THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS

By

Ng Kah Weng

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCEINCE (HONS)

Faculty of Information and Communication Technology

(Kampar Campus)

JAN 2020

UNIVERSITI TUNKU ABDUL RAHMAN

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Date: 23 April 2020

Date: 24/4/2020

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I declare that this report entitled "**THE DEVELOPMENT OF MOBILE APPLLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

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Date : 23 April 2020

ACKNOWLEDGEMENTS

I would like to express my utmost thanks and appreciation to my supervisors, Ts Dr Liew Soung Yue who has given me this opportunity to work on this mobile parking project. I appreciate the guidance provided and again million thanks to you.

Finally, I must give thanks to my parents and family for their never-ending love, support and continuous encouragement throughout the entire course.

ABSTRACT

This project is a campus parking mobile application project for academic purpose. The aim of this project is to develop a parking system that replace current old fashion system that can improve effectiveness during looking for parking space, to show the availability of parking space, and to remind user their vehicle location. The current parking system in the campus is not effective enough. Therefore, by implementing this project will improve the effectiveness and reduce the time needed to find a parking slot. Due to different obstacle faced, Quick Response (QR) are the best suited method to implement into the system. This system will improve student time management, reduce empty parking space time wasting. Other than that, the data of student can be gather from this system which can be further implement or perform behavior analysis on the user.

TABLE OF CONTENTS

LIST OF FIGURES

Figure Number Title **Page**

LIST OF TABLES

Table Number **Title** **Page**

LIST OF ABBREVIATIONS

RFID	Radio-frequency identification
GUI	Graphical user interface
UTAR	University Tunku Abdul Rahman
QR	Quick Response
RGB	Red Green Blue
ERD	Entity Relationship Diagram
SDM	System Development Methodology
IDE	Integrated development environment
iOS	Internetwork Operating System
GB	Gigabyte
RAM	Random Access Memory
SDK	Software Development Kit
SQL	Structured Query Language
JSON	JavaScript Object Notation

Chapter 1: Introduction

1.1 Background

Back in the old days when parking was not regulated anywhere yet, everyone would park their cars in the streets and leave them there until they were in need again. This created a serious traffic congestion problem in the streets as they became an obstacle for other drivers and reduced the smoothness of the traffic. On the other hand, shop and/or mall owners realized that the parking space occupied by the employees might leave no room for their potential customers, and this would hurt their businesses. Therefore, designated car park was then allocated to solve this problem. Car park are designated for parking vehicles in a cleared area, which is divided into the individual area called parking space. This parking space is usually indicated by a white or yellow mark line on the ground that forms squares that each fit one car. It is undeniable that car park plays an important factor to the society by reducing illegal car park at the side of the road, which might congest the road and increase travel time if the car park does not exist. Since vehicle cars are the dominant mode of transportation, car park was commonly found in places near building such as shops, mall, offices, restaurants, and other facilities that require parking. In other words, car park was the key feature of every city and suburban area.

Nowadays, it is hard to find available parking space in places like university campus especially during rush hours The most troublesome issue in university campus is to provide a location to all the staff and students for their study or working (Alshuwaikhat et al., 2008; Balsas, 2003; Shang, Lin, et al., 2007). At the campus of the university, difficulty of finding empty parking space increased due to the fact that limited number of parking space provided to the students and staff. Therefore, finding an available car park is always an issue when there are too many cars in certain car park that provide limited parking space. This problem is common around the world. Due to this problem, the staff and the students of the university will face the difficulty of finding an available parking space. Moreover, the current parking system is not flexible and ineffective. This will create problem such as being late to particular class. Most of the time user failed to park their car was because of the parking space was far

or it was blocked by obstacles. Apart from that, user tend to waste a lot of time in finding their own car as they forget where their car located. This will prevent other potential users from using the parking space. It is important to overcome these problems so that the parking environment in UTAR campus will achieve smoothness of traffic.

1.2 Motivation

In today's era, it is common to see electronic-based parking system in the market since it is more effective and efficient. There are a lot of system and research that have been done using different technology such as parking sensors, image processing, Radio-Frequency Identification (RFID) and etc. These existing system or application that show available parking spot for the drivers. But these existing systems contain limitations, which is unable to accurately show the available of the parking slot. The purpose of this project is to improve current parking management system that is used by the UTAR campus. The motivation of developing this project is to solve some issues that are currently happening in UTAR as well as other university which using same technology by implementing graphic user interface (GUI) that can show the location, availability of parking slot and parking spot to the user. Likewise, based on the parking space that is available during that time, user can pick their preferred parking space. However, there are several problems that exist in the current UTAR parking system.

1.3 Problem statement

A. **Ineffective way of finding an available parking space which is a waste of time, fuel consuming and even congested the traffic.**

   When user try to find empty parking space, it is a waste of time and consume a lot of fuel as the user need to circulated around the parking spot. In addition, although there is an available parking space but user failed to spot it. Because of this reason, users sometimes wait along the road side for another user to

remove their car from the car park. Hence, this user behavior will make the traffic congested.

B. **Lack of visual on parking space availability.**

The visual of human's physical eye became a limitation when the visual is blocked by obstacles such as car frame, cars, trees, etc. Hence, the user had the difficulty to spot an available space that is well hidden, far away or at the corner. This limitation turned into an important problem when the users will waste their time and fuel by checking every corner of the parking space.

C. **Time wasted on finding parking location when user forgotten the parking location of their car.**

There are a lot of parking space in the campus and users are unable to memorize their parking location as they need to park their car in the campus at least once every single day. Therefore, user will forget their car's parking location and look for their car by walking around the parking spot. When users look around for their cars, they wasted time of another parking potential user. This problem will drag the time of unavailable parking space longer and keeping potential user from using it.

