AR FLOOD

TUA YONG LIANG

Bachelor of Computer Science
(Computer Systems & Networking)
with Honours

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : TUA YONG LIANG

Date of Birth

Title : AR Flood

Academic Session : SEMESTER I 2022/2023

I declare that this thesis is classified as:

☐	CONFIDENTIAL	(Contains confidential information under the Official Secret Act 1997)*
☐	RESTRICTED	(Contains restricted information as specified by the organization where research was done)*
☑	OPEN ACCESS	I agree that my thesis to be published as online open access (Full Text)

I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

(Student's Signature)	(Supervisor's Signature)
New IC/Passport Number Date: 01st February 2023	Ts. Dr. HOH WEI SIANG Name of Supervisor Date: 10th February 2023

NOTE : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach a thesis declaration letter.

THESIS DECLARATION LETTER (OPTIONAL)

Librarian,
Perpustakaan Universiti Malaysia Pahang,
Universiti Malaysia Pahang,
Lebuhraya Tun Razak,
26300, Gambang, Kuantan.

Dear Sir,

CLASSIFICATION OF THESIS AS RESTRICTED

Please be informed that the following thesis is classified as RESTRICTED for a period of three (3) years from the date of this letter. The reasons for this classification are as listed below.

Author's Name
Thesis Title

Reasons (i)

(ii)

(iii)

Thank you.

Yours faithfully,

_____
(Supervisor's Signature)

Date:

Stamp:

Note: This letter should be written by the supervisor, addressed to the Librarian, *Perpustakaan Universiti Malaysia Pahang* with its copy attached to the thesis.

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Science (Computer System & Networking).

(Supervisor's Signature)

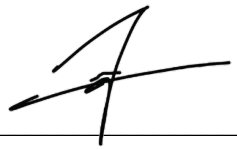
Full Name : TS. DR. HOH WEI SIANG

Position : Senior Lecturer

Date : 10th February 2023

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



(Student's Signature)

Full Name : TUA YONG LIANG

ID Number : CA19103

Date : 01st February 2023

AR FLOOD

TUA YONG LIANG

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Computer Science (Computer Systems & Networking) with Honours

Faculty of Computing
UNIVERSITI MALAYSIA PAHANG

JANUARY 2023

ACKNOWLEDGEMENTS

First of all, I would like to extend my warmest thanks to respected mentor, Ts. Dr. Hoh Wei Siang, who made this project possible. His immense knowledge, expertise and invaluable insights have been instrumental in completing this project His immense knowledge, expertise and invaluable insights have been instrumental in completing this project.

Secondly, I would like to express my gratitude to my friends and family who have been a constant source of encouragement and support throughout my academic journey. Their unwavering support has been a driving force in my determination to succeed.

Lastly, I would like to extend my heartfelt thanks to everyone who has supported me in one way or another in the completion of this project. I am grateful for all the knowledge and experiences that I have gained throughout this journey.

ABSTRAK

Banjir kilat telah menjadi semakin teruk di Malaysia akibat pembangunan bandar yang berlebihan, menyebabkan kerosakan dan gangguan yang ketara. Kerajaan Malaysia melaporkan MYR 6.1 bilion kerosakan akibat banjir baru-baru ini. Augmented reality (AR) dan Rapid Application Development (RAD) telah dicadangkan sebagai penyelesaian untuk membantu mengurangkan kesan banjir di negara ini. Teknologi AR menyediakan pengalaman interaktif persekitaran dunia sebenar dengan menindih elemen janaan komputer di atas dunia sebenar. Dengan AR Flood, rakyat Malaysia boleh melihat keterukan banjir di kawasan mereka dan melihat paras air masa nyata yang disediakan oleh Kementerian Alam Sekitar dan Air. Model RAD memberi tumpuan kepada membangunkan aplikasi dengan pantas dan cekap melalui maklum balas berterusan, menjadikannya lebih berkemungkinan diterima oleh pengguna akhir. Struktur kitaran hayat RAD terdiri daripada empat fasa: Perancangan Keperluan, Reka Bentuk Pengguna, Pembinaan dan Cutover. Kertas kerja ini membentangkan cadangan untuk melaksanakan AR Flood, aplikasi realiti tambahan, untuk membantu mengurangkan kesan banjir di Malaysia. Aplikasi itu akan menyediakan maklumat masa nyata tentang paras air, membolehkan rakyat Malaysia melihat keterukan banjir di kawasan mereka. Maklumat tersebut akan dikategorikan kepada tahap biasa, amaran, amaran dan bahaya, memberikan pengguna pemahaman yang jelas tentang situasi banjir yang diramalkan. Pelaksanaan AR Flood akan berdasarkan model Rapid Application Development (RAD), yang memfokuskan pada membangunkan aplikasi dengan pantas dan cekap melalui maklum balas berterusan. Struktur kitaran hayat RAD memastikan proses pembangunan diikuti dan merangkumi empat fasa asas: Perancangan Keperluan, Reka Bentuk Pengguna, Pembinaan dan Cutover. Cadangan ini bertujuan untuk menyediakan penyelesaian praktikal kepada masalah banjir kilat di Malaysia, membantu mengurangkan kesannya dan menyediakan persekitaran yang lebih selamat dan bermaklumat untuk rakyat Malaysia.

ABSTRACT

Flash floods have become increasingly severe in Malaysia due to overdevelopment of cities, causing significant damage and disruption. The Malaysian government reported MYR 6.1 billion in damages from recent floods. Augmented reality (AR) and Rapid Application Development (RAD) have been proposed as solutions to help mitigate the impact of floods in the country. AR technology provides an interactive experience of the real-world environment by superimposing computer-generated elements on top of the actual world. With AR Flood, Malaysians can preview the severity of floods in their area and view real-time water levels provided by the Ministry of Environment and Water. The RAD model focuses on developing applications rapidly and efficiently through continuous feedback, making it more likely to be accepted by end users. The RAD life cycle structure consists of four phases: Requirements Planning, User Design, Construction, and Cutover. This paper presents a proposal to implement AR Flood, an augmented reality application, to help mitigate the impact of floods in Malaysia. The application will provide real-time information on water levels, allowing Malaysians to preview the severity of floods in their area. The information will be categorized into normal, alert, warning, and danger levels, giving users a clear understanding of the predicted flood situation. The implementation of AR Flood will be based on the Rapid Application Development (RAD) model, which focuses on developing applications rapidly and efficiently through continuous feedback. The RAD life cycle structure ensures that the development process is followed and includes four fundamental phases: Requirements Planning, User Design, Construction, and Cutover. This proposal aims to provide a practical solution to the problem of flash floods in Malaysia, helping to mitigate their impact and provide a safer and more informed environment for Malaysians.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, flash flood has become more severe in Malaysia due to the overdevelopment of cities. There are a lot of places facing the same issue as Kuala Lumpur, Klang, Pahang, and Terengganu.(Nadirah H. Rodzi, 2022) On 28 January 2022, the Malaysian government said that recent floods (Khalid & Shafiai, 2015) had caused MYR 6.1 billion (USD1.46 billion or CHF 1.3 billion) in total damages.

One of the most common natural disasters to strike Malaysia, floods occur almost every year, particularly during the monsoon season. They are one of the most common natural disasters to hit the country.(Chan, 2015) The shores of peninsular Malaysia are particularly vulnerable to flooding during the northeast monsoon season, which runs from October to March. Flash floods were reported to have struck several areas of the deferral capital after heavy rain. Flash floods also caused the closure of the Smart Tunnel.(Bernama, 2022) In the first setting of the Smart Tunnel (*Smart Tunnel: What Is It, How Does It Work and the Real Example of Malaysia*, 2021), normal conditions, in which there is no storm and no flood water will be directed into the system, and the Smart Tunnel will operate. When the second mode is activated, flood water is redirected into the bypass tunnel underneath the tunnel that houses the highway. At this point, the highway segment can still accommodate vehicles in both directions. When the third mode is activated, the route will be off-limits to all vehicles. When all cars have left the highway, automated watertight gates will be released to allow flood waters to pass through. This will be done after verifying that all vehicles have gone the route. Following the cessation of the flooding, the tunnel will be checked for damage and cleaned using pressure washing before the highway is reopened to traffic within forty-eight hours of its closure. The fourth mode of operation of the tunnel was engaged for the eighth time by September

2020. The tunnel was able to redirect three million cubic meters of water during the flash flood on September 10, 2020.(Alexander Wong, 2021)

Augmented reality (AR) is an interactive experience of a real-world environment in which the items that dwell in the actual world are improved by computer-generated perceptual information. John Carmack first coined augmented reality in the 1960s.(Houston Ben, 2020) AR can be characterized as a system containing three fundamental features: a merging of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and actual items. The primary benefit of augmented reality is how elements of the digital world blend into a person's perception of the real world. This is accomplished not through the simple display of data but rather by incorporating immersive sensations, which are perceived as natural components of an environment. Augmented reality is a technique that enhances natural environments or scenarios by superimposing computer-generated elements on top of the actual world to create more immersive and richly sensory experiences. (*A Gentle Introduction to Computer Vision*, 2019) The information about the user's real-world environment can be made interactive and subject to digital manipulation with the assistance of more advanced augmented reality (AR) technologies. These technologies include adding computer vision, integrating AR cameras into smartphone applications, and object recognition.

In this project, AR Flood will be proposed with multiple features for the Malaysians, rescue departments, and government to discover the rescue plans. The Malaysians can preview the severity of the flood in their area in the application and view the real-time water level (Honingh et al., 2020) provided by the Ministry of Environment and Water(*Ministry of Environment and Water*, 2021). The river water can be categorized as normal, alert, warning, and danger levels. The user can directly view the predicted flood situation at a particular time.

1.2 Problem Statement

In Malaysia, floods are happened yearly due to the heavy rains in the rainy season. However, the number of recent flash floods has become more frequent and more severe. At the same time, there is also no mobile application that only focuses on AR Flood. Although there are some mobile applications that can view real-time data on water levels, but people don't know the severity of the flood. It will let the rescue teams cannot prepare in advance. Besides that, the news of the floods spread slowly to the public.

1.3 Objective

There are three objectives in this project which are:

1) To study the demand and requirement of AR Flood in Malaysia.
2) To design and develop an AR Flood to handle the flood in Malaysia.
3) To test and evaluate the efficiency of the proposed flood prediction and alarm system application when there is a flash flood.

1.4 Scope

The project's scopes are listed as follows:

i. The application is only available for Android devices.
ii. The application is designed for the Malaysian to aware the flash flood.
iii. The application will be developed by using Java Language.
iv. Firebase will be used as the database to store the data of the application.

1.5 Thesis Organization

In this thesis, it consists of five chapters. Chapter one discusses the introduction of the project, problem statement, objective, project scope, and the thesis organization.

Chapter two will discuss the literature review of the project. It includes the comparison of three existing systems on their functions, advantages, and disadvantages.

Chapter three will discuss the methodology used in this project. All use case diagrams, flowcharts, and proposed designs will be included in this chapter. In addition, this chapter will also explain all the hardware and software requirements required for project development. Moreover, this chapter can also find Gantt charts.

Chapter four will discuss the implementation and result of this project. The project implementation will be explained together with the user manual. At the same time, the results of the User Acceptance Test (UAT) will be documented in this chapter.

Chapter five, the last chapter will summarize the project development by revisiting the objective. At the same time, it will explain the limitations of the application and the work that can be done to improve the application in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nowadays, there are various flood mobile application that can be used locally for free. It allows the resident of that country to easily predict the flood and alert system. In this chapter, only three existing applications will be selected for research and review. It will explain and compare the functions of these three applications and features that can be adapted to the new application. These applications are AR Weather Simulator, MyPublicInfoBanjir, and InfoBencanaJKM.

2.2 Review of Existing Systems

2.2.1 AR Weather Simulator

Figure 2.1 AR Weather Simulator Logo

AR Weather Simulator is an application that only allows Japanese to experience weather and seasonal events in Augmented Reality (AR) pseudo. It can be used on both operating systems of mobile technology, android, and iOS. The size of the application is 140MB and the number of downloads by the user has exceeded 10 thousand. The only language provided in the application is Japanese.

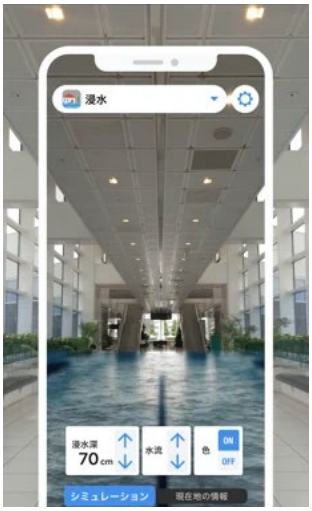


Figure 2.2 AR Weather Simulator page

One of the advantages is the user can stimulate the possible rainfall, flood and more in the current location. If the expected rainfall is 10mm/h then user can manually adjust the rainfall reading so that user can view the assumptions superimposed on the actual scenery. Other than that, AR Weather Simulator can let user experience the emergency disaster activities such as heavy rain, heavy snowfall, lightning strikes, flooding, fog, etc. more realistically.

The disadvantage of the AR Weather Simulator application is need to in-app purchases so that can receive timely and premium information such as weather phenomena and seasonal events with push notifications. Besides that, AR Weather Simulator application is only available for Japanese residents so others region users cannot experience it.

2.2.2 MyPublicInfoBanjir

Figure 2.3 MyPublicInfoBanjir Logo

MyPublicInfoBanjir is a mobile application that to provide an alert notification to the public, internal users Jabatan Pengairan dan Saliran (JPS) and external agencies for dissemination of the flood forecast and warning. This is because MyPublicInfoBanjir has been separated into two types, which are public users and agencies. It can be used on both operating systems of mobile technology, android and iOS, and also can be run in the web-based application. The application only occupied small spaces of memory, which is 12MB. There are two languages provided in the application, which are English and Malay. The public user of the application cannot switch the account to the agency because only internal JPS user and Government Agencies who already registered in FDC System can register the mobile device.

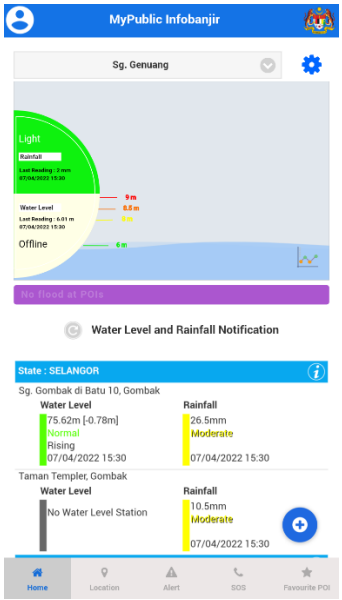


Figure 2.4 Main Page of MyPublicInfoBanjir

As public users, they can view the rainfall (RF) and water level (WL) of the home station directly on the main page. The public users can change the current location of home station to another home station. For the flood forecast, the public users can add Point Of Interest (POI) as more as they can but the POI alert only for three (3) river basin. The public users can receive the alert notification when the flood forecast, weather, current status (WL & RF), and announcement option are on. Besides that, the public users can view the location of the home station on the map provided and can direct call to the Malaysia Civil Defence Department (APM), Fire and Rescue Department of Malaysia (BOMBA), Ministry of Health of Malaysia (MOH), Majlis Gerakan Banjir, District Police Headquarters to seek the help.

One of the advantages of MyPublicInfoBanjir will show the real-time water level and rainfall alert that retrieved from Department of Irrigation and Drainage under Ministry of Environment and Water. This allows the public users to view the most accurate water level and rainfall alert more easily and in real-time.

The disadvantage of the MyPublicInfoBanjir is the user interface is difficult to view because all the information is pack and complicated. The public user is difficult to view the important notification or alert.

2.2.3 InfoBencanaJKM

Figure 2.5 InfoBencanaJKM Logo

InfoBencanaJKM is the mobile application that invented by Department of Social Welfare Malaysia (Jabatan Kebajikan Masyarakat Malaysia or JKM). In this application, the user can view any type of natural disaster that happening just now in any states of Malaysia. The application required 23MB of phone space and supported both operating

system of mobile technology, Android, and iOS. At the same time, it also can be run in the web-based platform. The user can choose the application language which are English and Malay.

Figure 2.6 Main Page of InfoBencanaJKM

In this application, the users especially victims can obtain information covering all disaster involving the opening of evacuation centers throughout Malaysia. The user can plan or determine the evacuation center to which to go in case any untoward catastrophe occurs. In addition, users can get information such as statistical map display on the state dashboard and a list of storage facilities.

One of the advantages of InfoBencanaJKM is that it is very convenient for the user to view the latest happened disaster and the opened evacuation center around. The user can have an emergency call by a choosing the nearest district. Other than that, the user also can view the river water level that retrieved from Department of Irrigation and Drainage under Ministry of Environment and Water.

The disadvantage of the InfoBencanaJKM application is the availability of the features to run in the application. In this application, there are some of the features that are not supported to run inside the application and will redirect to the web version of The Official Web of Public Infobanjir and JKR Disaster Management Official Website.

2.3 Comparative Analysis of Existing Systems

There are many functions that can be found on each existing system. In order to make the information clearer, the comparison of the function for all the existing system has been stated in the table below, Table 2.1 at the same time, each existing system has its own advantages and disadvantages. A comparison of their advantages and disadvantages has been made in Table 2.2 below.

	AR Weather Simulator	MyPublicInfoBanjir	InfoBencanaJKM
Size of Application	140 MB	12 MB	23MB
Operating System	Android & iOS	Android & iOS	Android & iOS
Notification	Yes	Yes	No
Interoperability	Mobile application	Mobile application & web-based application	Mobile application & web-based application
Language	Japanese	Malay, English	Malay, English
Subscription Fee	RM 3.38	No	No

Table 2.1 Comparison between three existing system

Application	Advantages	Disadvantages
AR Weather Simulator	Stimulate natural phenomenon by using AR visualization to stimulate the possible rainfall, flood and more in the current location.	Restricted on Japan. Only Japanese users can use this application. Only Japanese language. The application only shows in Japanese language. Subscription Fee. The application needs to subscribe so then can get premium update and notification.
MyPublicInfoBanjir	Real-time data. The application will show the real-time water level and rainfall alert.	Complex user interface. The user interface is complicated.
InfoBencanaJKM	Multiple function. The application can show the various type of disaster happened and its location.	No notification. The application does not show the notification.

Table 2.2 Advantages & Disadvantages of three existing systems

2.4 Chapter Summary

In this chapter, the three existing systems are compared. Based on the discussion, it shows that each of the existing system has its own advantages and disadvantages. At the same time, some functions developed on the existing system will be implemented in the proposed application.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discussed on the methodology that will be used in developing the Flood application with AR visualization mobile application. Software development methodology (SDM) is known as framework that is used to construct, organize, and manage the development process. It is necessary for the project development because it can help to ensure that the project is developed within the schedule, budget, and meeting requirements. There are many SDMs that are available for the project development, such as Waterfall Model, Spiral Model, Agile, Rapid Application Development (RAD), and Increment. However, each methodology will take a different approach to the system development.

In this project, RAD will be used to develop the AR Flood because it is flexible. The developer can make the adjustments quickly during the development process and also provide rapid development within a short time. It consists of four main phases, which are Requirement Planning, User Design, Construction, and Cutover. Each phase will be explained in detail. In addition, the hardware and software used in this project development are also stated in this chapter.

3.2 Software Development Methodology

Rapid Application Development (RAD) is a form of agile methodology that focuses on developing applications rapidly through frequent iterations and continuous feedback. It allows developers and users to measure the progress accurately and communicate in real-time on evolving issues or changes for greater efficiency and faster development. With a continuous stream of feedback and user interaction, the resulting system developed by RAD model is more likely to be acceptable by the end users and offer user-friendly functionality. At the same time, RAD is more suitable to be used when there is a need to develop a system within a short duration with high quality.

The Rapid Application Development (RAD) life cycle structure is created to ensure that the process of system development is followed as the structure. Requirements Planning, User Design, Construction, and Cutover are the four fundamental phases found in the RAD life cycle, as shown in Figure 3.1 below. Each phase will have its own activities and behaviours.

