

Map<Integer,Object> output_map=new TreeMap<>();
```

Figure 4.2.3.4 Convert Bitmap into Byte Buffer

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```
//predict the object and get the output from model and put a frame on the image
interpreter.runForMultipleInputsOutputs(input,output_map);
Object value=output_map.get(0);
Object Object_class=output_map.get(1);
Object score=output_map.get(2);
```

Figure 4.2.3.5 Predict the Object

Figure 4.2.3.5 is the code to predict the object from input byte buffer. Figure 4.2.3.6 is the code to put a frame to bound the object, display the predict result on frame and display the percentage of prediction on the frame that put-on object.

```
// calculate the percentage of prediction
int confidence_percent = (int) (score_value * 100);
// construct the label text with the class name and the percentage of prediction
String label_text = labelList.get((int) class_value) + " (" + confidence_percent + "%)";
// put a rectangle frame on the object
Imgproc.rectangle(rotated_mat_image,new Point(left,top),new Point(right,bottom),new Scalar(0, 255, 0, 255), thickness: 2);
// Write the label text to the bounding box
Imgproc.putText(rotated_mat_image, label_text, new Point(left, top), fontFace: 3, fontScale: 1, new Scalar(255, 0, 0, 255), thickness: 2);
// Write the  name of the object to the bounding box
Imgproc.putText(rotated_mat_image,labelList.get((int) class_value),new Point(left,top), fontFace: 3, fontScale: 1,new Scalar(255, 0, 0, 255), thickness: 2);
```

Figure 4.2.3.6 Add Frame, Result and Prediction Percentage Code

Figure 4.2.3.7 and figure 4.2.3.8 is the code to initialize the camera activity for camera object recognition by using OpenCV library. Figure 4.2.3.7 is the code to initialize the camera activity, ask for camera permission if the permission is not granted and load the model that used to recognize object. Figure 4.2.3.8 is the code that use OpenCV's CameraBridgeViewBase class to capture frames from a camera and process them using an object detection algorithm.

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```
requestWindowFeature(Window.FEATURE_NO_TITLE);
getWindow().addFlags(WindowManager.LayoutParams.FLAG_KEEP_SCREEN_ON);

int MY_PERMISSIONS_REQUEST_CAMERA=0;
// if camera permission is not given it will ask for it on device
if (ContextCompat.checkSelfPermission( context: Camera_activity.this, android.Manifest.permission.CAMERA)
        == PackageManager.PERMISSION_DENIED){
    ActivityCompat.requestPermissions( activity: Camera_activity.this, new String[] {Manifest.permission.CAMERA}, MY_PERMISSIONS_REQUEST_CAMERA);
}


setContentView(R.layout.activity_camera);



mOpenCvCameraView=(CameraBridgeViewBase) findViewById(R.id.frame_Surface);
mOpenCvCameraView.setVisibility(SurfaceView.VISIBLE);
mOpenCvCameraView.setCvCameraViewListener(this);
try{
    // input size is 300 for this model
    objectDetectorClass = new objectDetecterClass(getAssets(), modelPath: "ssd_mobilenet.tflite", labelPath: "labelmap.txt", inputSize: 300);
    Log.d( tag: "MainActivity", msg: "Model is successfully loaded");
}
```

Figure 4.2.3.7 Initialize Camera Activity

```
public void onCameraViewStopped() { mRgba.release(); }
public Mat onCameraFrame(CameraBridgeViewBase.CvCameraViewFrame inputFrame){
    mRgba=inputFrame.rgba();
    mGray=inputFrame.gray();
    Mat out = new Mat();
    out=objectDetectorClass.recognizeImage(mRgba);


    return out;
}
```

Figure 4.2.3.8 Capture Frame From Camera.

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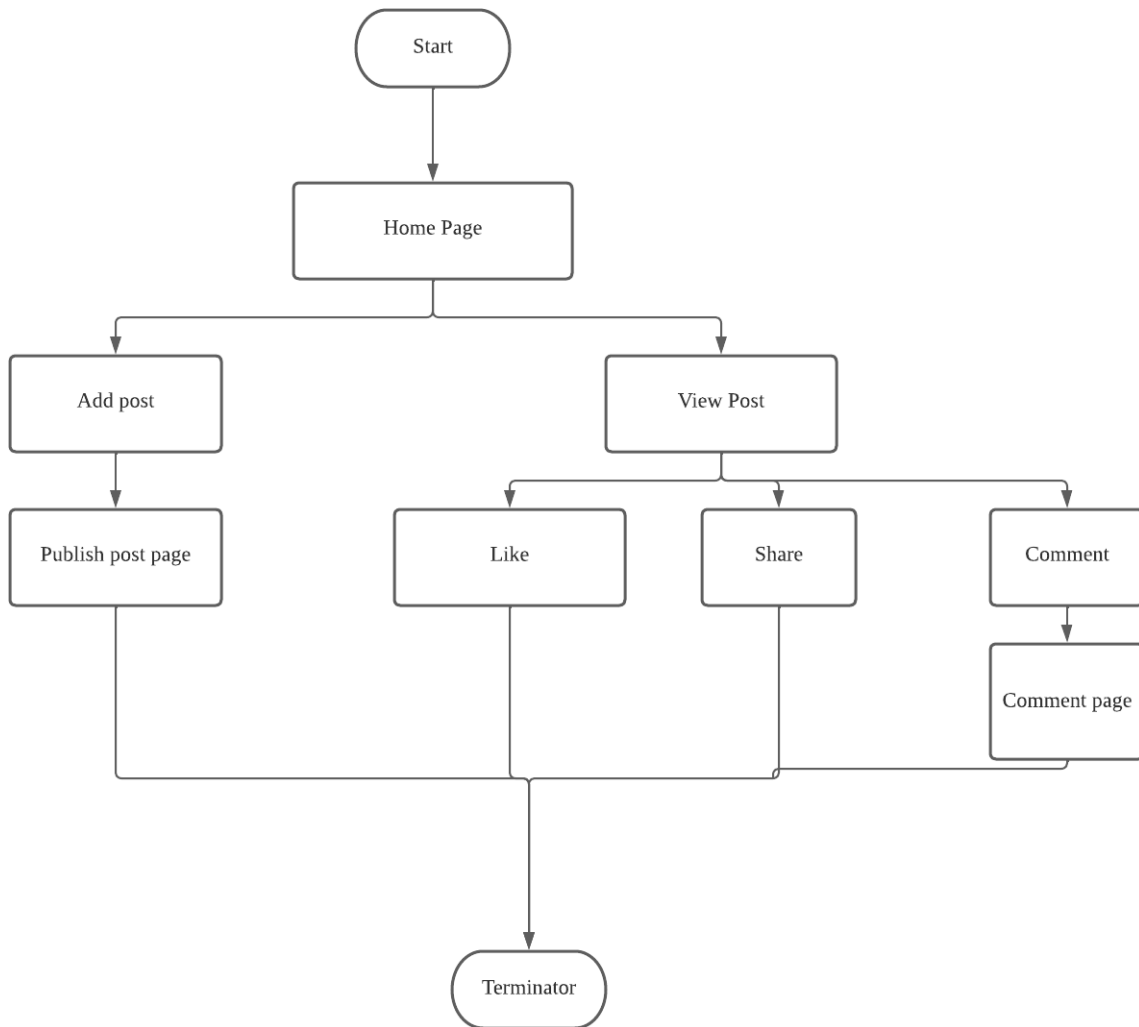
4.2.4 Home Module

Figure 4.2.4 Home Module flowchart

Figure 4.2.3 is the flowchart of home module. In this module, once user click on the home button, system will forward user to home page that will display the post that published by another user. User can interact with the published post by clicking on the like, comment and share button below the post. When user click on like button, the like number of post will be updated. User can cancel their like by click on the like button again. If user click on the comment button, system will forward user to comment page, user can view the comment of other user and leave a comment on that post. Once the send button was clicked, the comment will upload to firebase database and display on comment page. When user click on share button, a window will be alert, user can select the social media method to share the content of post. Besides, user can publish their own post by click the plus button on header of home page. Once user click on upload, the post will updated to database and display on home page.

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```
private void loadPosts(){
    DatabaseReference ref = FirebaseDatabase.getInstance().getReference( path: "Posts");
    ref.addValueEventListener(new ValueEventListener() {
        @Override
        public void onDataChange(@NonNull DataSnapshot snapshot) {
            postList.clear();
            for (DataSnapshot ds : snapshot.getChildren()){
                ModelPost modelPost = ds.getValue(ModelPost.class);
                postList.add(modelPost);

                adapterPost = new AdapterPost(getApplicationContext(),postList);
                recyclerView.setAdapter(adapterPost);
            }
        }

        @Override
        public void onCancelled(@NonNull DatabaseError error) {
            Toast.makeText( context: Home.this, text: "Error",Toast.LENGTH_SHORT).show();
```

Figure 4.2.4.1 Load Post Function

Figure 4.23.1 is the function to load the published post into home page. Model Post is a java class that contain constructor and getter, setter to retrieve the data. The post data will store into post list. Adapterpost is the java class to get the post.

```
holder.Likebtn.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View v) {
        Toast.makeText(v.getContext(),  text: "Like",Toast.LENGTH_SHORT).show();
        int pLikes = Integer.parseInt(postList.get(holder.getAdapterPosition()).getpLikes());
        mProcessLike = true;
        String postIde = postList.get(holder.getAdapterPosition()).getpId();
        likeRef.addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot snapshot) {
                if (mProcessLike){
                    if (snapshot.child(postIde).hasChild(myUid)){
                        postsRef.child(postIde).child( pathString: "pLikes").setValue(""+ (pLikes-1));
                        likeRef.child(postIde).child(myUid).removeValue();
                        mProcessLike = false;
                    }
                    else {
                        postsRef.child(postIde).child( pathString: "pLikes").setValue(""+ (pLikes+1));
                        likeRef.child(postIde).child(myUid).setValue("Liked");
                        mProcessLike = false;
                    }
```

Figure 4.2.4.2 Like Post Code

Figure 4.2.3.2 is the code of like button onclick listener. Once like button is clicked, system will update the plikes variable to database, variable plikes is the total numbers of user who like the post.