1.4 Objectives

The current parking system that UTAR using had some issue and problem, therefore the objective of this project is to develop and design and new system to solve these problems. At the end of this project, electronic-based parking system using mobile application will be developed and designed to let UTAR users park their cars in a time effective and time efficient way and reduce road congestion in the parking zone. This project shall achieve:

1. To design and develop a new system to replace current existing parking system that can improve the effectiveness during looking for parking space.
2. To design user interface that shows the availability of every parking space and total number of available parking space in a zone.
3. To inform parking location of the user's car through user interface screen.

1.5 Proposed approach/study

This project has performed study of the relationship at the user's behavior when they are driving, parking their car and even planning their parking location. This application allows both Android user and ios user to be use. This is a helpful application that helps people who are facing parking problem such as time wastage on looking for parking space, congested the traffic and forgot their parking space. This application currently only targeted Kampar residents as their targeted user. The intention of this application is to reduce time wastage in parking car. As current user inside the campus prompt to created traffic congestion by waiting for another user take their car out of the parking space. This will bring to a more serious problem which is possibility of traffic deadlock. When deadlock happened, the traffic will be more congested and harder to fix as deadlock prevent car from going forward not going backward. Therefore, few approaches are made to fix this issue. User can check the availability of the parking lot of every zone so that they can plan ahead. If user notice their target parking lot is full, they can go to nearby parking lot instead or waiting for parking space to be release. Furthermore, if users are able to reserve parking space, they can reserve their parking space when they are on the way to the campus where no one will able to steal user parking space.

1.6 Highlight of what have been achieved

First of all, this project has completed the authentication of users by using firebase. All the user's sign in details will be created and stored into firebase. The verifications of authentication module are done. Besides that, user can use the create account module which user can use to create account if user do not have the account. Other than that, GUI showing parking lot availability are created and function well. Showing the number of parking space available are created and allow user to plan ahead. Instead of using bidding sticker method, payment module is created where it will deduce usage of parking time to the account. As user use up all the parking time, they will need to refill time to their account. Time top up module are created which allow user refill time they used up and continue parking their car. Next, when user need to park their card to the respective reserved space. They would need to verify the parking space by using QR scanner. QR scanner are created to allow user scan the QR

code located on each parking space. All the module created are easy to learn where it only needs few steps to perform the whole process.

1.7 Target Audience

This project will aim for those users who park their car inside university campus. Therefore, users like student and staff will be the targeted audience for this project. The problem of lacks of parking lot usually happens during the daytime as there are a lot of activities going on during that time. This parking problem will cause traffic jam issue. Student may have no activities to do and have no reason to be inside the campus but still hog the parking lot for few hours. Thus, this project is to provide solution for the campus to problem face by parking management.

Other than that, since most of the users only use either android operating system or ios inside the campus, therefore this project will be targeting user with both android operating system and ios.

1.8 Report organization

This report is divided into 6 chapters. In chapter 1 contains the introduction of the project background, problem statement, motivation, objectives, proposed approach, highlight of what have been achieved and target audience.

The chapter 2 of this report will have review on lookalike system and make comparison with all the system that have been review. It also contains remarks of the reviewed system.

In the next chapter which is chapter 3, it consists of top-down system diagram, proposed framework, use case diagram, activity diagram and entity relationship diagram.

Next, chapter 4 show design specifications and implementations where it made up of development methodology, software and hardware requirement, user requirements, timeline and implementation

For the chapter 5, it consists of system testing with unit testing, functional testing and integration testing which evaluate the system.

The chapter 6 talks about overall conclusion that have project achievements, project review, implementation issues and challenges and future work.

Chapter 2: Literature Review

2.1 Review Description

There are a lot of existing parking system that use different strategic and approach to solve the problem of parking system. Few of the system that are unique and have a good strength were chosen and has been reviewed as in the below.

2.1.1 Review on ParkMobile Parking System

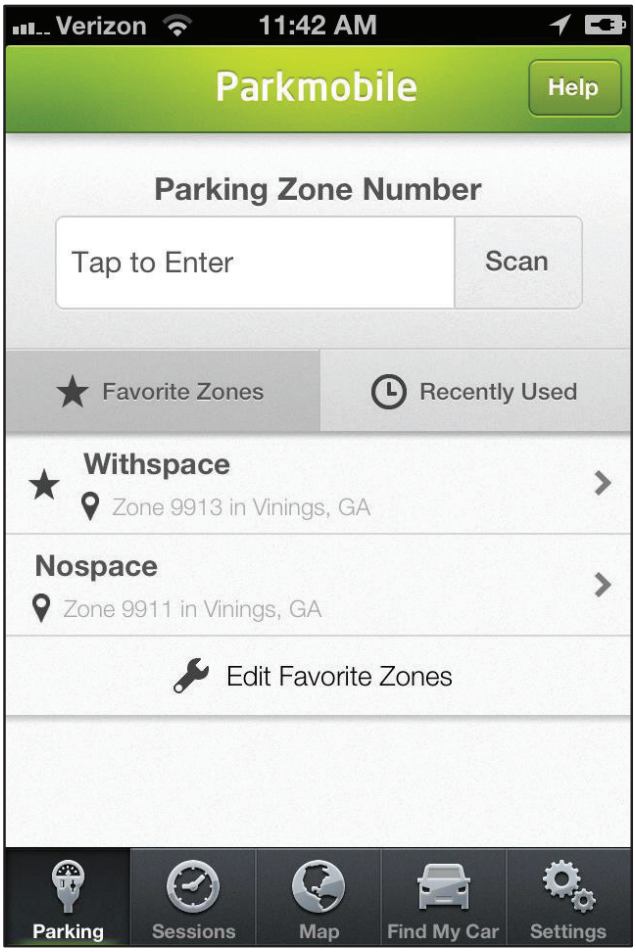

Figure 2-0-1: Mobile Parking Application that detect availability of car park

Brief

ParkMobile is a mobile parking application that support both iPhone and Android application. It is one of the smart parking and mobility solutions that increase parking revenue and decrease operational costs in places such as stadium, airports, and universities other businesses. It also improves customer service provided to customer and make payment process securely. It provided two different ways to pay when the user's car was parked in their facilities. ParkMobile have a vision called "A World in Which Today's Transportation Hassles No Longer Exist" which is to remove problem of parking grievances.