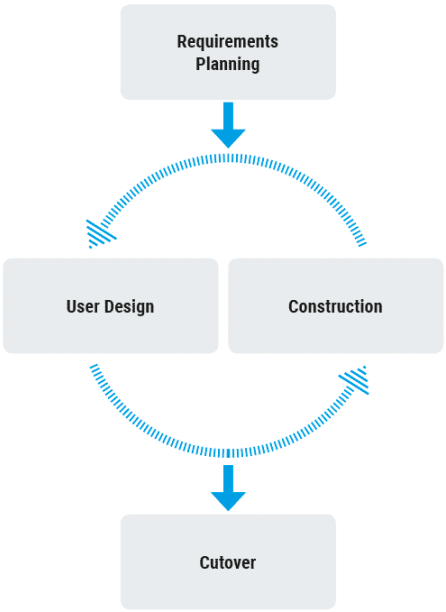


Figure 3.1 Rapid Application Development Life Cycle

3.2.1 Requirements Planning

Requirements planning is an initial phase, where the developer and client will have a project scope meeting. During the meeting, a discussion will be done to determine the project requirement and expectations such as the current and potential issues that would need to be addressed during the construction. At the same time, the user and developer will make a rough agreement on the scope of the project through the discussion to ensure that there are no misunderstandings occurring after the system was developed.

The purpose of developing the AR Flood is to allow Malaysian to take an action before the flood is occurring. At the same time, the rescue department also can use the application to evacuate the resident for the safety purpose.

3.2.2 Functional and Non-Functional Requirement

Functional Requirement	Non-Functional Requirement
The system should allow all the users to login their account with username and password.	The system must have login functions to protect the user's data and information to prevent the importance information been leaked to hackers.
The system should allow all the new users to register their account with filling their personal information.	Email verification should be sent not more than 12 hours.
The system should allow all the users to detect their location by using GPS.	The system should provide the accuracy results to ensure the accurate data successfully delivered to all the users.
The system should allow all the users to view the water level and its state.	The user's personal information must be protected to prevent data been hacked and leaked to public.

The system should allow all the users to receive the notification when there is an update.	The system should be available for use 24 hours per day. This is because can make all the users to check the real-time water level anywhere anytime.
The system should allow all the users to view and update their profile.	
The system should allow all the users to view the FAQs to have a quick solution when facing problem.	

Table 3.1 Functional and Non-Functional Requirement

3.2.3 Constraints and Limitation

AR Flood cannot support iOS interface. Besides that, users cannot receive the update when mobile phone's data or WiFi is off. Users cannot get the parameter update faster than the speed of light. The system response time also cannot predictable.

3.2.4 User Design

This phase is to develop the system structure, where the data from the user requirement is used to develop a project to meet the need of the users. Use case diagram, flowchart and the basic storyboards are constructed with some illustrations and plain details, so there are complete descriptions and schematics. Therefore, use case diagram, flowchart and storyboards should be designed together with the plan details to get schematic and description. Then, the storyboard for this project is created using draw io.

The Markerless AR is used in this proposed project. It will scan the real environment and places the digital elements. When the user does the selection for require using AR to view the scene, then the AR service will be active. The AR will show users that the predicted water level based on the real-time forecast data from related department under Malaysia government. Hence, all of these diagrams need to be created before the

system construction to make sure that the user can easily understand the system flow and give their feedback according to the design.

3.2.5 Construction

Once the design process is done, the developer will start to transform the design into a prototype. It is another continuous process, where the clients will suggest some changes or improvements throughout the process of development to ensure that the final result will meet their requirements. During the application construction, the developer will mainly focus on implementing the feedback provided by the client through coding, unit integration, and testing.

In this project, Android Studio will be used to develop the AR Flood, Firebase will act as the database for data storage, while the Unity will be used to develop the Augmented Reality scenes. All the application development will be based on the design and requirements that have been finalized before. At the end of the development, all the functionality of the application component will be tested by the developer and client to make sure that there is no bug or error found in the system and the user expectation can be achieved.

3.2.6 Cutover

Cutover will be the final phase of the development, where the AR Flood is ready to be delivered to the user. The full-scale testing will be performed in this phase by the clients to ensure that the application meets all the requirements and can be run successfully. Once the application is successfully assessed by the client, then it can be considered as the complete application and ready to be implemented into the live environment.

3.3 Context Diagram

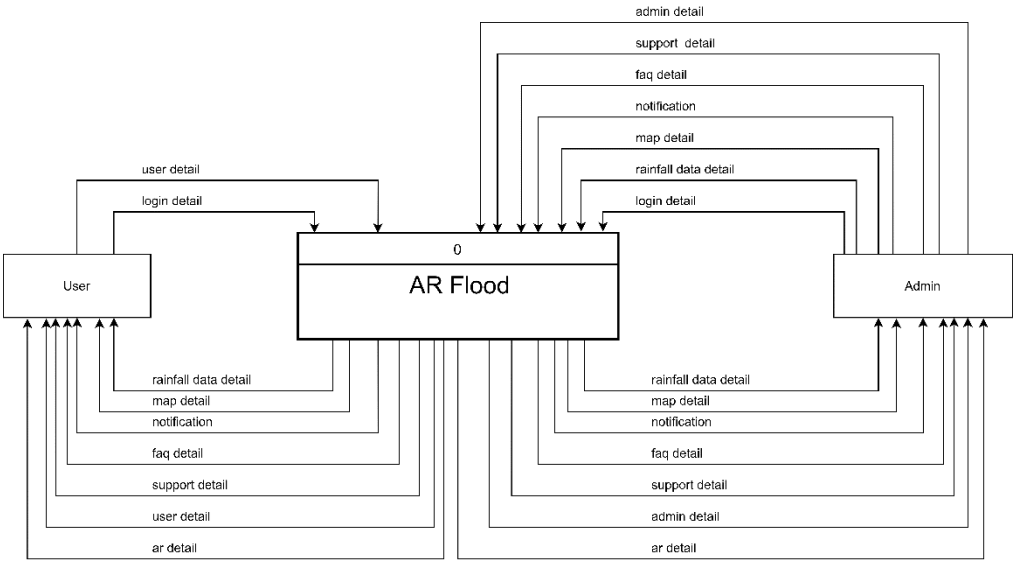


Figure 3.2 Context Diagram of AR Flood

The context diagram above shows that the user can enter their user information into this system. Users can also view the rainfall data, map, AR, notification, faq, support if they choose these modules in the system. The admin interacts with the system by edit and update the user information in the system. The admin can add, edit, delete, and view the rainfall data, map, notification, faq, and support in the system.

3.4 Use Case Diagram

Use case diagram indicates all the activities of the system. It represents in a graphical diagram the intercommunications and the distinction between the actors and the system. The actors in the proposed system are user and admin. The figure below shows the use case diagram of the AR Flood.

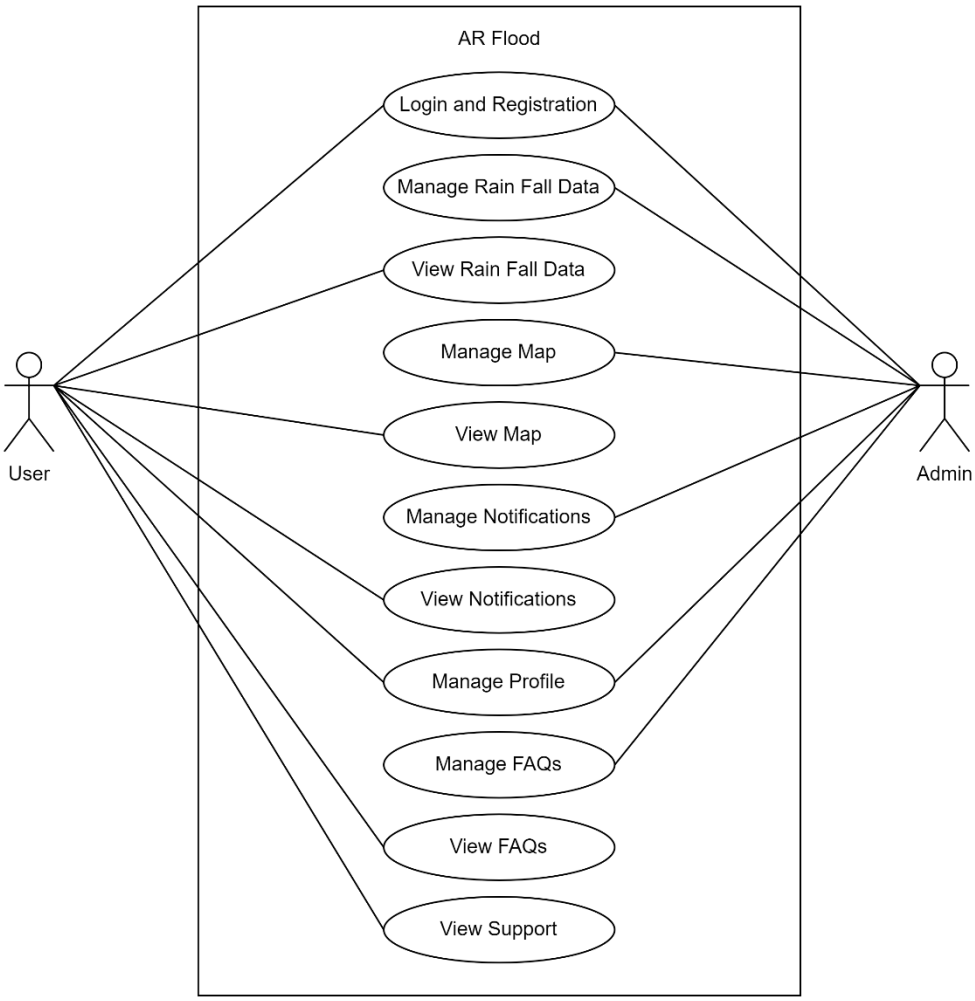


Figure 3.3 Use Case Diagram of AR Flood

Based on the use case diagram above, there are two actors that can be performed in the application, which are the user and admin. Users can register an account to perform all the functions and its own features. The activities that can be performed by the users are login and registration, view rain fall data, view map, view notifications, manage profile, view FAQs, view support, and view AR. After login to their account, they can

simply manage the profile and view locations, parameters, notifications, FAQs, and support.

Other than that, there are some functions that can be performed on the admin interface. For example, admin can manage rain fall data, manage map, manage notifications, manage FAQs, and manage AR. In addition, the admin can also manage login and registration of the users. After the locations is added, users can choose the location they need to view. At the same time, the admin may update and view the FAQs and support on the admin interface.

3.5 Flowchart

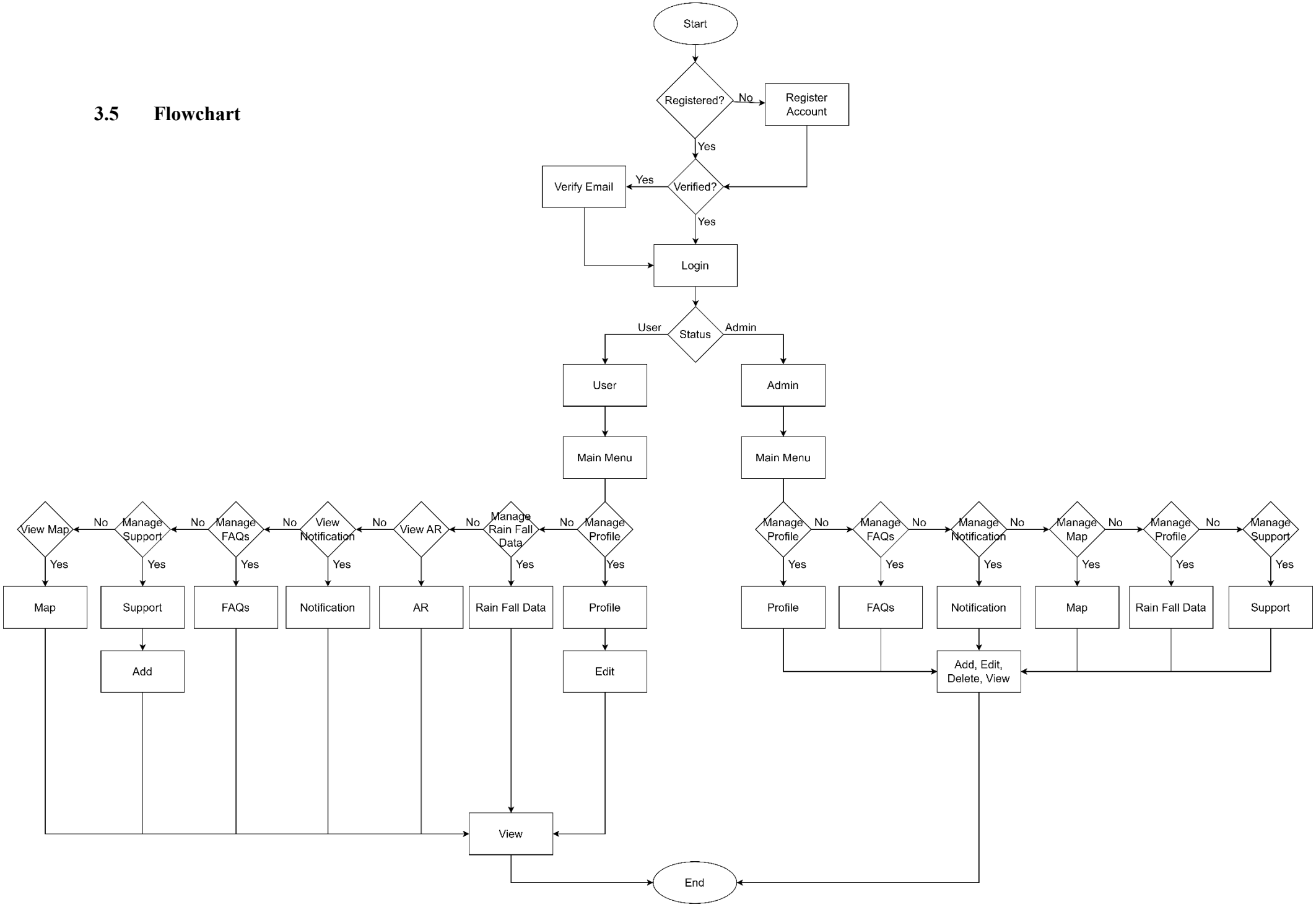


Figure 3.4 Flowchart of AR Flood

According to the figure above, the application will start from registration. If the user does not have an account, he/she needs to register. After completing the registration, they need to make sure that the email address is verified so that they can log in to the application.

After login, it will go to the main menu of the application and user. The user can browse the functions shown in the main menu. They can select the profile to view the details of their personal information. If the user is dedicated to update their personal information, he/she can directly update the details. The user can view the rainfall data in the location menu. When the user wishes to view the AR, the permission to use the camera is granted and the AR will show to the user. Instead of viewing the rainfall data, the user also can view the notifications through the application. They can view the notifications created by the application. Other than that, the user also can view FAQs and support on the user main menu interface.

In the admin's account, they can manage the user's profile. Admin have the permission to edit and update the user's details and delete the user's profile. Besides that, admin also can manage rainfall data. The added and updated location will be displayed in the user's rainfall data interface. Other than that, the admin can manage map, manage notification, and manage FAQs. At the same time, the admin can add and update the notification, FAQs, and support.

3.6 Activity Diagram

In a manner analogous to that of a flowchart or data flow diagram, an activity diagram graphically depicts a sequence of operations or the flow of control within a system. In the modelling of business processes, activity diagrams are frequently utilised.

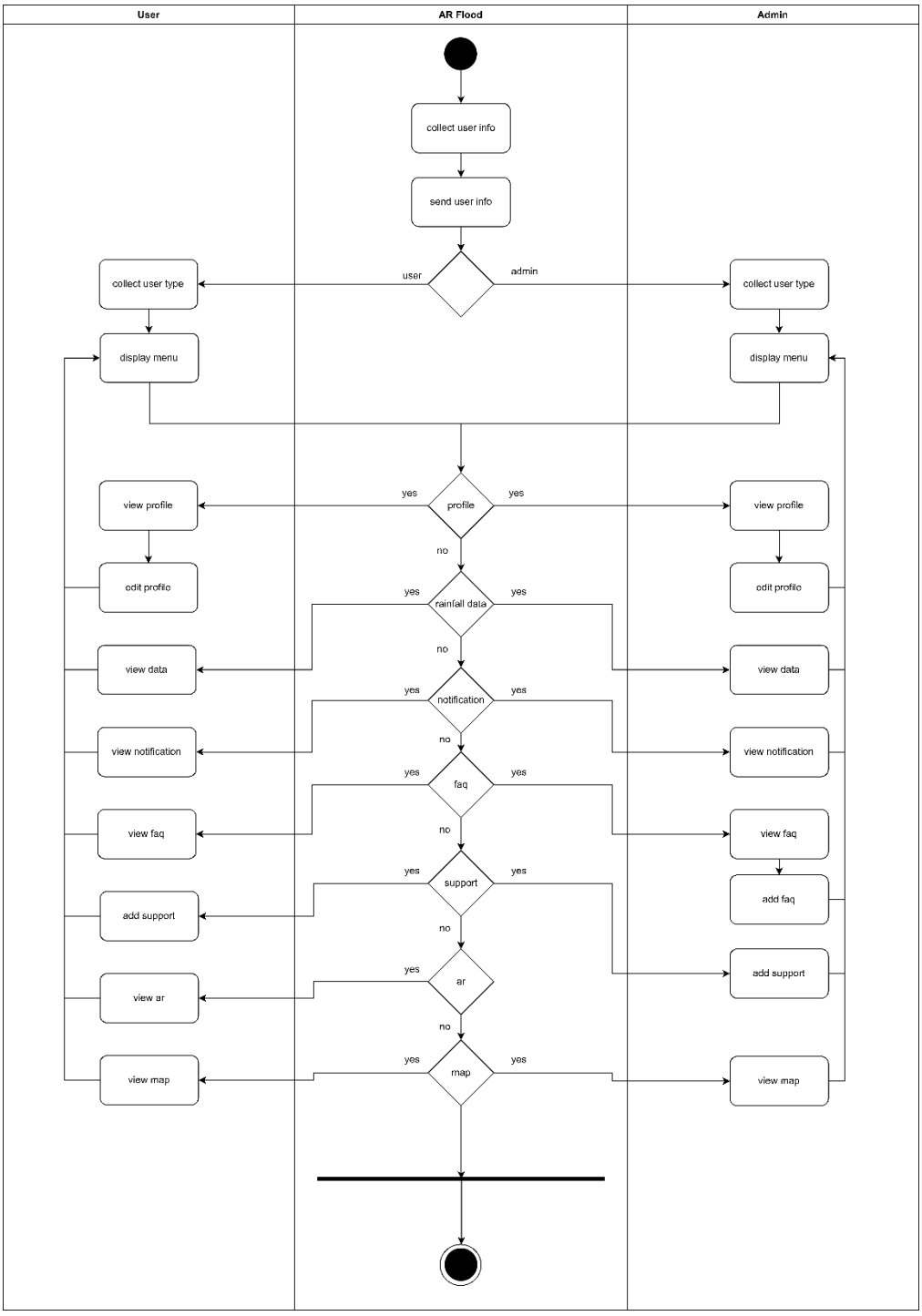


Figure 3.5 Activity Diagram of AR Flood

3.7 Entity Relationship Diagram

The Entity Relationship Diagram (ERD) is a structural diagram for describing the database design of the project. The ERD shows the relationships of the entity sets to store into the database. Figure 3.6 shows the Entity Relationship Diagram of the AR Flood.