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```
else {
    Bitmap bitmap = bitmapDrawable.getBitmap();
    File imageFolder = new File(v.getContext().getCacheDir(), child: "images");
    try {
        imageFolder.mkdirs();
        File file =  new File(imageFolder, child: "share_image.png");
        FileOutputStream stream = new FileOutputStream(file);
        bitmap.compress(Bitmap.CompressFormat.PNG, quality: 90,stream);
        stream.flush();
        stream.close();
        Uri uri = FileProvider.getUriForFile(v.getContext(), authority: "com.example.fyp2",file);
        v.getContext().grantUriPermission( toPackage: "com.example.fyp2", uri, Intent.FLAG_GRANT_READ_URI_PERMISS
        String shareBody = pTitle+ "\n" + pDescr;
        Intent sIntent = new Intent(Intent.ACTION_SEND);
        sIntent.setClipData(ClipData.newRawUri( label: "", uri));
        sIntent.putExtra(Intent.EXTRA_STREAM,uri);
        sIntent.putExtra(Intent.EXTRA_TEXT,shareBody);
        sIntent.putExtra(Intent.EXTRA_SUBJECT, value: "Subject Here");
        sIntent.setFlags(Intent.FLAG_ACTIVITY_NEW_TASK);
        sIntent.setType("image/*");


        v.getContext().startActivity(Intent.createChooser(sIntent, title: "Share via"));
    } catch (Exception e) {
        Toast.makeText(v.getContext(), text: ""+e.getMessage(),Toast.LENGTH_SHORT).show();
    }
}
```

Figure 4.2.4.3 Share Post Code

Figure 4.2.3.3 is the code to share the post by sharing the image and text that contain title and description of the post. Figure 4.2.3.4 is the code to load the comment from database.

```
1 usage
private void loadComment() {
    LinearLayoutManager layoutManager = new LinearLayoutManager(getApplicationContext());
    recyclerView.setLayoutManager(layoutManager);



    DatabaseReference ref = FirebaseDatabase.getInstance().getReference( path: "Posts").child(postId).child( pathString: "Comment");
    ref.addValueEventListener(new ValueEventListener() {
        @Override
        public void onDataChange(@NonNull DataSnapshot snapshot) {
            commentList.clear();
            for (DataSnapshot ds: snapshot.getChildren()){
                ModelComment modelComment = ds.getValue(ModelComment.class);
                commentList.add(modelComment);
                adapterComments = new AdapterComments(getApplicationContext(), commentList);
                recyclerView.setAdapter(adapterComments);
            }
```

Figure 4.2.4.4 Load Comment Function

ModelComment is the java class that contain constructor, getter and setter that used to modify the comment data, comment is added into comment list and a adapter is used to display the comment in comment list.

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```
else {
    HashMap<Object, String> hashMap = new HashMap<>();
    hashMap.put("uid",uid);
    hashMap.put("uEmail",email);
    hashMap.put("uName",name);
    hashMap.put("uDp",dp);
    hashMap.put("pLikes", String.valueOf(like));
    hashMap.put("pComments", String.valueOf(comment));
    hashMap.put("pId",timestamp);
    hashMap.put("pDescr",description);
    hashMap.put("pTitle",tittle);
    hashMap.put("pImage","noImage");
    hashMap.put("pTime",timestamp);

    DatabaseReference ref = FirebaseDatabase.getInstance().getReference( path: "Posts");
    ref.child(timestamp).setValue(hashMap)
            .addOnSuccessListener(new OnSuccessListener<Void>() {
                @Override
                public void onSuccess(Void unused) {
                    pd.dismiss();
                    Toast.makeText( context: addPost.this,  text: "Post published",Toast.LENGTH_SHORT).show();
                    titleEt.setText("");
                    descriptionEt.setText("");
                    imageIv.setImageURI(null);
                    image_rui = null;
```

Figure 4.2.4.5   Publish Post Code

Figure 4.2.3.5 is the code that used to publish post to database. All the data of a post is put into HashMap, HashMap is upload to firebase database by using setValue function of firebase database.

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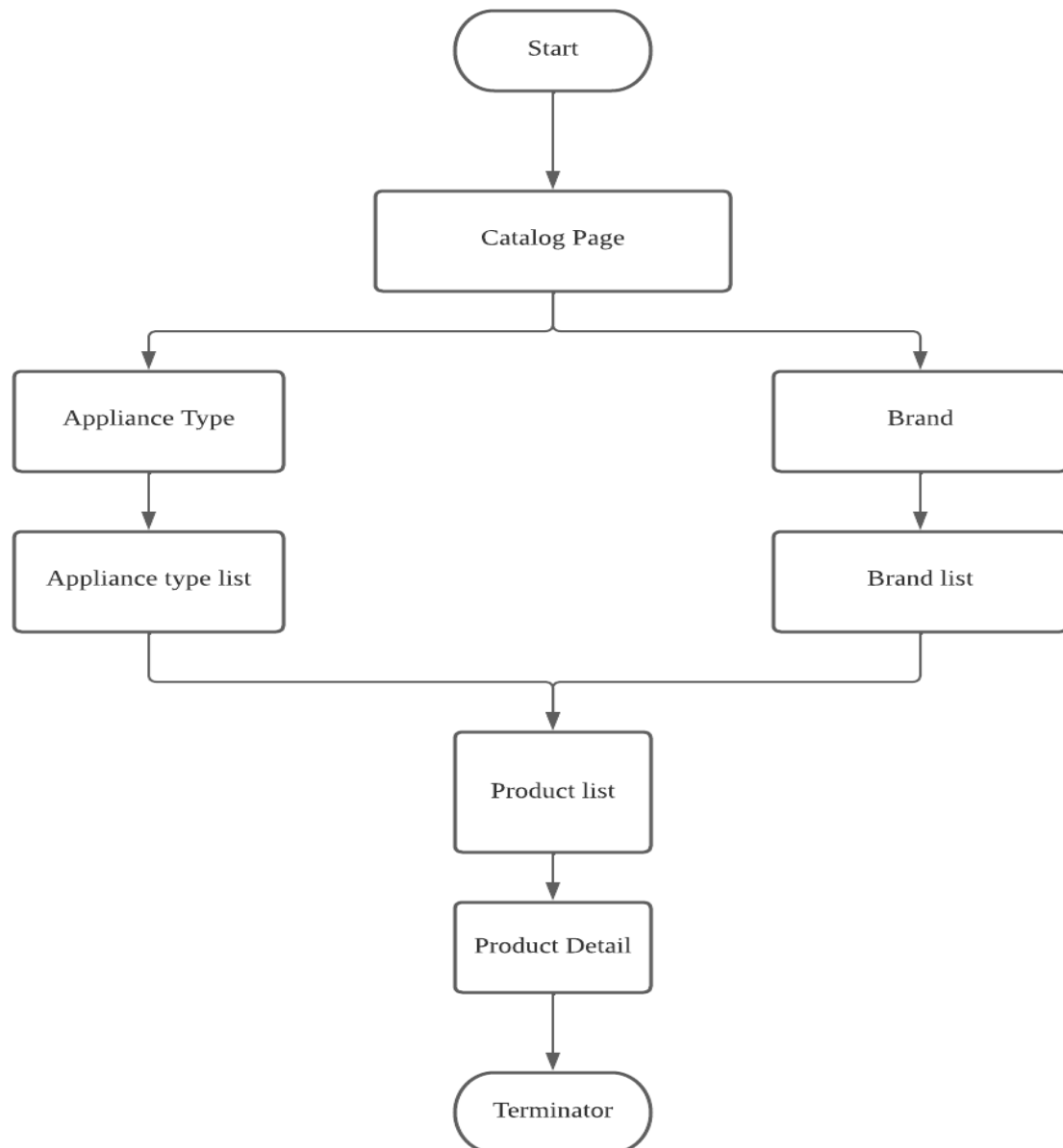
4.2.5 Catalog Module

Figure 4.2.5   Catalog module flowchart

Figure 4.2.5 is the flowchart of catalog module. When user click on catalog button on bottom navigation bar, system will forward the user to catalog page, in that page, there will have two buttons for user to select, one is appliance type, another is brand button. When user select appliance type button, system will return a list of product type for user, when user click on the appliance type, a list of product categories by appliance type will show to user. If user want to find more information, they can click on the product in list, system will forward user to product details page that display product information. Same process will be conducted when user click on brand button, a brand list is return, user can click to search product info.

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CHAPTER 5

SYSTEM IMPLEMENTATION

In this chapter, the software setup, hardware setup, system setting and configuration, system operation with screenshot and concluding remarks for this project will be presented.

5.1 Hardware Setup

Hardware that set up and used to develop this project is a laptop and a mobile phone, laptop is used for coding while mobile phone is used to test the output. Table 5.1.1 is the specification of laptop and table 5.1.2 is the specification of mobile phone.

