

A PORTABLE AND MULTIFUNCTION TRACKER

BY

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A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) COMMUNICATION AND

NETWORKING

Faculty of Information and Communication Technology

(Kampar Campus)

May 2021

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ACKNOWLEDGEMENTS

I would like to thanks my supervisor, Dr. Lau Phooi Yee for supporting me in this project. This the first project that I done by myself. Previously I work in a team and now for this project I have to work alone.

Thanks to my family and my girlfriend with their understanding and support and also standing on my side during my develop time. I want to express my appreciation to UTAR for giving me a chance to achieve this impossible project. Finally, thanks to all my fellow that helped me through this hard time.

ABSTRACT

In this century, people always travel and lack of financial literacy. In order to solve the problem, this project included both functions, tracking system with NFC tags and money managing system 2 in 1. The traditional trackers come with a lot of disadvantages that is already outdated in this century.

With the help of technology, this project can be done within Android Studio with Java language. The methodology that used in this project is Rapid Application Development. This project is going to research in the pros and cons of similar system and will try to implement anything that suitable for this project.

The goal of this project is to help Amnesia patients to keep their record of trace also helps kids who are 7 years old and above to have a good habit of financial. This project will be more focus on UI design and user experience. In order to attract the attention form kids, this project do some research for the theme, font, and color.

Besides, this application also including the Mysejahtera function with the NFC tags to fulfill those who really sensitive to their privacy and personal information.

TABLE OF CONTENTS

TITLE PAGE	I
REPORT STATUS DECLARATION FORM	II
FYP THESIS SUBMISSION OF ORIGINALITY	III
DECLARATION OF ORIGINALITY	IV
ACKNOWLEDGEMENTS	V
ABSTRACT	VI
TABLE OF CONTENTS	VIII
LIST OF FIGURES	IX
LIST OF TABLES	I
Chapter 1 Introduction	
1.1 Problem Statement and motivation	6
1.2 Project Scope	9
1.3 Project Objective	10
1.4 Contribution	11
1.5 Background Information	12
Chapter 2 Literature Review	
2.1 Review on Trackers	17
2.2 Review on Money Managing System	22
2.3 Comparison of NFC Tags	24
Chapter 3 Proposed Method/ Approach	
3.1 Methodology and General Work Procedures	28
3.2 Tools to use	31
3.3 System Design/ Overview	37
3.4 Implementation Issues and Challenges	49
3.5 Timeline	49
Chapter 4 Questionnaire	50

Chapter 5 System Implementation and Testing	
5.1 Module Testing	53
Chapter 6 Conclusion	73
Bibliography	74
Final Year Project Weekly report	76
Poster	78
Plagiarism Check Result	79
Checklist	84

LIST OF FIGURES

Figure	Title	Page
Figure 1.1.1	Missing persons files in United State in 2020	1
Figure 1.1.2	3G GPS Trackers	2
Figure 1.1.3	Global variations in financial literacy	3
Figure 1.1.4	Major Advanced Economies and Major Emerging Economies	4
Figure 1.1.5	GDP Per Capita Financial Literacy	4
Figure 1.5.1	Mini Tracker	13
Figure 1.5.2	GPS Constellation	14
Figure 1.5.3	Industry Revolution 4.0	15
Figure 2.1.1	TAG La	16
Figure 2.1.2	TAG La Beep Function	17
Figure 2.1.3	TAG La Ring Phone in Silent Mode	17
Figure 2.1.4	BlackCard	18
Figure 2.2.1	AndroMoney	21
Figure 2.2.2	Financial Calculators	22
Figure 2.3.1	NFC Contactless System	25
Figure 3.1.1	Rapid Application Development	27
Figure 3.2.1	Android Studio	30
Figure 3.2.2	Java	32
Figure 3.2.3	Kotlin	33
Figure 3.3.1	Use Case Diagram	36
Figure 3.3.2	Class Diagram	47
Figure 4.1.1	Questionaries for age	49
Figure 4.1.2	Questionaries for Smartphone Operation System	49
Figure 4.1.3	Questionaries for Money App Experience	50
Figure 4.1.4	Questionaries for Saving Habits	50
Figure 4.1.5	Questionaries for Budget Overspent	51
Figure 5.1	Login Page GUI	52
Figure 5.2	Login Page Source Code	53
Figure 5.3	Part of Register Page GUI	54

Figure 5.4	Part of Register Page Source Code	55
Figure 5.5	Dashboard GUI	56
Figure 5.6.1	Part of Dashboard Source Code	57
Figure 5.6.2	Part of Dashboard Source Code	58
Figure 5.6.3	Part of Dashboard Source Code	59
Figure 5.6.4	Part of Dashboard Source Code	60
Figure 5.6.5	Part of Dashboard Source Code	61
Figure 5.6.6	Part of Dashboard Source Code	62
Figure 5.6.7	Part of Dashboard Source Code	63
Figure 5.7	Part of Add Activity GUI	64
Figure 5.8	Part of Add Activity Source Code	65
Figure 5.9.1	Part of Start Activity	66
Figure 5.9.2	Part of Start Activity	67
Figure 5.10	User Profile Data Synced into Firebase	71
Figure 5.11	User Profile Pictures Synced into Database	71

LIST OF TABLES

Table	Title	Page
Table 2.1.1	Comparison of TAG La and Pebblebee-BlackCard	19
Table 2.1.2	Bluetooth Tracker vs GPS Tracker	20
Table 2.3.1	Comparison of NFC Tags	23
Table 2.3.2	Comparison of NTAG21x	26
Table 3.1.1	Pros and Cons of Rapid Application Development	29
Table 3.2.1	Comparison between Database Management	31
Table 3.2.2	Comparison Between Firebase and SQLite	34
Table 3.3.2	Login Use Case	37
Table 3.3.3	Register Use Case	37
Table 3.3.4	Dashboard Use Case	38
Table 3.3.5	Create Income Use Case	38
Table 3.3.6	Create Expenses Use Case	39
Table 3.3.7	View Income Use Case	39
Table 3.3.8	Update Income Use Case	40
Table 3.3.9	Delete Income Use Case	40
Table 3.3.10	Clear All Income Use Case	41
Table 3.3.11	View Expenses Use Case	41
Table 3.3.12	Update Expenses Use Case	42
Table 3.3.13	Delete Expenses Use Case	42
Table 3.3.14	Clear All Expenses Use Case	43
Table 3.3.15	Calculator Use Case	43
Table 3.3.16	View Category Use Case	44
Table 3.3.17	Upload Profile Use Case	44
Table 3.3.18	View Profile Use Case	45
Table 3.3.19	Logout Use Case	45
Table 3.3.20	Edit/ Update Profile Use Case	46
Table 3.5.1	Timeline	48
Table 5.1	Login Module	68

Table 5.2	Calculator Module	68
Table 5.3	Income Module	69
Table 5.4	Expenses Module	69
Table 5.5	User Profile Module	70
Table 5.6	Tracker Module	70

Chapter 1

Introduction

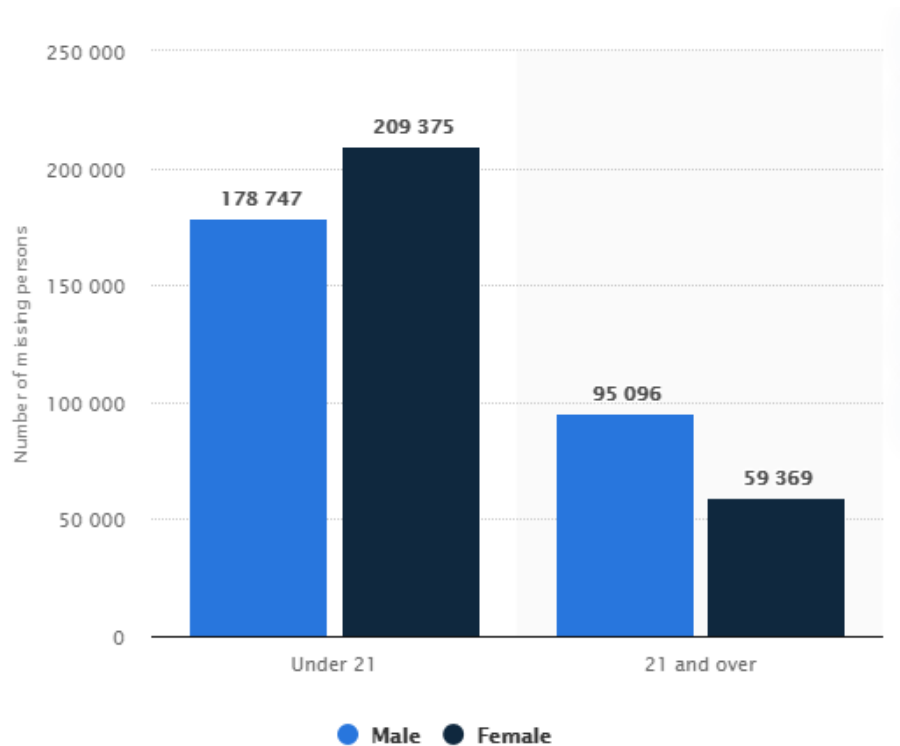


Figure 1.1.1 Missing persons files in United State in 2020

In this era of burgeoning digital technology, digital technology has taken around us. Buy Insurance for beloved ones is not the only choice to protect them. As the saying goes, prevention better than cure, there is always a better prevention plan than buying insurance. There are many trackers in the market which claim to provide real time GPS to track down people and belongings, but the performance and additional functions are poor. Amnesia patient, children and forgetful user are usually the most highlighted group for this kind of product. They need a trusted and reliable product to ensure their safe. *Figure 1-1* show that the numbers of missing persons files in United State in 2020. An estimated 854,141 children were reported missing in Australia, Canada, Germany, India, Spain, United Kingdom and United Stated. (Missing Children's Statistics - Global Missing Children's Network, 2021) Among these countries, United States took the first place, an

estimated 460,000 children are reported missing every year. One missing child is one too many. (Number of missing persons files in the U.S. by age and gender 2020 | Statista, 2020)



Figure 1.1.2 3G GPS Trackers

Nowadays, a portable tracker has become a must. There are many kinds of tracker in the market with their own aims and main goals. But the problem is, is it necessary to have a physical tracker which would relatively increase the trouble to a user? A traditional tracker is usually in 5cm x 5cm x 3cm size, uses a 2032 battery or a rechargeable battery and comes with cellular function. In the other word, users have to get a cellular plan for the trackers and have to replace or charge the battery. Not to say that the design is bad, as that's the disadvantages of a physical device. In this project, it aims to solve the disadvantages in traditional trackers and add a few essential functions inside.

In 2017, Amazon made a refund of \$70 million worth of app purchases which were made by kids as reported by The Atlantic. This amount is just a tip of the iceberg, there are more that amount of payment was made by kids and even adults as they do not have a financial concept. Based on the research of Cambridge, children who are older than 7 years old should understand some of the financial concepts. Eventually, 7 years old kids now normally will be distributed a smartphone from their parents to have better communication and ensure their safety. Besides, according to calendar.com, Howie Jones also mentioned that kids should be reached for money habits at age of 7. Kids should be reminded of the importance of waiting. Patience is the key, whenever they want to buy something, they need to wait, save and then spend. That is a cycle for every expense. (Smith, 2021) There are a lot of financing applications which are targeted for kids such as Yuby, AdVenture Capitalist, RoosterMoney, PiggyBot and etc. The number of financial

app is raising up because these kinds of applications usually will be more attractive and better in user experience are.

MAP 1: GLOBAL VARIATIONS IN FINANCIAL LITERACY
(% OF ADULTS WHO ARE FINANCIALLY LITERATE)

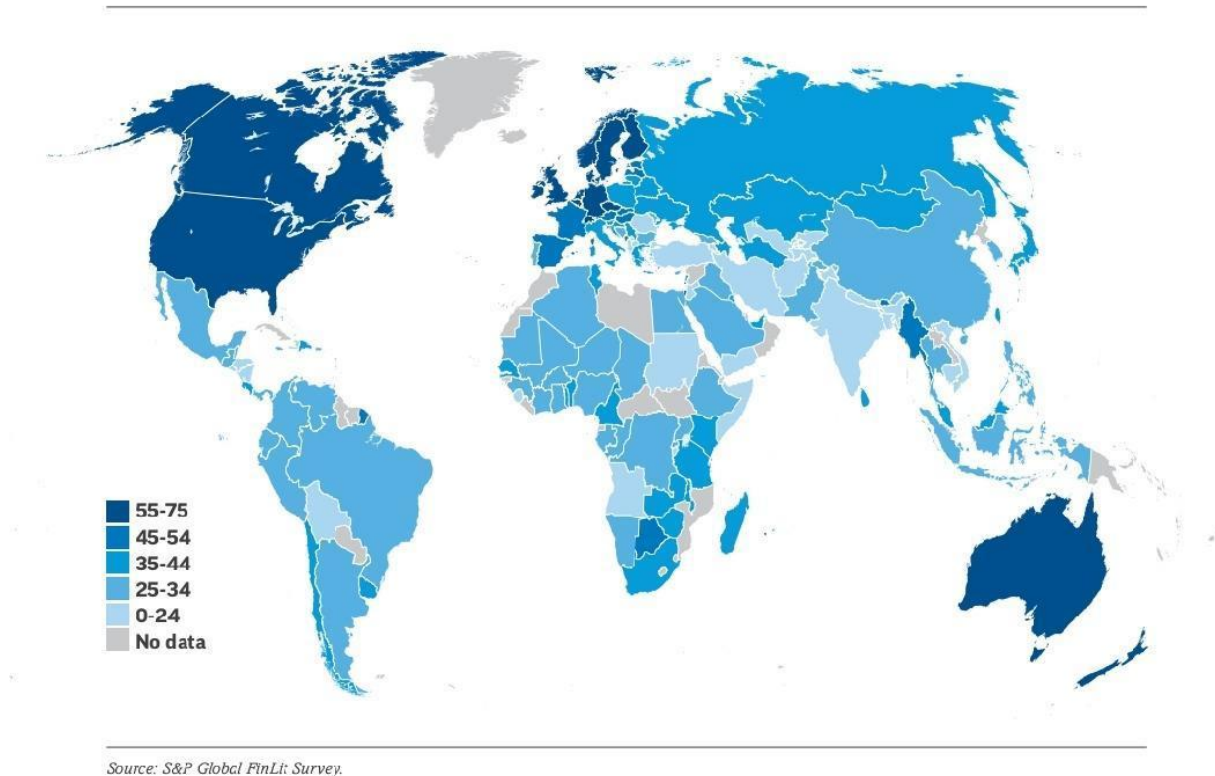
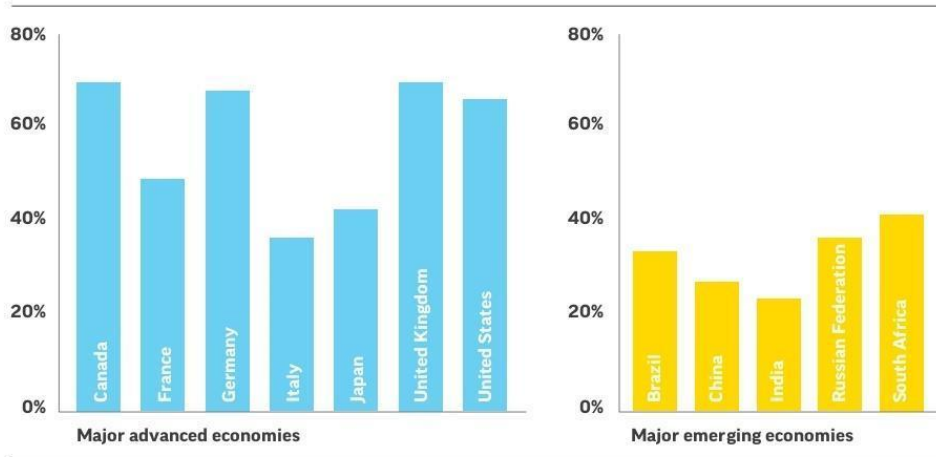