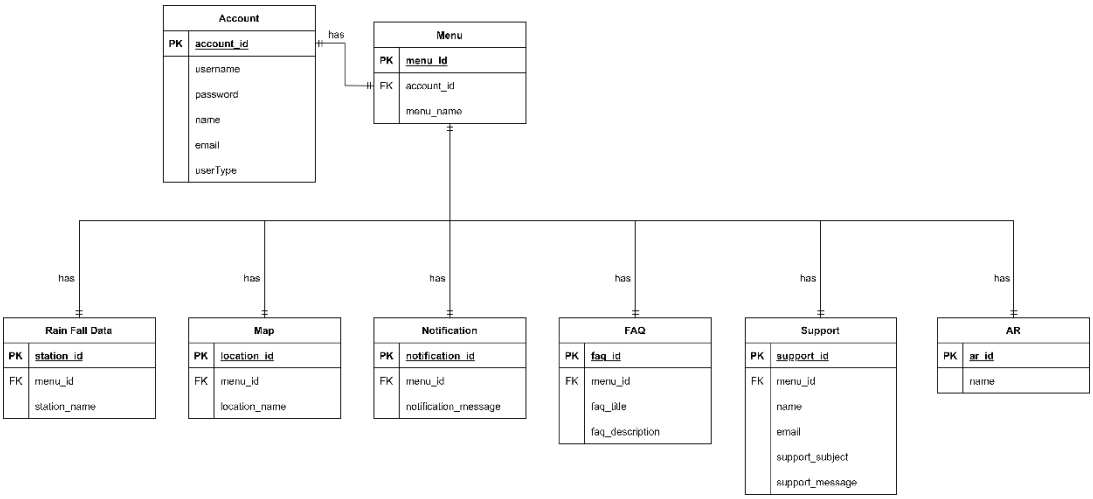


Figure 3.6 ERD of AR Flood

There are eight entities in this project. Account table is used to store the username, password, name, email, and user type of the admin and user to log in to their account. Menu table is used to store the menu name, Rain Fall Data table is used to store rainfall data, Map table is used to store location name, Notification table is used to store notification, FAQ table is used to store faq, Support table is used to store support, AR table is used to store AR data.

3.8 Data Model

Field Name	Description	Data Type	Constraint
account_id	Account ID	*INT*	*PK, NOT NULL*
username	Username	*VARCHAR(20)*	*NOT NULL*
password	Password	*VARCHAR(20)*	*NOT NULL*
name	Name	*VARCHAR(50)*	*NOT NULL*
email	Email	*VARCHAR(50)*	*NOT NULL*
userType	User Type	*VARCHAR(10)*	*NOT NULL*

Table 3.2 Data Dictionary for Account Table

Field Name	Description	Data Type	Constraint
menu_id	Menu ID	*INT*	*PK, NOT NULL*
account_id	Account ID	*INT*	*FK, NOT NULL*
menu_name	Nemu Name	*VARCHAR(50)*	*NOT NULL*

Table 3.3 Data Dictionary for Menu Table

Field Name	Description	Data Type	Constraint
station_id	Station ID	*INT*	*PK, NOT NULL*
menu_id	Menu ID	*INT*	*FK, NOT NULL*
station _name	Station Name	*VARCHAR(100)*	*NOT NULL*

Table 3.4 Data Dictionary for Rain Fall Data Table

Field Name	Description	Data Type	Constraint
location_id	Location ID	*INT*	*PK, NOT NULL*
menu_id	Menu ID	*INT*	*FK, NOT NULL*
Location_name	Location Name	*VARCHAR(100)*	*NOT NULL*

Table 3.5 Data Dictionary for Map Table

Field Name	Description	Data Type	Constraint
notification_id	Notification ID	*INT*	*PK, NOT NULL*
menu_id	Menu ID	*INT*	*FK, NOT NULL*
notification_message	Notification Name	*VARCHAR(200)*	*NOT NULL*

Table 3.6 Data Dictionary for Notification Table

Field Name	Description	Data Type	Constraint
faq_id	FAQ ID	*INT*	*PK, NOT NULL*
menu_id	Menu ID	*INT*	*FK, NOT NULL*
faq_title	FAQs Title	*VARCHAR(100)*	*NOT NULL*
faq_description	FAQs Description	*VARCHAR(200)*	*NOT NULL*

Table 3.7 Data Dictionary for FAQ Table

Field Name	Description	Data Type	Constraint
support_id	Support ID	*INT*	*PK, NOT NULL*
menu_id	Menu ID	*INT*	*FK, NOT NULL*
name	Name	*VARCHAR(50)*	*NOT NULL*
email	Email	*VARCHAR(50)*	*NOT NULL*
support_subject	Support Subject	*VARCHAR(100)*	*NOT NULL*
support_message	Support Message	*VARCHAR(200)*	*NOT NULL*

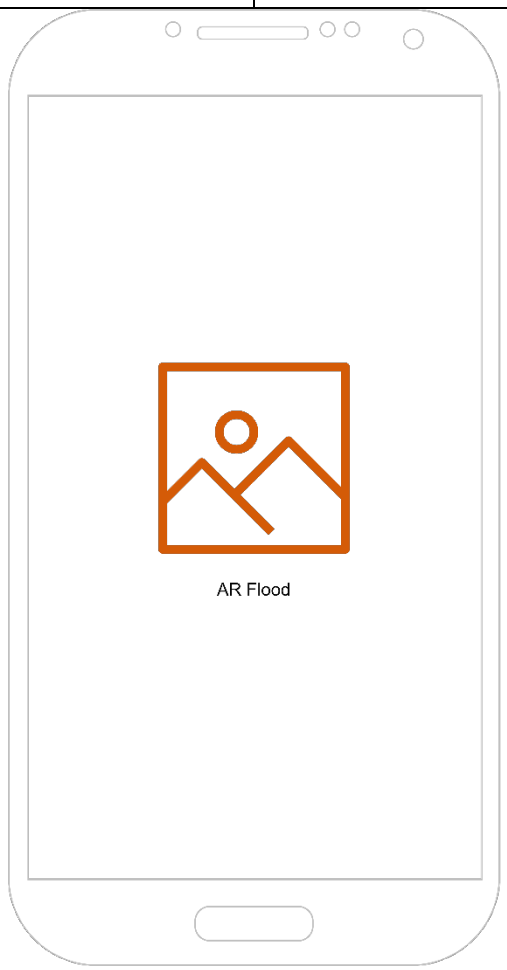
Table 3.8 Data Dictionary for Support Table

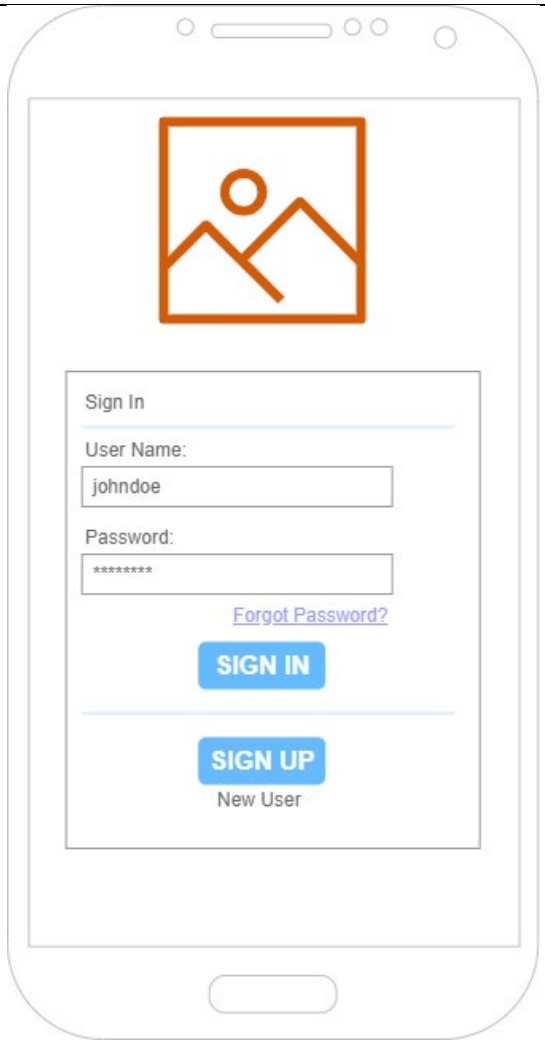
Field Name	Description	Data Type	Constraint
ar_id	AR ID	*INT*	*PK, NOT NULL*
parameter_id	Parameter ID	*INT*	*FK, NOT NULL*
name	Name	*VARCHAR(50)*	*NOT NULL*

Table 3.9 Data Dictionary for AR Table

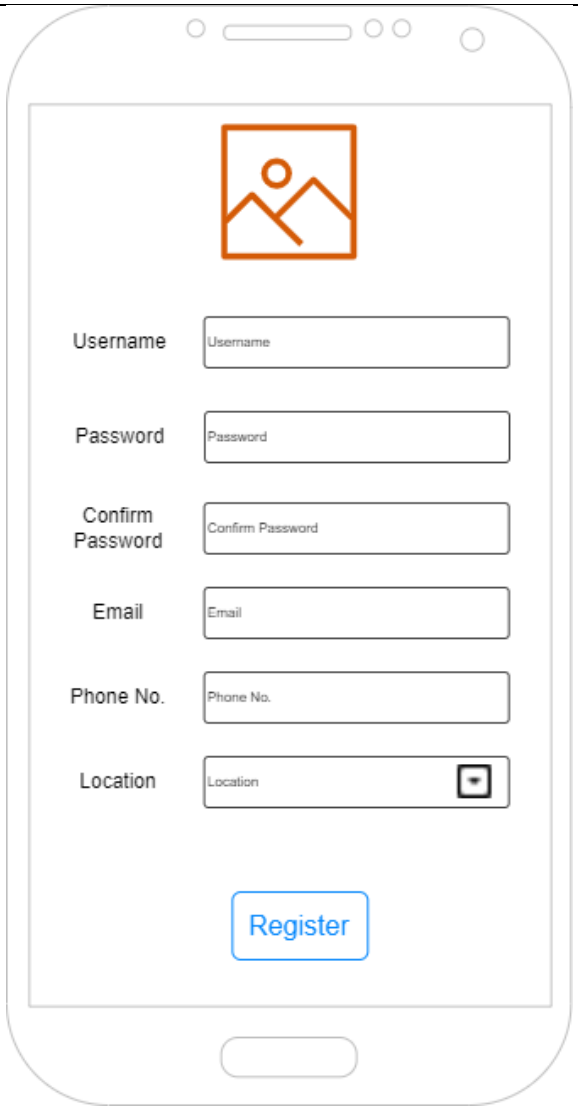
3.9 Storyboard

Storyboard is essential as it can help the developer and client to understand the overall flow of the application. Clients can determine whether the design is suitable for the project requirements before the development process begins. Each interface will be represented as an activity and will be discussed in Table 3.9 below.

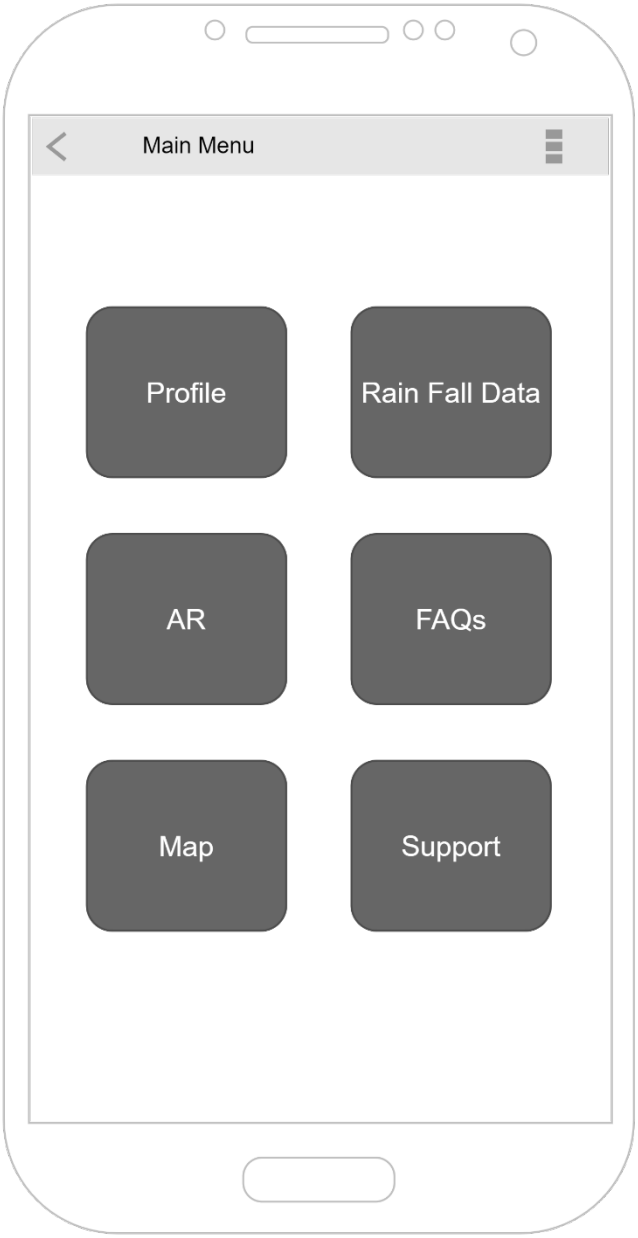
Frame	**Description**
	
1. Introduction Page	This is the first page of the application. The purpose of design this page is to introduce to users the logo and name of the application.



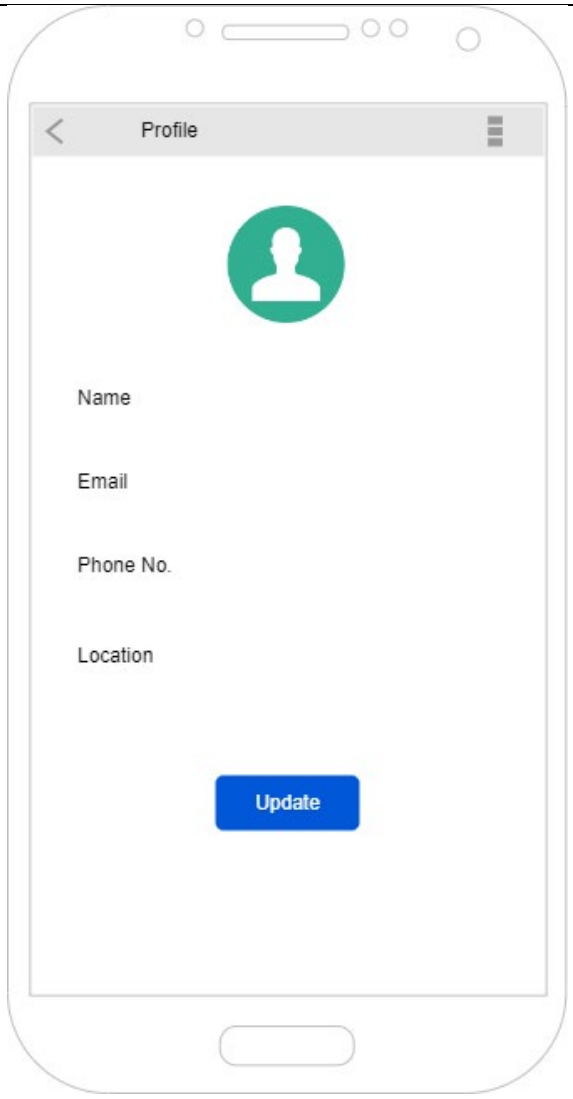
2. Login Page	This is the second page of the application. Users are required to login with a valid username and password. They cannot login to the application without any registration or using a wrong username or the wrong password. Hence, the user needs to click the hyperlink “Sign Up” to register an account. If the users accidentally forgot their password, they can click the hyperlink “Forgot Password?” to change a new password.



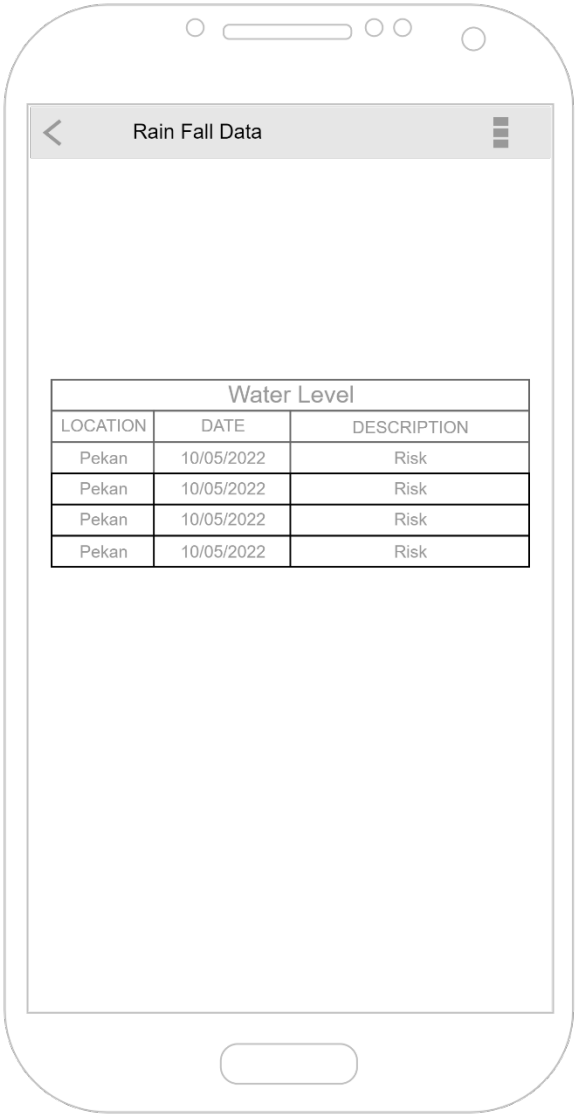
3. Registration Page	This is the register page of the application. All fields are mandatory, except the profile picture. User needs to fill in all required information before clicking the register button. The information that the new user needs to enter are the username, password, confirmation password, email, phone number, and location. The user needs to ensure that the entered password is similar to the confirm password.



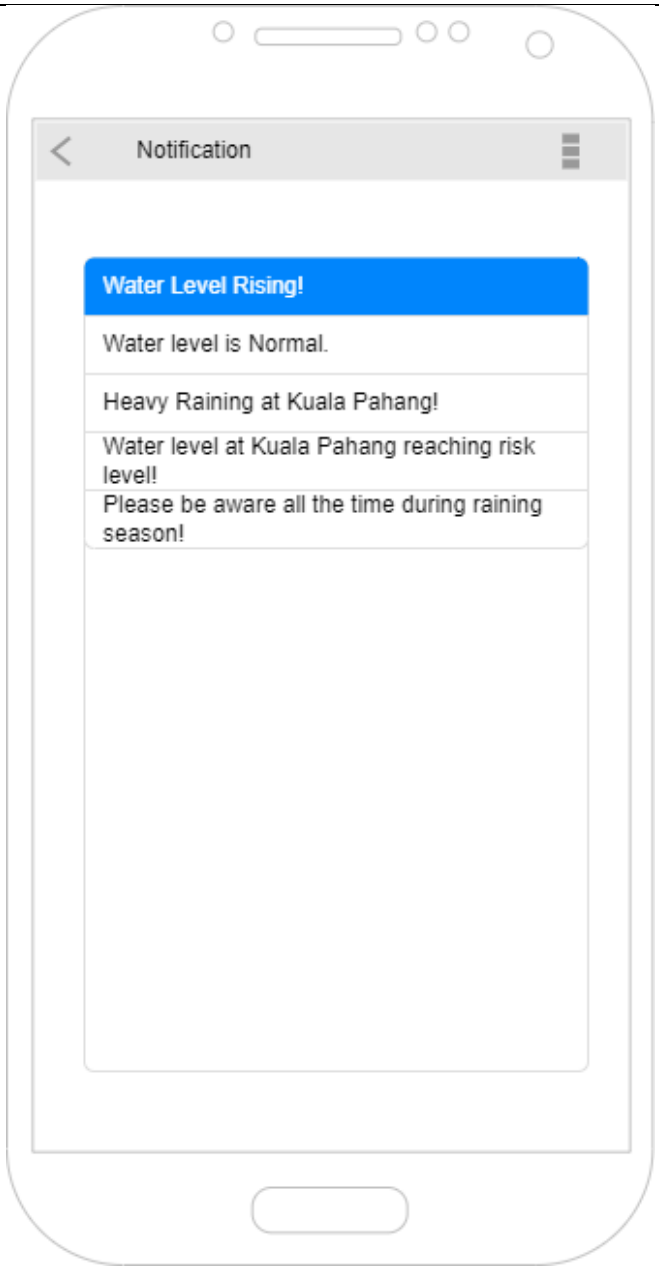
4. User's Main Menu Page	This is the user's main menu page of the application. The application will display the available buttons with function for user. There are total six button such as Profile, Rain Fall Data, AR, FAQs, Map, and Support.