System Type	64-bit Operating System
Operating System	Windows 10 Home Single Language
Processor	Intel(R) Core(TM) i5-8265U CPU @ 1.60GHz 1.80 GHz
Memory	8GB RAM
Storage	512 GB Solid State Drive

Table 5.1.1 Laptop Specification

Model	JNY-LX2
Camera	8000 x 6000pixels,1080 x 2310 pixels,24bits
Processor	Huawei Kirin 810
Display	Resolution 2310 x 1080
RAM	8GB
Storage	128GB
Software	EMUI 12

Table 5.1.2 Mobile Phone Specification

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5.2 Software Setup

The software that set up and used to develop this project as shown in Table 5.2 below.

Software/ Development tools	Used
Android Studio	Used to provide a rich application framework that can allow user to build innovative application for mobile devices in Java language environment.
Java Language	A programming language that is used to develop software and writing script for the AR object reocgnition app in Android App Development.
Firebase - Realtime Database & Cloud Firestore	A cloud-hosted database that used data synchronization - every time data changes, any connected device receives that update within milliseconds. - Used to store users, and post.
OpenCv	a library of programming functions mainly aimed at real-time computer vision tasks. Used to get camera frame as input into model
TensorFlow Lite	an open-source software library for machine learning and artificial intelligence developed by Google. Used TensorFlow API to recognized an object

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Picasso	A powerful image downloading and caching library for Android. Used to download image

Table 5.2 Software Set Up.

5.3 Setting and Configuration

5.3.1 OpenCV Library

    OpenCV is used to do Feature Detection and Matching in object recognition process. To use OpenCV, OpenCV library had to import into Android Studio. An OpenCV module is download from OpenCV official website and import as new module in Android studio. Figure 5.3.1.1 shows the module that impoet into Android Studio
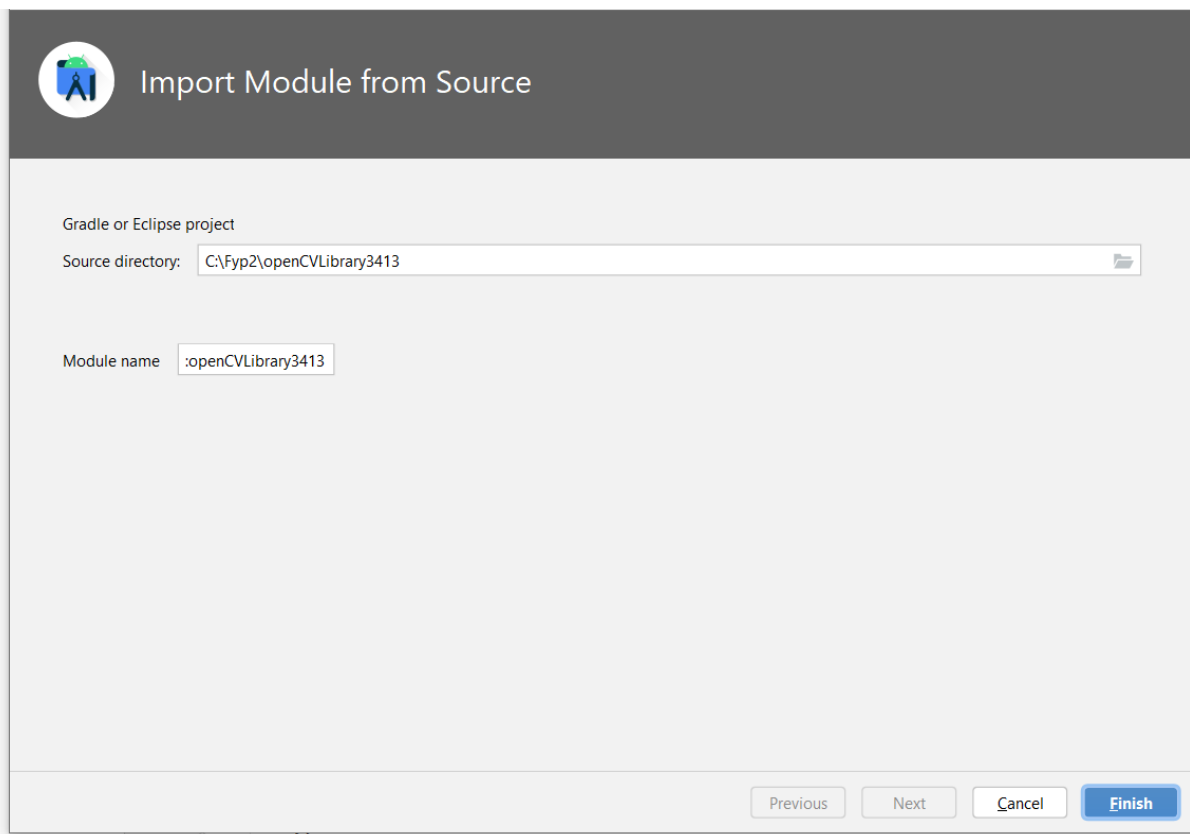
Figure 5.3.1.1 Import OpenCV Module

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5.3.2 TensorFlow Lite

To use TensorFlow Lite in Android studio, several of dependencies had to download and implement into the Gradle file of project. Figure 5.3.2 is the dependencies that download and implement to use TensorFlow Lite

```
implementation 'org.tensorflow:tensorflow-lite:2.5.0'
implementation 'org.tensorflow:tensorflow-lite-metadata:0.1.0-rc1'
implementation 'org.tensorflow:tensorflow-lite-gpu:2.2.0'
implementation 'org.tensorflow:tensorflow-lite-support:0.1.0'
implementation 'org.tensorflow:tensorflow-lite-task-vision:0.1.0'
implementation 'org.tensorflow:tensorflow-lite-task-text:0.1.0'
```

Figure 5.3.2.1 TensorFlow Lite Dependencies

In Gradle file several code had to add to use Tensorflow. Figure 5.3.2.2 is the code that add to Gradle file. "aaptOptions { noCompress "tflite" noCompress "lite" } " This configuration tells the Android Asset Packaging Tool (AAPT) not to compress files with the extensions "tflite" and "lite". "buildFeatures { mlModelBinding true }"This configuration enables the Model Binding feature of Android's Gradle plugin.

```
aaptOptions {
    noCompress "tflite"
    noCompress "lite"
}
buildFeatures {
    mlModelBinding true
}
```

Figure 5.3.2.2 TensorFlow Lite Configuration

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5.4 System Operation

First, when user enter the application, main page will show to user. As shown in figure 5.4.1, there are two buttons in main page which are register button and login button. If user yet have an account, they will click on register button to register an account. If they already had an account, they would click on login button. In register page that shown in figure 5.4.1, user need to enter an email address and their password to register an account
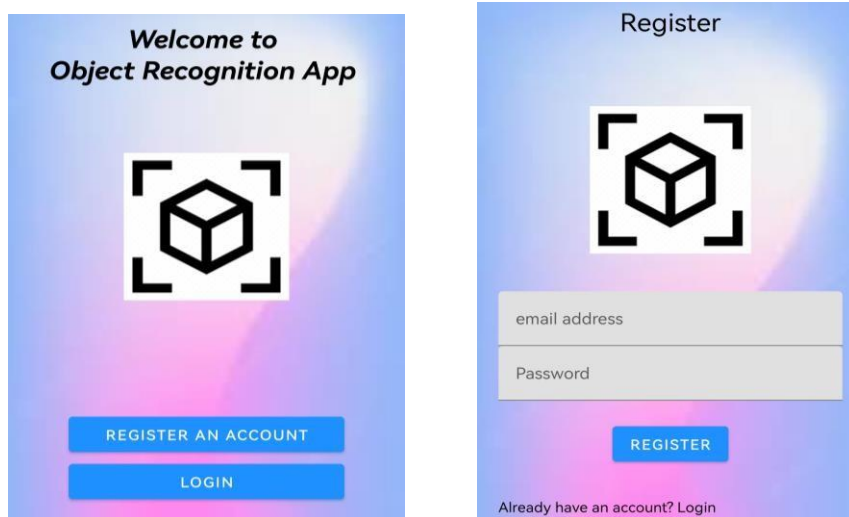
Figure 5.4.1 Main page and Register Page

After register an account, user can login into account in login page that shown in figure 5.4.2,If user forgot their account password and wish to reset or recover their password, they can click on the forgot password? word, system will promp a window as shown in figure 5.4.2 and ask user to key in an email address, a recover password email will send to the email address that key in by user.
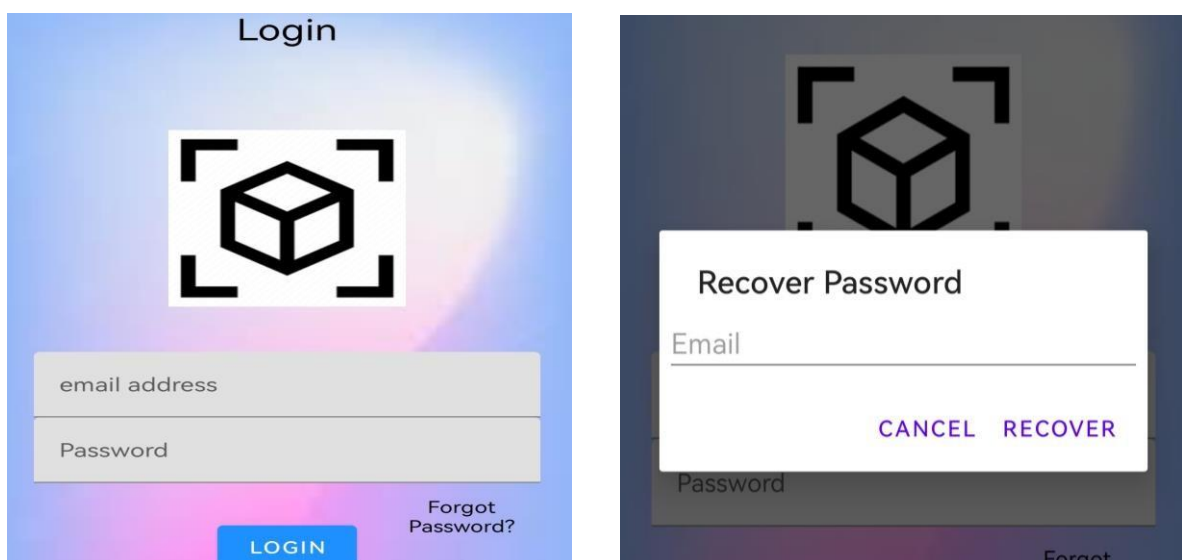
Figure 5.4.2 Login Page and Recover Password Window