Figure 1.1.3 Global variations in financial literacy

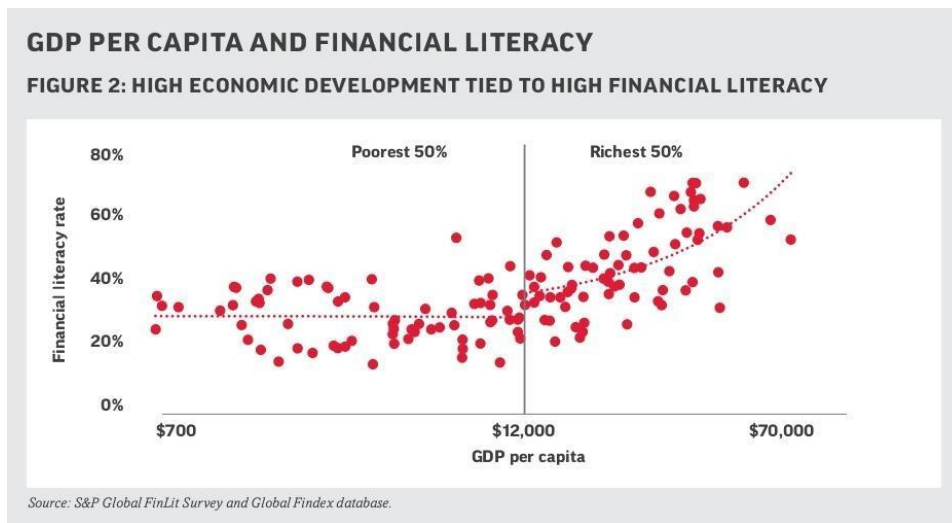
As the figure above, it showed the financial literacy rate of the world. The highest financial literacy rates are literally Canada, Japan, United States, Norway, Sweden, Finland, Australia, New Zealand and France which are more than 55 percent of people are financially literate. Not surprising that most of the people in the world are normally without financial literacy.



Source: S&P Global FinLit Survey.

Figure 1.1.4 Major Advanced Economies and Major Emerging Economies

As the chart above showed, the major advanced economies are having a higher percentage of financial literacy while the percentage of major emerging economies are at the average of 30%.



Source: S&P Global FinLit Survey and Global Findex database.

Figure 1.1.5 GDP Per Capita Financial Literacy

The figure above showed the relationship of GDP per capita and financial literacy. Is financial literacy affected by average income? The answer is yes. As the figure showed, when GDP per capita is in the range of \$700 to \$12,000, the percentage of financial literacy rate is around 30%. However, when the GDP per capita rises significantly from \$12,000 to \$70,000, the financial literacy rate is increasing accordingly.

For this project the budget problem and user experiences are the most concerned. Aiming to resolve the problem of financial literacy means this project is dealing with the major emerging economies and people whose GDP per capita \$12,000 and below. In order to accomplish the goal, this project will be based on software. All of the functions of the multifunction trackers will rely on the smartphone's performance in order to cut down the cost of the tracker to the user.

The major functions of this project are tracker, money manager and calculator. The project goal is to become an essential application, daily helper to users. In the money manager, users can simply key in expenses and incomes. The expenses and incomes will be categorized which makes the refer back action easier. With the tracker, it is able to read and write the specified NFC tags in order to perform some tasks.

1.1 Problem Statement and Motivation

People in the world are forgetful and without a habit of managing money, that is why this project is developed. Products on the market all rely on the hardware itself, but the critical problem because that user needs a tracker is they are always forgetful and one more device to be carried is one more thing to be lost. So, in this scenario, this project will focus on software development and will be added a money manager system to help users to calculate their expenses and income. There is no such software that combines all NFC read and write functions, GPS location service, and money manager system. This project will solve the problem of users which is that they always forget where their money has been used and how they can manage their money every day.

The motivation to develop this project is that many people in the world are without a habit of managing money and are always forgetful. In order to solve users' problems, this project is developed. The products that have been published are limited with their size and the functions are not well developed. This project aims to develop a fully functional tracker which can communicate with our smartphone so that it can penetrate into our life. Besides that, this project also aims to design a user-friendly interface so that our target user can hands on easily.

The problem in this project also the disadvantage of GPS is the locating issue. GPS is not functioning in indoor conditions because the radio waves will be blocked by walls and other objects. The signal will drop significantly when the tracker is positioned indoors. Besides, the accuracy of GPS is always greater than 3 meters, there will be some difficulty to locate our mini tracker within 3 meters. Also, the reflections of the indoor surface will redirect the radio wave of GPS which can cause multipath propagation and lead to unexpected errors. The solution of the disadvantages of GPS will be NFC tags. When users are in the indoor venue, users can scan the NFC tags in the venue in order to replace the signal loss of GPS.

This project is also suitable for kids, especially those with smartphones. Parents can educate their children with the money management system and also can monitor their location with the GPS located system which is built in the software.

This project will come out with a software-based tracker with GPS, NFC and money management system. Why does the project not come out with the traditional hardware tracker? There are few reasons for this question. First, the purpose to develop this kind of project is to minimize the trouble of users, and also to reduce the burden of users. Instead of creating a hardware-based product which will be forgotten to bring out, left in some other places, lost, we

prefer it to be embedded into the user's phone. Another reason is budget problems. In order to develop a hardware-based tracker, it required a lot of material which at the end the cost will be added to the final selling price. This project is looking to publish to all users without any threshold, price should not be a concern to users. The last reason why the project does not come out with the traditional way (hardware-based) is because the smartphone now is mostly equipped with GPS and NFC components which are quite high end. There is no reason for this project to buy a high-end component to maximize the performance as this project is aimed for budget build. Since that smartphone is almost equipped with what this project needs, then why not develop a software-based product then?

The second function included in this project is money manager. This major problem to implement this function is the ease of use. Money manager function is boring so the challenge here to have an attractive system UI especially this project targeted to the kids too. The next challenge is the language has to be plain and easy to be understood. The target users for this project are not really highly educated, since the range is specified for 7 years old and above. The word cash flow, payout, gross profit and financial statement, bad debts are not usually used by the most people. To ensure the user can enjoy the application, the language has to be understandable to everyone.

The next problem has to be solved is the user experience. The most direct impression to users must be the system design and animation. User experience is important because it is what will fulfill users. User experience aims to provide a positive experience to users so that users will stick to the applications as long as possible.

First, this project is targeted to the range of 7 years old and above. After knowing the target user, the direction is clear enough. This information allows this project to develop experiences that are suitable for target users. Setting up user personas is needed. A user persona is a model of this project target user based on the data research. Then, when finishing developing user personas, we are able to talk to similar users that reflect the same result as the user personas. When creating user persona, we have to include demographic (age, location, familial status, career), motivations (fear, power), personality (creative, introvert) and any others information that will help in this project. (Teaching Kids About Money: An Age-by-Age Guide, 2021)

The task for this project is to develop a multifunction tracker that can help Amnesia and kids to have financial literacy and keeps them safe with the tracker function. The motivation of this project is to help out the people that without any financial literacy to have a habit of managing

money and keep them safe with the function of tracker. There are too many kids missing everyday while the saddest part is the scenario is still there without any changes. This project aims to deliver an application that can help people to manage their money and also keep them safe with the tracker's function. The introduction of software-based multifunction tracker is not a new concept in 2021. But that will not stop this project to be done. In this project, it is equipped with money manager function and tracker function also the calculator. This project aims to provide a new lifestyle to people that are already familiar and comfortable with their present situation.

1.1 Project scope

At the end of the project, I would like to deliver a piece of software. Although my project is named as “A portable and multifunction tracker”, it is a software-based project. With the assist of NFC tags and GPS on smartphones, this software can achieve what must be delivered in this project. First, this project will be able to store the data into firebase and. Users will be required to sign up for an account in order to use this software. There will be a history tab in this software so that users can track their activity history in the past of an hour and up to 1 year.

So basically, this project will be cooperating with NFC tags, GPS, and smartphone’s network. With this software, users can write their NFC tags for some command. As example, the user had set up the command for NFC tag A to call her husband. So, when the user arrives at her company, the user puts down her phone to a NFC tag A on her working table, her phone will immediately call to her husband. This is just an example of the use of this software. This software will indeed be including the read and write functions to the NFC tags to perform the task.

Besides, with GPS assisted, this software will upload user location to firebase frequently. When a user signs up for an account, a user is required to key in one of his family members’ email or his spouse’s email so that his guardian can login to monitor his location randomly. Besides that, this tracker will also include a pocket money manager system. As the title mentioned this project is a multifunction tracker, this project will include a money manager system so that the project target user can fully utilize the software to solve their problem in their life.

With the help of the money management function, users can simply key in the expenses and income in this project and sit back then generate a report for their financial status. It is just some clicks compared with the traditional bookkeeping methods. The calculation of the expenses and incomes are easy to computer. With a designed coding in Java language, it can be accomplished perfectly.

1.3 Project Objectives

The main objective of this project is to develop a multifunction mini tracker for Amnesia patients and forgetful users. With the power of the technology, Amnesia patients will stay able to know exactly where they have been and when they are lost, their friends and family are able to locate them.

The aim of the thesis is to propose an improved mini tracker with a multifunction such as GPS, NFC and money management system. This project is not only to be used to monitor location of users, but when you lose your phone, you can use this project software to locate and find back your phone. Besides, with this software, we can pair the additional NFC panel with the build in NFC panel in our phone and set up for some command in order to control your smart home devices. With an NFC panel, we can do a lot of this such as replace the access card with this NFC panel embedded in the smartphone. Also, a GPS function is going to report its coordinates every minute when it is out of certain range with our smart phone.

To find out which of the NFC tags is the most suitable for this project, a research will be brought up to test out the performance of different types of the NFC tags in the market, which included Ntag213, Ntag215, Ntag 216 and also Classic 1k. The research will find out the range, size, read- only mode, writable, signature select Acknowledge, technologies available of all these NFC tags.

This project aims to improve the quality of life of 1% of users in the world as this project will be uploaded to play store and available to all android users around the world. In general, this project will help user to bring up the habit of managing money and monitor the location of their children for safety issue.

This project will deeply focus on user experience because the human and computer interaction is the most important part to this project. Believe that the best GUI will gives user the best experience when user using this project. As the project target user included children, the user friendliness of the project is the most important part.

1.4 Contribution

This project is going to change the style how Amnesia patient, forgetful user and children live. With this project, they are not going to worry that the flow of their money they can also monitor how long did they took to arrive point to point. This mini tracker is a software-based product which will helps user to manage their money and it is automatically synced to firebase. With the GPS location function, parent can always monitor their children with their location so that parent who work at office can ensure that their children are safe. It is a big contribution to a family especially who parents are busy at their work and their children needs to live independently. In addition, we are on the way to industry revolution 4.0, everything is going to connect to network, our home devices also not an exception. With the mini tracker, it can be used in many situations. Imagine that when you come back to home, you place phone on the regular place, which already paired with the NFC tags with some command such as open aircons, turn on humidifier and etc. This project is now multifunction with only GPS and NFC for monitor location and included money management system. That is a huge improvement for the tracker history. This project has to be carried out because there is no such software that can combine location monitoring and money managing systems in our real life. It is a need specially for children as they are still young, and education of money management is important to them while the most important is their safety issue which can be solved by implementing the GPS tracking system into the software.

With the function of Money Managing, user can record down the expenses and incomes easily. This project's main features include a tracker, a money manager, and a calculator. The project's aim is to become a necessary application that users can rely on a daily basis. Users will simply insert expenses and incomes into the money manager. The expenditures and incomes will be divided into categories, making it easier to refer back to them.

1.5 Background Information



Figure 1.5.1 Mini Tracker

In this chapter, we present the background and motivation of our research, our contributions to the field and the outline of the thesis. We are going to do a software-based mini tracker which is aimed to be user friendly and ease of use to users. A mini tracker, on the name we can imagine that it should be mini, portable and multifunction. However, you will never expect it will be a software-based product. This is a software-based multifunction mini tracker which can be used to track user, to monitor the location and also it comes with the NFC function.

A tracker can be described as a mini IOT device, which aims to provide information such as location, data of the host. A tracker can be very expensive. A tracker for vehicles can be very expensive as the components are high end products, in order to provide accurate and instant information. There are few products established on the market now. The manufacturers combine the tracker functions with so others devices such as watches, pen drive, but most of them are just single function, which is only providing tracking function. They target in few sectors like children,

pets, and motorcycles and luggage. None of them really customize their product for Amnesia patient.

In 2019, there are more than 50,000,000 people suffering Amnesia around the world. Amnesia is a form of memory losing or not able to form a new memory Patient will facing memory impairment; it is a form of memory loss. Patient with Amnesia usually having trouble with forming new memories or cannot recall and history and past experiences. But the fun fact is, they usually maintain their oral skill and driving skill as the always practice them. (Amnesia: Types, Symptoms, and Causes, 2020)



Figure 1.5.2 GPS Constellation

Back to 1978, the first GPS tracking devices was invented by Rockwell International. It is inspired by the military and intelligence applications from the Cold Word in 1960s. In the early years, the GPS technology are not yet functioning as the satellites orbiting are not enough of quantity on our earth. (GPS Tracking: A Brief History | Rewire Security Blog, 2020)

As we know that GPS real time tracker is widely used in cars, lorries and motorcycles, which provide a very good result. But at the first launching of the tracking, in order to achieve a high accuracy, every vehicle need to install a GPS tracking unit. Users are required to pay high monthly

fee to use the satellites for the GPS tracking system. This make the popularity of GPS being low at the first few years.

However, in 1990s, the GPS tracking system implemented Global Navigation Satellite System as this Navigation Satellite System using microwave impulses that are transmitted to the GPS to gives info on location, vehicle speed, time, angle and route history.

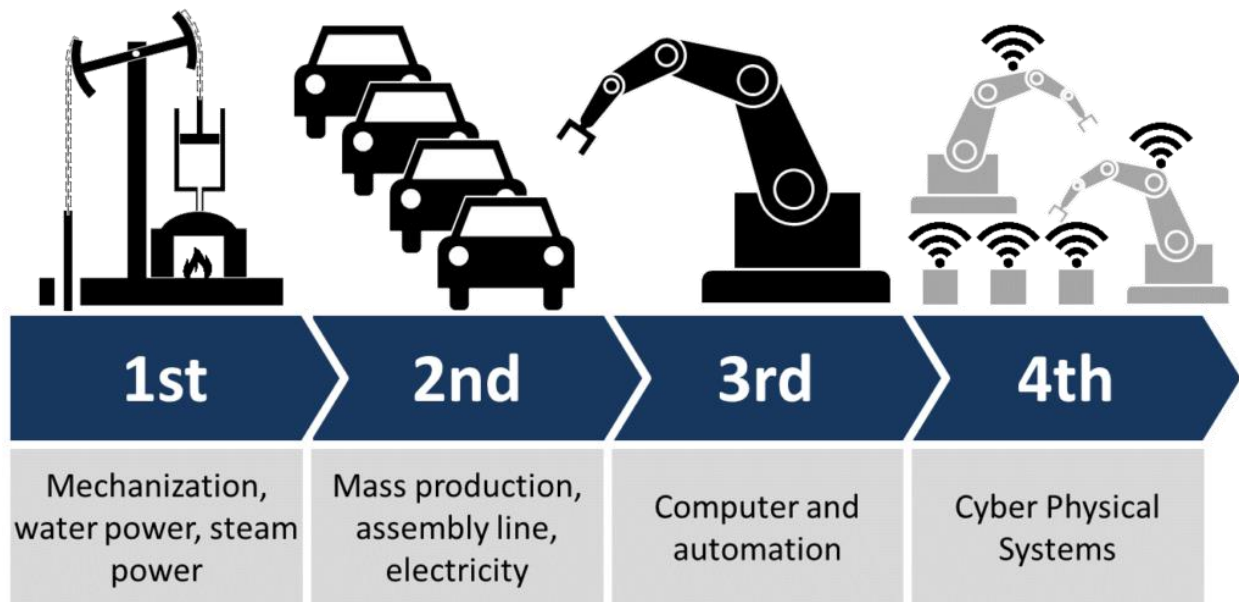


Figure 1.5.3 Industry Revolution 4.0

Nowadays smartphone is equipped with useful NFC function, GPS function and network. This will be a perfect combination as now we are on the path to Industry Revolution 4.0. We are on the way to fully furnished our home with Internet of Things. The “Smart Home” concept is popular for now; it will be great if our mini tracker can be a part of our smart home devices.