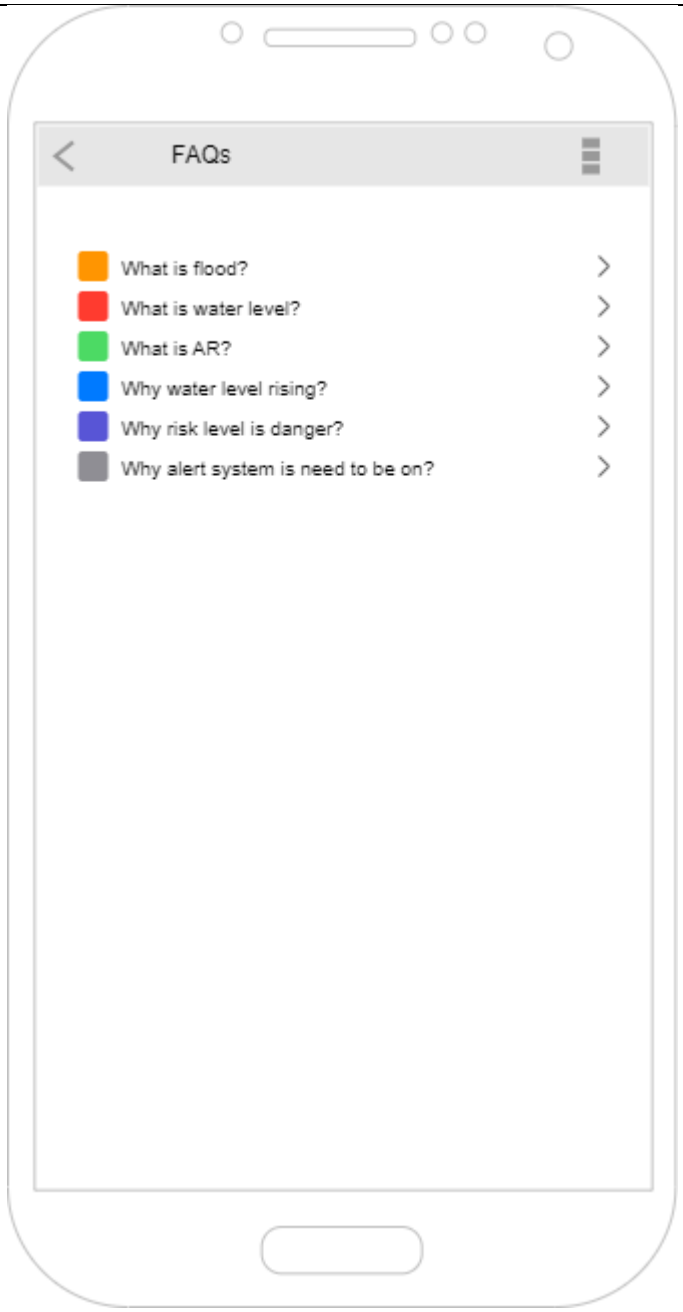
5. User's Profile Page	This is the user's profile page of the application. The user can edit their profile information, such as the name, email, phone number, and location. At the same time, the profile picture is also editable by clicking the circular people icon at the top of the interface. After editing, user can click the "Update" button to update their personal information.



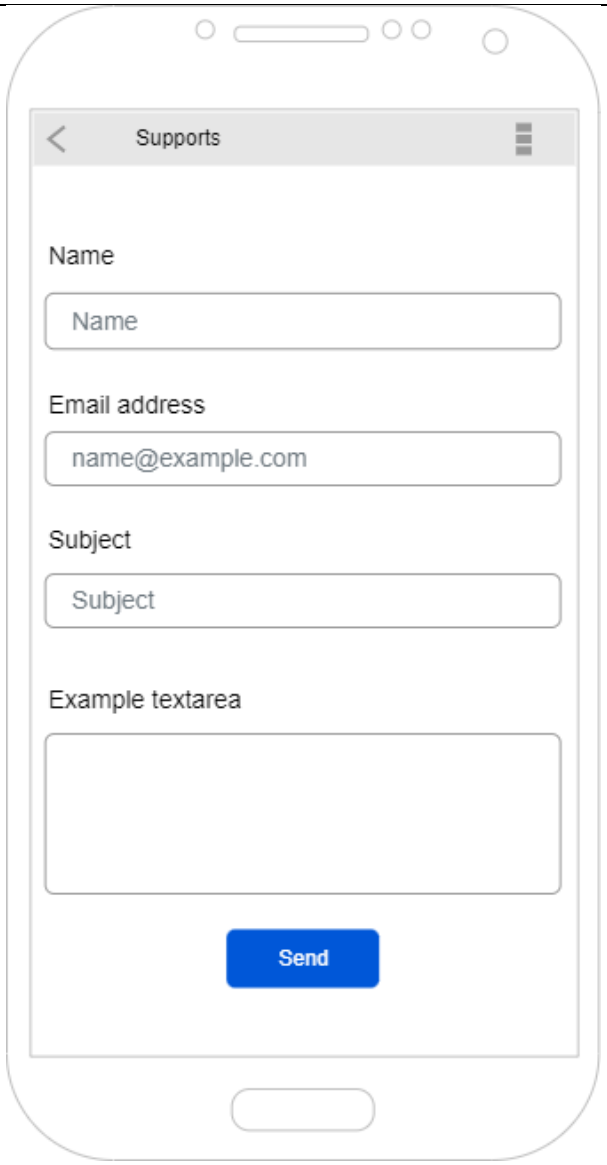
6. User's Rain Fall Data Page	This is the user's rain fall data page of the application. The user can view the data of water level with the current location, date, and the description.



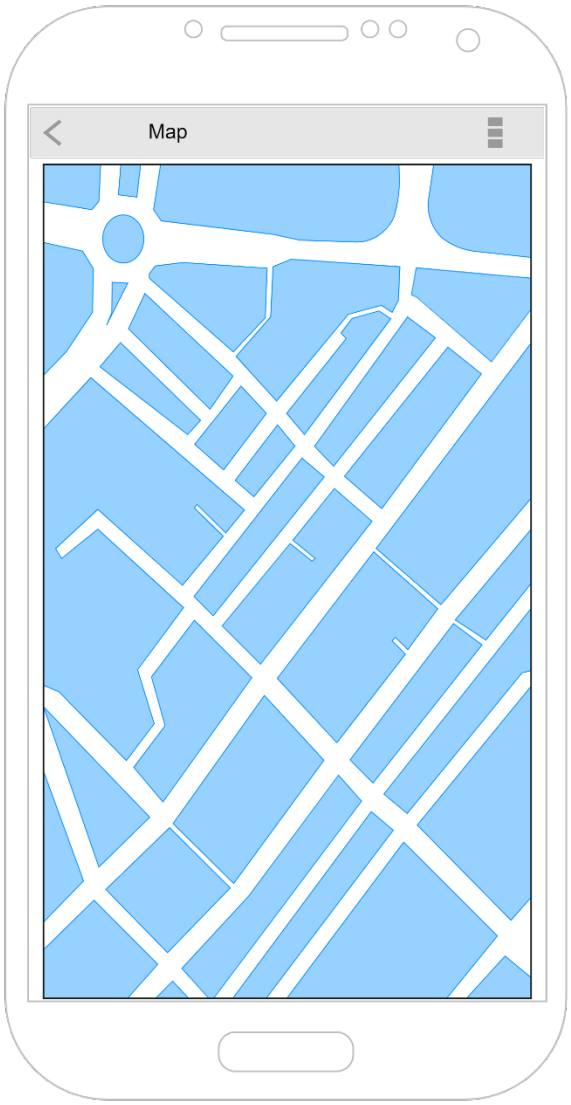
7. User's Notification Page	This is the user's notification page of the application. The user can receive the notification either in the application or outside the application when there is an update. At the same time, user also can view the history of the received notification.



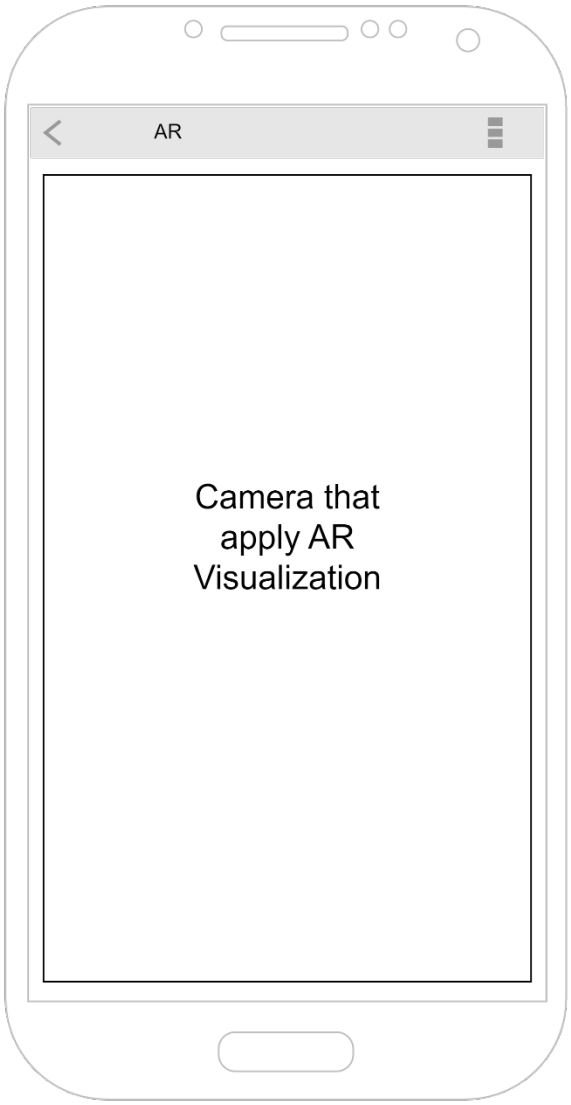
8. User's FAQs Page	This is the user's faq page of the application. The user can view the frequently asked question when facing problem while using the application.



9. User's Support Page	This is the user's support page of the application. The user can send an email to the administrator to request a support. All fields are mandatory to fill. After completing the form, click the "Send" button will redirect to the email application to send the request support email.

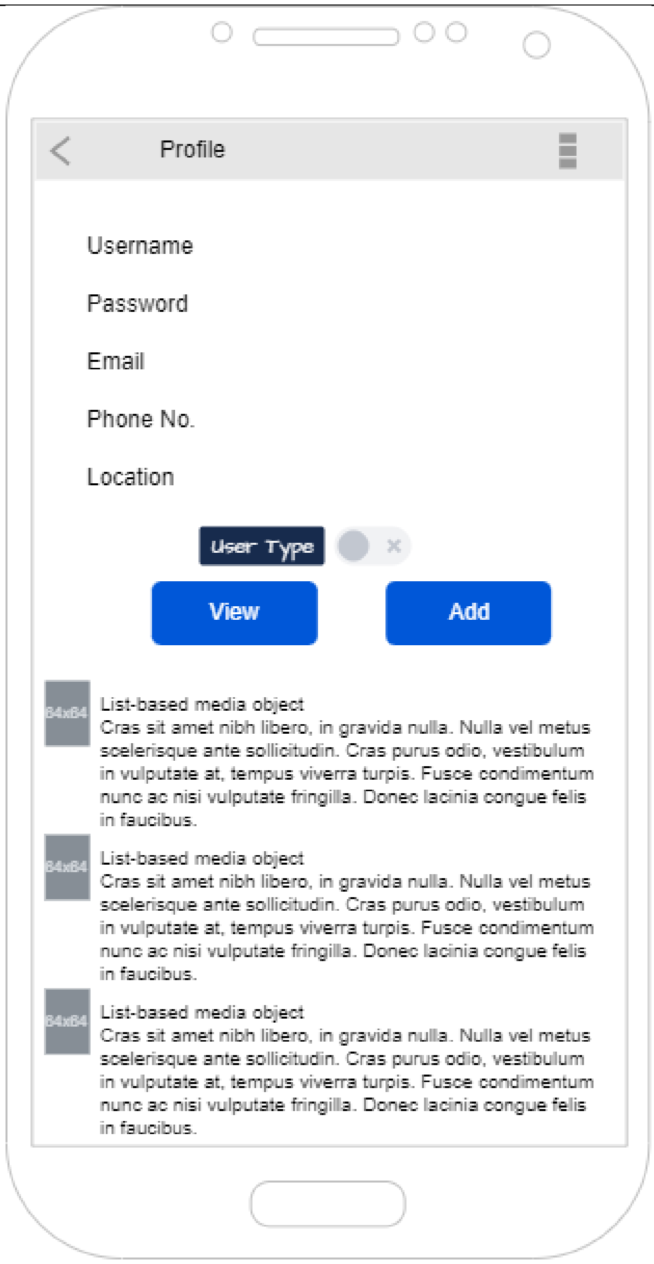


10. User's Map Page	This is the user's map page of the application. The user can view the evacuation centre on the map. All the evacuation centre can let the users get the direction to the nearest evacuation centre.



11. User's AR Page	This is the user's AR page of the application. The user can view the augmented reality flood simulation.

12. Admin's Main Menu Page	This is the admin's main menu page of the application. The application will display the available buttons with function for user. There are total five button such as Profile, Rain Fall Data, FAQs, Map, and Support.



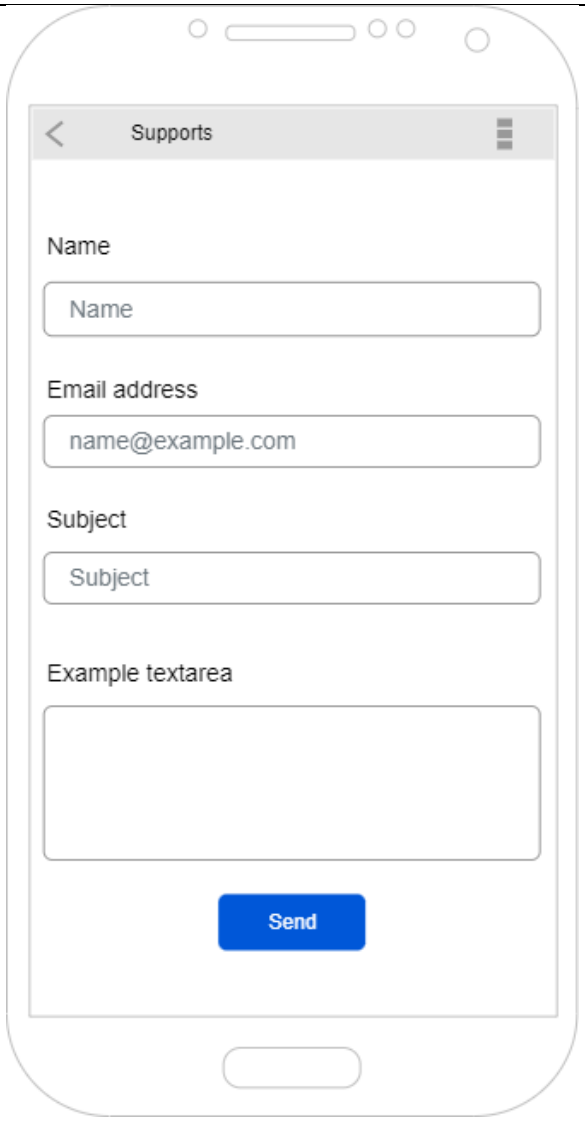
13. Admin's Profile Page	This is the admin's profile page of the application. The admin can add, edit, view, and delete the user's profile information. At the same time, the scrollable user's profile list will show below the form when admin press the "View" button or "Add" button.

14. Admin’s Rain Fall Data Page	This is the admin’s rain fall data page of the application. The admin can view the data of water level with the current location, date, and the description.

<table>
<tr><td colspan="2"> 
</td></tr>
<tr><td>15. Admin’s Notification Page</td><td>This is the admin’s notification page of the application.

The admin can add, edit, view, and delete the notification. At the same time, the scrollable notification list will show below the form when admin press the “View” button or “Add” button.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

16. Admin's FAQs Page	This is the admin's faq page of the application. The admin can add, edit, view, and delete the frequently asked question. At the same time, the scrollable frequently asked question list will show below the form when admin press the "View" button or "Add" button.



17. Admin's Support Page	This is the admin's support page of the application. The admin can reply to an email for the user that requested support. All fields are mandatory to fill. After completing the form, click the "Send" button will redirect to the email application to send the replied request support email to user.

Table 3.10 Storyboard and Description

3.10 Hardware & Software Specification

In order to develop the AR Flood, it is required to use some software and hardware to complete the development. The list of hardware and software used has been described as below, Table 3.10 and Table 3.11.

3.10.1 Hardware Requirements

Hardware	Specification	Purpose
Laptop	• Acer Aspire 5 • Windows 11 Home Single Language • Intel Core i7-8565U CPU 1.8GHz • 12.00GB RAM • 64-bit operating system	Used for document preparation and development of mobile application
Android Smartphone	• POCO F3 • Android 12, MIUI 13.0.3.0 for POCO • Qualcomm SM8250-AC Snapdragon 870 5G (7 nm) • Li-Po 4520 mAh • 256GB storage • 8GB RAM • 1080 x 2400 pixels	Used to open the system via mobile seem this application is mobile friendly.

Table 3.11 Hardware Requirement

3.10.2 Software Requirements

Software	Purpose
Android Studio	Used to perform coding in Java language for the development of mobile application.
Firebase	Used as a database to store information and data.
Draw.io	Used to draw the flowchart and use case diagram.
Microsoft Word 365	Used to prepare the documents.
GanttPro	Used to draw the Gantt Chart.
Microsoft Edge	Used to search for the resources.

Table 3.12 Software Requirement

3.11 Gantt Chart

A graphical representation of a project schedule is an essential component of the project management tool known as a Gantt Chart. It displays the beginning and ending times for a number of the tasks that make up a project. The Gantt Chart of this project is prepared in Appendix A.

3.12 Testing Plan

Utilizing the testing plan allows for the design of the User Acceptance Test (UAT) form that is tailored to the specifications of the mobile application.

No.	Module	Activities	Status (Pass/Fail)	Comments
1.	Login	User Registration		

		User Login		
		User Logout		
2.	Manage Profile	Change Profile Picture		
		Update Name		
		Update Phone Number		
		Update Location		
3.	Manage Rain Fall Data	Update Location		
4.	Manage Notification	Add Notification		
		View Notification		
5.	Manage FAQs	Add FAQs		
		View FAQs		
6.	Manage Support	Add Support		
		View Support		
7.	AR	View AR		
8.	Manage Map	Add Pointer		
		View Pointer		

This test has been performed by:

Name:

Signature:

Date:

3.13 Chapter Summary

As a summary, this chapter has completely discussed the methodology used in the project development. All the use case diagram, flowcharts, and prototype are also included in the detailed explanation.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

AR Flood is developed in a mobile Android platform. An iterative flood simulation view using augmented reality technology will help to guide the users to have an early preparation about the flood during heavy raining. For this Chapter 4, the development of AR Flood will be discussed in this chapter. Besides, the implementation, result and discussion will also be stated in this chapter.

4.2 Implementation

The implementation of the AR Flood will be explained in detail in this section. The environmental setup and the development of modules are included in the implementation stage.

4.2.1 Implementation of Android Studio

AR Flood is an Android application that has been developed by using the Java programming language. Android Studio is the Integrated Development Environment (IDE) for android application development, which is used in this project to perform the whole coding process of the application.