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Figure 5.4.3 shows the error message when user input invalid format of email address and account password when register or login an account
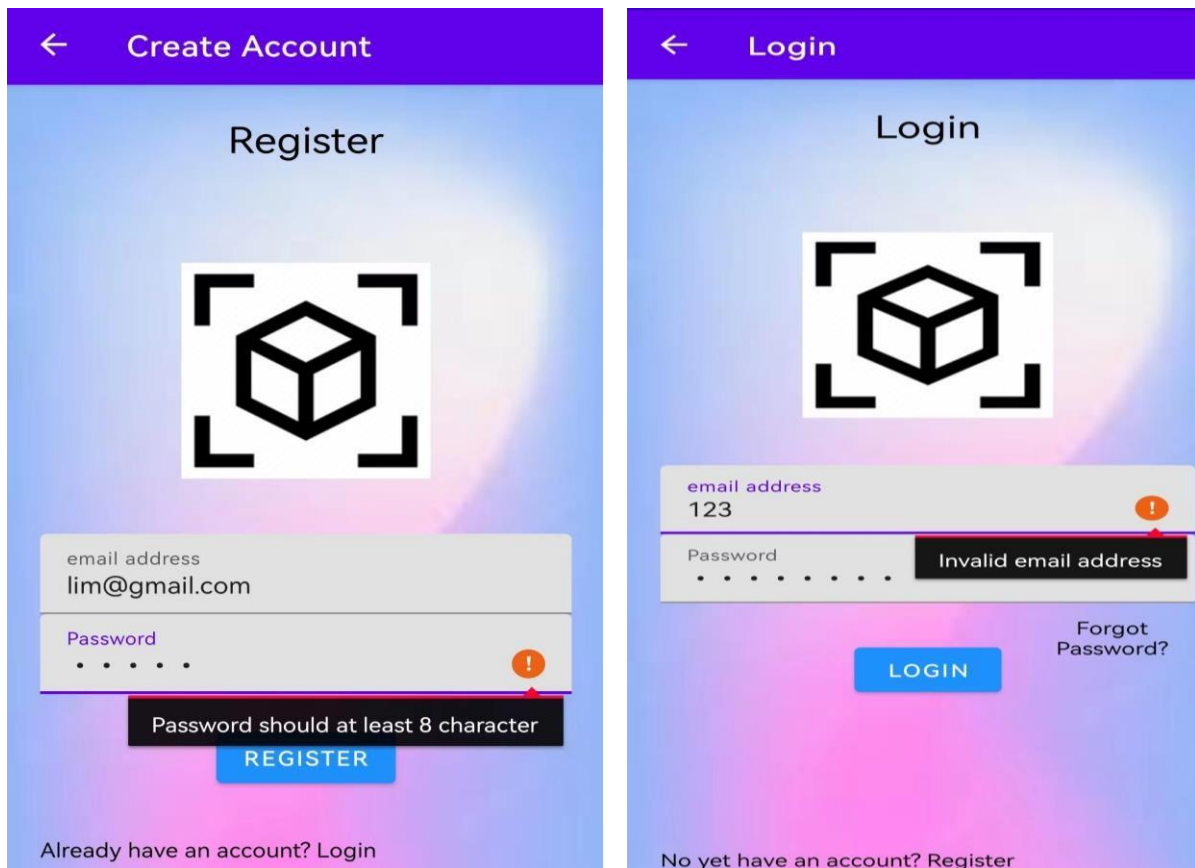
Figure 5.4.3 Error Message On Invalid Input Format

After user login to their account successfully, profile page will show to user, Profile information such as name,date of birth, email, gender and phone number.By default,profile information only display regietered email of the account as shown in figure 5.4.4, others information need to update by user by clicking update profile button. After user update the information, profile page will display the data updated by user as shown as figure 5.4.4

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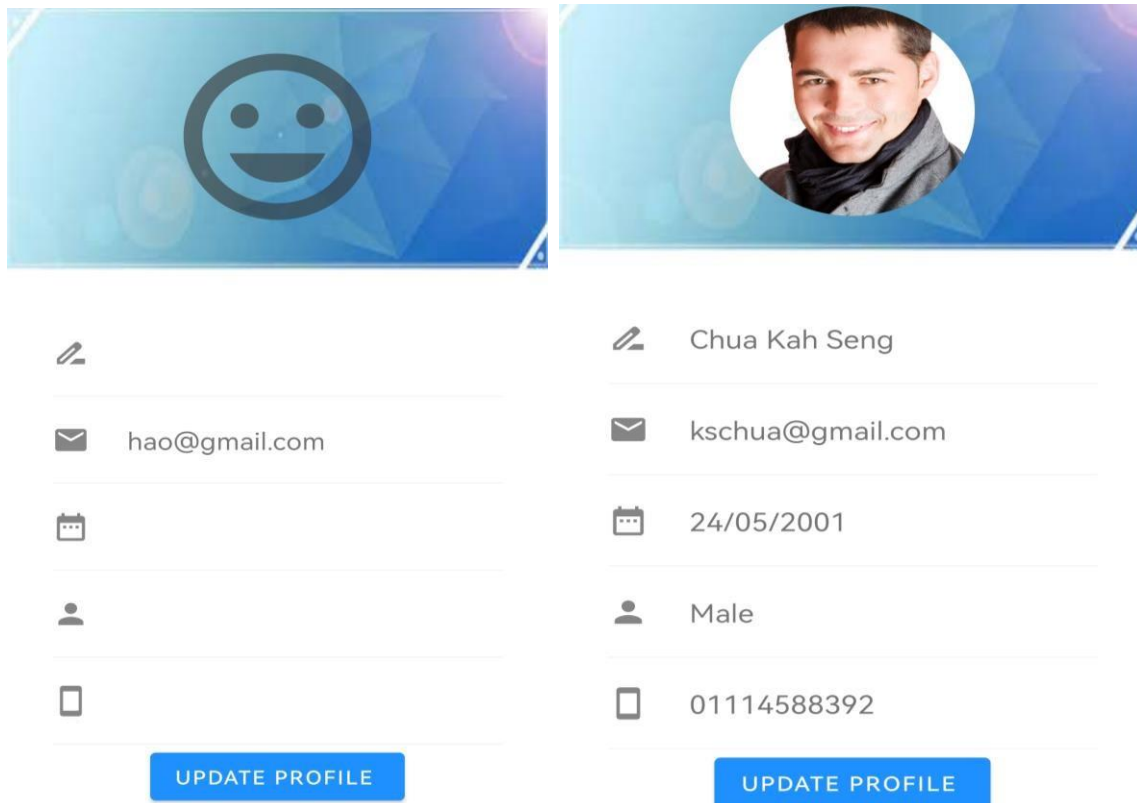
Figure 5.4.4 Profile Page Before and After Update

When user click on update profile button, system will forward user to information update page, user can key in their profile information into the input text and click on update to update profile information as shown as figure 5.4.5.User will able to update their profile picture by click on change profile picture button, user will see a change picture page that allow user to pick an image from device storage by clicking on choose yout picture button and click update button to upload the picture.

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Figure 5.4.5 Update Profile Information and Picture Page