What is NFC? NFC stands for near-field communication. It is a popular wireless technology which allow mobile gadgets and other devices to share data and information with other NFC-equipped devices. The advantage of NFC technology is NFC consumes small amount of battery while offering a huge benefit that improve the functionality of our devices. Although it has a same function as Bluetooth but NFC is always a better choice in our project. (What is NFC and how does it work, 2020) We going to pair our software with some NFC tags in order to complete some

command and order. As example, we can put an NFC chip at our table. When we get back to home, we regularly put our phone on the table so that the phone can have a quick scan to set your house to prefixed situation. These passive tags which located in the house do not require power consumption as it is automatically started when another NFC enters it range. Once in the range, both NFC immediatly communicate. (Near-field communication - Wikipedia, 2020)

Chapter 2

Literature Review

In order to have a good project output, I had done some research on similar product on the market. I will make a comparison between them and try my effort to implement their advantages into this project and try to avoid the mistakes and any error had been done by previous product.

Currently the traditional trackers are still in form of physical, there are several different types of trackers on the market, each with its own set of targets and objectives. But the question is if a physical tracker, which might add to the user's inconvenience, is essential or not. A traditional tracker is usually 5cm x 5cm x 3cm in size, with a 2032 battery or a rechargeable battery, and cellular capability. To put it another way, consumers must buy a wireless service for their trackers and repair or charge the battery. Not to say that the architecture is bad, that is one of the drawbacks of a physical system.

In the past, people are not able to travel around the world so easily. People were limited to travel only locally but barely overseas. The same logic also applies to spending money, people cannot easily spend their money to buy overseas product. The trace back task is easy to be done either their footprint or their daily expenses. But now is 2021, in this century, the advanced of technology indeed brings a lot of convenience to people. They can fly to New York or buy some signature snacks from Korea effortless. So, the solution is to educate and remind people to be wise on spending money and keep their safety.

2.1 Review on Trackers

TAG La



Figure 2.1.1 TAG La

TAG La was founded in December 2015 by 2 young guys, Edison Lim and Max Chua. They aim to stop and eliminate the problem of losing items. TAG La is a local brand which already been noticed and popular in ASIA. With more than 5 years' experience, TAG La has become mature and stable product which can be a good indicator for our proposed project. (TAG La™, 2020)



Figure 2.1.2 TAG La Beep Function

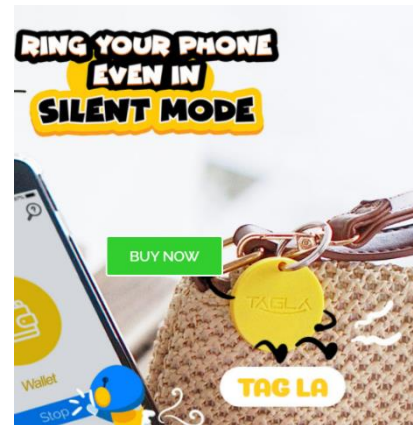


Figure 2.1.3 TAG La Ring Phone in Silent Mode

TAG La is a Bluetooth tracker with 3 main function. It can be found and beep when you are in the Bluetooth range, it can be a phone finder in the reserve way when you press the button on TAG La twice, and the last function is it can show the last shown up of its position from their apps. The advantage of TAG La is, it is a Bluetooth tracker which will consume less power and compare with GPS tracker, it can be used without cellular network. Another additional mark to TAG La is it can ring your paired phone even the phone is in silent mode as Figure 2.3 shown. TAG La will keep connected with your phone and when the distance of both devices is greater than 22 meters, a notification will pop up to the paired phone and display the last location of TAG La. (TAG La™, 2020)

Pebblebee- BlackCard



Figure 2.1.4 BlackCard

BlackCard is a Bluetooth tracker that works with Alexa and Google Assistant. BlackCard and TAG La are both completed with mobile apps so that both of them can be remote from mobile apps but BlackCard has a better connection with Smart Home concept as it can be connected with Alexa and Google Assistant. BlackCard is positioned as wallet finder as the design of it is same as a credit card but the thick is 2mm. Although 2mm seems too thick when it is compared with a credit card, but it is the slimmest tracker. It has a rechargeable battery which can last up to 4 months with full charged.

	TAG La	Pebblebee- BlackCard
Range	500 feet	72.1785 feet (22 metres)
LED Light	No	Yes
Rechargeable	Replaceable CR2032	Yes
Last Known Location	Yes	Yes
Button	Double press to find phone even in silent mode	Press to find phone
Material	Plastic	Plastic
Price	RM79.90	RM120.76 (\$29)
Technology	Bluetooth Low Energy	Crowd GPS
Left behind notification	Yes	Yes
Alexa and Google Assistant	No	Yes
Battery Life	Up to 6 months	Up to 4 months
Sound Level	88 dB	105 dB

Table 2.1.1 Comparison of TAG La and Pebblebee-BlackCard

The main difference between TAG La and Pebblebee- BlackCard is one of it using Bluetooth Low energy technology and the another using crowd GPS technology. Both of this have their pros and cons. However, this project will not be using either one of them as we are going to use a NFC tags as the media.

	Bluetooth Tracker	GPS Tracker
Price	Cheap	Expensive
Range	200 feet maximum	No limit
Battery Consumption	Low	High
Sound alerts	Yes	Additional function
Geofencing	Limited to tracking when in range	Able to set up multiple area
Cummunity Help	Yes	No
Size	Small	Big

Table 2.1.2 Bluetooth Tracker vs GPS Tracker

Bluetooth Low Energy technology only started from 2012 but the advances in Bluetooth technology provided the Bluetooth tracker a stable connection and lower power consumption. In this situation, it allows the devices equipped with Bluetooth Low Energy technology be smaller, lighter and can easily be carried around.

GPS tracking technology has been developed few decades ago, it has been widely used in public sector.

The disadvantages of traditional trackers are shown. Both of the compared trackers need to be recharged or replaced battery in order to maintain their functions. The most important part is, the traditional tracker does not function better than a NFC tags that is associated with a smartphone.

As a conclusion, after done the survey on these two trackers, the limitations and the advantages of the traditional trackers had showed up. The lack of physical design is a critical part to any physical devices. When user needs to take care of the product or have to do some maintenance like charge it up, pay for cellular data plan for GPS tracker. Follow by the rules of ease of use,

2.2 Review on Money Managing System

AndroMoney

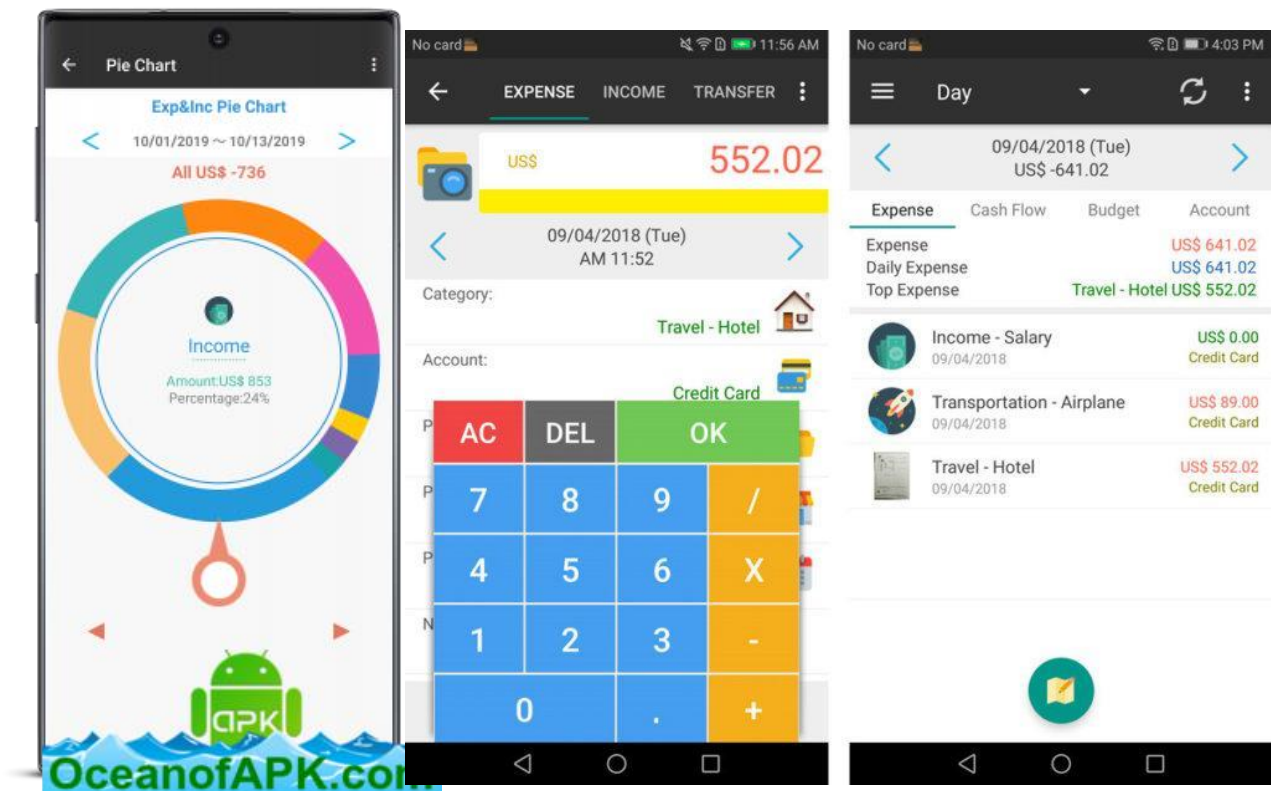


Figure 2.2.1 AndroMoney

On Google Play, AndroMoney is one of the most popular and effective expense trackers. The software is cross-platform, meaning it works on both the mobile and iOS. Multiple accounts, account balances and transfers, budgeting functions, support for multiple currencies, and backup to Excel are just a few of the features. The architecture is remarkably simple, and the analytics are presented in a logical and easy-to-read format. We really appreciate the fact that this is a free app. There are advertisements, but it's difficult to stick to a budget when you're spending a hundred bucks a year on a subscription option. In any case, there's not anything wrong with this app. It seems to be very successful. (10 best Android budget apps for money management, 2021)

AndroMoney is developed in a light theme which equipped with the colourful design. This is a very good design direction which can be included in this project. Besides, the figure showed in *Figure 2.2.1 AndroMoney* are highlighted in different color which can be easily noticed. The

disadvantages in AndroMoney is the icon are not categorized which means that the system is abit messy and complicated.

Financial Calculator

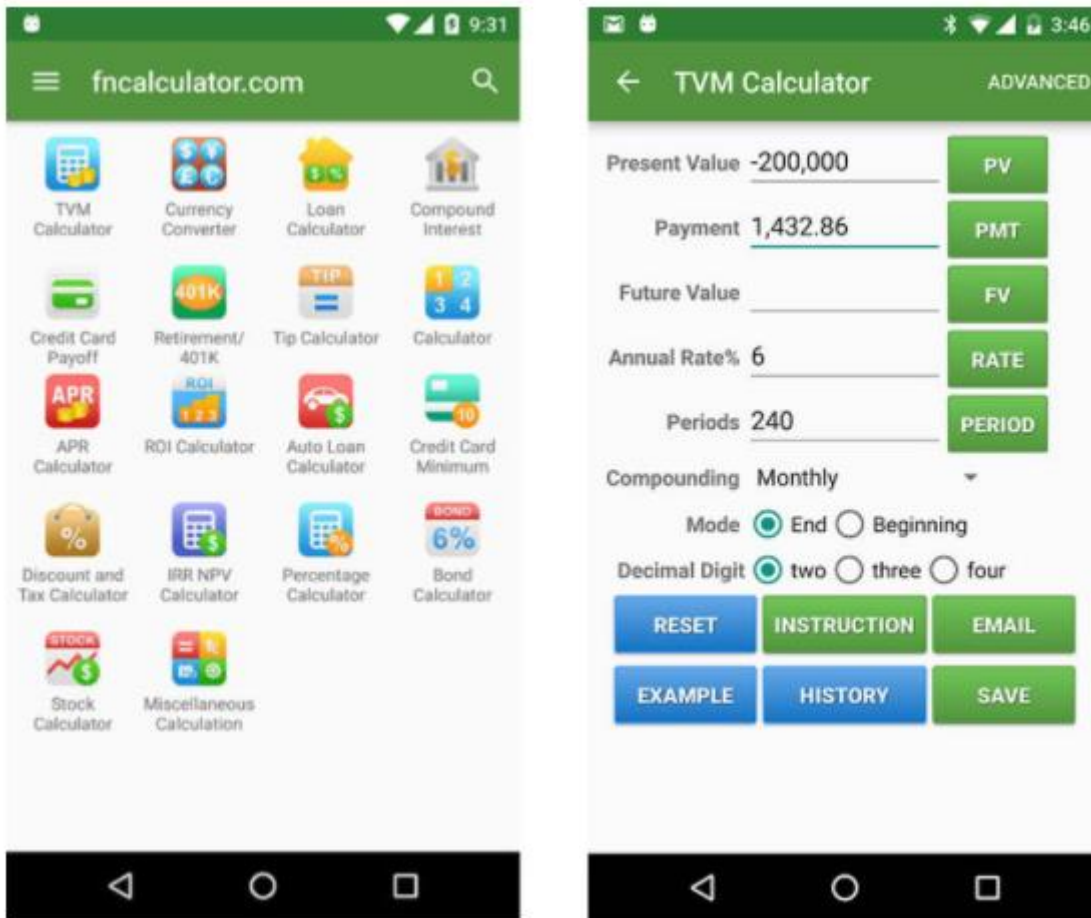


Figure 2.2.2 Financial Calculators

Financial Calculators are an important method for creating a future budget. The software is basically a set of calculators that can assist you with a range of activities. It has a debt tracker, for example, so you can see what the costs and interest would be like. This software contains several hundred calculators ranging from home ownership to fixed versus dynamic rates and even a return-on-investment calculator. It will not control your assets, but it will assist you in making fewer poor decisions about upcoming transactions. It's one of the most important budgeting apps. (10 best Android budget apps for money management, 2021)

The disadvantage of Financial calculator is the icon/ function on the dashboard is too many. A dashboard should only include some essential function like expenses and incomes also scan tracker functions so that user can be easier to reach any main function but not distracted by some subfunction.