Strengths

From the Figure 2-1, this mobile application allows user to check the availability of the parking space. It also allows user to save particular car park as favorite. This allow user to easily select car park that they often parked. Therefore, users will have availability of the parking space knowledge and plan their journey beforehand.

Weaknesses

However, it doesn't show the availability to first time users. This is because the availability of the parking space will only show up upon user save the parking zone as favorite or existing parking history was made, in which first time user is not eligible to use this function. Thus, first time user unable to know the availability of the car park. Apart from that, this mobile application shows the availability of the parking space but it does not provide the number of available parking space. By knowing the number of available parking space in a car park help user improve their parking plan.

Recommendation

The limitation mentioned above, can be solved by make a simple interface that show the availability of every parking space to the user. Other than that, the number of available parking space will also show to the application mobile screen.

2.1.2 Review on Parker Parking System

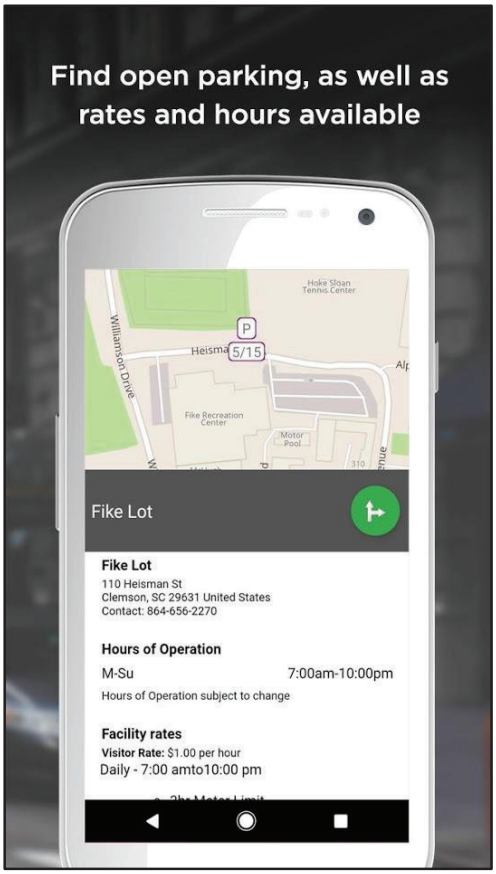

Figure 2-0-2: Mobile parking application with price rate of car park

Brief

Parker is another mobile parking application that solve the problem of car park. This mobile application provides features of easily access pricing, time limits, hours of operations and parking restrictions, so it allows user park their car securely and worry free. Parker use mobile payment options such as ParkMobile, Passport and Pay-by-Phone where the payment transaction was done in a secure method. This mobile parking application also provide user real-time guidance. It will guide the user to the available parking space. The application will notify the user and show on the screen when the parking space became available.

Strengths

This mobile application operates using payment system. It allows users access the price rate of each of the car park. This convenient feature show parking rate to the user. It helps user knows the parking price and let the user plan their parking budget well.

Recommendation

In UTAR campus, car parks are free to park if the car has the parking sticker for the semester. The feature of providing price rate of each car park are not able feasible to implement into the system since the payment system are different. Therefore, it is recommended to use the current payment system instead of hourly pay system.

2.1.3 Review on Image Processing Based Parking System

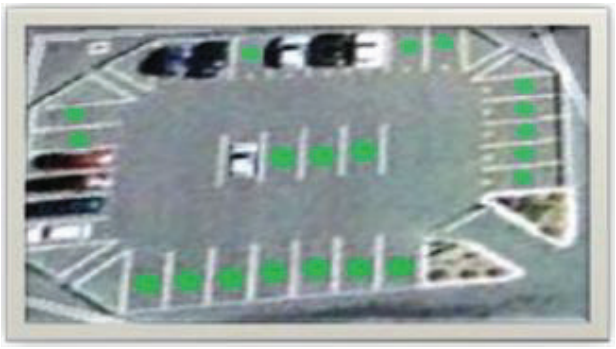

Figure 2-0-3 Car Park with green dots parking space

Brief

In nowadays technology, system with image processing technology was widely used in all kind of area. Based on the article paper of "Intelligent Parking Management System Based on Image Processing" (Al-Kharusi & Al-Bahadly, 2014), car park system with image processing implemented was able to provide more efficient and effective parking enforcement and a better public service. The main objective of this article was to resolve problem of traffic congestion, waste of time and reduced car emissions, pollution by using image processing technology in parking system. It uses camera to perform image processing to detect the availability of parking space by identifying the green rounded image drawn on each parking space. By changing the RGB value of an image, the green dots on the parking space will appear more clearly and the availability of the parking space will then be identified.

Strengths

There are a few strengths that had been found in this parking system with image processing technology. With this parking system, it can identify the availability of each car park spaces by constantly capturing image of the whole area. Due to that, installation of two camera will be enough for one car park in which can provide efficient and inexpensive solution to the problem. This method does not require any

sensor device in each parking space to detect the availability of the parking space which is expensive.