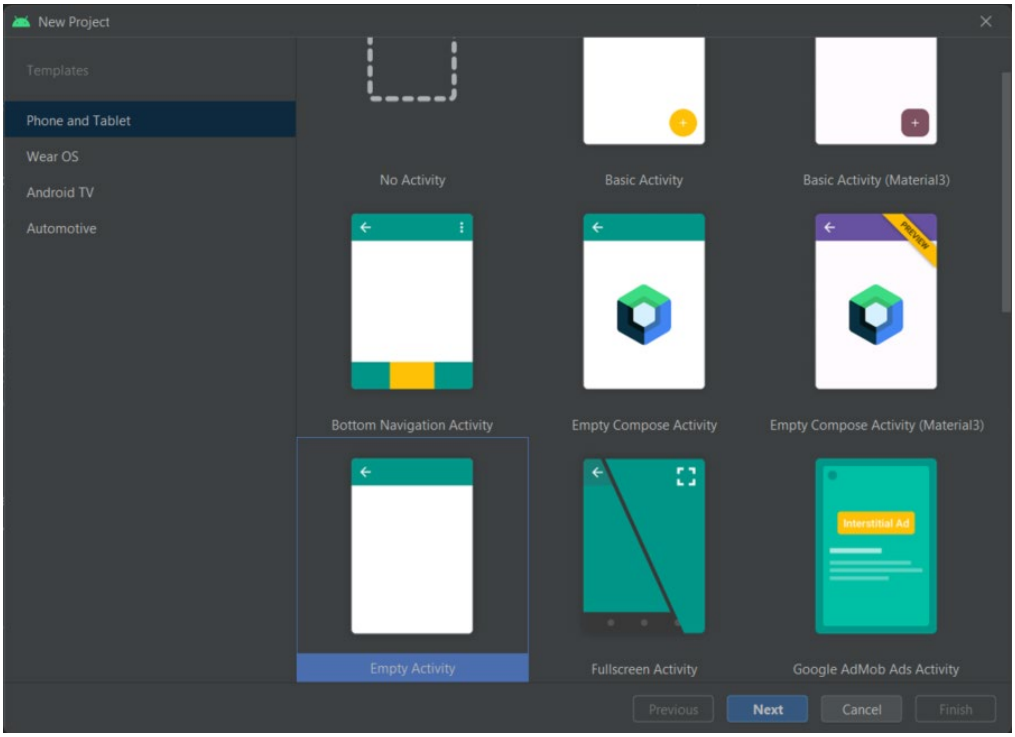


Figure 4.1 Android Studio Interface

Figure 4.1 above shows the interface of the Android Studio. It needs to create a new project before starting the application development. Once the project file is created, an empty activity can be created, which will include the Java class and XML layout file. All the interface layouts will be developed in XML files and the Java class will use to execute the function of each layout. Each Java class has its own XML file and all the variables in the XML files need to be called in the Java class to perform its functionalities.

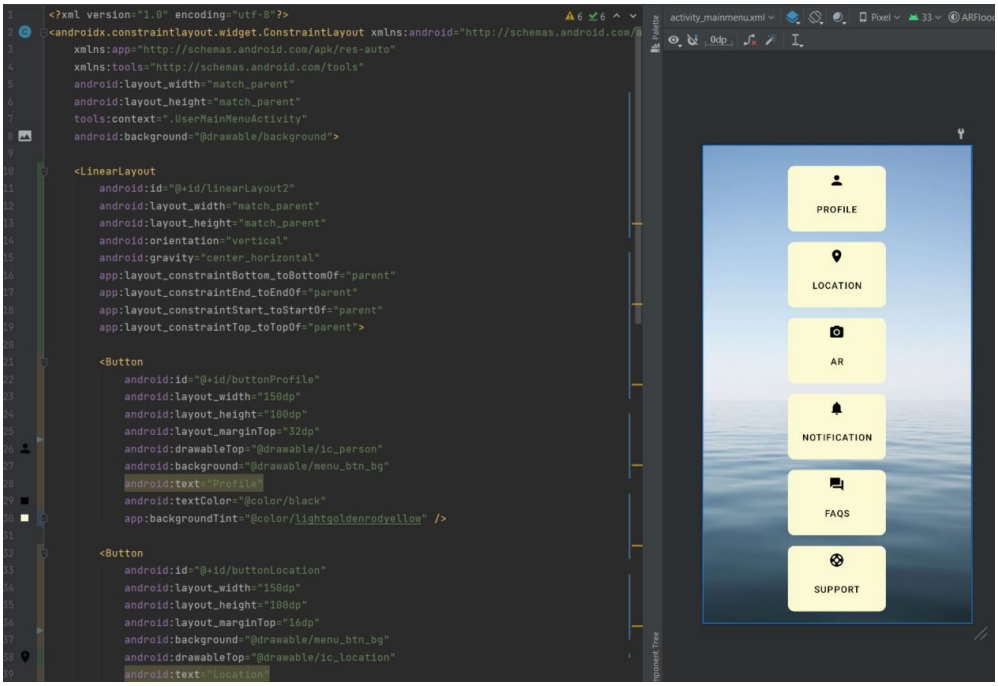
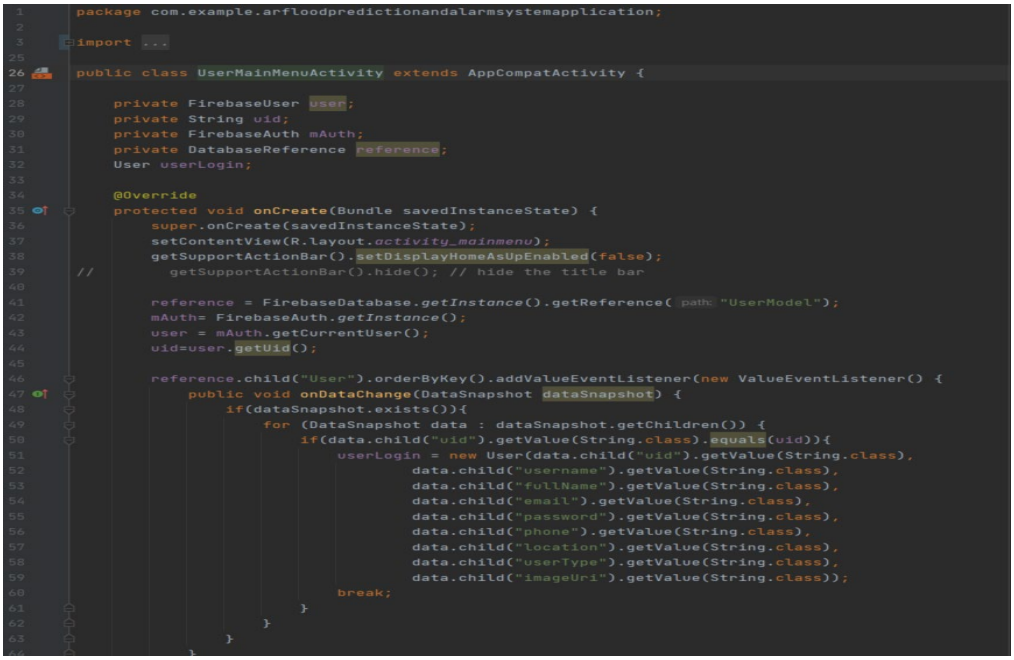


Figure 4.2 XML Layout File of User's Homepage Interface

Figure 4.2 above shows the XML Layout File for the interface of the user homepage. The left side of the image is the coding part and the right side is the preview of the interface. The preview of the interface will keep updated whenever there are any changes happened in the coding part.



```
package com.example.arfloodpredictionandalarmsystemapplication;

import ...

public class UserMainMenuActivity extends AppCompatActivity {

    private FirebaseUser user;
    private String uid;
    private FirebaseAuth mAuth;
    private DatabaseReference reference;
    User userLogin;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_mainmenu);
        getSupportActionBar().setDisplayHomeAsUpEnabled(false);
//          getSupportActionBar().hide(); // hide the title bar

        reference = FirebaseDatabase.getInstance().getReference( path: "UserModel");
        mAuth= FirebaseAuth.getInstance();
        user = mAuth.getCurrentUser();
        uid=user.getUid();

        reference.child("User").orderByKey().addValueEventListener(new ValueEventListener() {
            public void onDataChange(DataSnapshot dataSnapshot) {
                if(dataSnapshot.exists()){
                    for (DataSnapshot data : dataSnapshot.getChildren()) {
                        if(data.child("uid").getValue(String.class).equals(uid)){
                            userLogin = new User(data.child("uid").getValue(String.class),
                                    data.child("username").getValue(String.class),
                                    data.child("fullName").getValue(String.class),
                                    data.child("email").getValue(String.class),
                                    data.child("password").getValue(String.class),
                                    data.child("phone").getValue(String.class),
                                    data.child("location").getValue(String.class),
                                    data.child("userType").getValue(String.class),
                                    data.child("imageUri").getValue(String.class));
                            break;
                        }
                    }
                }
```

Figure 4.3 Java Class of User's Homepage Interface

Figure 4.3 above shows the Java class for the functionality of the user homepage. All the variables need to be inserted correct before proceed with each of the function.

4.2.2 Implementation of Firebase Realtime Database

In this project, the Firebase Realtime Database is being used as the database. It is a cloud-hosted database that enables storing and synchronizing data in the NoSQL method where data is stored s a JSON tree structure. There is no table required to store the records but only nodes are needed for storing data values. However, the android studio needs to create a connection to a Firebase in order to perform its function, such as data storage and authentication.

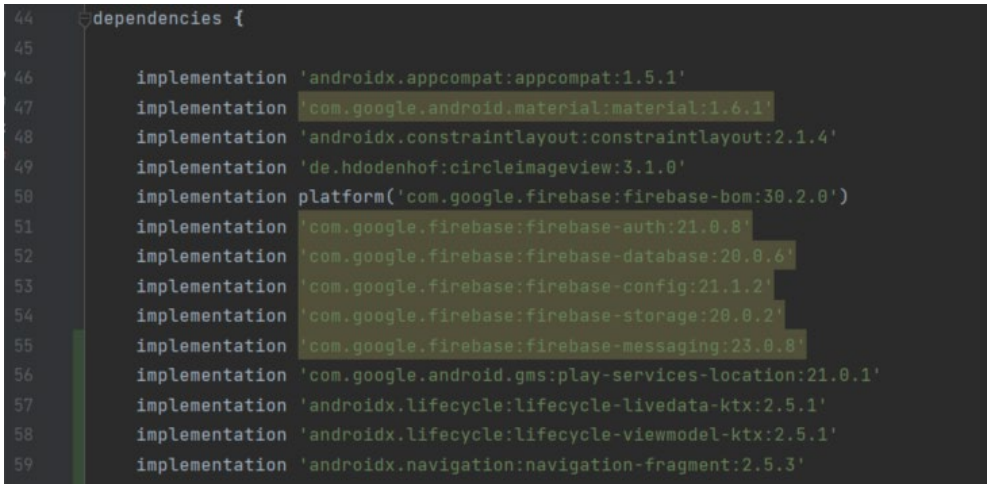


Figure 4.4 Dependencies of Firebase Elements

Figure 4.4 above shows the dependencies of the Firebase elements that are required to connect with the Firebase. The line of 51 is the dependency of the Firebase Authentication. It will use to handle the user registration, password reset, and account verification. The email verification will be used in this project. Next, the line of 52 is the dependency of the Firebase Database, which used to perform the real-time database. It will ensure that the data is synced across all the clients in real-time and remains available when the application goes online. Besides that, the line of 54 is the dependency of the Firebase Storage that will use to store the image file. Lastly, the line of 55 is the dependency of the Firebase Cloud Messaging, which enable the function of notification.

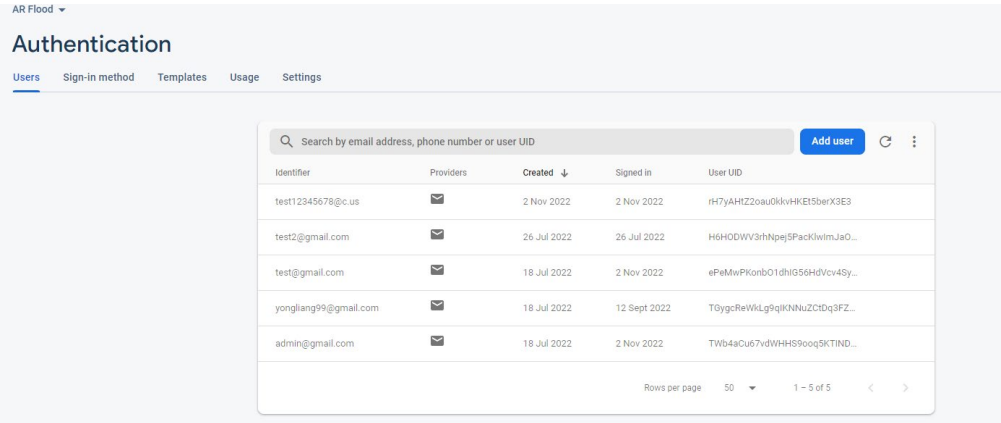


Figure 4.5 User Aunthentication

Figure 4.5 above shows the list of users that has successfully create the account in the AR Flood. The UID is unique for each of the user and will be used in the real-time database. The users need to register their account with a valid email because they need to do the verification through their registered email.

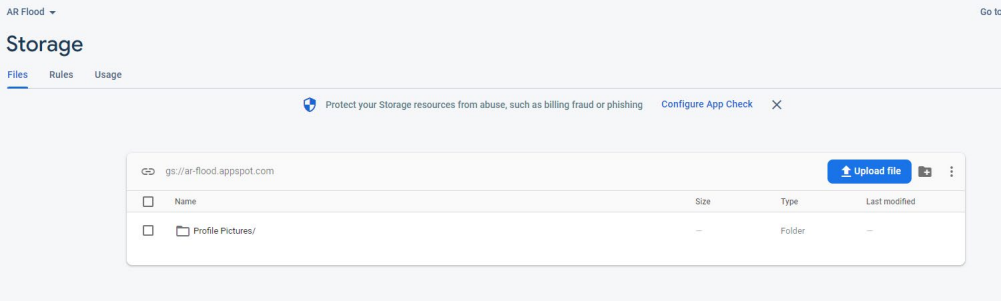


Figure 4.6 Storage

All the images published in the application will be saved in the Firebase Storage as shown in Figure 4.6 above. Different types of images will save in different folders for better discrimination.

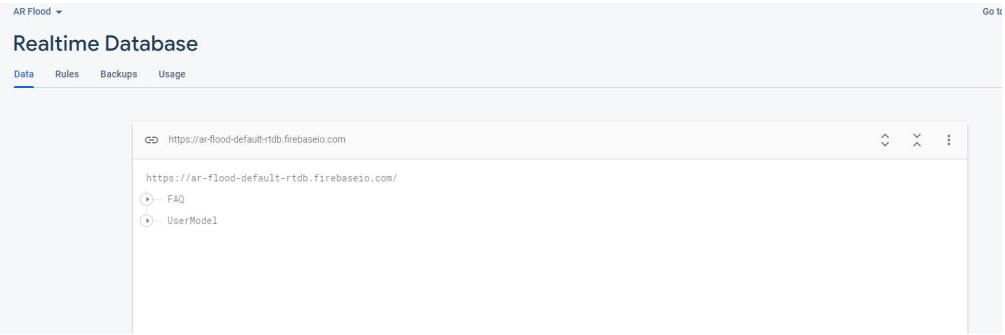


Figure 4.7 Realtime Database

By implementing the data architecture of this project using Firebase Realtime Database, the overall structure of the data schema is created as shown in Figure 4.7 above. There is total 2 nodes representing the data, which are the FAQ, and UserModel.

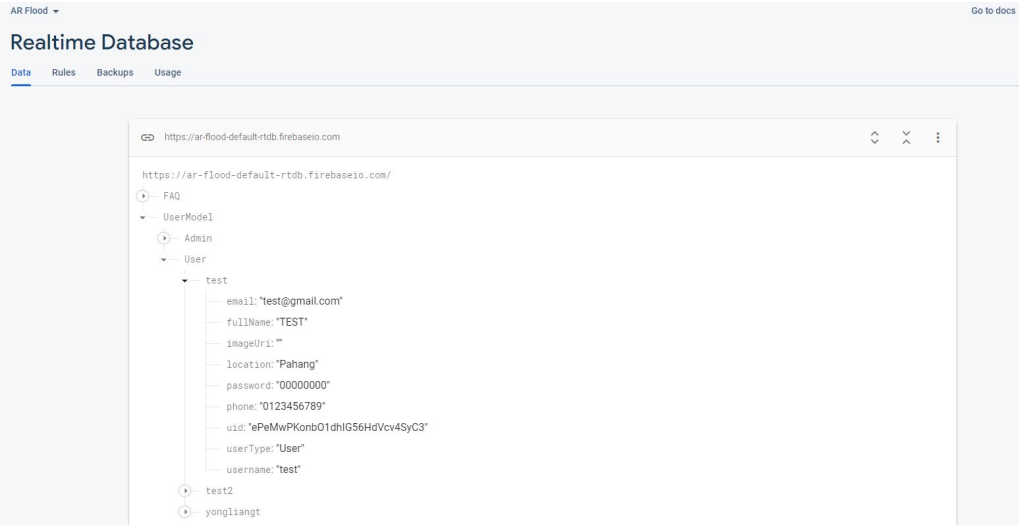


Figure 4.8 UserModel nodes structure

UserModel node is used to store all the user registration data and its data structure is shown in Figure 4.8 above.

4.3 Functionality of AR Flood

AR Flood is an android application that focuses on freelance services. The targeted users are within Malaysian. There are a lot of features provided in the AR Flood to ensure that the problems stated in Chapter 1 can be solved.

4.3.1 Module of Login, Register

When AR Flood is installed and opened for the first time, the login interface will be displayed, as shown in Figure 4.9 below. User must register an account before they can login to the application, as shown in Figure 4.10 below. The email address needs to be valid because it will be verified after the account is created. Without verification, the user cannot log in to the application even if there are records in the database. The email verification interface is shown in Figure 4.11 below.

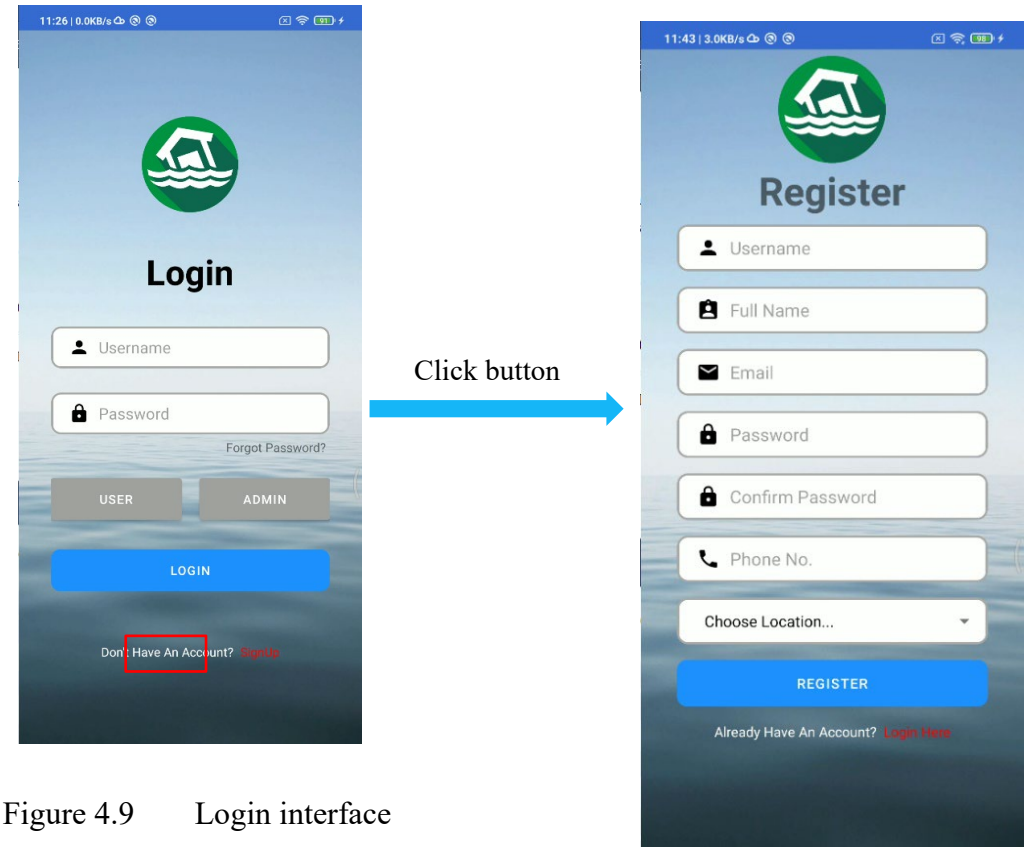


Figure 4.9 Login interface

Figure 4.10 Sign Up interface

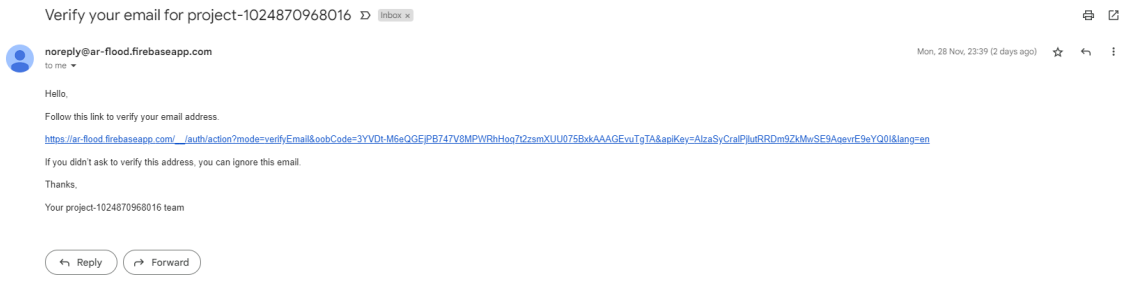


Figure 4.11 Email Verification

4.3.1.1 Reset Password

User can reset their password if they forgot their password or want to change the password. They need to fill up their registered email address to change the password, as shown in Figure 4.13 below. A confirmation link will be sent to the user's email to update a new password, as shown in Figure 4.14 below.