2.3 Comparison of NFC tags

NFC Forum Platform					
	Type 1 Tag NFC-A compliant	Type 2 Tag NFC-A compliant	Type 3 Tag NFC-F compliant	Type 4 Tag NFC-A, NFC-B compliant	Type 5 Tag NFC-V compliant
Compatible Products	Broadcom Topaz	NXP MIFARE Ultralight/ NXP MIFARE Ultralight C NXP NTAG 21s (F) NXP NTAG I2C	Sony Felica	NXP DESFire / NXP SmartMX-JCOP (MIFARE DESFire implementation) / ST Microelectronics	NXP ICODE SLI (x) / Texas Instruments Tag-It HF-I / EM423x / ST Microelectronics
Memory Size	454 Bytes	48 / 128 / 144 / 504 / 888 / 1904 Bytes	1, 4, 9 KBytes	2 / 4 / 8 KBytes / up to 144 Kbytes / 106 Kbytes	32 / 112 / 128 / 160 / 256 Bytes
Unit Price	Low	Low	High	Medium / High	Low / Medium
Data Access	Read/Write	Read/Write or Read-only	Read/Write or Read-only	Read/Write or Read-only	Read/Write
Active Content*	-	-	-	x /	-
Operation Specification	ISO/IEC 14443-3 A	ISO/IEC 14443-3 A	JIS 6319-4	ISO/IEC 14443-4 A/B	ISO/IEC 15693

*Active Content refers to the ability for a developer to store and run small applications (called 'barilets') on the tag. Only the Type 4, non-DESFire tags have this ability, all other tags are treated as static storage device.
MIFARE Ultralight, NXP MIFARE Ultralight C, MIFARE DESFire, SmartMX, NXP ICODE SLI(x) are registered trademarks of NXP B.V.
Tag-It HF-I is a registered trademark of Texas Instruments.
EM423(x) is a registered trademark of EM Microelectronic.

Table 2.3.1 Comparison of NFC Tags

Tag 1 Type

The ISO14443A standard serves as the basis for the Tag 1 Type. These NFC tags can be read and re-written, and users can customize them to be read-only. The usable memory is 96 bytes, which is more than enough to store a website URL or any small amount of data. However, the memory can be expanded up to 2 Kbytes. This NFC tag has a transmission speed of 106 kbit/s. Because of its simplicity, this tag type is inexpensive and suitable for a wide range of NFC applications.

Tag 2 Type

The ISO14443A standard is also used for the NFC Tag 2 Type. These NFC tags can be interpreted and re-written, and users can customize them to be read-only. This tag type's simple memory size is only 48 bytes, but it can be extended to 2 Kbytes. The data transfer rate is 106 kbit/s.

Tag 3 Type

The Sony FeliCa system serves as the basis for the NFC Tag 3 Type. It currently has a memory space of 2 Kbytes and a data communication speed of 212 kbit/s. As a result, this NFC tag class is better suited for more complex applications, although at a higher cost per tag.

Tag 4 Type

The ISO14443A and B standards are supported by the NFC Tag 4 Form. These NFC tags are pre-configured at the factory and can be read/writeable or read-only. The memory space is up to 32 Kbytes, and the transmission speed ranges from 106 to 424 kbit/s.

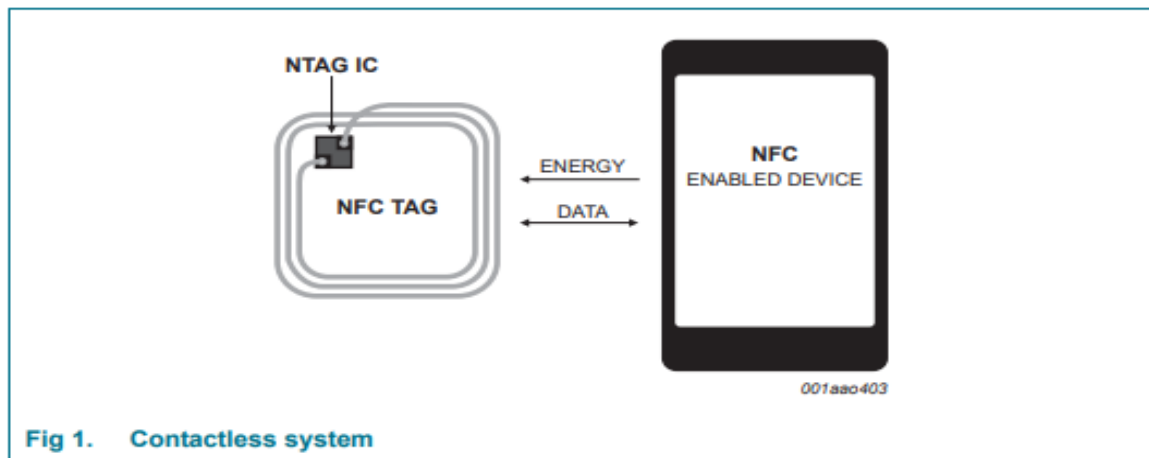


Figure 2.3.1 NFC Contactless System

As a conclusion, this project will be using a type 2 Tag which is Ntag21x and this is the most suitable NFC tags for this project. The memory size is from 48 Kbytes up to 1904 Kbytes. The unit price for this type of NFC tags is relatively low compare to others. The ISO14443A standard is also the mainstream standard now. In the other word, most of the smartphones that equipped with NFC tags are compatible with this NFC Tags. The transmission speed of 106 kbit/s is quite impressed also. (notes, 2021)

	Storage	Size	Working Frequency	Chips	Reading Distance	Erasing Life
White IC Cards		85.5x54mm	13.56MHz	S50	5-10cm	>100,000 times
NTAG 215	504 bytes	25mm diameter	13.56MHz	Ntag215	1-5cm	>100,000 times
NTAG 216	924 bytes	42mm x 26mm	14.5MHz	Nag216	1-10cm	100,000 times
NTAG 213	180 bytes	25mm diameter	13.56MHz	Ntag 213	1-10cm	100,000 times

Table 2.3.2 Comparison of NTAG21x

NTAG213, NTAG215 and NTAG216 have been developed as standard NFC tag to be used in retail, gaming and consumer electronics, in combination with NFC devices or NFC compliant Proximity Coupling Devices. The NTAG213, NTAG215 and NTAG216 are designed to fully according to NFC Type 2 Tag and ISO/IEC14443 Type A specifications.

The NTAG213, NTAG215 and NTAG216 are advanced in contactless transmission of data and supply energy. The frequency of operation is 13.56MHz. The operating distance is up to 1cm (depends). The NTAG213, NTAG215 and NTAG216 is suitable for voucher and coupons Bluetooth and Wi-Fi pairing and electronic labels.

As a conclusion, this project will be using NTAG215 as the media of the tracker. NTAG21x is a series of NFC tags that provide low cost and high performance in retail world. With the combination of the result of money manager research, this project will bring out a combination of tracking and money managing system which will give a new impression to user.

Chapter 3

System Methodology/Approach OR System Model

3.1 Methodology and General Work Procedures

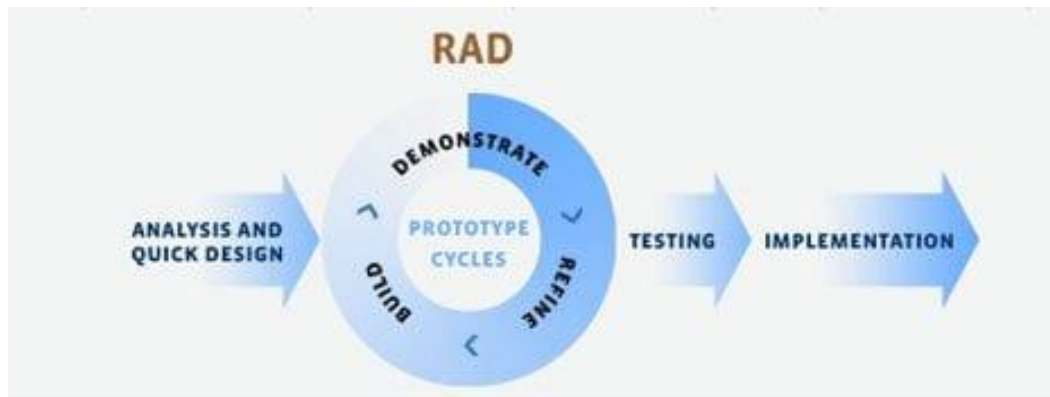


Figure 3.1.1 Rapid Application Development

I am using Rapid Application Development methodology in this project. Rapid application development (RAD) is an agile system development methodology which is quite popular in software development. It prioritizes prototyping and fast feedback over long-drawn-out development and testing cycles. The reason why I choose this methodology for my project is because it provides fast project turnaround, focus on the planning step and maximize on the prototype development step. RAD allows me to check for the progress of the project and communication accurately on evolving modification.

Besides, RAD also allows me break the project down into smaller, more manageable tasks so the flexibility and adaptability are what I need. Furthermore, it can boost the efficiency of the design as it gives regular communication between supervisor. It is providing higher productivity when the project is in charged by a small group of people.

Define the requirements

First of all, the first step is to do project planning. In order to deliver a good project, the project planning step has to be narrow down. In this phase, stakeholders and developers will determine the expectations and goals and also discuss about the potential problem for this project.

1. Prototype

Once first step was done, the second step is prototype. The developers are going to come out with a prototype with a minimum framework and essential function as a model to show to stakeholders to confirm that the final products direction. With the prototype, user can give some feedbacks and some suggestions to developers because this is design to user. Later then, developers will create the final product with the suggestion and correction which collected at the first of the prototype section.

2. Rapid Construction

At this step, enhancement and additional touch up from the feedbacks will be applied. Prototype is turning into the final retail product at this step. Most of the function are mature now and developers should only focus on debugging and touch up. The developers will continue polishing the final deliverable to the perfect situation.

3. Finalize Product

This is the last step of the Rapid Application Development. The project is finalized and ready to be launched. Stakeholders will review the last time for the final deliverable and make sure the functions and interface have no problem.

Pros and Cons of Rapid Application Development

Advantages	Disadvantages
It allows to change the requirements anytime.	Team with strong collaboration is required.
Encourages and priorities customer feedback.	large teams are hard for incorporation.
Reviews are received quickly.	Advanced skilled developers are required.
It greatly reduces the time in development.	The product requires user requirement at each of its life cycle.
Fewer people can produce more productivity.	Only appropriate for projects with small development time.
The time is short between prototypes and iterations.	Compared to other models, it will be more complex.
Integration is not a problem since it integrates from project inception.	Only systems that can be modularized can be developed using Rapid application development.

Table 3.1.1 Pros and Cons of Rapid Application Development

In this chapter, we present the background and motivation of our research, our contributions to the field and the outline of the thesis. In order to help human being to ease their life and solving their problem, we are going to design a portable and multifunction tracker which is suitable for kids and adults. This project will include 3 main functions which are money managing, tracking system and calculator. Besides, we are going to make sure the Graphic User Interface are in term of ease of use. User experience is always in the first place.

3.2 Tools to use

Integrated Development Environment (IDE)

An IDE, or Integrated Development Environment, enables programmers to consolidate the different aspects of writing a computer program. IDEs increase programmer productivity by combining common activities of writing software into a single application: editing source code, building executables, and debugging. (What Is an IDE? | Codecademy, 2021)



Figure 3.2.1 Android Studio

Android Studio is the first choice as the Integrated Development Environment. Android Studio is an application that developed and recommended by Google. It is an open source platform which means developers can speed up their develop speed. It is specialized to speed up the process for development of Android mobile application. It also enhanced the experience for developers.

Database

Database is where a system stores its data in cloud. The data can include user information, records and user data and history also user account. Data that stores in the database can be modified, read and write randomly. It allows developers to create their database by setting up a specified requirement. Database is useful and important as now applications are all connect with internet and a database can fulfill real-time database update which is almost immediately synced when the data was modified. With this advantage, developers are allowed to design a high-performance application to fulfill any requirement from user.

Name	Firestore Database	SQLite
Description	Cloud-hosted real time document store.	Widely used embeddable, in-process Relational Database Management System (RDBMS).
Primary database model	Document Store	DBMS
Cloud	Yes	No
Server operating systems	Hosted	Server-less
SQL Support	No	Yes
APIs	Android iOS REST API JavaScript API	Ado.Net JDBC ODBC
Programming languages supported	Objective-C Java JavaScript	C C# C++ Java JavaScript PHP PL/SQL Python
User concepts	Yes	No

Table 3.2.1 Comparison between Database Management

In this project, Firebase Realtime Database will be used. As mentioned as above, Firebase Realtime Data Base allows real-time update. The performance is the top one and when it is synchronized data between platforms and devices, the speed is almost immediately. Realtime Database is essentially a NoSQL cloud-storage that can be connected with the application to provide real time access to the data across different platforms. One of the advantages is that the database can work offline, caching the data in device memory, and after reconnecting to the internet, synchronizing it. (The Good and the Bad of Firebase Backend Services, 2021)

Authentication

For the authentication, this project will prefer to use Firebase authentication. Inside the Firebase Authentication, there are options like Google sign-in authentication, Facebook Authentication, and custom authentication.

Operating System

To develop this project in Android Studio, a Windows OS is selected. Windows is suitable for most of the application and software in the world. There is more developer using Windows as their operating system so when there is any problem occurred, developers can get a help at the very short time.

Programming Language

Programming language is as important as hardware. With programming language, hardware is not able to communicate and function. There are many programming languages in the world but only two are allow to be used in Android Studio which are Java and Kotlin.



Figure 3.2.2 Java

Java is the most famous and most used programming language in the world. It is a powerful programming language when compared with the C++ and others. It is the best programming language that suitable for Android Studio.



Figure 3.2.3 Kotlin

Kotlin is a free, open source, programming language that designed for the JVM (Java Virtual Machine) and Android that combines object-oriented and functional programming features. The Kotlin team currently has more than 90 full-time members from JetBrains, and the Kotlin project on GitHub has more than 300 contributors. JetBrains uses Kotlin in many of its products including its flagship IntelliJ IDEA. (Heller, 2021)

Name	Firestore Realtime Database	SQLite
Description	Cloud-hosted real time document store.	Widely used embeddable, in-process Relational Database Management System (RDBMS).
Primary database model	Document Store	DBMS
Cloud	Yes	No
Server operating systems	Hosted	Server-less
SQL Support	No	Yes
APIs	Android iOS REST API JavaScript API	Ado.Net JDBC ODBC
Programming languages supported	Objective-C Java JavaScript	C C# C++ Java JavaScript PHP PL/SQL Python
User concepts	Yes	No

Table 3.2.2 Comparison Between Firestore and SQLite

According to Table 3.2, the Firestore Realtime Database is more suitable for this project. As this project is going to become a cloud data-based application, Firestore Realtime Database provides a better service and supporting Java language.