Weaknesses

This parking system method are not suitable to implemented in campus car park because it required to install a camera at high places such as on the wall of building. Since campus often have a lot of tree, this will block video capturing of the camera and not able to detect the availability of the parking space. Hence, decrease the credibility of the parking system.

Recommendation

From the statement above, the parking system that implemented image processing technology has the weakness of camera vision blocked by obstacles. Therefore, instead of using image processing, Quick Response (QR) code could be used to identify the availability of parking space. Since this method do not require visual ability, it was able to solve the weakness of stated above.

2.2 Highlight and compare proposed study with previous work

2.2.1 Recommendation

From the statement above, the parking system that implemented image processing technology has the weakness of camera vision blocked by obstacles. Therefore, instead of using image processing, Quick Response (QR) code could be used to identify the availability of parking space. Since this method do not require visual ability, it was able to solve the weakness of stated above.

Features	System Name			
	Park Mobile	Parker	Image Processing Based	Proposed Application
Show number of parking space left in zone	✓	✓	✓	✓
Show each parking space availability				✓
Gated Parking	✓			
Reservations	✓	✓		✓
Save car location		✓		✓
Expiration Notifications	✓			✓
Navigation		✓		✓
Remotely Extend Parking Session	✓			
Save Parking	✓			

Zones				
Suggested Nearby Zones	✓	✓		✓
Link MasterPass, Visa Checkout, Or PayPal Account	✓			
Search for Parking Zone Numbers	✓	✓		✓
Filter Price and duration		✓		

Table 1: Comparison between reviewed system

2.2 Critical Remarks of previous works

Develop mobile application with android studio but in java language. The strength of that project was java have been used for long time. Therefore, it has a full framework and libraries that are develop by third party community. But developing mobile application using java language is slow due to java lacks of hot reload function. Thus, when testing it is time consuming to build and install it to the emulator or phone. Other than that, react native do have hot reload and better communities but the flutter widget is build using native widget. Therefore, flutter is much faster compared to react native.

Chapter 3: System Design

3.1 Top-Down System Diagram

Figure 3-1 shows a breakdown of parking application to its lowest manageable levels. These arrange module will gives basis ideas on how to further proceed this project development.