4.3.2 Module of Admin

4.3.2.1 Manage Profile

In the AR Flood, admin can manage the user's profile in a list view. Admin also can view the particular user information by search their username in the search bar. Admin can update the user's information if request by the user in future. The interface are shown in Figure 4.12, Figure 4.13, and Figure 4.14 below.

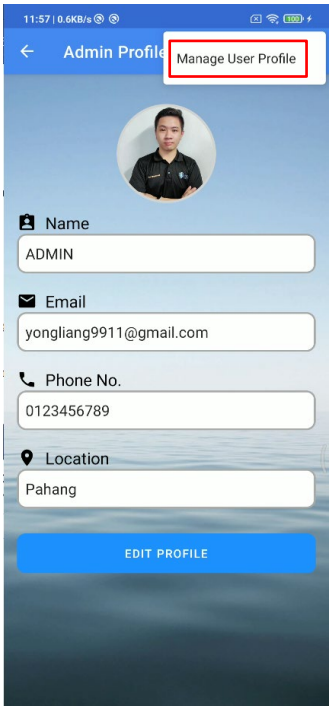


Figure 4.12 Manage User Profile Menu

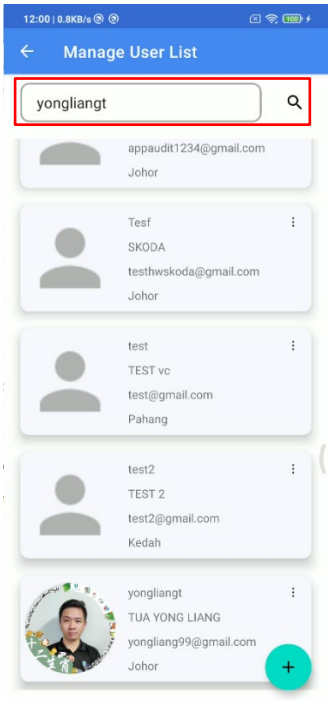


Figure 4.13 Manage User List

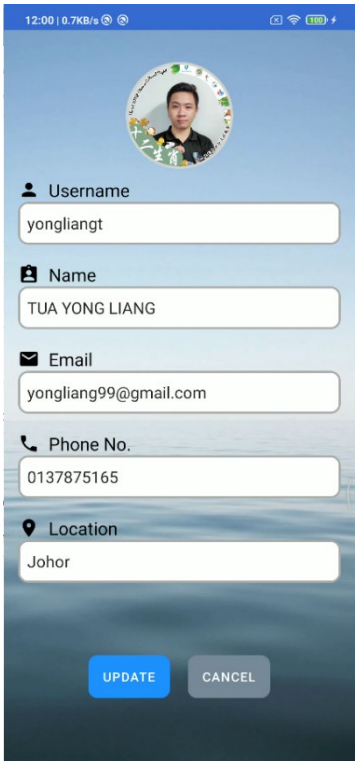


Figure 4.14 User Details

Admin can click the "+" add button at the bottom right corner to register a new admin or user as shown in Figure 4.15. After admin register the new admin or user, they need to click the verification link in the email as shown in Figure 4.17 below.

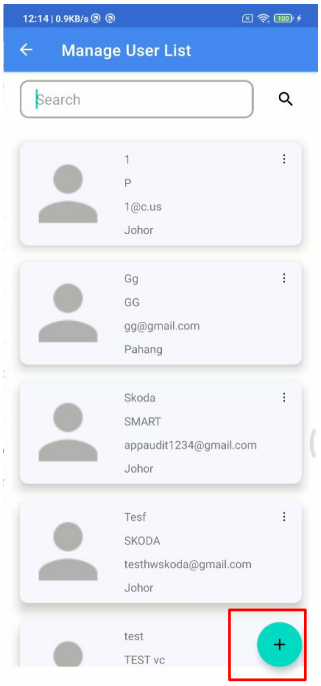


Figure 4.15 User List

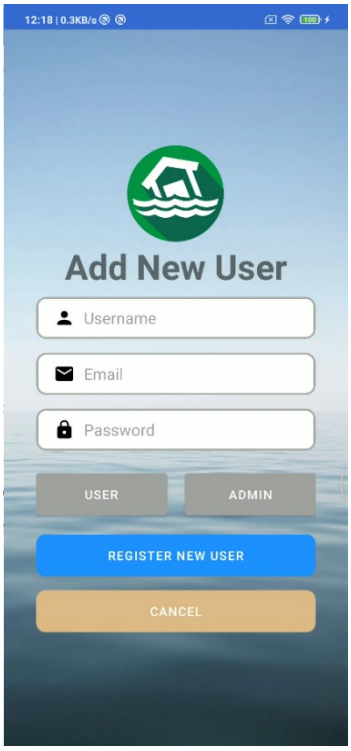


Figure 4.16 Add New User

Figure 4.17 Email Verification

Admin also can upload his profile picture by tap the avatar as shown in Figure 4.18 below. It will prompt admin to select which image need to be upload. The profile image will be saved on Firebase Cloud Storage as shown in Figure 4.21 below.

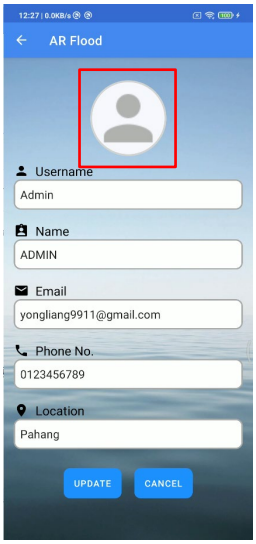


Figure 4.18 Admin Profile Page

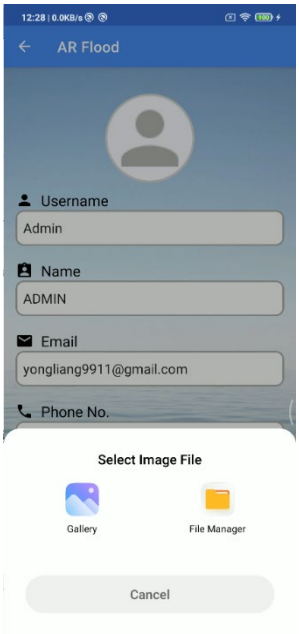


Figure 4.19 Select Image File

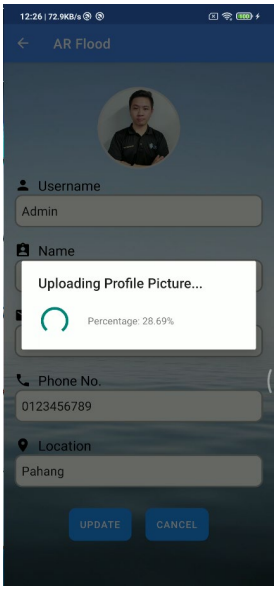


Figure 4.20 Upload Image

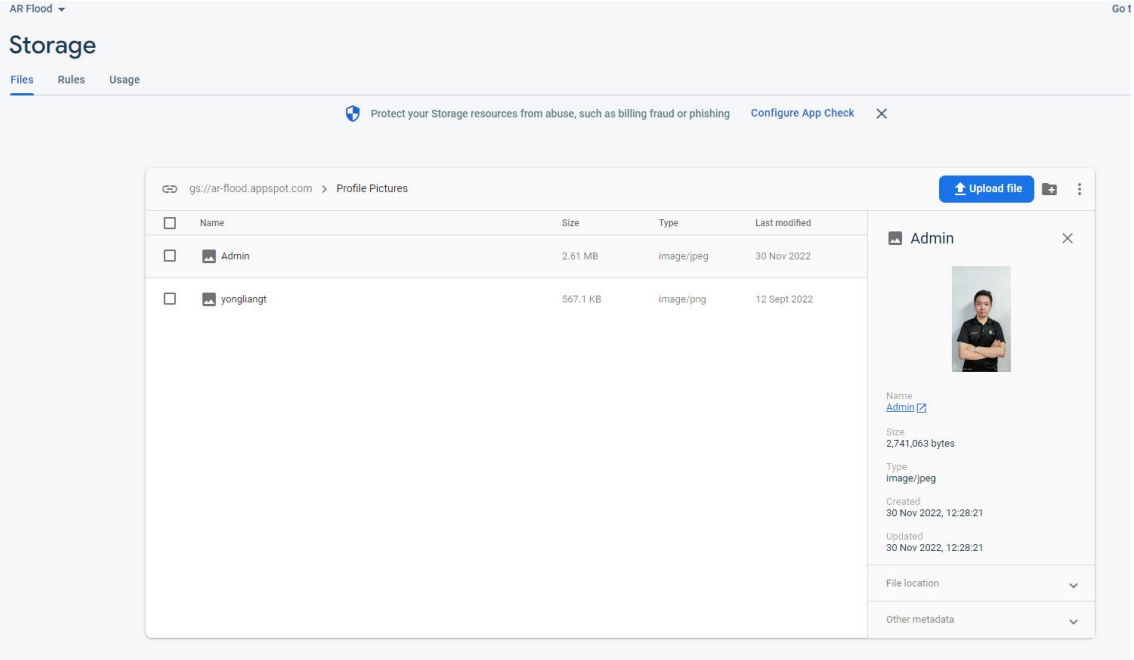


Figure 4.21 Firebase Cloud Storage

4.3.2.2 Browse Rain Fall Data

Admin can view the rainfall data over Malaysia. By choosing the state and district, it will show the real-time rainfall data for all the stations under that particular district as shown in Figure 4.23 below.

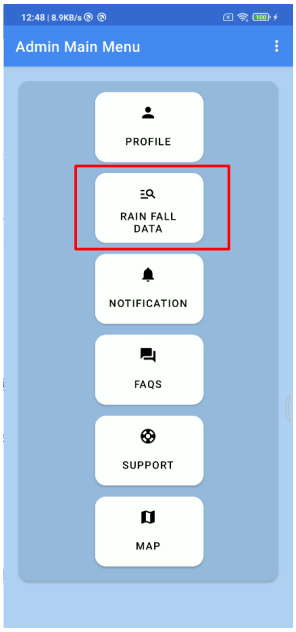


Figure 4.22 Rain Fall Data Button

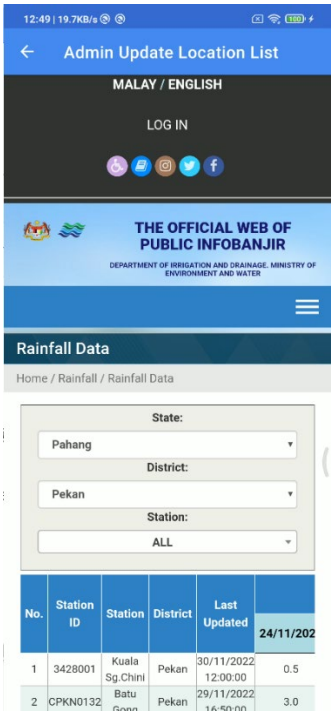


Figure 4.23 Rainfall Data

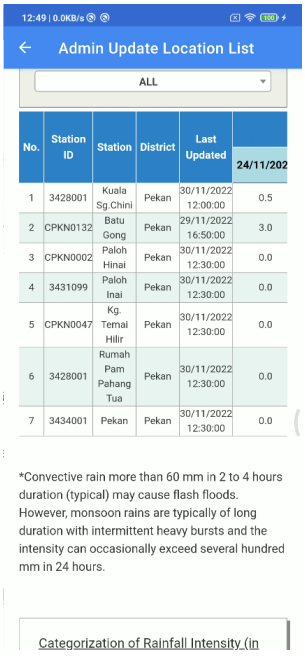


Figure 4.24 Rainfall Details

4.3.2.3 Manage Notification

Once there is an emergency situation or any heavy rainfall, admin can send the In-app notifications and push notifications for all the users that in the particular region as shown in Figure 4.25 below.

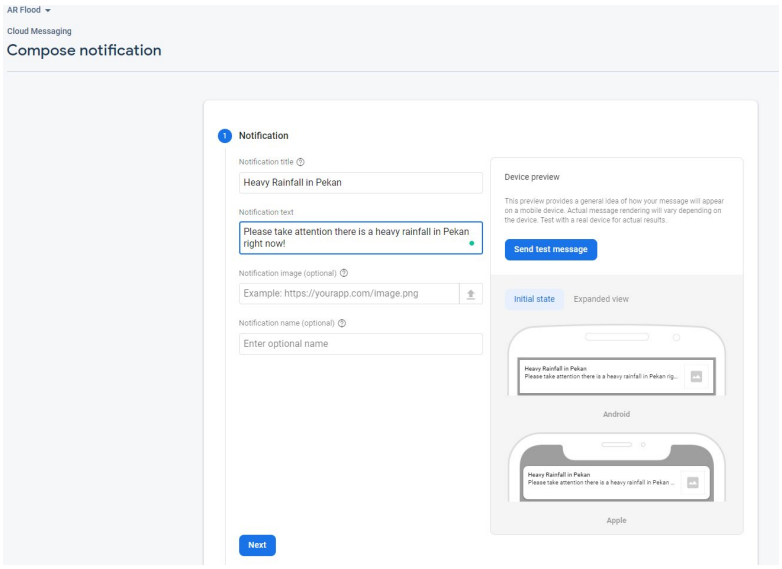


Figure 4.25 Notification page

4.3.2.4 Manage FAQ

Since there many user will have questions about the application, hence the FAQ section is prepared. Admin can add the new question and answer by tapping the “+” add button at the bottom right corner as shown in Figure 4.26 below.

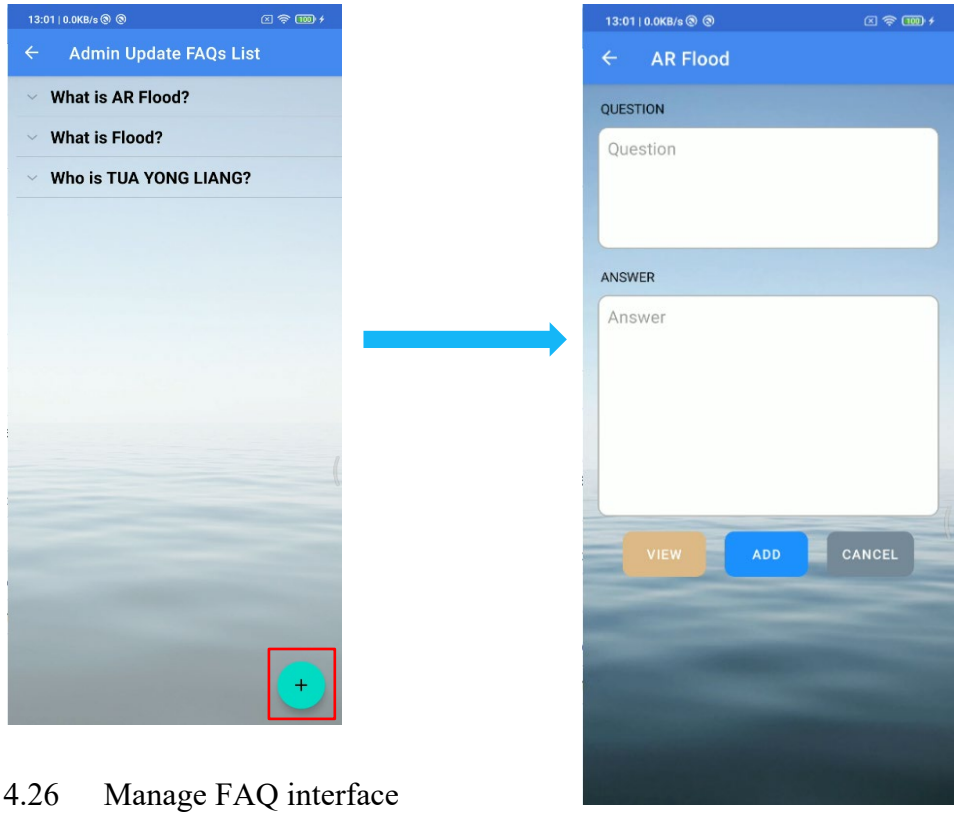


Figure 4.26 Manage FAQ interface

Figure 4.27 Add FAQ interface

4.3.2.5 Manage Support

As mentioned before, users will have questions to ask. Another feature in the admin account is support email. Admin can view the email and reply the email received from the users.

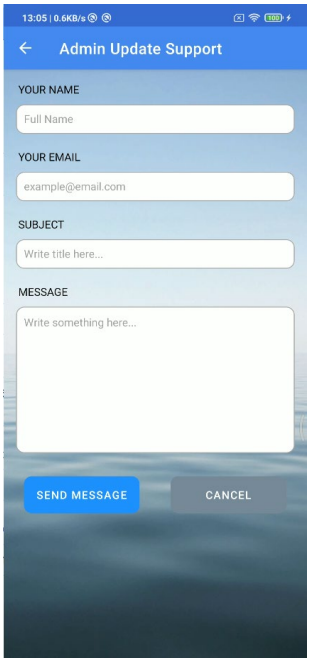


Figure 4.28 Send Support Interface

4.3.2.6 Manage Map

Admin can manage the evacuation centre on the map. This is easing the users can get the nearer evacuation centre by one tap when there is a flood. On the map there will have the designed icon shown at the evacuation centre to attract the user's attention and to differentiate the pointer in the map.

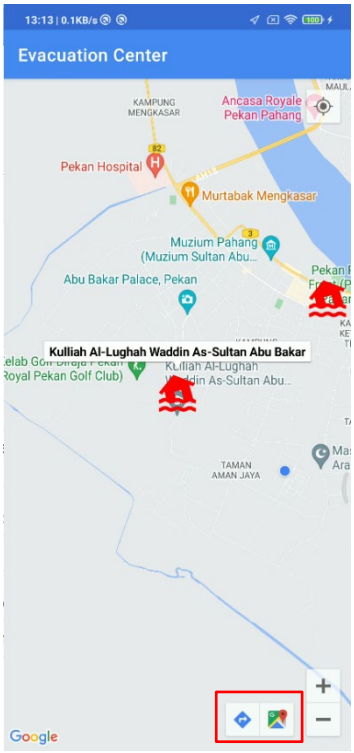


Figure 4.29 Evacuation Centre Interface

Figure 4.30 Google Map Direction

4.3.3 Module of User

4.3.3.1 Manage Profile

In the AR Flood, user can manage their profile. User can update their personal information by click the edit button. User also can upload the profile picture by tap the avatar as shown in Figure 4.32 below. It will prompt user to select which image need to be upload.