Personal Computer

The minimum requirement of the personal computer is listed as below:

1. Operating System

Microsoft® Windows® 7/8/10 (64-bit)

2. Processor

AMD Ryzen R3 1200 or relevant

3. Memory

Minimum 4GB RAM, Recommended 8GB RAM

4. Screen Resolution of Monitor

1200 x 800 pixel

5. Keyboard and mouse

3.3 System Design

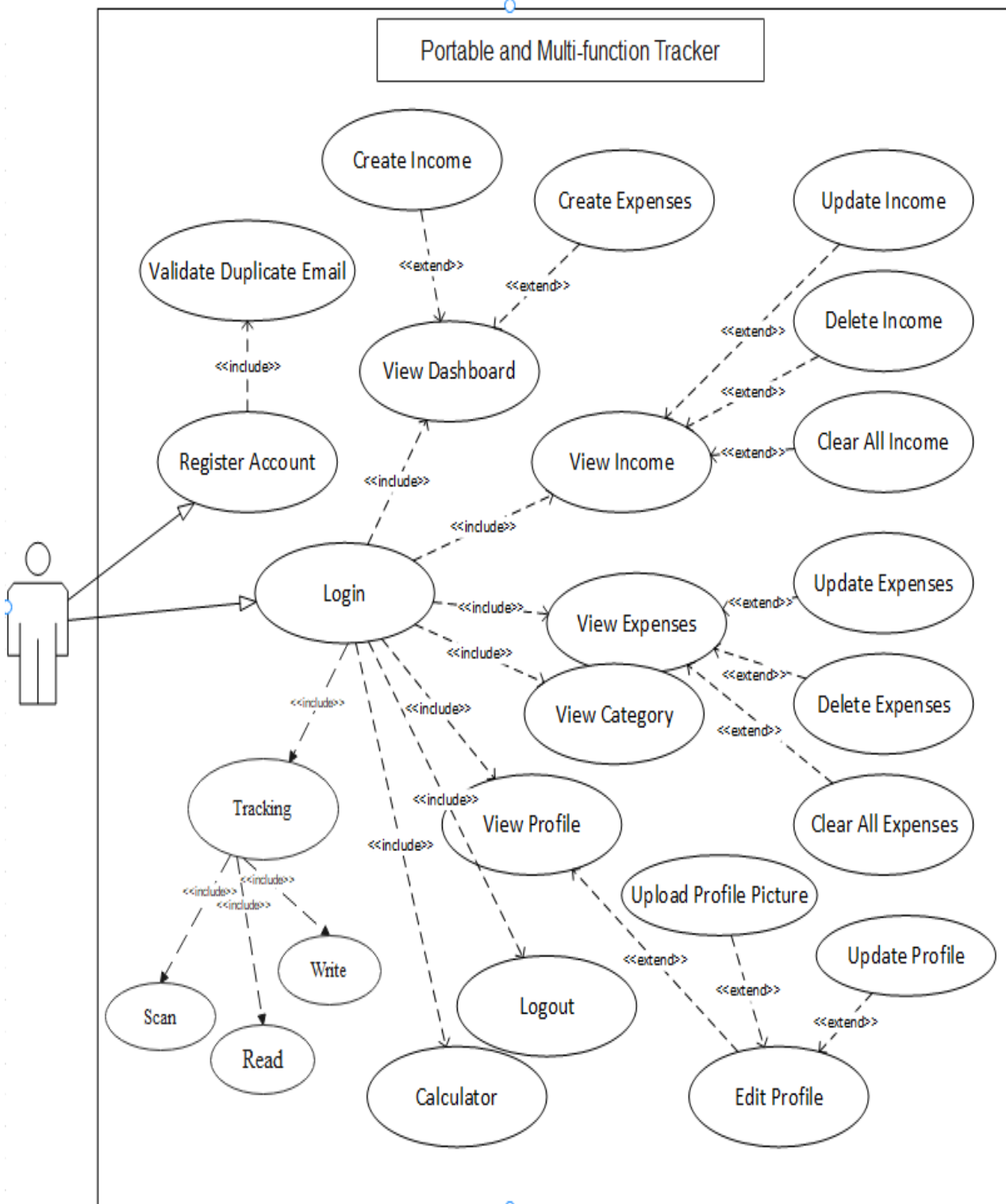


Figure 3.3.1 Use Case Diagram

Use Case Name	Login
Summary Description	To enable the user to login into the app
Actors	User
Pre-Condition	Valid email and password
Post Condition	Login successfully
Main Flow	<ol style="list-style-type: none"> 1. Enter email and password 2. Click Login Button 3. The actor logged in to the system and redirect to the dashboard
Alternative Flow	The error message will be displayed if the text field is empty or the details entered are wrong
Priority	High

Table 3.3.2 Login Use Case

Use Case Name	Register
Summary Description	To enable the user to register an account of the app
Actors	User
Pre-Condition	Valid username, Unique email, phone number, and password
Post Condition	User-created successfully
Main Flow	<ol style="list-style-type: none"> 1. Enter full name, email, phone number, and password 2. Click Register Button 3. The new user is created successfully and ready to redirect to the dashboard page
Alternative Flow	The error message will be displayed if the textbox is empty or the details entered are in a bad format.
Priority	High

Table 3.3.3 Register Use Case

Use Case Name	View Dashboard
Summary Description	To enable the user to view the current status of incomes and expenses in the dashboard
Actors	User
Pre-Condition	There are incomes and expenses stored in the database
Post Condition	Incomes and expenses retrieved and displayed successfully
Main Flow	1. Press the Dashboard Button at the bottom menu
Alternative Flow	-
Priority	High

Table 3.3.4 Dashboard Use Case

Use Case Name	Create Income
Summary Description	To enable the user to create the income
Actors	User
Pre-Condition	Category Type, Amount, Notes
Post Condition	Income has been added successfully
Main Flow	<ol style="list-style-type: none"> 1. Click Add Button 2. Select Category Type from Income Category 3. Enter Amount and Notes 4. Click Save Button
Alternative Flow	The error message will be displayed if the text field is empty.
Priority	High

Table 3.3.5 Create Income Use Case

Use Case Name	Create Expenses
Summary Description	To enable the user to create the expenses
Actors	User
Pre-Condition	Category Type, Amount, Notes
Post Condition	Expenses have been added successfully
Main Flow	<ol style="list-style-type: none"> 1. Click Add Button 2. Select Category Type from Expenses Category 3. Enter Amount and Notes 4. Click Save Button
Alternative Flow	The error message will be displayed if the text field is empty
Priority	High

Table 3.3.6 Create Expenses Use Case

Use Case Name	View Income
Summary Description	To enable the user to view the created income
Actors	User
Pre-Condition	There is income stored in the database
Post Condition	Income retrieved and displayed successfully
Main Flow	<ol style="list-style-type: none"> 1. Press the Income Button at the bottom menu
Alternative Flow	-
Priority	High

Table 3.3.7 View Income Use Case

Use Case Name	Update Income
u	To enable the user to edit and update the income
Actors	User
Pre-Condition	-
Post Condition	Income has been updated successfully
Main Flow	<ol style="list-style-type: none"> 1. Select the target income from the table list to edit 2. Change the Category Type, Amount, or Notes. 3. Click the Save Button
Alternative Flow	-
Priority	High

Table 3.3.8 Update Income Use Case

Use Case Name	Delete Income
Summary Description	To enable the user to delete the created income
Actors	User
Pre-Condition	-
Post Condition	Income has been deleted successfully
Main Flow	<ol style="list-style-type: none"> 1. Select the target income from the table list to delete 2. Click the Delete Button
Alternative Flow	-
Priority	High

Table 3.3.9 Delete Income Use Case

Use Case Name	Clear All Income
Summary Description	To enable the user to clear all the income at one click
Actors	User
Pre-Condition	-
Post Condition	All income has been deleted successfully
Main Flow	1. Click the Clear All Button
Alternative Flow	-
Priority	High

Table 3.3.10 Clear All Income Use Case

Use Case Name	View Expenses
Summary Description	To enable the user to view the created expenses
Actors	User
Pre-Condition	There are expenses stored in the database
Post Condition	Expenses retrieved and displayed successfully
Main Flow	1. Press the - button at the bottom menu
Alternative Flow	-
Priority	High

Table 3.3.11 View Expenses Use Case

Use Case Name	Update Expenses
Summary Description	To enable the user to edit and update the expenses
Actors	User
Pre-Condition	-
Post Condition	Expenses have been updated successfully
Main Flow	<ol style="list-style-type: none"> 1. Select the target expenses from the table list to edit 2. Change the Category Type, Amount, or Notes. 3. Click the Save Button
Alternative Flow	-
Priority	High

Table 3.3.12 Update Expenses Use Case

Use Case Name	Delete Expenses
Summary Description	To enable the user to delete the created expenses
Actors	User
Pre-Condition	-
Post Condition	Expenses have been deleted successfully
Main Flow	<ol style="list-style-type: none"> 1. Select the target expenses from the table list to delete 2. Click the Delete Button
Alternative Flow	-
Priority	High

Table 3.3.13 Delete Expenses Use Case

Use Case Name	Clear All Expenses
Summary Description	To enable the user to clear all the expenses at one click
Actors	User
Pre-Condition	-
Post Condition	All expenses have been deleted successfully
Main Flow	1. Click the Clear All Button
Alternative Flow	-
Priority	High

Table 3.3.14 Clear All Expenses Use Case

Use Case Name	Calculator
Summary Description	To enable the user to do some simple calculations
Actors	User
Pre-Condition	User must log in to the application
Post Condition	User can use the calculator to process some calculations
Main Flow	1. Select Calculator from the submenu list
Alternative Flow	-
Priority	Low

Table 3.3.15 Calculator Use Case

Use Case Name	View Category
Summary Description	To enable the user to view the default category provided
Actors	User
Pre-Condition	User must log in to the application
Post Condition	The category is showed successfully
Main Flow	1. Select Category from the submenu list
Alternative Flow	-
Priority	Medium

Table 3.3.16 View Category Use Case

Use Case Name	Upload Profile Picture
Summary Description	To enable the user to upload their profile picture
Actors	User
Pre-Condition	User must log in to the application
Post Condition	Images uploaded successfully
Main Flow	1. Click the images from the Edit Profile Page 2. Select the images to be uploaded
Alternative Flow	-
Priority	Medium

Table 3.3.17 Upload Profile Use Case

Use Case Name	View Profile
Summary Description	To enable the user to view the profile information
Actors	User
Pre-Condition	User must log in to the application
Post Condition	The name, email, and phone number of the user is displayed successfully
Main Flow	1. Select Profile from the submenu list
Alternative Flow	-
Priority	Medium

Table 3.3.18 View Profile Use Case

Use Case Name	Logout
Summary Description	To enable the user to log out of the application
Actors	User
Pre-Condition	User must log in to the application
Post Condition	The user logged out successfully
Main Flow	1. Select Logout from the submenu list
Alternative Flow	-
Priority	High

Table 3.3.19 Logout Use Case

Use Case Name	Edit/Update Profile
Summary Description	To enable the user to edit and update the profile information
Actors	User
Pre-Condition	User must log in to the application
Post Condition	Profile updated successfully
Main Flow	<ol style="list-style-type: none"> 1. Press Edit Button from Profile Page 2. Change the username or phone number 3. Press Save Button
Alternative Flow	-
Priority	Medium

Table 3.3.20 Edit/ Update Profile Use Case

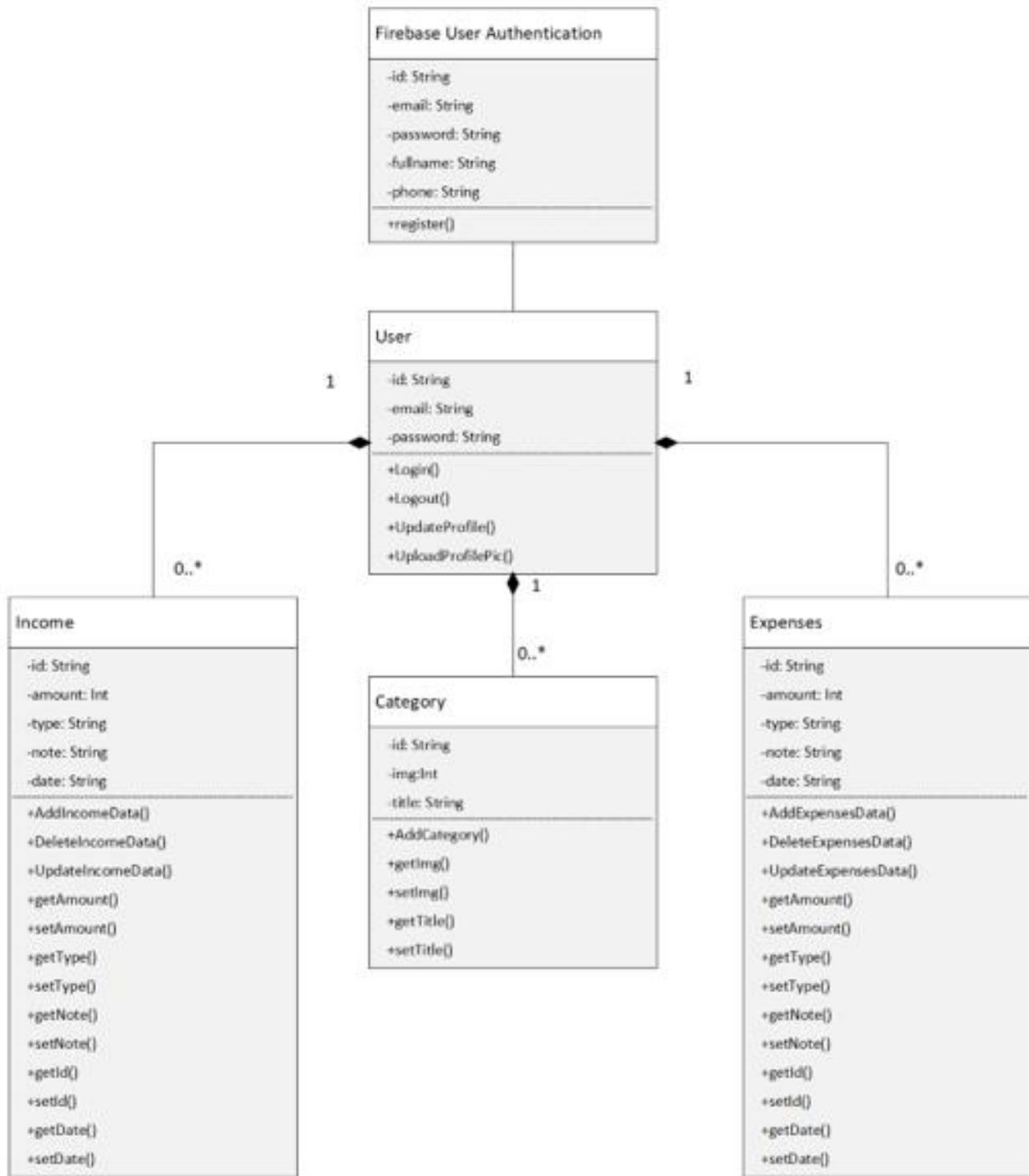


Figure 3.3.2 Class Diagram

3.4 Implementation Issues and Challenges

The biggest challenge in this project is the new IDE (Android Studio). Developers are not familiar with this IDE before. It could be a challenge to develop this project in a totally new IDE. Time consuming to get familiar with the Android Studio means the progress will be delayed. Besides, this is the first time develop a mobile application. Developers have no idea and logic how does it works. Developers need to spend some time to watch some tutorial in order to develop the deliverable.

3.5 Timeline

TASK	START DATE	END DATE	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
UI POLISH	7/6/2021	14/6/2021										
CREATE API FOR TRACKER SYSTEM	14/6/2021	28/6/2021										
ADD IN API	28/6/2021	26/7/2021										
IMPLEMENTATION	26/7/2021	8/8/2021										
TOUCH UP	8/8/2021	17/8/2021										

Table 3.5.1 Timeline

For next semester, the schedule are as the Table 3.5.1. This project should be completed by the timeline given.