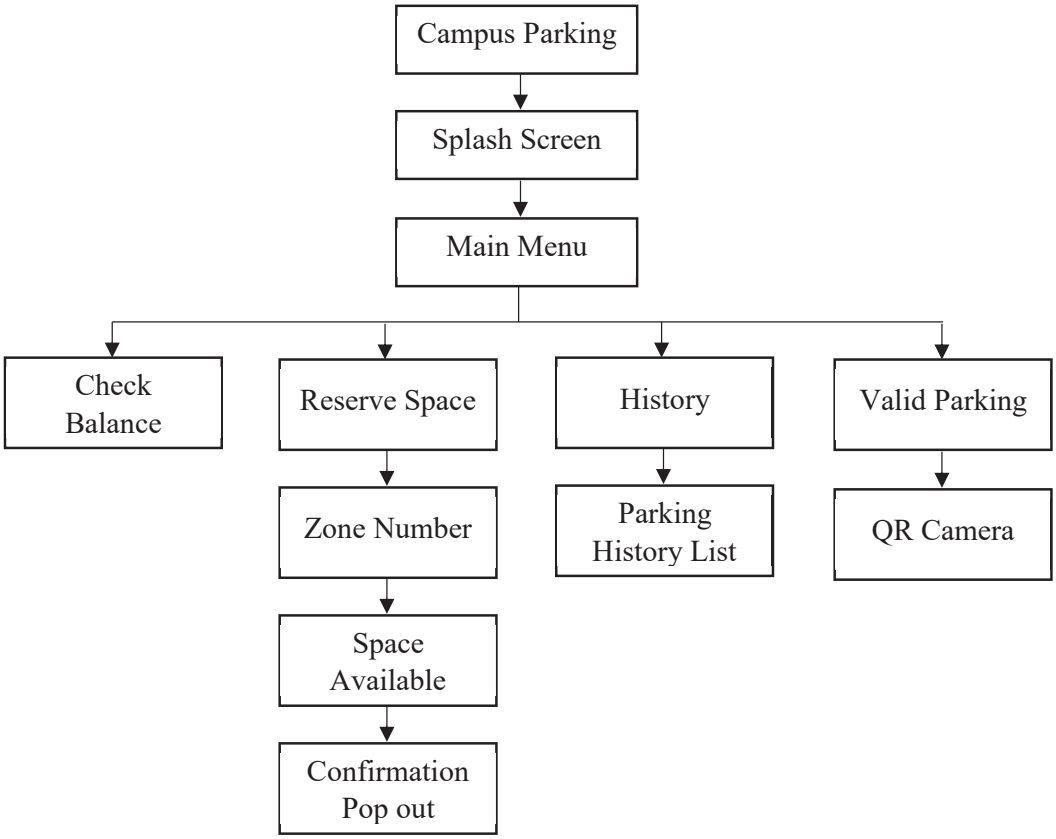

Figure 3-0-1: Top-Down System Diagram

3.2 Proposed Framework

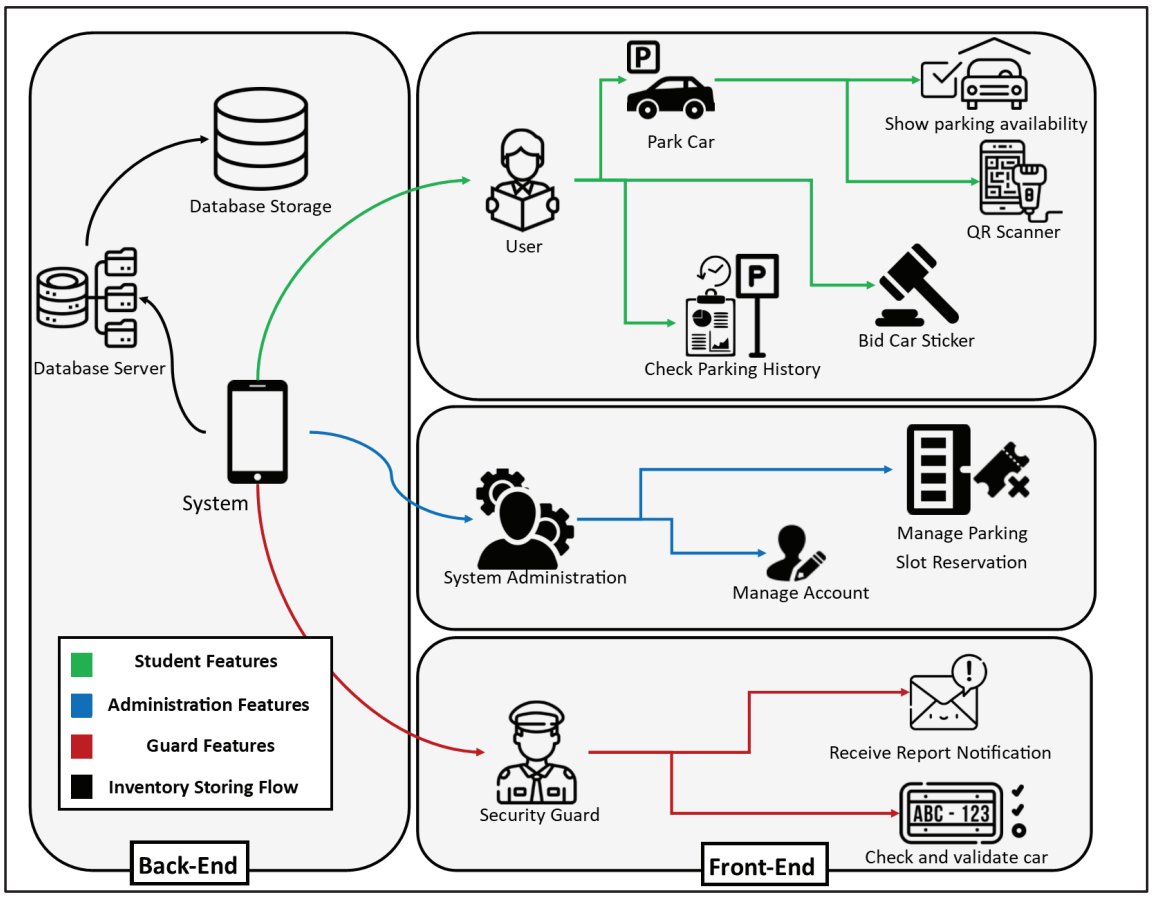

Figure 3-2: Proposed System Framework

From the Figure 3-2, it shows the proposed system framework of this project. At the end of this project, a mobile application will be developed according to this system framework which user can check the availability of the parking space and confirm the parking space by scanning the QR code. User can user this parking application to check its parking location and parking history. Car sticker bidding system also will be implemented in this application. Other than that, this application allows system admins to manage user account and manage parking space reservation. When users want to update their status which they are not authorized, they need to approach system admins to change the information. When user want to reserve a parking space, they can make a request which will then be approved by the system admins. Last but not least, this application will need the help of the security guard. This application allows security guard to receive report notification made by the user and went to the

parking space location. After that, the security guard can validate the report and make a statement using the mobile application.

A. User Features Flow

The user features flow allows user to reserve parking slot when they want to parking their car inside the school campus. It also allows user to check the parking availability which help user to find a parking space easily. Other than that, user required to scan the QR code to validate their arrival. User allow to view their parking history which contain the parking time, parking area and parking slot. Finally, this flow also provides bidding feature which help user to bid their parking car sticker.

B. Administration Features Flow

For the administration features flow contain the authority to manage account and manage parking slot reservation. They can retrieve, update or even delete the account data. In case there are any guest will be coming here, they can reserve specific parking slot and prevent user from using it.

C. Guard Features Flow

The jobs of the guard will be user to validate the report function. If the guard receive report notification from the system. The guard will go to the location reported and validate the report.

D. Inventory Storing Flow

In this flow, the mobile communication with the database server which will then store data into the database. All those user history and account history can be store into and retrieve from the database.