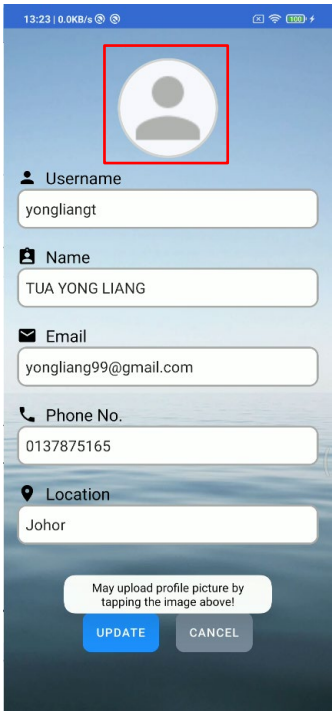


Figure 4.31 User Profile interface

Figure 4.32 Select Image File

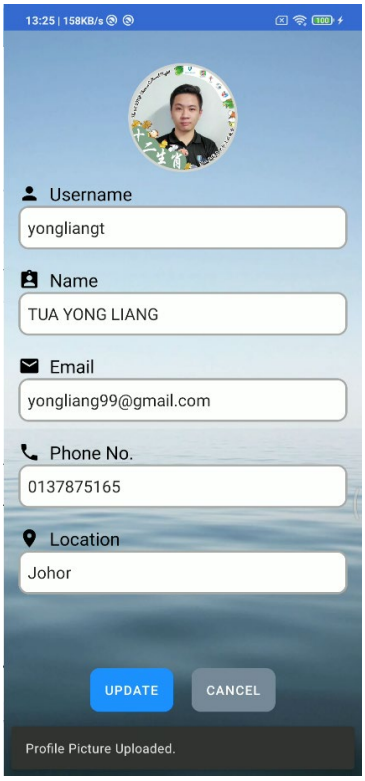


Figure 4.33 Image Uploaded

4.3.3.2 Browse Rain Fall Data

User can view the rainfall data over Malaysia. By choosing the state and district, it will show the real-time rainfall data for all the stations under that particular district as shown in Figure 4.35 below.

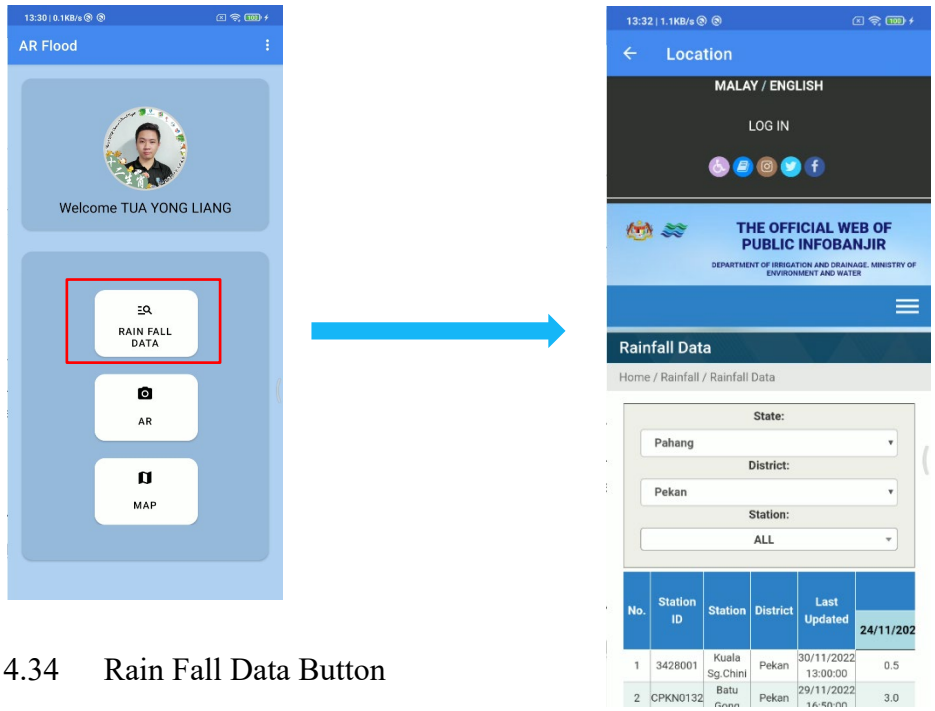


Figure 4.34 Rain Fall Data Button

Figure 4.35 Rainfall Data

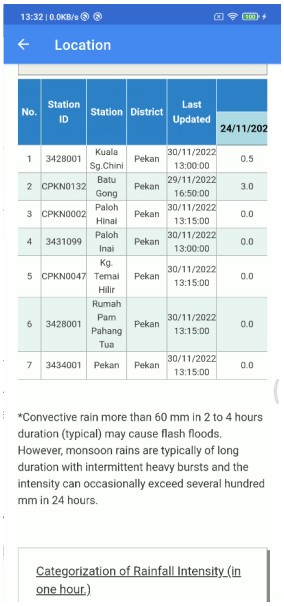


Figure 4.36 Rainfall Details

4.3.3.3 View AR

With the visualization method, the Augmented Reality technology has been used to let the users can see the flood simulation by using their smartphone with one tap. When the user clicks the AR button on the homepage, user will directly saw the flood simulation in the screen.

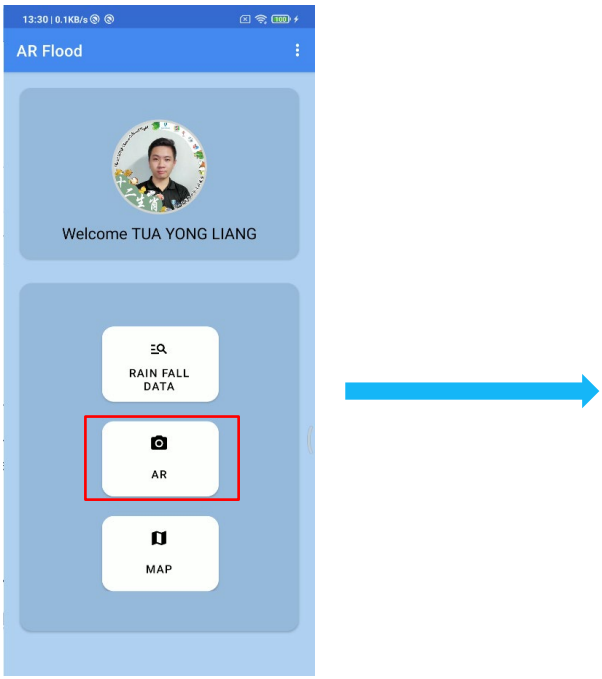


Figure 4.37 User Homepage AR Button

Figure 4.38 AR interface

4.3.3.4 View FAQ

Since there many users will have questions about the application, hence the FAQ section is prepared. User can view the question and answer by tapping the question and it will expand the particular section.

Figure 4.39 FAQs interface

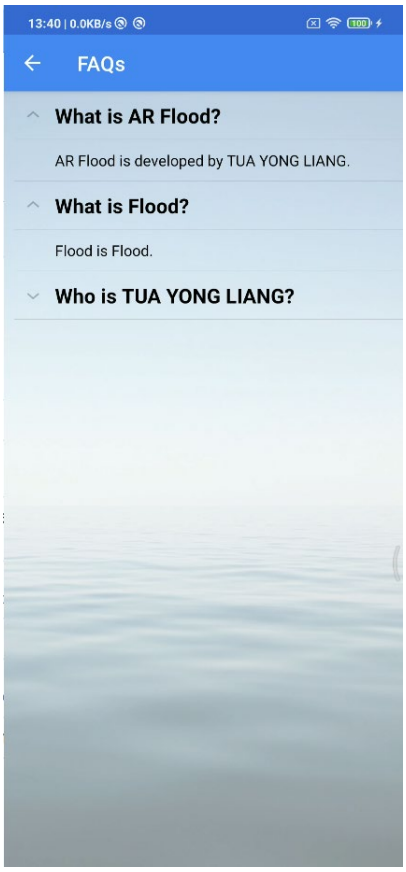


Figure 4.40 Expanded FAQs interface

4.3.3.5 Manage Support

As mentioned before, users will have questions to ask. Another feature in the users account is support email. User can send the email and receive the reply email from the admin.

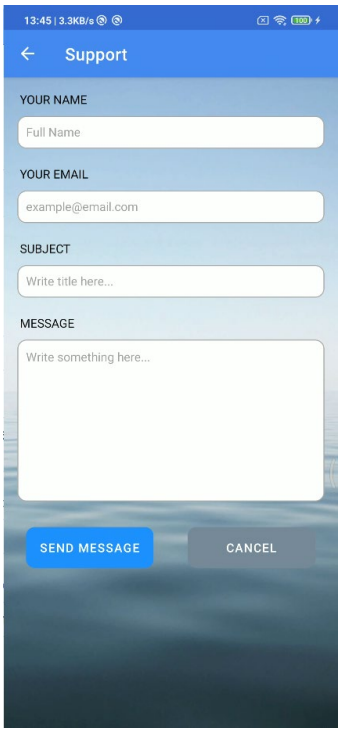


Figure 4.41 Send Support interface

4.3.3.6 View Map

User can view the evacuation centre on the map. This is easing the users can get the nearer evacuation centre by one tap when there is a flood. On the map there will have the designed icon shown at the evacuation centre to attract the user's attention and to differentiate the pointer in the map.

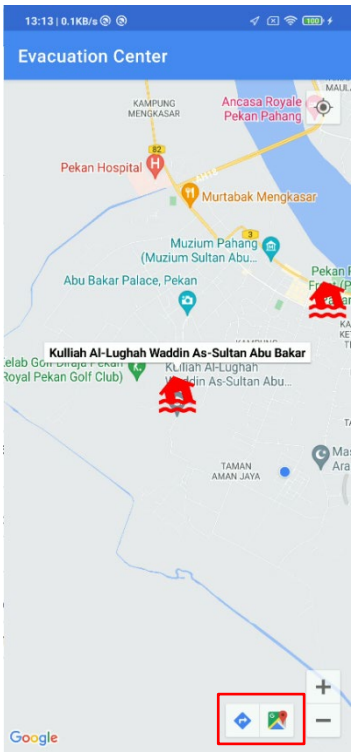


Figure 4.42 Evacuation Centre interface

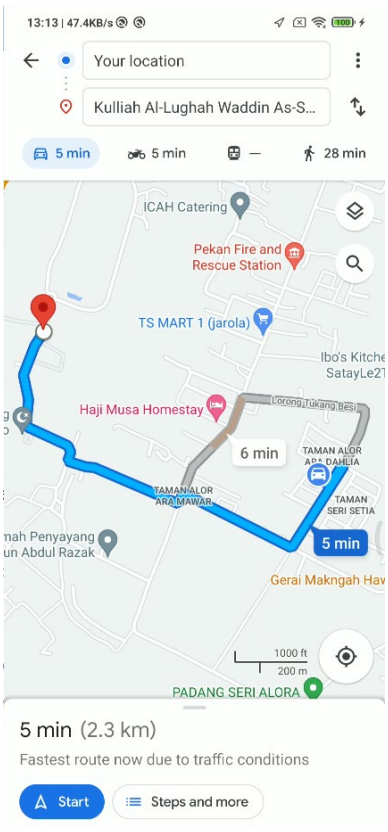


Figure 4.43 Google Map Direction

4.4 Testing and Result

Application testing is one of the important stages that need to be performed during and after application development to ensure that the project goals can be achieved. During the development of application, all essential parts are tested using android emulator and real device to ensure that the application can run perfectly without problems or errors. after the development process is completed, the User Acceptance Test (UAT) will be conducted by the users, such as Malaysian and the Government Sectors. all the testing results will be recorded in the UAT form through the Google Form.

A. Introduction

This section outlines the test activities that need to be done by the user. Any errors or problems found by the user must be recorded on this UAT form.

General Information

Name

Name

21 responses

Ang Yon Jie

Lee Bee Lin

Pagie Lau Ting Ying

Choo Jian Won

Tan Kah Yi

Cheah JL

HONG

Fach

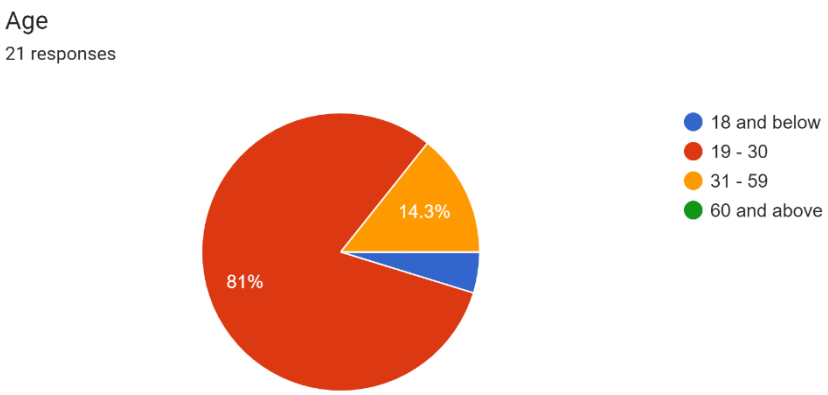
See Sian Tian

Yap Yi Shan

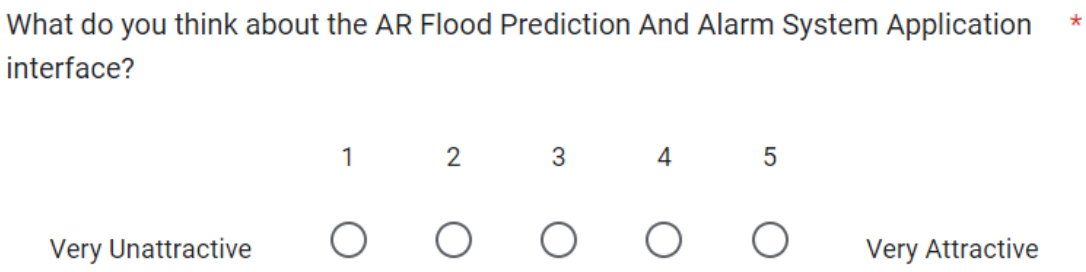
Yap Jie

Soo Hui Lun

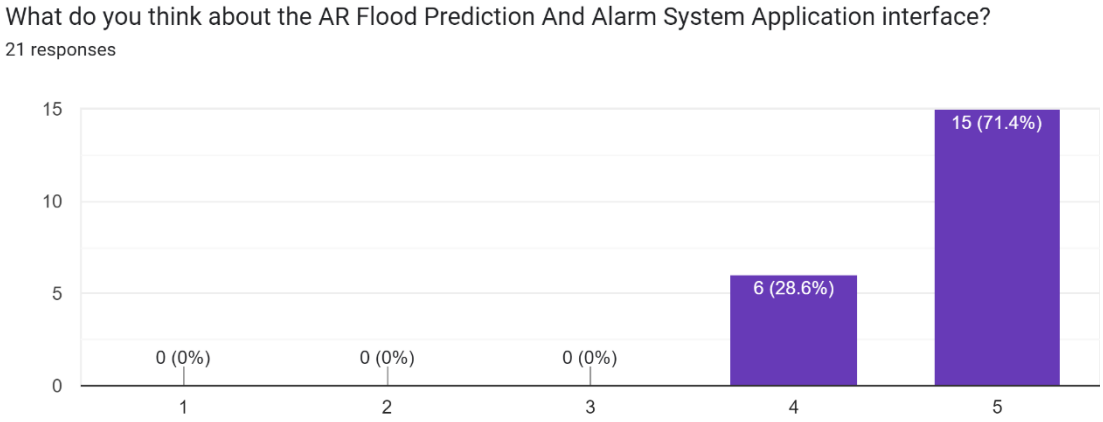
Age



User Acceptance Test Questions and Results



Question 1

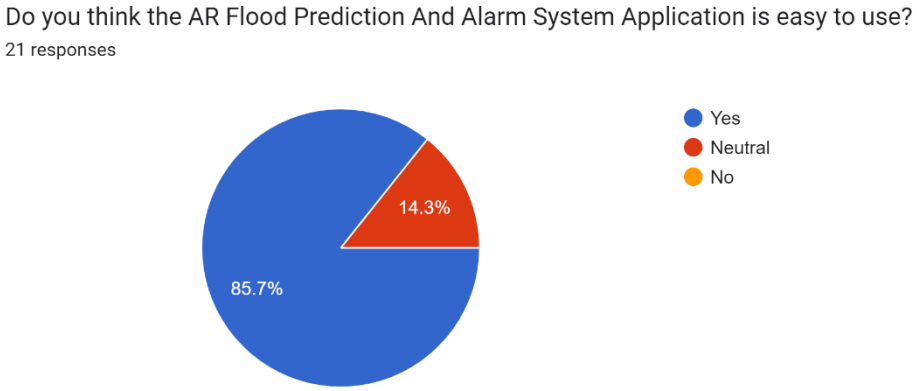


There are 15 users with 71.4% think that the application interfaces are very attractive. The other 28.6% of users think that the interfaces are attractive and suggested to make some improvements on the interfaces for better user experience.

Do you think the AR Flood Prediction And Alarm System Application is easy to use? *

- ◯ Yes
- ◯ Neutral
- ◯ No

Question 2

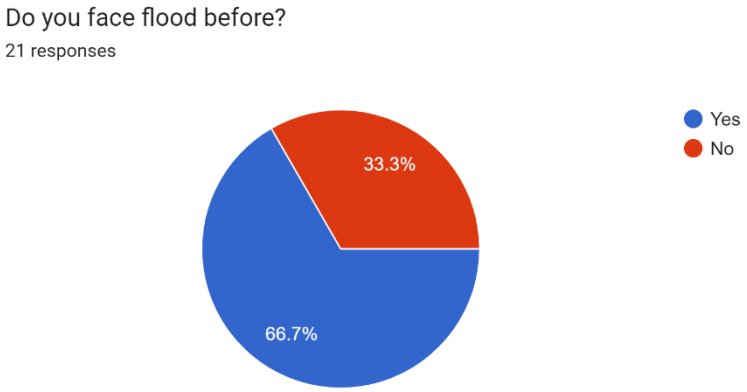


85.7% of users think that the features provided in the AR Flood are easy to use and understandable. The other 14.3% of users think that the features provided are good and suggested to make improvements on features for more easy to use and understandable.

Do you face flood before? *

- ◯ Yes
- ◯ No

Question 3

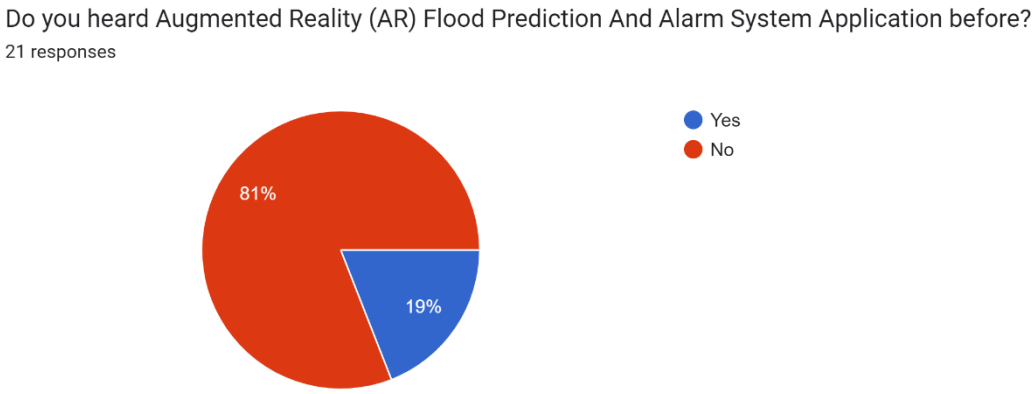


66.7% of users faced flood before while 33.3% of users say that they haven't experiences flood before.