Chapter 4

Questionnaire/ Improvement

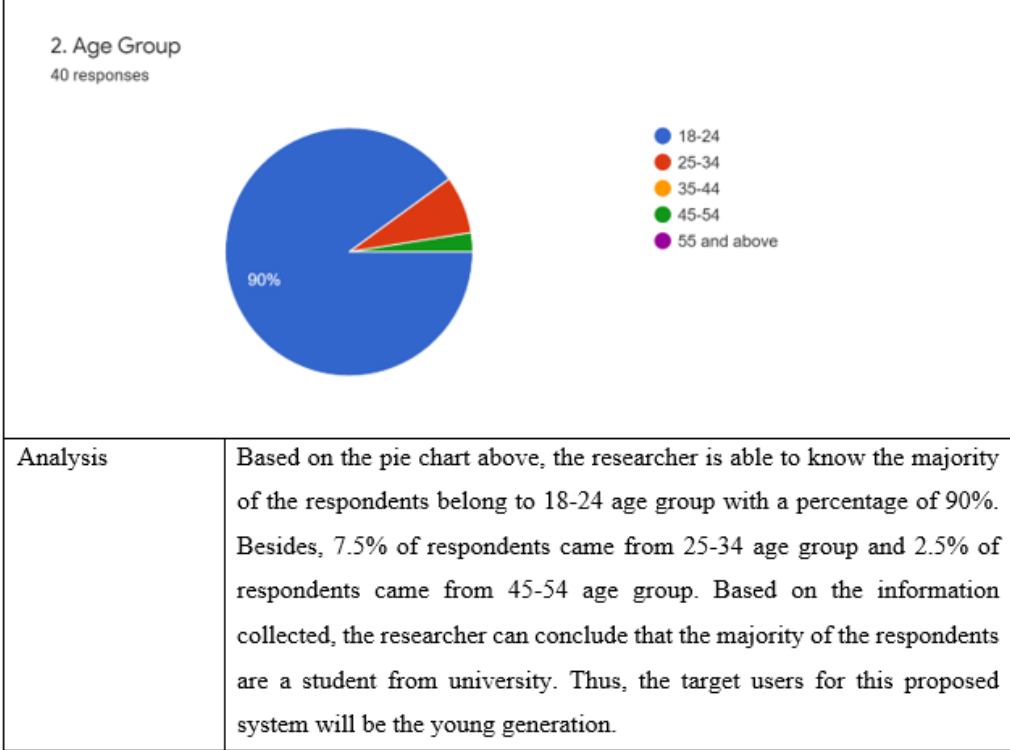


Figure 4.1.1 Questionnaires for Age

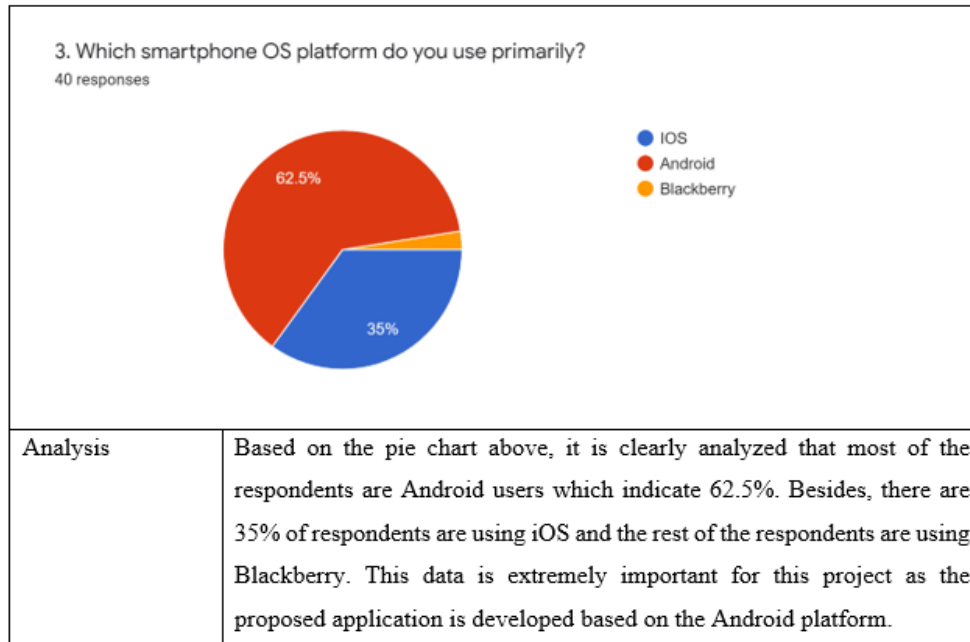


Figure 4.1.2 Questionaries for Smartphones Operation System

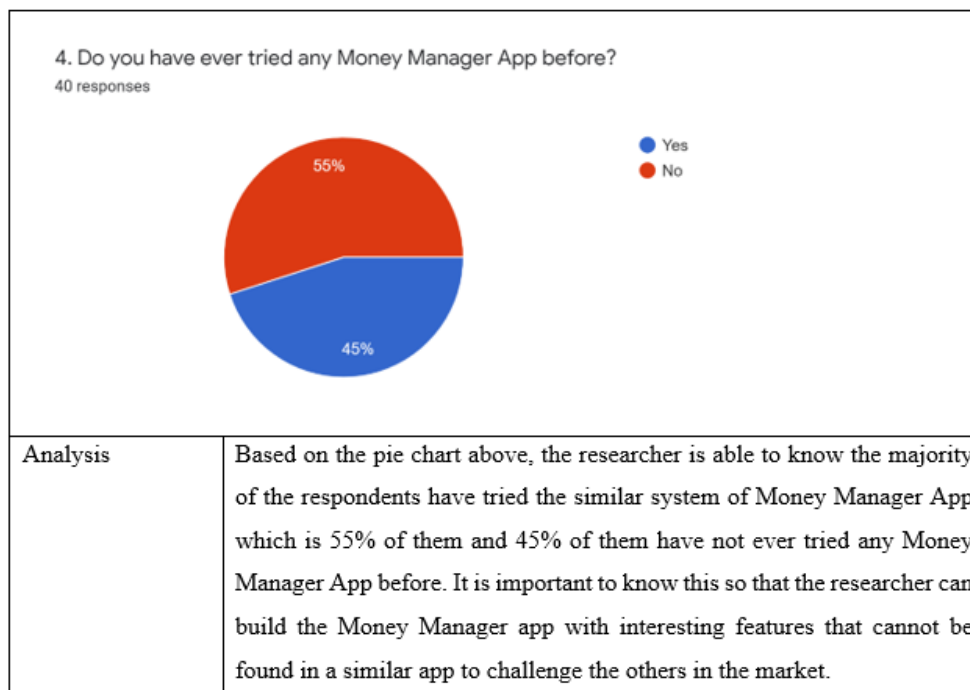


Figure 4.1.3 Questionaries for money app experience

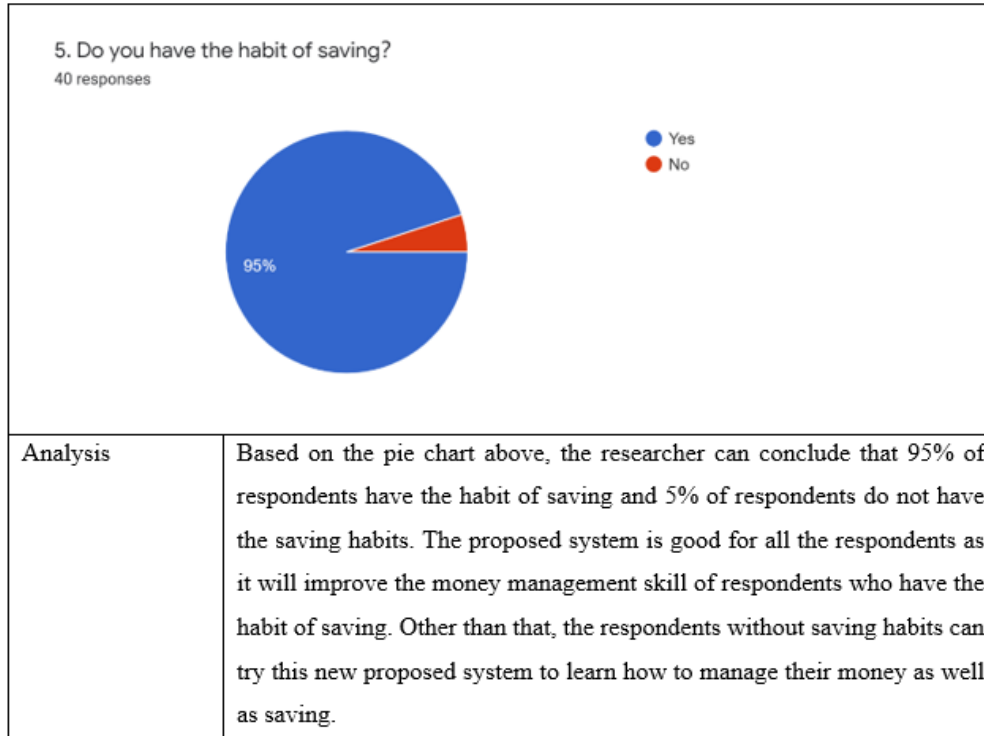


Figure 4.1.4 Questionnaires for saving habits

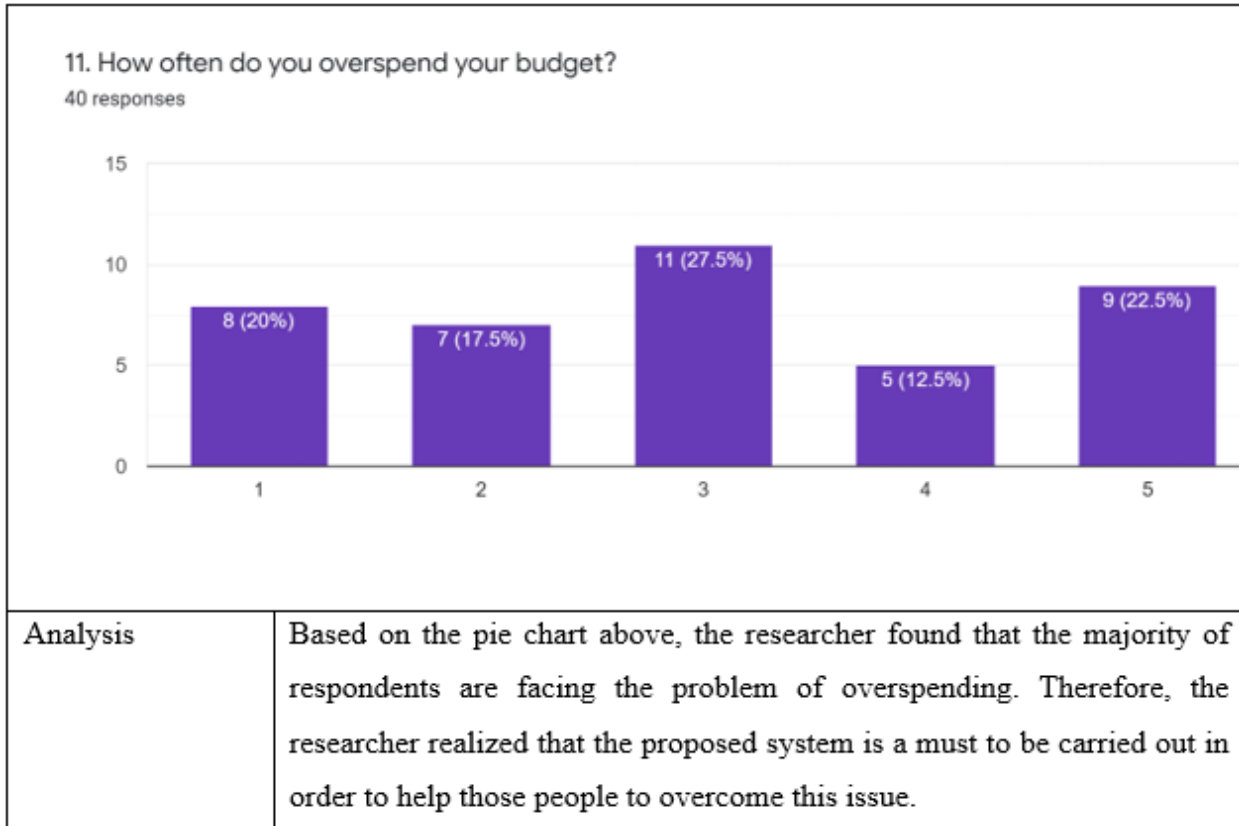


Figure 4.1.5 Questionnaires for budget overspent

Chapter 5

System Implementation and Testing

System implementation

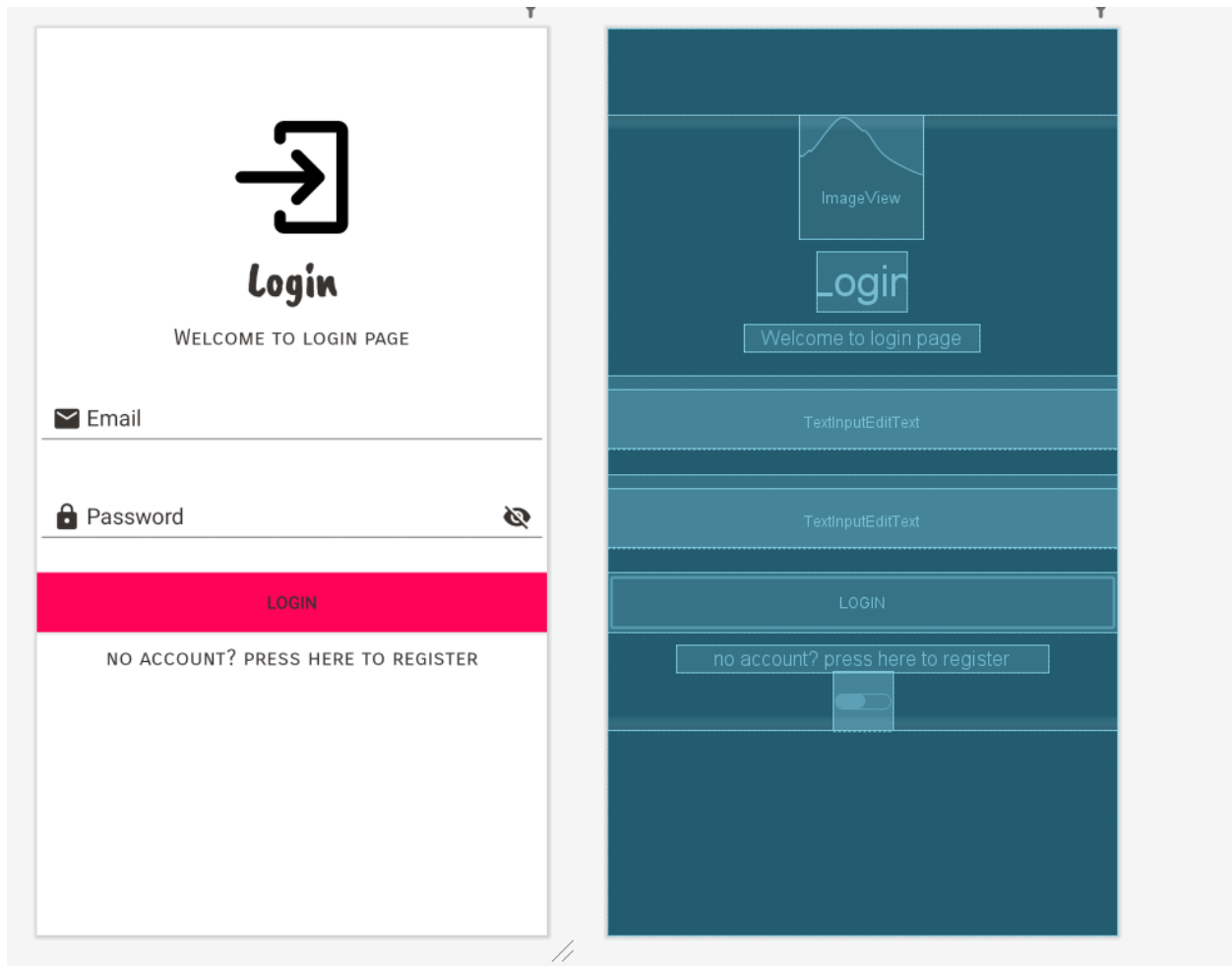


Figure 5.1 Login Page GUI

```

if(fa.getCurrentUser() != null) {
    startActivity(new Intent(getApplicationContext(), HomeActivity.class));
    finish();
}

btnLogin.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {

        String email = etEmail.getText().toString();
        String password = etPassword.getText().toString();
        if(TextUtils.isEmpty(email)){
            etEmail.setError("Email is Required!!");
            return;
        }
        if(TextUtils.isEmpty(password)){
            etPassword.setError("Password is Required!!");
            return;
        }
        if(password.length() < 6){
            etPassword.setError("Password invalid! Please try again!");
            return;
        }
        pbProgressBar.setVisibility(View.VISIBLE);
        //authenticate the user
        fa.signInWithEmailAndPassword(email,password).addOnCompleteListener(new OnCompleteListener<AuthResult>() {
            @Override
            public void onComplete(@NonNull Task<AuthResult> task) {
                if(task.isSuccessful()){
                    Toast.makeText( context: Login.this, text: "Login Successfully", Toast.LENGTH_SHORT).show();
                    startActivity(new Intent(getApplicationContext(),HomeActivity.class));
                }else{
                    Toast.makeText( context: Login.this, text: "Wrong password! Please try again!" +task.getException().getMessage(), Toast.LENGTH_SHORT).show();
                    pbProgressBar.setVisibility(View.GONE);
                }
            }
        });
    }
});

tvRegister.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        startActivity(new Intent(getApplicationContext(), Register.class));
    }
});