After user click on the object recognition button on bottom navigation bar, user able to see object recognition page as shown as figure 5.4.6 that provide two method for user to recognize the object which are using device camera or using an image.The result of clicking on camera or storage button is shown as figure 5.4.6, when user point their camera to a object, an AR frame will surround the object and display the name og object and percentage of prediction on AR frame.
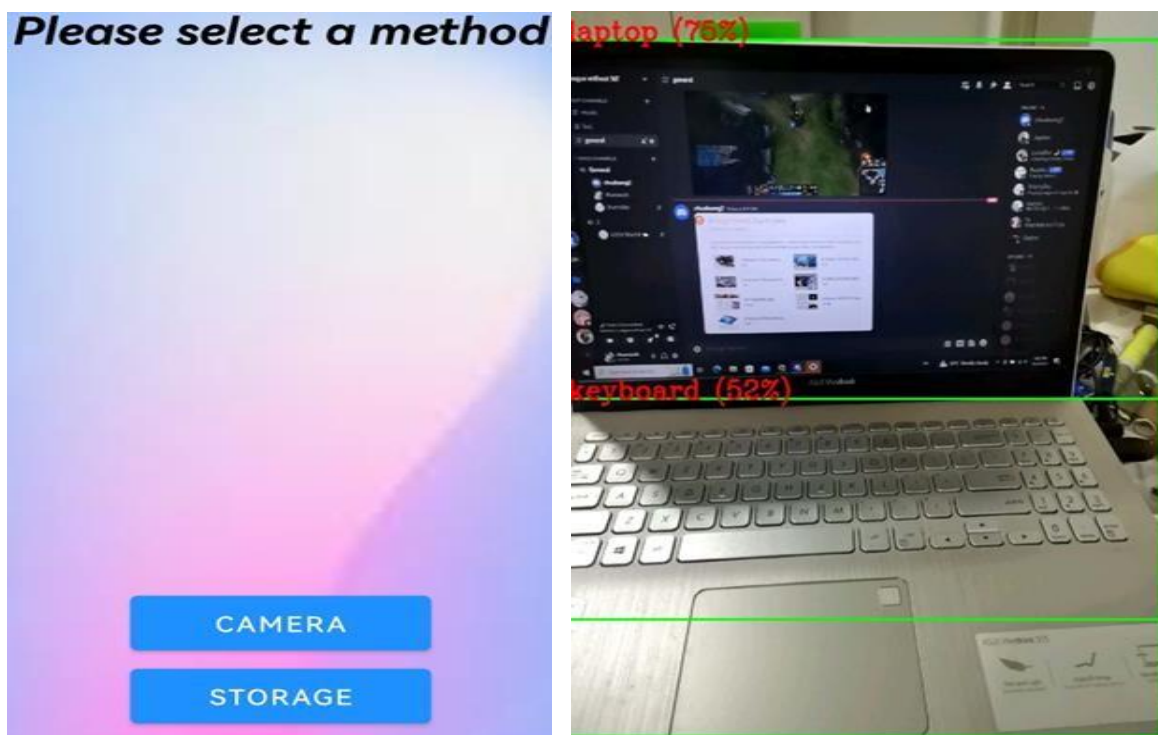
Figure 5.4.6 Camera Object Recognition Page

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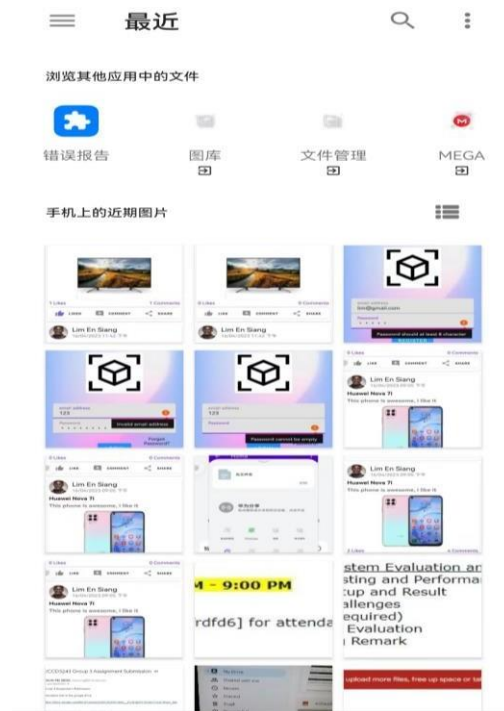
Figure 5.4.7 Image recognition page

Figure 5.4.7 shows the object recognition page that allow user pick an image from their device storage and send to system recognize the object in the image.

When user click on Home button, community module will show to user.In Home page, user are able to see the post that publish by themselves or other user that had an account in this application.As shown as figure 5.4.8, the post published by other user is display in home page.User can interact with the post by like the post, leave a comment under the post or share the post.When the like button is clicked, the like image will turn into blue color and the like count will add one.When user click on comment button, user will forward to comment page as shown in figure 5.4.8 , user can leave the comment under the post by upload the comment to database by clicking thes end button

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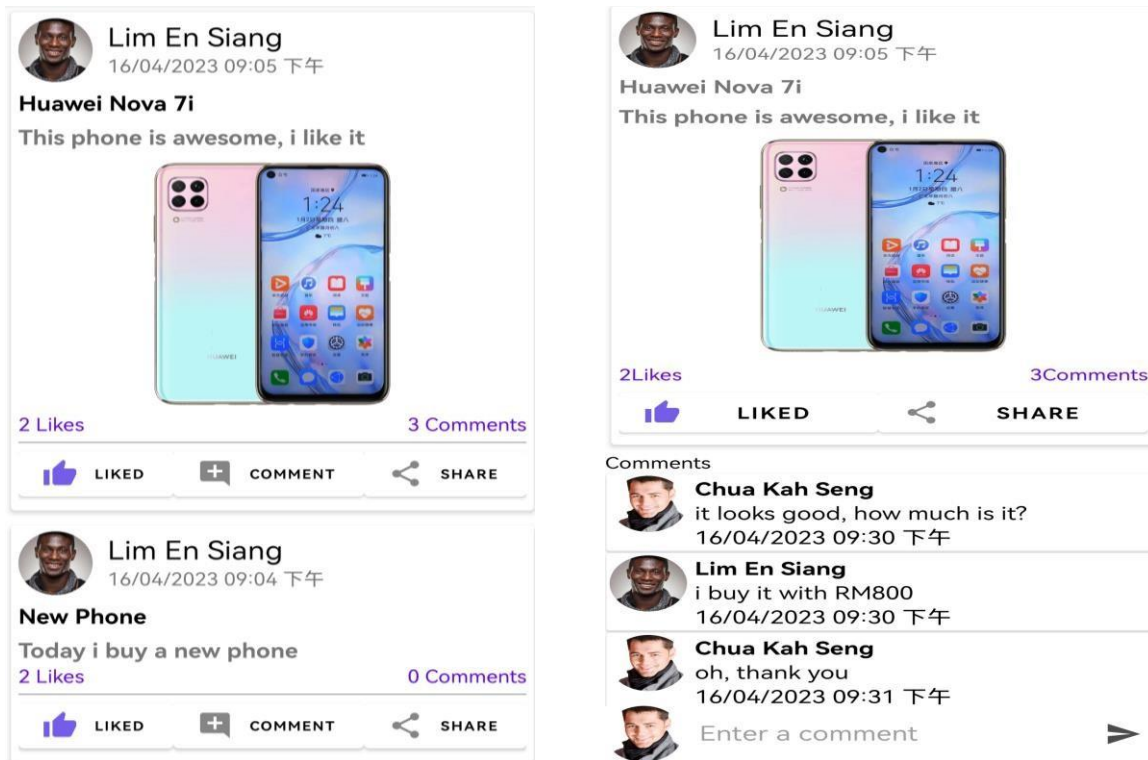
Figure 5.4.8 Home Page and Comment Page
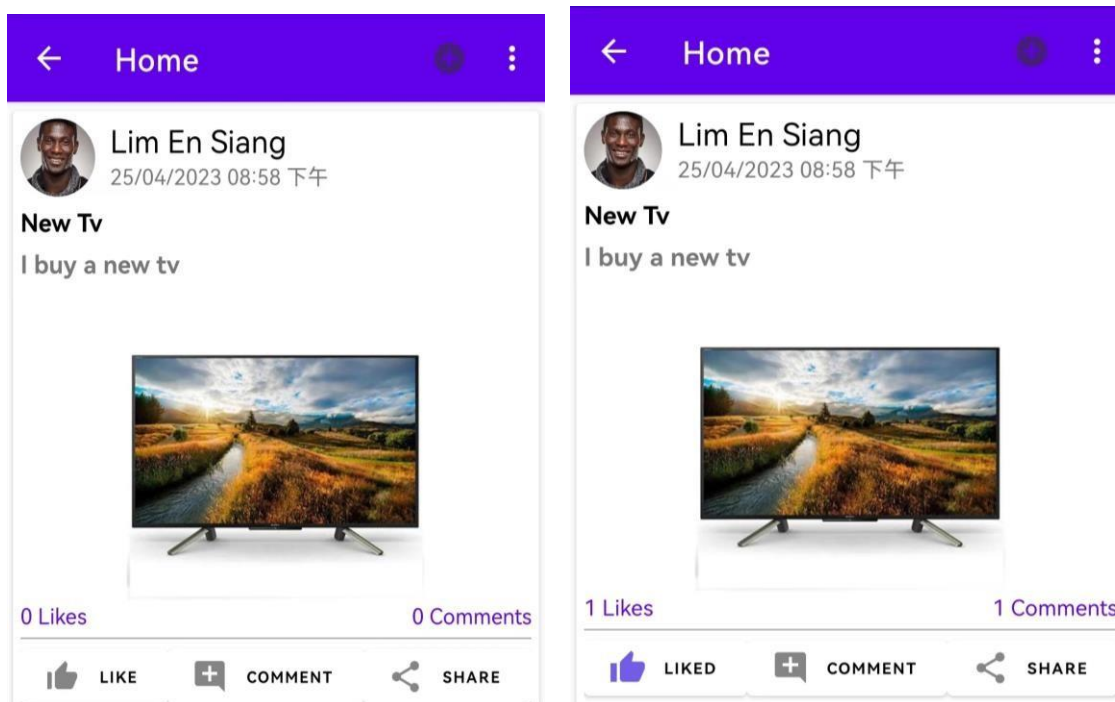
Figure 5.4.9 Change of Like Button,Like Counts and Comment Counts

Figure 5.4.9 shows the like button change before and after like button was clicked, the like counts will also change after user click on like button and the change of comment counts when someone leave a comment under the post. Figure 5.4.10 shows the share path page when user click on share button to share the post.