Do you heard Augmented Reality (AR) Flood Prediction And Alarm System Application before? *

- ◯ Yes
- ◯ No

Question 4

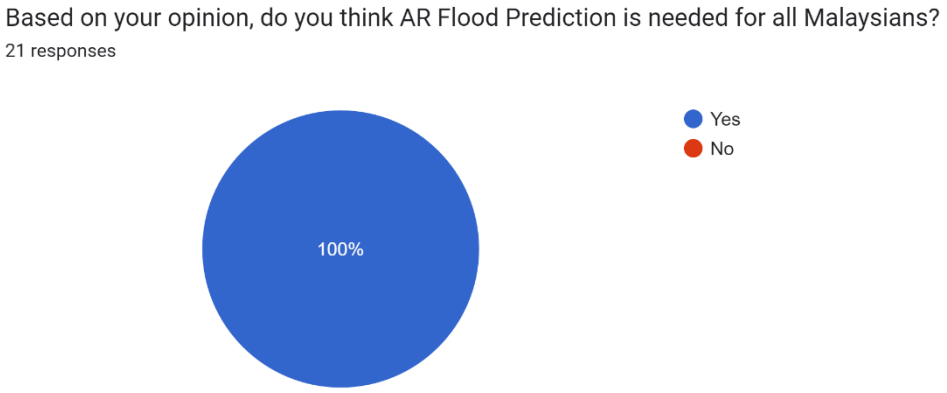


81% of users stated that they didn't heard the AR Flood before. The other 19% of users stated that they heard the AR Flood before this through the Science fiction movie.

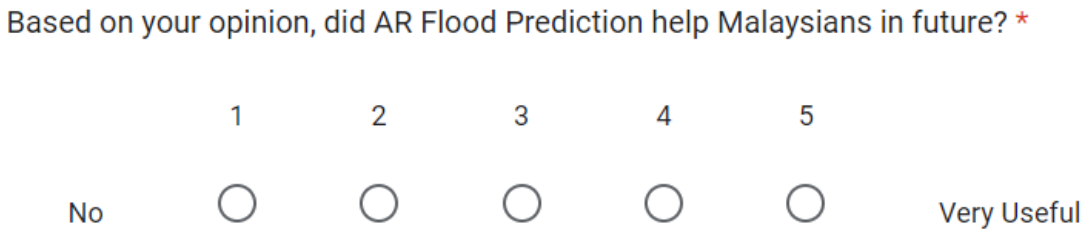
Based on your opinion, do you think AR Flood Prediction is needed for all Malaysians? *

- ◯ Yes
- ◯ No

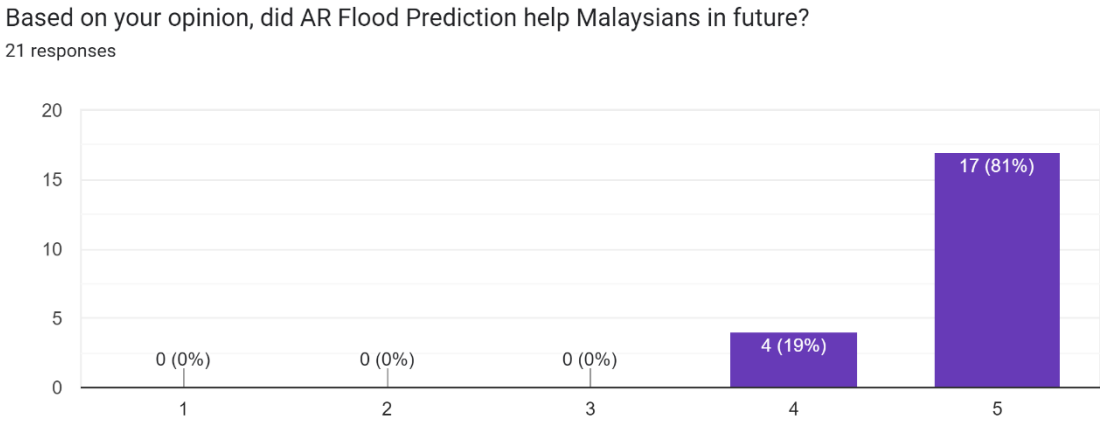
Question 5



100% of users think that the AR Flood is needed for all Malaysians.



Question 6



There are 17 users with 81% think that the AR Flood are very useful in future. The other 19% of users think that the AR Flood are useful and suggested to make some improvements on it for better user experience.

4.5 Chapter Summary

To conclude, 10 responses have been randomly asked to test on the AR Flood. The results and opinions from the responses have been collected and analysed for the improvement of application. The testing phase is to evaluate the system functionality and user satisfaction of the application developed. Based on the testing result, this application helps the Malaysian to make the preparation earlier. This application also easy to use for elderly people, students, and public users since all the responses are satisfied with the user experience.

CHAPTER 5

CONCLUSION

5.1 Introduction

Augmented reality (AR) technology is becoming more famous and widespread. It is an interactive experience of a reality environment where the objects in reality are improved by computer-generated perceptual information. Hence, this technology is used to develop an interactive indoor navigation to help and guide the people with poor sense of direction in a large shopping mall.

In conclusion, this chapter will discuss the summarization of introduction, literature review, methodology and implementation for this project by revisiting the project objectives that have been stated in Chapter 1. Besides, the application limitations and the suggestion future work for improvement of application will be also discussed in this chapter.

5.2 Objective Revisited

The purpose of developing the AR Flood mobile application is to help Malaysians, rescue departments, and government to discover the rescue plan. Malaysians can simulate the flood at their current location by using the application.

Based on the first objective mentioned in Chapter 1, it is about to study the demand and requirement of AR Flood mobile application in Malaysia. To achieve this objective, research has been conducted on different kind of identities in Malaysia. Also, the interviews were conducted with Malaysians to understand the current situation of the flood situation in Malaysia.

Next, the second objective is to design and develop an AR Flood mobile application to handle he flood in Malaysia. This goal has been achieved because the

application has been successfully developed with multiple functions and excellent UI design, allowing Malaysian users to easily manage the activities in a single platform.

Lastly, as stated in the third objective, the efficiency of the proposed AR Flood mobile application needs to be evaluated. The application has been successfully evaluated by Malaysians through the User Acceptance Test (UAT) to test its effectiveness and functionality. The evaluation showed positive feedback from the users and the goal was successfully achieved.

5.3 Limitation

One of the limitations that can be found in this project is the AR Flood mobile application only supports Android and HarmonyOS users, not iOS users. This is because the android studio can only be used to develop Android and HarmonyOS applications.(Yash Mishra, 2021)

Besides that, users can only receive notifications of incoming new alert messages from the admin. Any update of the flood status cannot be detected through the notification, and the admin need to send the notifications manually from time to time. This is because the notification of the status could not be successfully implemented on the application and no errors were found in the code.

In addition, there is no animated 3D augmented reality water model in the application because the animated 3D model needs to be paid and is complex to develop by myself. The water model is only been shown by 2D during the augmented reality function is used.

5.4 Future Work

In future work, AR Flood mobile application can be developed using application frameworks such as Flutter so that it can support all Android, HarmonyOS, and iOS users. Besides that, notification of flood status can be added to the application to make it easier for users to get notified about the flood. Other than that, the application can also implement the animated 3D water model to let the flood simulation more real. Furthermore, the developer can also enhance the view data functions by displaying the data by using the interactive method.

REFERENCES

A Gentle Introduction to Computer Vision. (2019, July 5). https://machinelearningmastery.com/what-is-computer-vision/

Alexander Wong. (2021, December 20). *SMART tunnel sets new record after diverting 5 mil cubic metres of water - SoyaCincau*. https://soyacincau.com/2021/12/20/smart-tunnel-malaysia-record-diverting-5-mil-cubic-metres-of-flood-water/

Bernama. (2022, March 7). *Smart Tunnel closed for flood diversion operations*. https://www.nst.com.my/news/nation/2022/03/777778/smart-tunnel-closed-flood-diversion-operations

Chan, N. W. (2015). *CHALLENGES IN FLOOD DISASTERS MANAGEMENT IN MALAYSIA*.

Houston Ben. (2020, May 28). *What Is Augmented Reality (AR)? A Practical Overview*. https://www.threekit.com/blog/what-is-augmented-reality

Khalid, M. S. bin, & Shafiai, S. B. (2015). Flood Disaster Management in Malaysia: An Evaluation of the Effectiveness Flood Delivery System. *International Journal of Social Science and Humanity*, *5*(4), 398–402. https://doi.org/10.7763/IJSSH.2015.V5.488

Ministry of Environment and Water. (2021, April 30). https://www.ctc-n.org/about-ctcn/national-designated-entities/ministry-environment-and-water

Nadirah H. Rodzi. (2022, March 7). *Malaysia's Klang Valley hit by flash floods again after heavy downpour | The Straits Times*. https://www.straitstimes.com/asia/se-asia/parts-of-kuala-lumpur-flooded-after-non-stop-downpour

Smart tunnel: what is it, how does it work and the real example of Malaysia. (2021, July 16). https://tomorrow.city/a/smart-tunnel

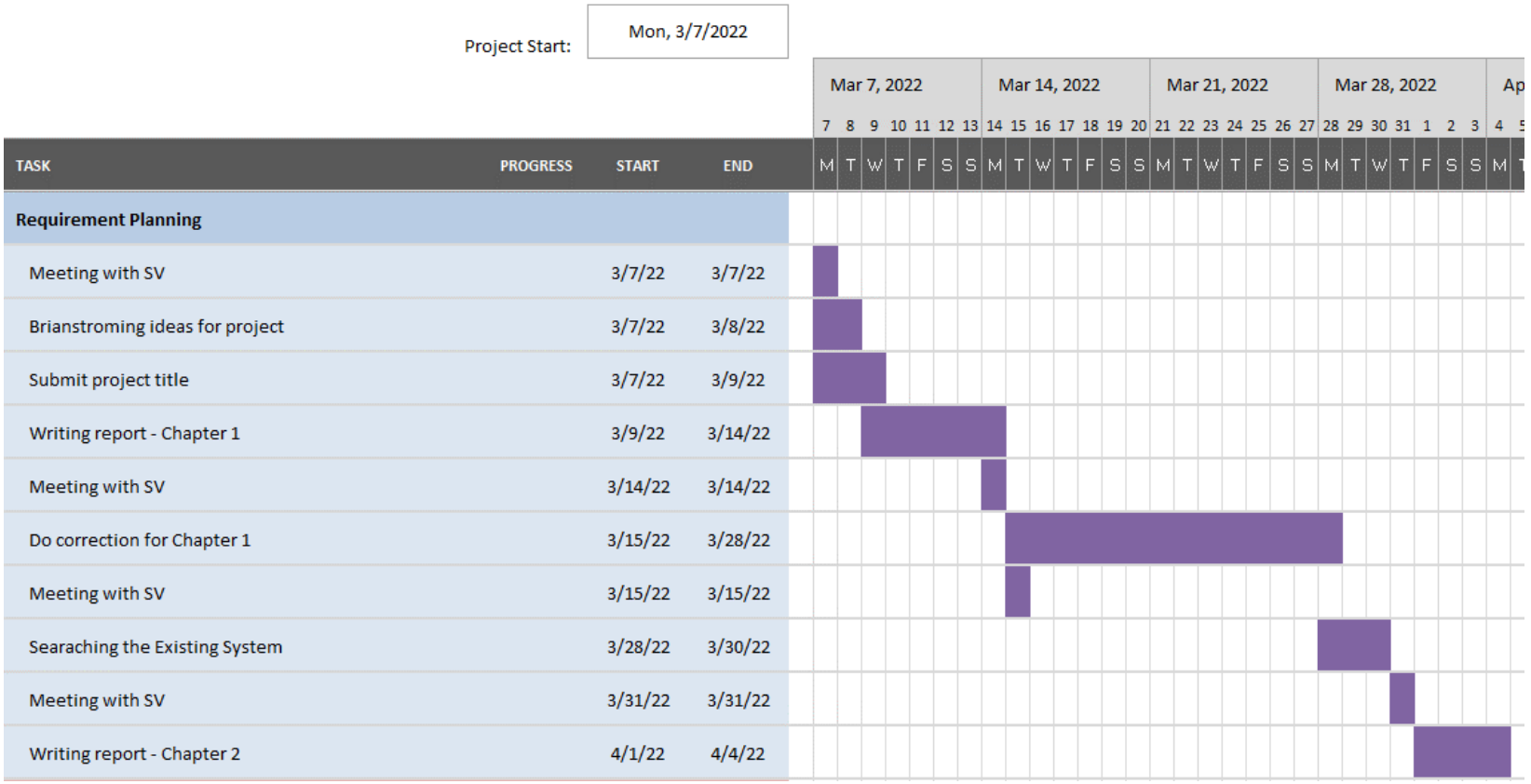
Yash Mishra. (2021, January 13). *HarmonyOS vs iOS vs Android: Here are the differences - Huawei Central*. https://www.huaweicentral.com/harmonyos-vs-ios-vs-android-here-are-the-differences/

APPENDIX A

GANTT CHART

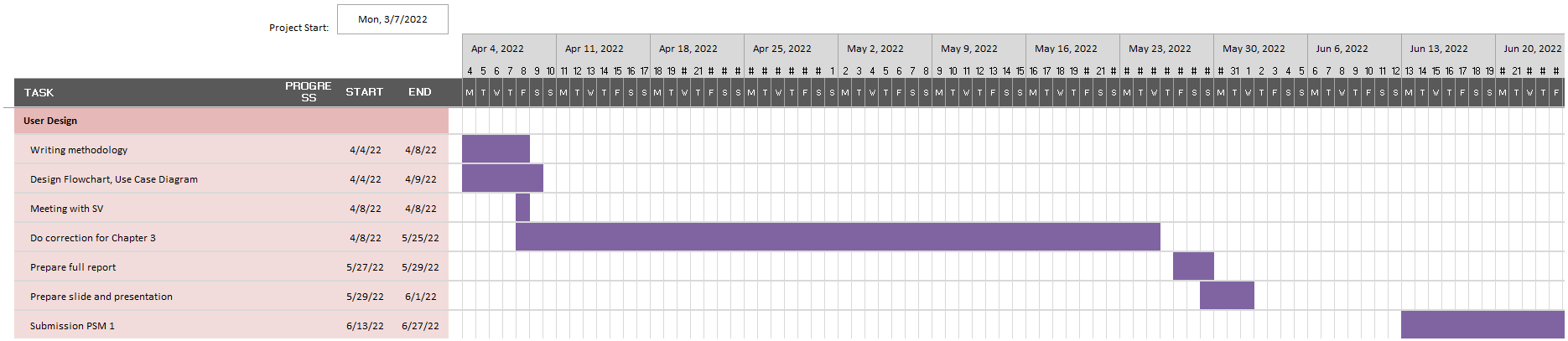
AR FLOOD PREDICTION AND ALERT SYSTEM

Project Start: Mon, 3/7/2022

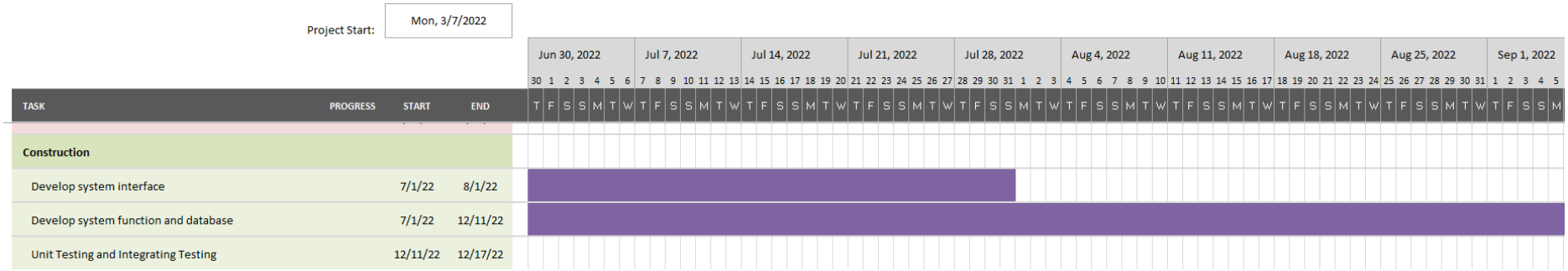


TASK	PROGRESS	START	END
Requirement Planning			
Meeting with SV		3/7/22	3/7/22
Brianstroming ideas for project		3/7/22	3/8/22
Submit project title		3/7/22	3/9/22
Writing report - Chapter 1		3/9/22	3/14/22
Meeting with SV		3/14/22	3/14/22
Do correction for Chapter 1		3/15/22	3/28/22
Meeting with SV		3/15/22	3/15/22
Searaching the Existing System		3/28/22	3/30/22
Meeting with SV		3/31/22	3/31/22
Writing report - Chapter 2		4/1/22	4/4/22

AR FLOOD PREDICTION AND ALERT SYSTEM

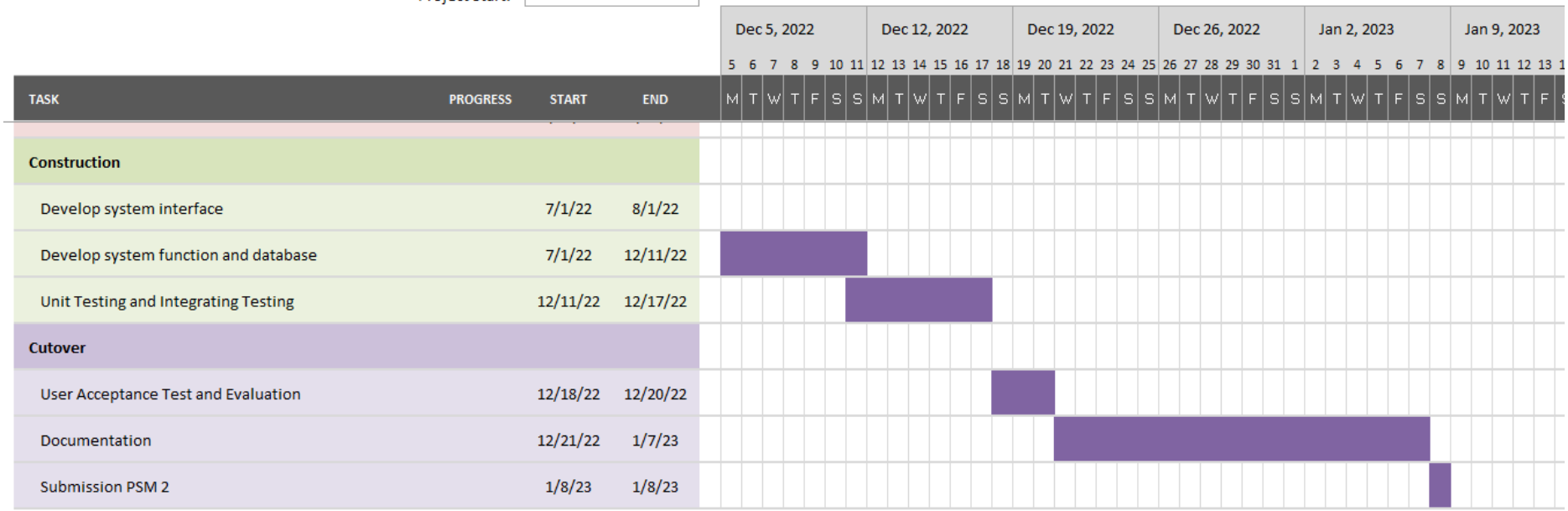


AR FLOOD PREDICTION AND ALERT SYSTEM



AR FLOOD PREDICTION AND ALERT SYSTEM

Project Start: Mon, 3/7/2022



TASK	PROGRESS	START	END
Construction			
Develop system interface		7/1/22	8/1/22
Develop system function and database		7/1/22	12/11/22
Unit Testing and Integrating Testing		12/11/22	12/17/22
Cutover			
User Acceptance Test and Evaluation		12/18/22	12/20/22
Documentation		12/21/22	1/7/23
Submission PSM 2		1/8/23	1/8/23