```

Figure 5.2 Login Page Source Code

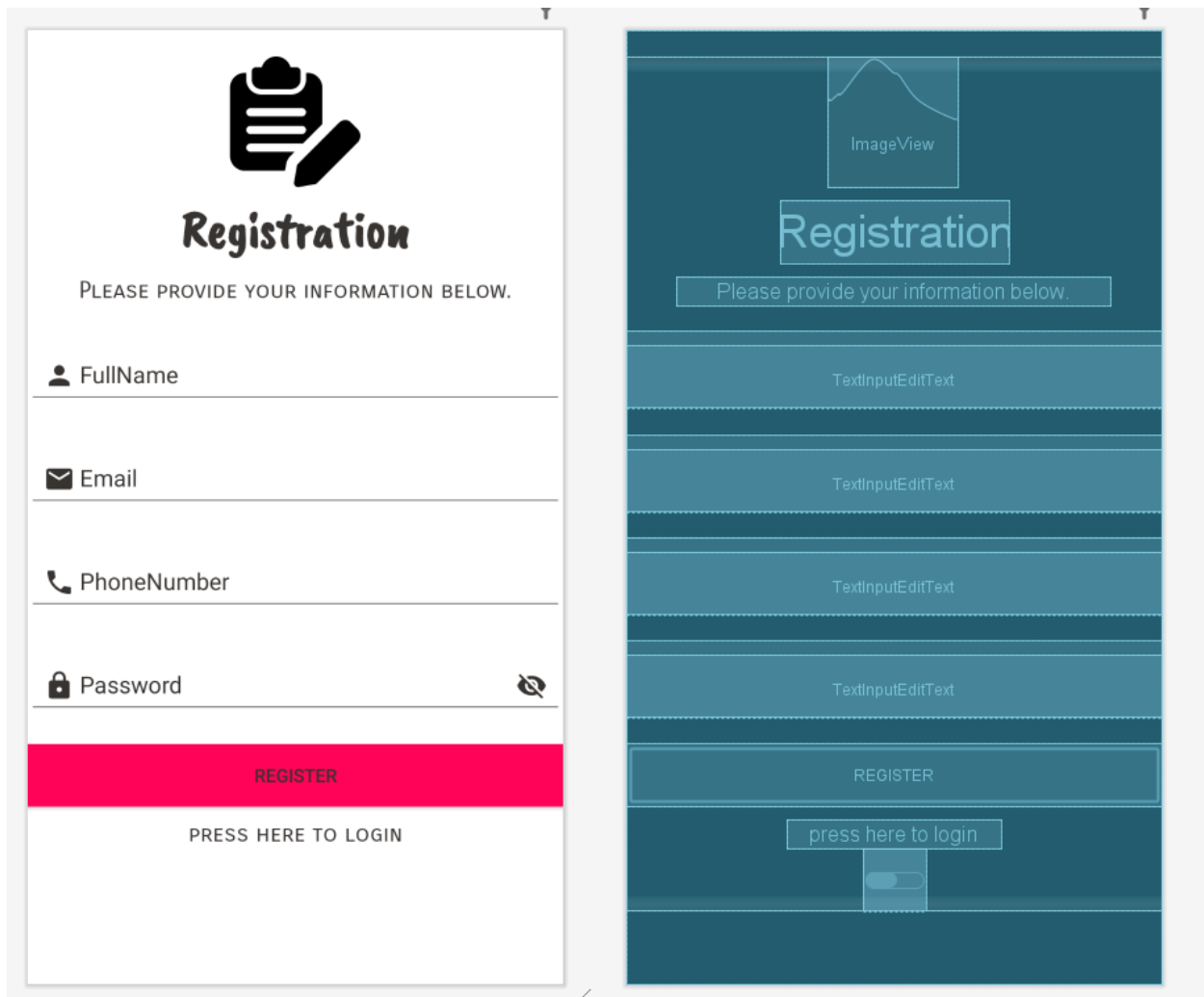


Figure 5.3 Part of Register Page GUI

```

btnRegister.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        String email = etEmail.getText().toString();
        String password = etPassword.getText().toString();
        String fullName = etName.getText().toString();
        String phone = etPhone.getText().toString();

        if(TextUtils.isEmpty(email)){
            etEmail.setError("Email is Required!!");
            return;
        }
        if(TextUtils.isEmpty(fullName)){
            etName.setError("Name is Required!!");
            return;
        }
        if(TextUtils.isEmpty(phone)){
            etPhone.setError("Phone Number is Required!!");
            return;
        }

        if(TextUtils.isEmpty(password)){
            etPassword.setError("Password is Required!!");
            return;
        }

        if(password.length() < 6){
            etPassword.setError("Password must more than five characters!!");
            return;
        }

        pbProgressBar.setVisibility(View.VISIBLE);
        // TO REGISTER THE USER INTO THE FIREBASE
        fa.createUserWithEmailAndPassword(email,password).addOnCompleteListener(new OnCompleteListener<AuthResult>() {
            @Override
            public void onComplete(@NonNull Task<AuthResult> task) {
                if(task.isSuccessful()){
                    Toast.makeText(context, Register.this, text: "User was successfully created!", Toast.LENGTH_SHORT).show();
                    userID = fa.getCurrentUser().getUid();
                    DocumentReference documentReference = fStore.collection(collectionPath: "users").document(userID);
                    final HashMap<String, Object> user = new HashMap<>();
                    user.put("fullname", fullName);
                    user.put("email", email);
                    user.put("phone", phone);
                    documentReference.set(user).addOnSuccessListener(new OnSuccessListener<Void>() {
                        @Override

```

Figure 5.4 Part of Register Page Source Code



Figure 5.5 Dashboard GUI

```

/.../

package my.utar.kampar.MultifunctionTracker.Fragment;

import ...

public class DashBoardFragment extends Fragment {

    //Floating button
    private FloatingActionButton fab_main_btn;
    private FloatingActionButton fab_income_btn;
    private FloatingActionButton fab_expense_btn;
    //Floating button TextView
    private TextView fab_income_text;
    private TextView fab_expense_text;
    //Boolean for floating button
    private boolean isOpen=false;
    //Animation
    private Animation FadeOpen,FadeClose;
    //Dashboard income and expense
    private TextView totalIncomeResult;
    private TextView totalExpenseResult;
    private TextView totalBalanceResult;
    //Firebase
    private FirebaseAuth fa;
    private DatabaseReference IncomeDatabase;
    private DatabaseReference ExpenseDatabase;
    private DatabaseReference Database;
    private String currentUserID;
    //Recycler view
    private RecyclerView RecyclerIncome;
    private RecyclerView RecyclerExpense;
    public static final String TAG = "ERROR";
    private Button btnback;

    @Override
    public View onCreateView(LayoutInflater inflater, ViewGroup container,
        Bundle savedInstanceState) {

        View myview= inflater.inflate(R.layout.fragment_dash_board, container, attachToRoot: false);
        //firebase
        fa= FirebaseAuth.getInstance();
        currentUserID = fa.getCurrentUser().getUid();

        ExpenseDatabase= FirebaseDatabase.getInstance().getReference().child("ExpenseData").child(currentUserID);
    }
}

```

Figure 5.6.1 Part of Dashboard Source Code

```

//Connect floating button to layout
fab_main_btn= myview.findViewById(R.id.fb_main_plus_btn);
btnback = myview.findViewById(R.id.btnBack);

//Total income and expense result
totalIncomeResult = myview.findViewById(R.id.income_set_result);
totalExpenseResult = myview.findViewById(R.id.expense_set_result);

//Recycle
RecyclerIncome = myview.findViewById(R.id.recycler_income);
RecyclerExpense = myview.findViewById(R.id.recycler_expense);

//Balance
totalBalanceResult = myview.findViewById(R.id.balance_set_result);

fab_main_btn.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        startActivity(new Intent(getContext(), AddActivity.class));
    }
});

IncomeDatabase= FirebaseDatabase.getInstance().getReference().child("IncomesData").child(currentUserID);
//Calculate total income..
IncomeDatabase.addValueEventListener(new ValueEventListener() {
    @Override
    public void onDataChange(@NonNull DataSnapshot snapshot) {
        int totalsum = 0;
        for(DataSnapshot mysnap:snapshot.getChildren()){
            ModelData modeldata = mysnap.getValue(ModelData.class);
            totalsum+=modeldata.getAmount();
            String stResult = String.valueOf(totalsum);
            totalIncomeResult.setText("RM"+stResult+".00");
        }
    }
    @Override
    public void onCancelled(@NonNull DatabaseError error) {
    }
});

//Calculate total expense..
ExpenseDatabase.addValueEventListener(new ValueEventListener() {
    @Override

```

Figure 5.6.2 Part of Dashboard Source Code


```

//Calculate total expense..
ExpenseDatabase.addValueEventListener(new ValueEventListener() {
    @Override
    public void onDataChange(@NonNull DataSnapshot snapshot) {

        int totalsum = 0;
        for(DataSnapshot mysnap:snapshot.getChildren()){
            ModelData modeldata = mysnap.getValue(ModelData.class);
            totalsum+=modeldata.getAmount();
            String stResult = String.valueOf(totalsum);
            totalExpenseResult.setText("RM"+stResult+".00");
        }
    }

    @Override
    public void onCancelled(@NonNull DatabaseError error) {
    }
});

Database= FirebaseDatabase.getInstance().getReference();
Database.addValueEventListener(new ValueEventListener() {
    @Override
    public void onDataChange(@NonNull DataSnapshot snapshot) {
        final int[] totalsum1 = {0};
        Database.child("ExpenseData").child(currentUserID).addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot snapshot) {
                for (DataSnapshot mysnap : snapshot.getChildren()) {
                    ModelData modeldata1 = mysnap.getValue(ModelData.class);
                    totalsum1[0] += modeldata1.getAmount();
                    String stResult1 = String.valueOf(totalsum1[0]);
                    totalBalanceResult.setText("RM-" + stResult1 + ".00");
                }
            }
            @Override
            public void onCancelled(@NonNull DatabaseError error) { }
        });
        Database.child("IncomesData").child(currentUserID).addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot snapshot) {
                int totalsum2 = 0;
                int totalsumall =0;
                for (DataSnapshot mysnap : snapshot.getChildren()) {
                    ModelData modeldata2 = mysnap.getValue(ModelData.class);
                    totalsum2 += modeldata2.getAmount();

```

Figure 5.6.3 Part of Dashboard Source Code

```

        String stResult2 = String.valueOf(totalsum2);
        totalsumall = totalsum2 - totalsum1[0];
        totalBalanceResult.setText("RM" + totalsumall + ".00");
    }
}
@Override
public void onCancelled(@NonNull DatabaseError error) { }
});
}

@Override
public void onCancelled(@NonNull DatabaseError error) { }
});

//Recycler
LinearLayoutManager layoutManagerIncome = new LinearLayoutManager(getActivity(),LinearLayoutManager.HORIZONTAL, reverseLayout: false);
layoutManagerIncome.setStackFromEnd(true);
layoutManagerIncome.setReverseLayout(true);
RecyclerViewIncome.setHasFixedSize(true);
RecyclerViewIncome.setLayoutManager(layoutManagerIncome);
LinearLayoutManager layoutManagerExpense = new LinearLayoutManager(getActivity(),LinearLayoutManager.HORIZONTAL, reverseLayout: false);
layoutManagerExpense.setStackFromEnd(true);
layoutManagerExpense.setReverseLayout(true);
RecyclerViewExpense.setHasFixedSize(true);
RecyclerViewExpense.setLayoutManager(layoutManagerExpense);

return myview;
}

@Override
public void onStart() {
    super.onStart();
    //Recycler Income
    FirebaseRecyclerOptions options =
        new FirebaseRecyclerOptions.Builder<ModelData>()
            .setQuery(IncomeDatabase, ModelData.class)
            .build();
    FirebaseRecyclerAdapter<ModelData, MyViewHolder> adapter
        = new FirebaseRecyclerAdapter<>(options) {
        @Override
        protected void onBindViewHolder(@NonNull final MyViewHolder holder, final int position, @NonNull final ModelData modelData) {
            currentUserID = getRef(position).getKey();
            IncomeDatabase.child(currentUserID).addValueEventListener(new ValueEventListener() {
                @Override
                public void onDataChange(@NonNull DataSnapshot dataSnapshot) {
                    if (dataSnapshot.exists()) {

```

Figure 5.6.4 Part of Dashboard Source Code

```

        if (dataSnapshot.exists()) {
            String amount = dataSnapshot.child("amount").getValue().toString();
            String date = dataSnapshot.child("date").getValue().toString();
            String type = dataSnapshot.child("type").getValue().toString();
            holder.amount.setText("RM " + amount);
            holder.date.setText(date);
            holder.type.setText(type);
        }
    }
    @Override
    public void onCancelled(@NonNull DatabaseError error) {
    }
}
);
}
@NonNull
@Override
public MyViewHolder onCreateViewHolder(@NonNull ViewGroup viewGroup, int viewType) {
    View view = LayoutInflater.from(viewGroup.getContext()).inflate(R.layout.dashboard_income, viewGroup, attachToRoot: false);
    MyViewHolder viewHolder = new MyViewHolder(view);
    return viewHolder;
}
};
RecyclerIncome.setAdapter(adapter);
adapter.startListening();

//Recycler Expense
FirebaseRecyclerOptions options2 =
    new FirebaseRecyclerOptions.Builder<ModelData>()
        .setQuery(ExpenseDatabase, ModelData.class)
        .build();

FirebaseRecyclerAdapter<ModelData, MyViewHolder2> adapter2
    = new FirebaseRecyclerAdapter<>(options2) {
    @Override
    protected void onBindViewHolder(@NonNull final MyViewHolder2 holder, final int position, @NonNull final ModelData ModelData) {
        currentUserID = getRef(position).getKey();
        ExpenseDatabase.child(currentUserID).addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot dataSnapshot) {
                if (dataSnapshot.exists()) {
                    String amount = dataSnapshot.child("amount").getValue().toString();
                    String date = dataSnapshot.child("date").getValue().toString();
                    String type = dataSnapshot.child("type").getValue().toString();
                }
            }
        });
    }
};