3.3 Use Case Diagram

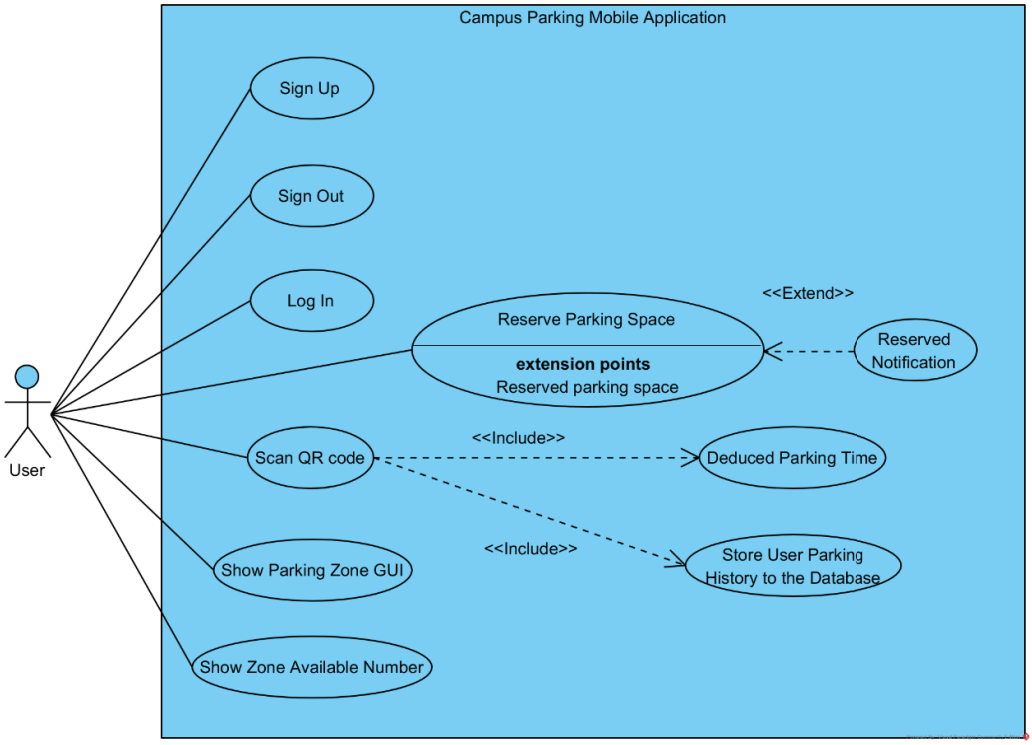

Figure 3-3: Use Case Diagram of the system

This use case diagram only consists of one actor which is the user. From the diagram **Error! Reference source not found.**above, the system required users to have an account before able to perform any application features. Therefore, users can register an account and login into the application. Before reserve parking space, users able to view the number of available parking space for each parking area and interact with GUI. Then, user can reserve the parking space where there will be notification alert if the reservation was successful. After that user are require to use the QR code scanner to confirm their arrival to parking space and verify the correct parking slot. Finally, user can sign out to change user.

A. Sign Up

This use case allows user to register account with email and password which will be use in the application. These data will be stored to the database and retrieved in the future.

B. Sign Out

This use case will help user sign out from the application.

C. Login

This use case will let user to key in their registered email and password which will then validate by the application. If email and password match with the database, it will let user to access to more application features.

D. Reserve Parking Slot

This use case allows user to reserved and lock a parking slot which will be the user car's parking slot until user release the parking slot.

E. Scan QR Code

This use case will allow user's mobile camera to scan QR code which will confirm the arrival of the user and verify whether do user park at the correct parking slot.

F. Show Parking Zone GUI

This use case will show the available parking slot in a parking area to the user and allow user to interact with the application.

G. Show Parking Zone Available Number

This use case will give prior knowledge of how many parking slots are left for each parking area to the user.

3.4 Login Activity Diagram

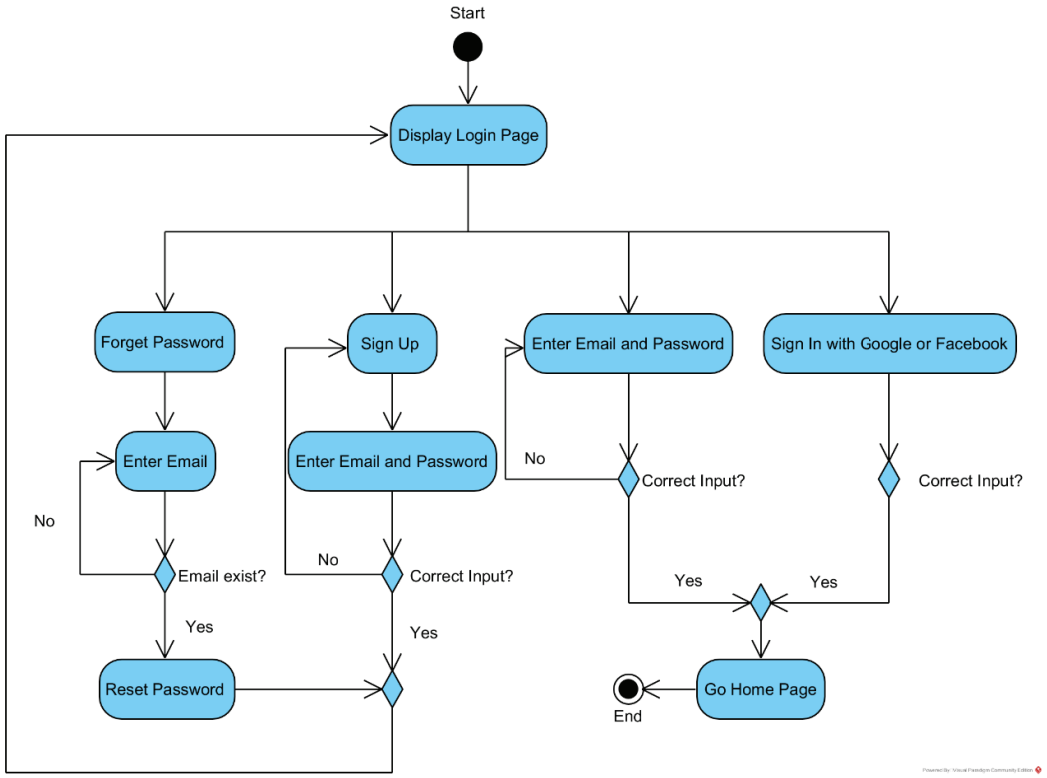

Figure 0-4: Login Activity Diagram

The figure above shows the flow for the user to login to the system. If user do not have any account of this system, they can create an account with email and password. Other than that, this application allows user to recover their password by using the forget password feature which will then send a request to their email and reset password. Last but not least, this application allow user to use two method to sign in which are either via email-password method or with third party sign-in provider such as Google Sign-In and Facebook Sign-In.