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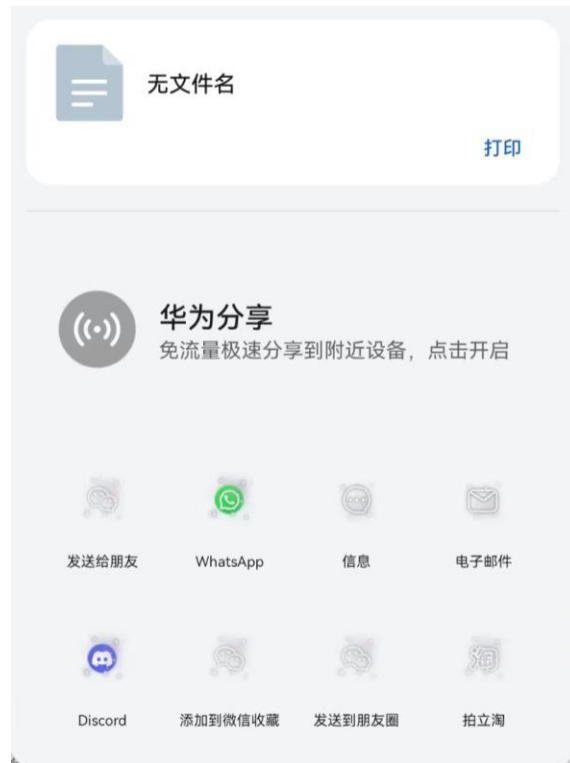
Figure 5.4.10 Share Path

Besides, user are able to publish their own post by clicking the plus icon on top of the Home page.User will forward to addpost page as shown as figure 5.4.11, user can enter message to title and discription of the post.User can select to publish a post with image or without image.If user wish to publish a post with image, user can click on select image item button, then user can pick an image in device storage.Finally, click on upload button to publish the post.

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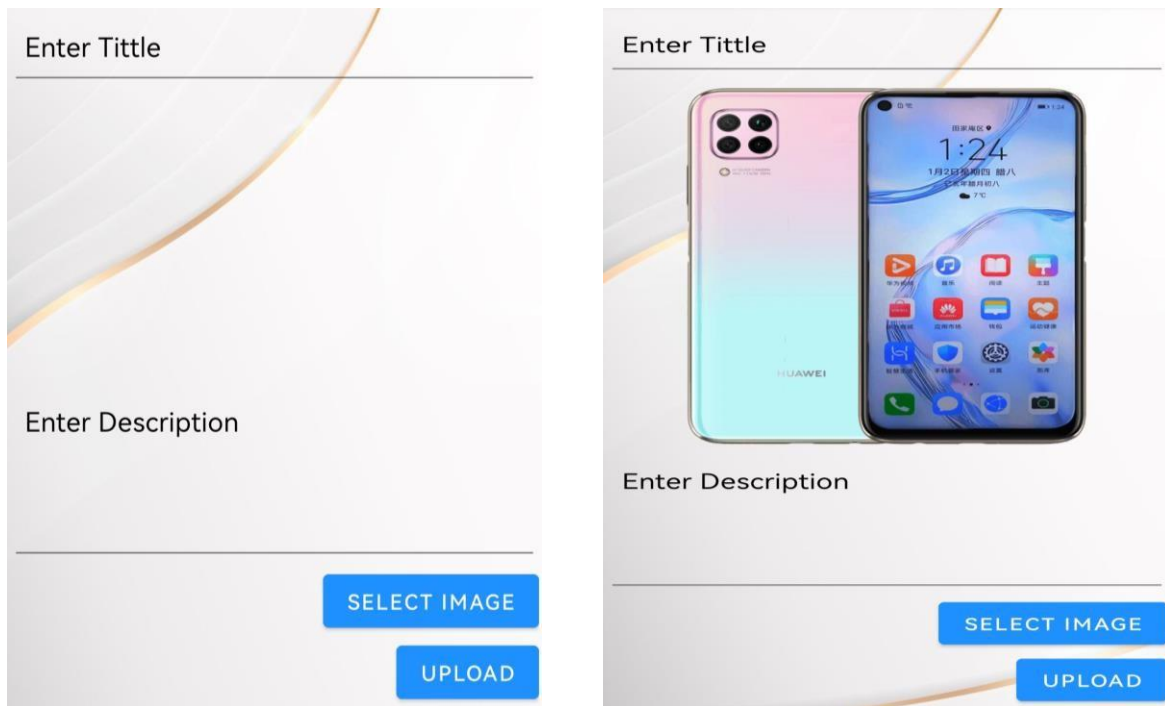
Figure 5.4.11 Publish Post Page With Image And Without Image

When user click on catalog button, system will forward user to catalog page as shown as figure 5.4.12, there are two button in catalog page which are appliance type button and brand button. A appliance type list or brand list as shown as figure 5.4.12 will display to user base on the button clicked by user
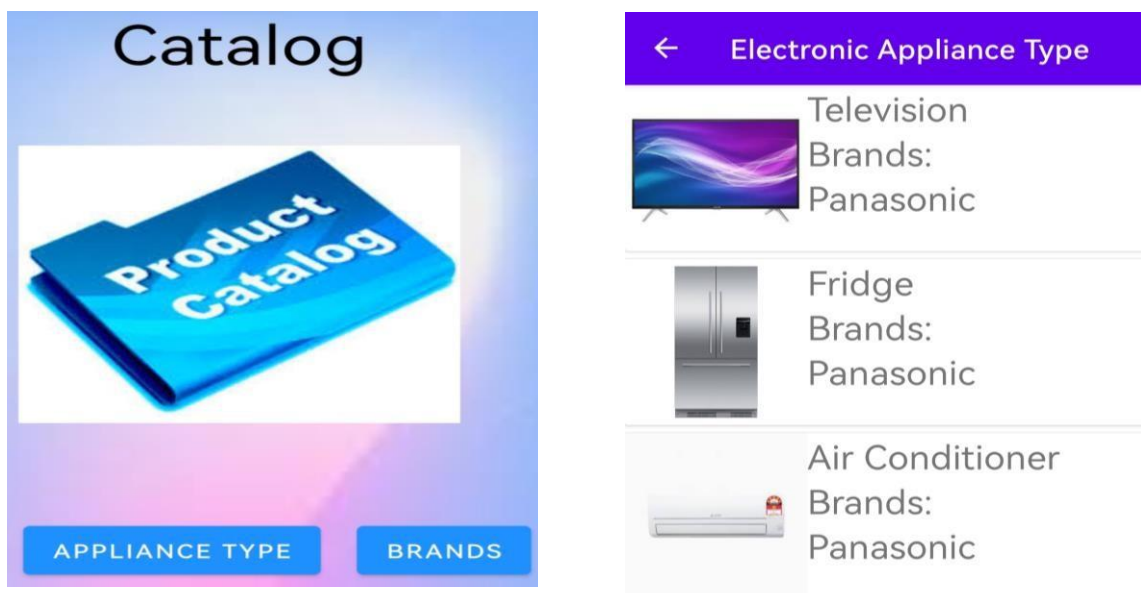
Figure 5.4.12 Catalog Page and Appliance Type List Page

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After click on the card view in appliance type list or brand list, a product list as shown as figure 5.4.13 will show to user. If user wish to have more information about the product, user can click on the product in product list, system will forward user to product detail page as shown as figure 5.4.9 that display more information about the product.
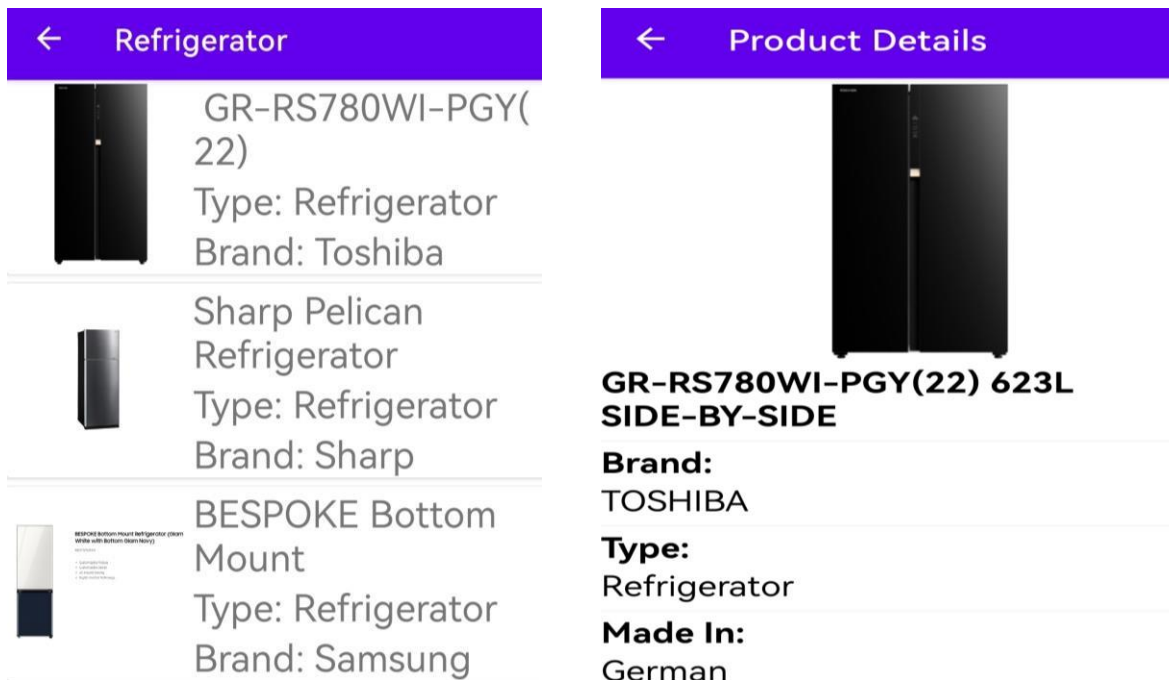
Figure 5.4.13 Product List page and Product Detail Page

Lastly, when user click on info button, the info page as shown as figure 5.4.1 will display some application info and developer comment to the user.