```

Figure 5.6.5 Part of Dashboard Source Code

```

        holder.amount.setText("RM " + amount);
        holder.date.setText(date);
        holder.type.setText(type);
    }
}
@Override
public void onCancelled(@NonNull DatabaseError error) {
}
});
}

@NonNull
@Override
public MyViewHolder2 onCreateViewHolder(@NonNull ViewGroup viewGroup, int viewType) {
    View view = LayoutInflater.from(viewGroup.getContext()).inflate(R.layout.dashboard_expense, viewGroup, attachToRoot: false);
    MyViewHolder2 viewHolder = new MyViewHolder2(view);
    return viewHolder;
}
};
RecyclerExpense.setAdapter(adapter2);
adapter2.startListening();
}

public static class MyViewHolder extends RecyclerView.ViewHolder {
    TextView amount;
    TextView date;
    TextView type;

    public MyViewHolder(@NonNull View itemView) {
        super(itemView);
        amount = itemView.findViewById(R.id.amount_income_ds);
        date = itemView.findViewById(R.id.date_income_ds);
        type = itemView.findViewById(R.id.type_income_ds);
    }
}

public static class MyViewHolder2 extends RecyclerView.ViewHolder {

    TextView amount;
    TextView date;
    TextView type;

    public MyViewHolder2(@NonNull View itemView) {

```

Figure 5.6.6 Part of Dashboard Source Code

```
public MyViewHolder2(@NonNull View itemView) {  
    super(itemView);  
    amount = itemView.findViewById(R.id.amount_expense_ds);  
    date = itemView.findViewById(R.id.date_expense_ds);  
    type = itemView.findViewById(R.id.type_expense_ds);  
}  
}
```

Figure 5.6.7 Part of Dashboard Source Code

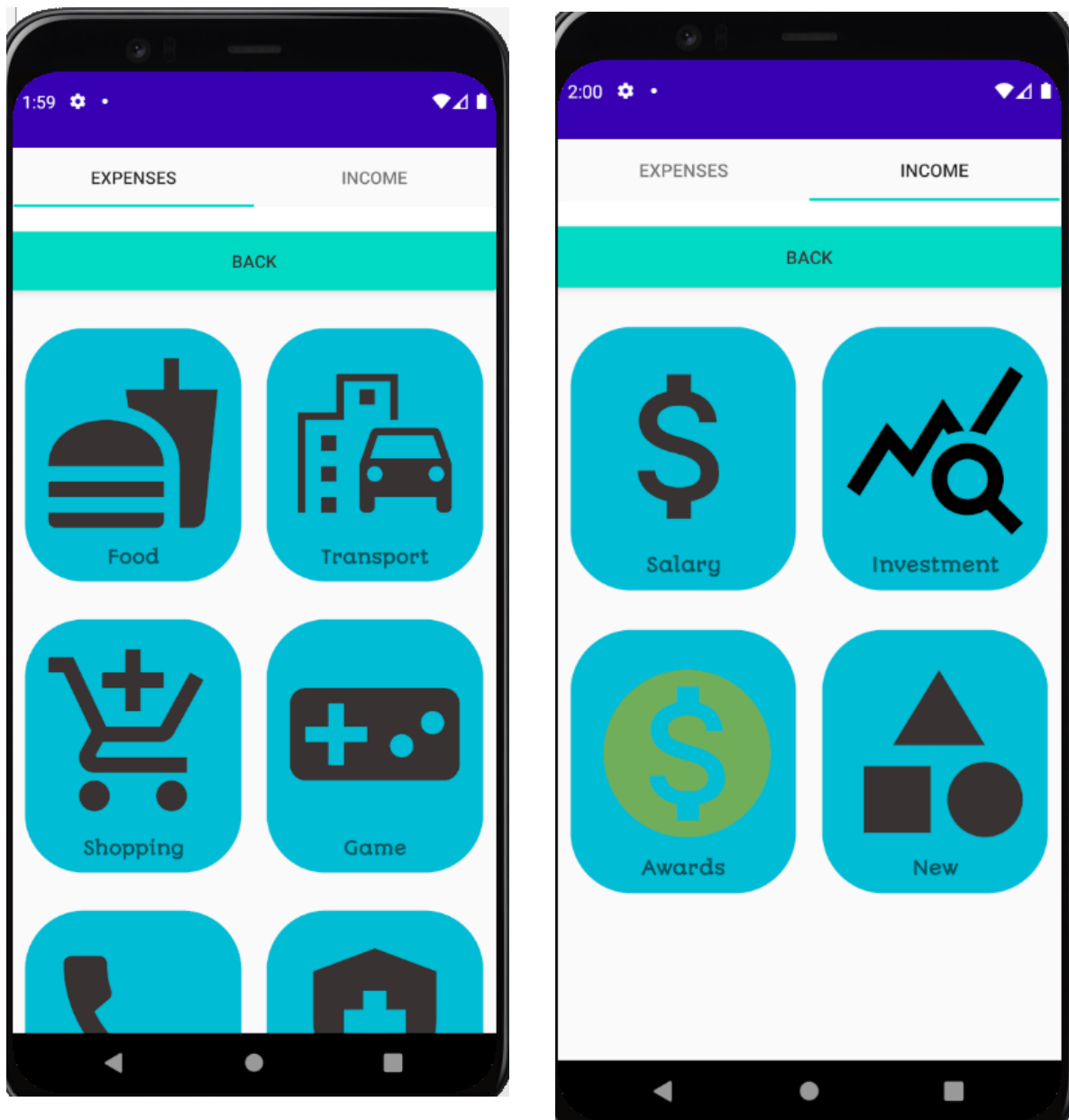


Figure 5.7 Part of add activity GUI

```

/.../

package my.utar.kampar.MultifunctionTracker.Activity;

import ...

public class AddActivity extends AppCompatActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_add);
        TabLayout tabLayout = findViewById(R.id.tabBar);
        TabItem tabExpenses = findViewById(R.id.tabExpenses);
        TabItem tabIncome = findViewById(R.id.tabIncome);
        ViewPager viewPager = findViewById(R.id.viewPager);
        AddPagerAdapter addPagerAdapter = new AddPagerAdapter(getSupportFragmentManager(), tabLayout.getTabCount());
        viewPager.setAdapter(addPagerAdapter);

        tabLayout.addTabSelectedListener(new TabLayout.OnTabSelectedListener() {
            @Override
            public void onTabSelected(TabLayout.Tab tab) {
                viewPager.setCurrentItem(tab.getPosition());
            }

            @Override
            public void onTabUnselected(TabLayout.Tab tab) {
            }

            @Override
            public void onTabReselected(TabLayout.Tab tab) {
            }
        });
    }
}

```

Figure 5.8 Part of add activity source code

```

/.../

package my.utar.kampar.MultifunctionTracker.Activity;

import ...

public class StartActivity extends AppCompatActivity {

    private ImageView iconImage;
    private LinearLayout linearLayout;
    private Button register;
    private Button login;
    FirebaseAuth fa;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_start);

        iconImage = findViewById(R.id.icon_image);
        linearLayout = findViewById(R.id.linear_layout);
        register = findViewById(R.id.btnRegister);
        login = findViewById(R.id.btnLogin);
        fa = FirebaseAuth.getInstance();

        linearLayout.animate().alpha(0f).setDuration(20);
        TranslateAnimation animation= new TranslateAnimation( fromXDelta: 0, toXDelta: 0, fromYDelta: 0, toYDelta: -1500);
        animation.setDuration(1000);
        animation.setFillAfter(false);
        animation.setAnimationListener(new MyAnimationListener());
        iconImage.setAnimation(animation);

        if(fa.getCurrentUser() != null){
            startActivity(new Intent(getApplicationContext(), HomeActivity.class));
            finish();
        }

        register.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                startActivity(new Intent(getApplicationContext(), Register.class));
            }
        });
    }
}

```

Figure 5.9.1 Part of Start Activity


```

login.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        startActivity(new Intent(getApplicationContext(), Login.class));
    }
});
}

private class MyAnimationListerner implements Animation.AnimationListener{

    @Override
    public void onAnimationStart(Animation animation) {

    }

    @Override
    public void onAnimationEnd(Animation animation) {
        iconImage.clearAnimation();
        iconImage.setVisibility(View.INVISIBLE);
        linearLayout.animate().alpha(1f).setDuration(500);
    }

    @Override
    public void onAnimationRepeat(Animation animation) {

    }
}
}
}

```

Figure 5.9.2 Part of Start Activity

Test Case

Login Module

No.	Feature	Result	Result
1	Register Account (Data sync to firebase)	Valid	Successfully register account and data synchronize to firebase
	Login to application	Valid	Data from firebase can be read correctly

Table 5.1 Login Module

Calculator Module

No.	Feature	Result	Result
1	Sum	Valid	Sum up all the number correctly
2	Abstraction	Valid	Deduction is correct
3	Multiplication	Valid	$300 * 400 = 12000.0$
4	Division	Valid	$6 / 3 = 2$

Table 5.2 Calculator Module

Income and Module

No.	Feature	Result	Result
1	Adding Salary	Valid	Adding income successfully
2	Adding Investment Earning	Valid	Adding income successfully
3	Adding Award	Valid	Adding income successfully
4	Adding other new income	Valid	Adding income successfully
5	Showing sum of the total salary	Valid	Correctly added to sum of the salary

Table 5.3 Income Module

Expenses Module

No.	Feature	Result	Result
1	Adding Food Expenses	Valid	Adding income successfully
2	Adding Transportation Fee	Valid	Adding income successfully
3	Adding Shopping Transaction	Valid	Adding income successfully
4	Adding Gaming Expenses	Valid	Adding income successfully
5	Adding Phone Bill	Valid	Correctly added to sum of the salary
6	Sum up all the expenses and show on dashboard	Valid	Correctly Sum up the expenses
7	Calculate the balance from income and expenses	Valid	Calculate correctly without any error

Table 5.4 Expenses Module

User Profile Module

No.	Feature	Result	Result
1	Display profile picture, Email, full name and phone number	Valid	Display user information correctly
2	Update user profile picture	Valid	Upload user profile successfully
3	Update username and phone number	Valid	Update user information correctly
4	Synchronize data to firebase	Valid	Data synced correctly

Table 5.5 User Profile Module

Tracker Module

No.	Feature	Result	Result
1	Display profile picture, Email, full name and phone number	Valid	Display user information correctly
2	Write MySejahtera Information into the NFC tag	Valid	Correctly write the information into the application
3	Link to MKN website	Valid	Once function is written into the NFC it can be link to the MKN website

Table 5.6 of Tracker Module

Testing

Cloud Firestore

Data Rules Indexes Usage

The screenshot shows the Cloud Firestore console interface. The breadcrumb path is 'users > 10T8rbCdaeUU...'. The selected collection is 'users' within the project 'multifunction-tracker-152f0'. A document with ID '10T8rbCdaeURKEzgduq21bGLlo2' is selected, showing its content: email: 'wong@gmail.com', fullname: 'Adam Wong', and phone: '0167090933'. The document ID is also visible in the left sidebar.

Figure 5.10 User Profile Data Synced into Firebase

The screenshot shows the Google Cloud Storage console interface. The breadcrumb path is 'gs://multifunction-tracker-152f0.appspot.com > images'. A table lists three image files:

<input type="checkbox"/>	Name	Size	Type	Last modified
<input type="checkbox"/>	10T8rbCdaeURKEzgduq21bGLlo2.jpg	57.65 KB	image/jpeg	Apr 19, 2021
<input type="checkbox"/>	QQA63DdVwYy1kCGZHvGrbLbLZS2.jpg	55.37 KB	image/jpeg	Apr 19, 2021
<input type="checkbox"/>	mfMmH8WuiqeaPTEg4xJ25XFK2Yr2.jpg	7.9 MB	image/jpeg	Apr 18, 2021

Figure 5.11 User Profile Pictures Synced into Database

Chapter 6

Conclusion

As a conclusion, there are no existed system that combine both function of money managing and also the tracking system. This project will bring out the advantages of combining both systems which can bring a new-living-habits to all people. In the future, this project will become on of the daily application that will be used by people just like Facebook and Google Meet.

In order to achieve it, developers implement with the sample source code and taking some suggestion from Github and Stackoverflow. The objectives of this project are keeping user a good user experience and educate them to financial literacy.

In the future, I hope that this application can be implement to the public but not just for my own use. This application should be able to directly or indirectly connected to the database of the Mysejahtera. In order to replace the “Mysejahtera” application, the NFC tags should be able to store the Mysejahtera information and when officer are doing the daily checking there will be a active devices to scan the NFC tags and verify the information from NFC tags with the information that is stored in the database on the cloud.

Most of the people think that smartphone is a very personal device. Not everyone is willing to take it out and pass to any officer to be checked. If this Portable and Multifunction Tracker can replace the traditional “Mysejahtera”, it would be good to protect the privacy and personal information to the public.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 13
Student Name & ID: Adam Wong Wei Jiang 18ACB07001	
Supervisor: Dr. Lau Phooi Yee	
Project Title: A Portable and Multifunction Tracker	

1. WORK DONE

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

Week 6

Improved the GUI

Week 7

Implemented Calculator Module

Week 8

Implemented Income Module

Week 9

Implemented Expenses Module and finished balance calculation

Week 10

Addon User Profile Picture

Week 11

Implemented NFC function

Week 12

Final testing and wrote report

2. WORK TO BE DONE

WEEK 2

Improve previous GUI

Week 3

Decided which function to be implemented.

Week4

Approach to supervisor.

Week 5

Improve GUI

3. PROBLEMS ENCOUNTERED

Week 7

Debugging the function

Week 9

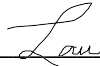
Expenses and Income Modules are buggy, have to solve the problem

4. SELF EVALUATION OF THE PROGRESS

Need to be more discipline.

Have to learn more about time arrangement and practice a non-procrastinating habit.

Be more positive.



Supervisor's signature



Student's signature

Poster



UNIVERSITY TUNKU ABDUL RAHMAN

A Portable and MultiFunction Tracker

PREPARED BY ADAM WONG WEI JIANG

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INTRODUCTION



A Portable Multifunction Tracker is an application that developed based on Android Studio. As the title showed, this application included tracker, money management and calculator functions. It provides supreme user experience and flawless animation to users.

PROJECT OBJECTIVES



The major objectives of this project is to keep safety of user and also to cultivate user to form a habit and financial concepts.

PROBLEM STATEMENT



There is more than 50% of people without financial literacy.
Kids are lack of concentration to learn financial concepts through book.
Lack of multifunction application that combine tracking system money managing system.

PROJECT SCOPE



Scan, Read and Write NFC tags system
Money managing system which include (categorized expenses and income)

METHODOLOGY



Rapid Application Development

CONCLUSION



Provide a suitable platform for kids to form their financial habit
Gain kids' attention to use tracking system to record down their trace
Amnesia patient can solve their forgetful mind with the help of this application
Portable and Multifunction Tracker became a daily reliable application to all people.
Including Mysejahtera Function in the NFC tags to protect the privacy from the smartphone.

A Portable and MultiFunction Tracker

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