3.5 Parking Reservation Activity Diagram

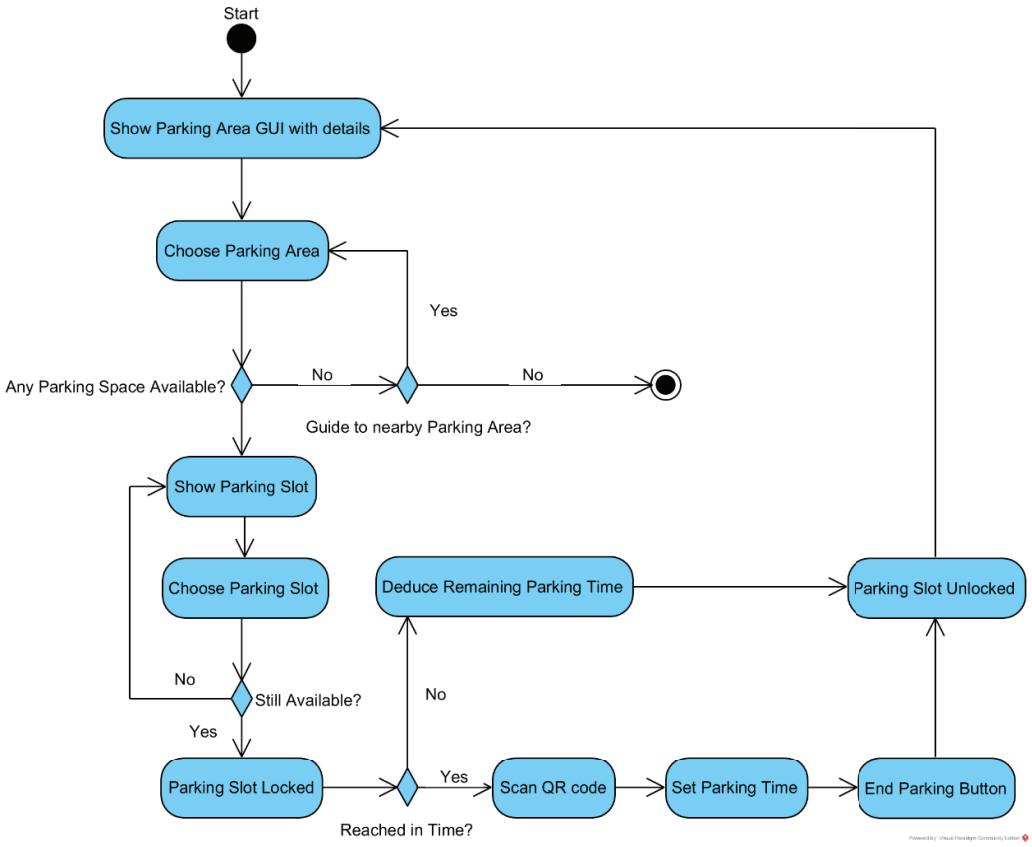

Figure 3-5: Parking Space Reservation Activity Diagram

The figure above, shows the flow of user reserving a parking space. When the parking space reservation are performing, the application will show GUI of each parking area. User was then required to choose one parking area. If the parking area no longer available, the application will then request guiding user to nearby parking area or process will end when user decline the request. In the other hand, the application will show both available and unavailable parking slot to the user, if the parking area was available. When user has chosen which parking slot to park their car, that specific parking slot will then be locked and prevent other from using it. User are required to use QR code to confirm their arrival the moment they manage to park and set they wanted to park. If user fail to arrive in time, user remaining parking time will be deducted. Parking Slot will be unlocked at the end of the process.

3.6 Entity Relationship Diagram

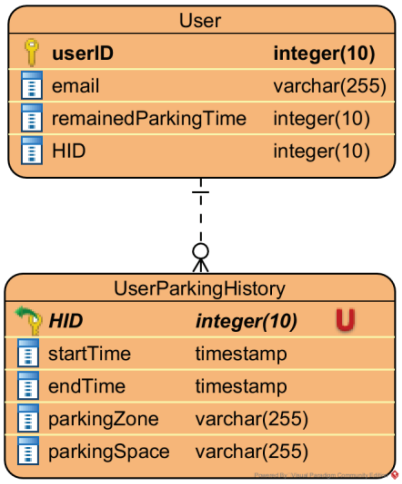

Figure 3-0-2: Entity Relationship Diagram of the system

The figure above represents the storing Entity Relationship Diagram (ERD) of the system. The user will have their record save in userID, email, remainedParkingTime, HID, startTime, endTime, parkingZone, and parkingSpace. The userID is the primary key which will be automatic generate. The email will be the email that the user registered with the system. The remainedParkingTime is the time remained to reserve car park slot. HID is the primary key for the UserParkingHistory table and it contain user parking start time (startTime), end time (endTime), parking area (parkingZone) and parking slot (parkingSpace).