Figure 5.4.14 Info Page

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5.5 Conclusion Remark

As a concluding remark, the hardware that have been used to develop this project is a Asus's laptop with a Windows 10 Home Single Language and 64-bit Operating System. A mobile phone with model JNY-LX2 and processor Huawei Kirin 810 is used to develop and perform testing on the project. This AR object recognition application is developed by using Android Studio and use Firebase as database of the application. Android Studio with Java programming language has been used to develop software and writing script for the AR object recognition application. All the data are stored in Firebase Realtime Database and all the image is stored in Firebase Storage. Object recognition process in this AR object recognition application is done by OpenCV and TensorFlow Lite.

To do object recognition process in a mobile phone, the project had to import OpenCV library as a module into Android Studio. The function that stored in OpenCV library is used in this project. To recognize an object, some TensorFlow Lite Dependencies had to download and added into the project, beside adding the dependencies, come setting had to configured in project Gradle file.

Finally, system operation of this application had been covered in this chapter. In this application, user had to register and login into their account before they can access to the service of the application. There are 4 services provided in this application which are profile module, object recognition module, community or home module and Catalog module. In this application, user can recognize an object by using device camera or an image, publish their own post to share user experience, interact with others post by like, comment and share the post, edit and change their profile information and lastly search for electronic appliance information that stored in application and categorized by appliance type and brand. In short, this AR object recognition project provide a platform for user recognize an object, share user experience and searching for information that stored in this application.

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Chapter 6

System Evaluation and Discussion

In this chapter, system testing and performance metrics, project challenges, objective evaluation and concluding remark for this project will be presented.

6.1 System Testing and Performance Metrics

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Enter valid email address, 8 characters of password, register button is pressed	Email: limemsiang@1utar.my Password: ensiang0	Account should be created	Account created successful	Pass
2.	Enter invalid email address, 8 characters password, register button is pressed	Email: Limemsiang.com Password: ensiang0	Failed to create account, error message displayed	An error message "Invalid email address "displayed	Pass
3.	Enter valid email, 7-character password, register button is pressed	Email: limemsiang@1utar.my Password:	Failed to create account, error message displayed	An error message "Password should at least 8 "character "displayed	Pass

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
		ensiang			
4.	Enter empty Data, register button is pressed	none	Failed to create account, error message displayed	Error message "Email address cannot be empty "and "Password cannot be empty "displayed	Pass

Table 6.1.1 Verification Plan for Register Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Enter registered email address, correct password, login button is pressed	Email: limemsiang@1utar.my Password: ensiang0	Successful login into account	Login into account successfully, profile page is displayed	Pass
2.	Enter registered email address, wrong password, login button is pressed	Email: Limemsiang.com Password: ensiang0555	Failed to login into account, error message displayed	Fail to login into account, error message" Authentication fail" displayed	Pass
3.	Enter unregistered, correct password, login button is pressed	Email: limemsiang@1utar.my Password:	Failed to login into account, error message displayed	Fail to login into account, error message " Authentication fail" displayed	Pass

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
		ensiang			
4.	Enter empty Data, register button is pressed	none	Failed to login into account, error message displayed	Error message "Email address cannot be empty "and "Password cannot be empty "displayed	Pass

Table 6.1.2 Verification Plan for Login Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Forgot Password? is pressed, enter a valid email address, recover button is pressed	Email: limemsiang@1utar.my	Successful send an email	Email sent to the email address that entered, a message "email sent" displayed	Pass
2.	Forgot Password? is pressed, enter an invalid email address, recover button is pressed	Email: Limemsiang.com	Failed to send an email	Fail to send a recover email, error message displayed	Pass
3.	Forgot Password? is pressed, enter empty email	none	Failed to send an email	Fail to send a recover email, error message displayed	Pass

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
	address, recover button is pressed				

Table 6.1.3 Verification Plan for Recover Password Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Enter name, date of birth, gender and phone with correct format	Name: Lim En Siang Date of birth: 25/05/2001 Gender: Male Phone: 011-10636822	Update Profile information successful	Update information successful, return to login page, information display on profile correctly	Pass
2.	Enter name, date of birth with incorrect format, gender, and phone with correct format	Name: Lim En Siang Date of birth: 25052001 Gender: Male Phone: 011-10636822	Fail to update profile information	error message "invalid date format "displayed	Pass
3.	Enter name, date of birth with correct format but invalid date, gender, and phone with correct format	Name: Lim En Siang Date of birth: 25/15/2001 Gender: Male Phone: 011-10636822	Fail to update profile information	error message "invalid date format "displayed	Pass
4.	Enter name, date of birth, gender with correct format	Name: Lim En Siang Date of birth: 25/05/2001	Fail to update profile information	error message "invalid phone number format "displayed	Pass

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	and phone with invalid format	Gender: Male Phone: 01110636822			
5.	Enter empty name, date of birth, gender and phone with correct format	Name: Date of birth: 25/15/2001 Gender: Male Phone: 011-10636822	Fail to update profile information	error message "Name cannot be empty "displayed	Pass
6.	Enter name, empty date of birth, gender and phone with correct format	Name: Lim En Siang Date of birth: Gender: Male Phone: 011-10636822	Fail to update profile information	error message "date of birth cannot be empty "displayed	Pass
7.	Enter name, date of birth, empty gender and phone with correct format	Name: Lim En Siang Date of birth: 25/15/2001 Gender: Phone: 011-10636822	Fail to update profile information	error message "Gender cannot be empty "displayed	Pass
8.	Enter name, date of birth, gender with correct format and empty phone	Name: Lim En Siang Date of birth: 25/05/2001 Gender: Male Phone:	Fail to update profile information	error message "Phone cannot be empty "displayed	Pass
9.	Enter empty data	None	Fail to update profile information	Display error message	Pass

Table 6.1.4 Verification Plan for Update Profile Information Function

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Click on choose your picture button, select an image, click on upload button	An image from device storage	Upload the picture successful	Picked image was display on screen, message "Upload Successful" is displayed. Profile picture changed	Pass
2.	Did not click on choose your picture button click on upload button	none	Fail to upload the picture	System does not give any respond	Pass

Table 6.1.5 Verification Plan for Update Profile Picture Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Click on camera button, point the camera to an object	Point camera to a laptop	Success recognizes the object as laptop	An AR frame with object name "Laptop" and prediction percentage appear on device camera and bounded the laptop	Pass
2.	Click on camera button, do not point the camera to any object	none	Fail to recognize object	AR frame does not appears on device camera	Pass

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| 3. | Click on storage button, click on select an image button, select an image with object | An image of laptop | Success recognizes the object as laptop | Picked image display on screen, a green frame with object name "Laptop" and prediction percentage was draw on the image | Pass |
| 4. | Click on storage button, click on select an image button, select an image without an object | An image without object | Fail to recognize object | Picked image display on screen, No green frame add on image | Pass |

Table 6.1.6 Verification Plan for Object Recognition Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Click on like button on a post	none	Liked the post, like count + 1	Like button turn to blue color, text like change to liked, 0 likes become 1 likes	Pass
2.	Click on like button on a post and click like button again	none	Cancel the like	Like button change from black to blue to black color, 0 likes become 1 likes and change to 0 likes	Pass

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
3.	Click on comment button	none	Enter comment page	System forward user to comment page	Pass
4.	Click on share button, select on any share methos	none	Share the post successfully	A window pops out and forward to user to share method application that choose	Pass

Table 6.1.7 Verification Plan for Home Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Enter a comment and click on send button	Comment: This is a testing comment	Comment upload successful	Comment upload to database and display on comment page, a message "Comment added" displayed	Pass
2.	Enter empty comment and click on send button	none	Fail to upload a comment	Error message "Empty Comment" is displayed	Pass
3.	Click on like button on a post	none	Liked the post, like count + 1	Like button turn to blue color, text like change to liked, 0 likes become 1 likes	Pass

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
4.	Click on like button on a post and click like button again	none	Cancel the like	Like button change from black to blue to black color, 0 likes become 1 likes and change to 0 likes	Pass
5.	Click on share button, select on any share methos	none	Share the post successfully	A window pops out and forward to user to share method application that choose	Pass

Table 6.1.8 Verification Plan for Comment Function

Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Enter post title, post description, pick an image, click on upload button	Title: Test title Description: Test description Image: a phone image	Post upload successful	Post update successful and displayed on home page	Pass
2.	Enter post title, post description, did not enter an image, click on upload button	Title: Test title2 Description: Test description2 Image: none	Post upload successful	Post update successful and displayed on home page	Pass

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3.	Enter post description, empty post title, pick an image, click on upload button	Title: none Description: Test description3 Image: a phone image	Fail to upload the post	Error message "Post title is empty" displayed	Pass
4.	Enter post title, empty post description, pick an image, click on upload button	Title: Test title3 Description: none Image: a phone image	Fail to upload the post	Error message "Post description is empty" displayed	Pass
5.	Enter post description, empty post title, did not enter an image, click on upload button	Title: none Description: Test description3 Image: none	Fail to upload the post	Error message "Post title is empty" displayed	Pass
6.	Enter post title, empty post description, did not enter an image, click on upload button	Title: Test title3 Description: none Image: none	Fail to upload the post	Error message "Post description is empty" displayed	Pass

Table 6.1.9 Verification Plan for Add Post Function

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Test Case	Test Description	Test Data	Expected Result	Actual Result	Pass/Fail
1.	Click on appliance type button, click on appliance type card in list, click on product in list	none	Product detail display successful	An appliance type list displayed, a product list displayed, and product detail displayed	Pass
2.	Click on appliance type button, click on brand card in list, click on product in list	none	Product detail display successful	A brand list displayed, a product list displayed, and product detail displayed	Pass

Table 6.1.10 Verification Plan for Catalog Function

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6.2 Project Challenges

During the implementation phase of the AR object recognition mobile application project, several challenges and issues arose. The primary challenge faced was the lack of knowledge and experience in developing the proposed project using the TensorFlow Lite. Object recognition process require OpenCV library to capture camera frame and do prediction, there is some bug or code need to modify to implement OpenCV library into Android Studio.

Other than that, difficulty in object recognition is the most challenging parts in this project. To recognize an object by using camera, function in OpenCV library had to called and used to capture the camera frame as input into the model. Due to lack of knowledge and experience in using OpenCV library, it took several days to learn and modify the code to get suitable input. Besides, using TensorFlow API to recognize an object is a big challenge due to lack of knowledge and experience in machine learning, it is difficult to understand the concept of object recognition in programming language and it took several weeks to learn the knowledge so that the object recognition process can be conducted successfully as the camera image can be converted into suitable input datatype and as an input into model to do prediction then add the frame to the output.

Furthermore, upload and attract data from firebase database is also challenging and time consuming. There are lots of error on code had to try it out and debug to attach and store the data into and from firebase database.

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6.3 Objectives Evaluation

According to project objectives stated in Chapter 1, the project objectives has been successfully achieved as shown below

1. Successful develop an AR object recognition mobile application that integrate with augmented reality technology for user to recognize the object by using device camera or an image from device storage.

2. Successful develop and provide a social media platform for all the user to share user experience and asking question on certain electronic appliance that the bought or wish to buy.

3. Successful develop an information gallery that store different details of electronic appliance for user to do research on product details.

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6.4 Concluding Remark

To perform testing on the function and outcomes of this AR object recognition mobile application, verification for each function and module was written. Each function module was tested based on the data that stated in verification plan. All the module and function were test on possible action performed and input data. The data tested involved valid and invalid data input to ensure that the system can handle all possible scenarios and edge cases. Valid inputs are used to test whether the system can perform the intended function correctly and produce the expected results and invalid inputs are used to test how the system responds to unexpected or erroneous inputs.

On the other hand, the implementation phase of the AR object recognition mobile application project faced several challenges and issues. The lack of knowledge and experience in developing the project using TensorFlow Lite and OpenCV library was the primary challenge. The difficulty in object recognition and using TensorFlow API also presented significant challenges. It required several days of learning and code modification to get suitable input and several weeks to understand the concept of object recognition in programming language. Uploading and retrieving data from the Firebase database also posed significant challenges, and debugging was necessary to store the data successfully. Despite these challenges, the project team persevered and successfully completed the implementation phase of the AR object recognition mobile application project.

The project has successfully achieved its objectives as stated in Chapter 1. The team has successfully developed an AR object recognition mobile application that integrates with augmented reality technology, enabling users to recognize objects using their device's camera or an image from device storage. Additionally, they have provided a social media platform for all users to share their experiences and ask questions about certain electronic appliances they have purchased or wish to buy. Overall, the project has met all of its objectives, and it is expected to have a positive impact on users' experiences when purchasing and using electronic appliances.

As a concluding remark, function and module of the application had been tested and the output is match with the expected outcome, all the function had well performance in handling different type of scenario. Challenge in developing this application had discussed and all the project objectives had achieved.

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CHAPTER 7

CONCLUSION AND RECOMMENDATION

In this chapter, conclusion and Recommendation for this project will be presented.

7.1 Conclusion

The integration of real-life experiences with digital technology has reinforced the evolution of modern society to accommodate the advancements in Industry 4.0. Augmented Reality (AR) technology has now reached a level of maturity, and it can overlay computer-generated graphics onto a user's real-world environment, making previously unreal concepts achievable. In the future, self-service shops are likely to become increasingly popular due to the convenience they offer. Customers will be able to browse and purchase products at their own pace without the need for assistance from a sales associate. With the advancement of technology, these self-service shops may also include features such as automated checkouts, interactive displays, and even virtual assistants that can provide personalized recommendations. This trend towards self-service is driven by the desire for efficiency and convenience, and it is expected to continue to shape the retail industry in the years to come. AR object recognition technology can be used in future self-service shops to enhance the customer experience and streamline the shopping process. With AR object recognition, customers can use their smartphones or other devices to scan items and get instant information about them, such as price, nutritional value, and reviews. This technology can also be used to identify products that are out of stock or to suggest similar items based on the customer's preferences. By incorporating AR object recognition technology into self-service shops, retailers can provide a more personalized and efficient shopping experience for their customers.

The objective of this project is to develop an AR object recognition mobile application that allow users to use their device camera to scan an object and recognize it. Some information such as name of the object will display on AR frame that bounded the object. Other than that, this project wishes to provide a platform to users share their user experience on certain electronic appliance by publishing a post and communicate by using comment function of the post.

In the conclusion, this project proposed an AR object recognition mobile application that can put an AR frame on the object that recognized by application. This application successfully displays information on AR frame of recognized object by scanning the object with device camera. Besides, this application has some sub function such as home module, profile module

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and catalog module. Finally, this application has potential contribute to self-service shop that free from staff needed.

7.2 Recommendation

Current version of the application only meets the basic requirements, but there is room for improvement through recommendations and future work. The following list suggests potential areas for improvement in future iterations.

1. **Train a custom model that can only recognize different electronic appliance.**

   Current object recognition model can recognize on different object including electronic appliance, train a custom object recognition model can help the application focus on recognize electronic appliance only.

2. **Improve the accuracy of the model.**

   Improve the accuracy of model by training the model with large amount of dataset can make the application predict the object more accurately.

3. **Implement a search bar on catalogue module.**

   Current catalog module did not provide any search bar to search on product detail, search function can bring more convenience to the user when they search for certain specific product.

4. **Add on more function after system recognize the scanned object.**

   Implement some function such as prompt a window ask user whether to redirect or forward user to product detail page after system successful recognize the scanned object or stay in current page.

5. **Display more information on AR frame**.

   Display more information about object such as brand, price, or some details of the project.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: Week 2**
Student Name & ID: Lim En Siang (19ACB04652)	
Supervisor: Ts Saw Seow Hui	
Project Title: THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

1. I had first meeting with my supervisor, we discussed an overview of this project.
2. Searching for object recognition online Resource
3. Download and configure development tools.

2. WORK TO BE DONE
1. Code the object recognition function.
2. Test on the output result

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Need to speed up the process and start to code the project.

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT
(Project II)

Trimester, Year: Y3S3	**Study week no.: Week 3**
Student Name & ID: Lim En Siang (19ACB04652)	
Supervisor: Ts Saw Seow Hui	
Project Title: THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

1. Implement OpenCV library into Android Studio successfully, OpenCV can function well in Android Studio
2. Implement TensorFlow Lite API Successful

2. WORK TO BE DONE
1. Get Camera image by using OpenCV.
2. Program Function for

3. PROBLEMS ENCOUNTERED

1. Encounter some issue to get the camera image by using OpenCV.
2. Encounter some issue to get the correct input to model.

4. SELF EVALUATION OF THE PROGRESS
Need to start code others function module of the project.

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: Week 7**
Student Name & ID: Lim En Siang (19ACB04652)	
Supervisor: Ts Saw Seow Hui	
Project Title: THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

1. Finish program object recognition function
2. Successful obtain the input from camera and display the output correctly.

2. WORK TO BE DONE
   1. **Code the post function of home module**
   2. **Code for authentication function of the application**
   3. **Code the function of profile module**

3. PROBLEMS ENCOUNTERED

   1. Encounter some issue to get correct input to model
   2. Encounter problem on coding object recognition function

4. SELF EVALUATION OF THE PROGRESS
Need to speed up my project progress.

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: Week 10
Student Name & ID: Lim En Siang (19ACB04652)	
Supervisor: Ts Saw Seow Hui	
Project Title: THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

1. Finish code the authentication function of application
2. Finish code the function of home module and profile module

2. WORK TO BE DONE
1. Code the function of catalog module
2. Perform testing again on all the function.
3. Adjust user interface of application.

3.PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS
Need to do more research on how to use OpenCV and TensorFlow Lite

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: Week 12
Student Name & ID: Lim En Siang (19ACB04652)	
Supervisor: Ts Saw Seow Hui	
Project Title: THE OBJECT RECOGNITION FOR AUGMENTED REALITY (AR)	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

1. Complete all the programming process of the application.
2. Complete testing on application output.

2. WORK TO BE DONE
1. Complete full report of project

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS
Had to compete my full report before the deadline

_____
Supervisor's signature

_____
Student's signature

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PLAGIARISM CHECK RESULT

fyp2 report

ORIGINALITY REPORT

5%	**%**	**5**%	**%**
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Ana Lameira, Rui Jesus, Nuno Correia. "Real-time object recognition using mobile devices", Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services, 2011 Publication	1%
2	Tiffany Yu-Han Chen, Lenin Ravindranath, Shuo Deng, Paramvir Bahl, Hari Balakrishnan. "Glimpse", Proceedings of the 13th ACM Conference on Embedded Networked Sensor Systems - SenSys '15, 2015 Publication	1%
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