Chapter 4 Design Specifications and Implementations

4.1 Development Methodology

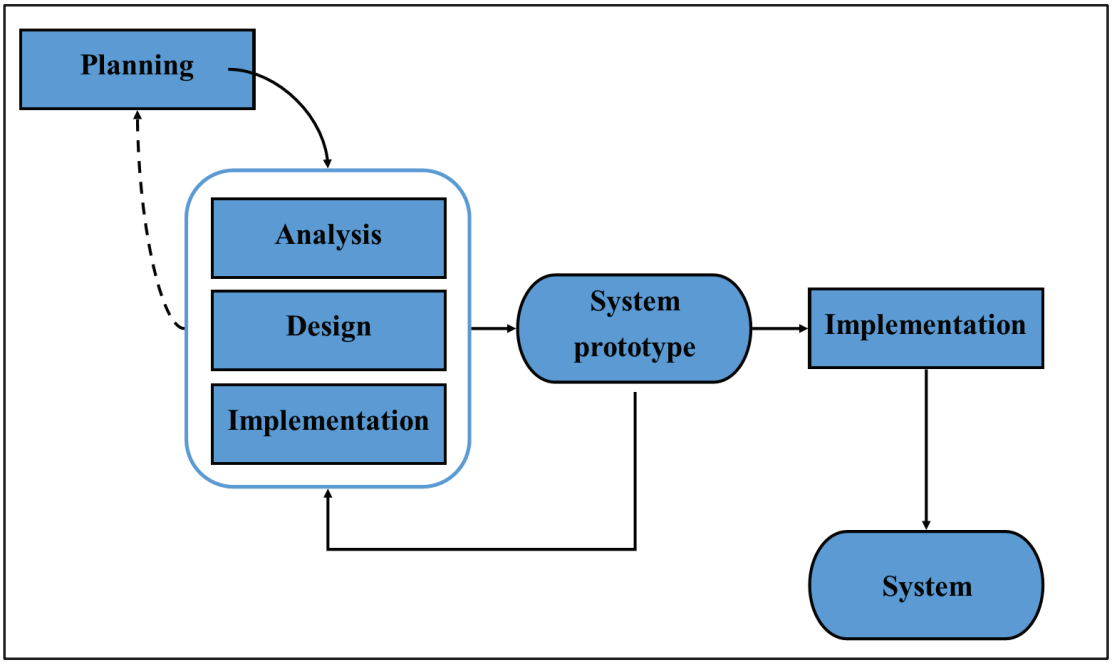

Figure 4-0-1: Prototyping-based Methodology

The prototyping-based type of development methodology have chosen for this project. This Prototyping Model is a Systems Development Methodology (SDM) within which a paradigm output is constructed, tested, and then reworked (The Economic Times, 2017). This methodology contains five stages which is planning, analysis, design, prototype implementation and system implementation.

4.1.1 Planning Phase

The first phase of the prototyping methodology is planning phase, a discussion with the supervisor, Ts Dr. Liew Soung Yue was carried out. The discussion was about the type of project to be developed. After the discussion, decision of developing a mobile application for car park management at university campus was made. After the project title was chosen, the project was initiated by forming the problem statement based on the issues and problems happening on the current parking system in UTAR. The project scope is aiming to improve and replace the current traditional parking system which is still used by UTAR campus. Next, design and develop a new parking system to increase the efficiency and effectiveness of managing UTAR parking system and resolve the problem caused by the parking system.

4.1.2 Analysis Phase

In the analysis phase, a literature review was carried out to study on the existing parking system. Based on the studies performed, the strength and weaknesses of existing system were found and make comparison. Comparing both strength and weakness of existing systems is to make an improvement based on the weakness of existing system. The system will be an improved version of existing system in this project.

4.1.3 Design Phase

During the design phase, a user interface of prototype will be developed and show to the user. The purpose of showing prototype to the users is to let user visualize the end product and features of the end product. By doing so, the development will be moving toward the right direction. Right after the first prototype has been developed, new features will be added into second prototype designed and fixed problem evaluate by the user that exist in first protype. This looping phase will keep on repeating until the prototype met the all the requirement stated by the user. After that, a test will be

conducted on the usability of the system. The application will be fixed and corrected if any error or issue found.

4.1.4 Implementation Phase

In the final phase, the implementation of the application on the mobile device will be made. The final version of the prototype will be implemented to the mobile device. After that, a certain number of users will be selected to test and evaluate the system. This testing and evaluation data will then be recorded for further update on the system

4.1.5 System Prototype

The analysis, design, implementation and system prototype phases are performed in loop. It will continuously loop until it reached the user targeted goal. System Prototype phase develop a simplified version quickly which meet the bare minimum requirement of the user requested and allow users to try and evaluate. By doing so, user can evaluate the prototype and provide a feedback to the developer regarding the problems and issues. Through the feedback provided by the users, the system will then reanalyze, redesign and reimplement a second version prototype which contain the improvement of previous issues and additional features. This cycle will continually loop until the analyst and the end users satisfied with the prototype which fulfilled the requirements and functionalities.

4.2 Software and Hardware Requirements

4.2.1 Software

A. Android Studio IDE

This software will be used to develop mobile application for the parking system. Through using Android Studio editor tool, it can develop a creative user interface for the user.

B. Flutter

Flutter is use to develop both Android and iOS mobile application. It is single codebase with dart language which is easy to learn and use. It has Stateful Hot Reload allow to develop faster and it uses native compilers which mean much faster performance.

C. Web Service

i. Google Authentication

Firebase Authentication build a secure application by providing a sign-in method for the user. It provides end-to-end identity solution such as email and password accounts, phone auth, Google and Facebook. The aim of using this is to authenticate users and allow them access function of the device.

ii. Google Firestore

Cloud Firestore is a flexible and scalable database to use on mobile development. It has real-time database supported which keeps user's data in sync across client apps. User information will be kept using Firestore as well as parking details. Each of the parking space will also save to Firestore as a Boolean variable.

4.2.2 Hardware and Software requirement

Android smartphone device with Wi-Fi Chip

An android smartphone device that has basic specification with Wi-Fi chip is needed in this project. User will need to use this device to open and use the mobile application. This device will act as the input of the user when they need to park their car.

Description	Requirements
Processor	Octa core (2.2 GHz, Quad core, Cortex A73 + 1.7 GHz, Quad core, Cortex A53)
Graphic processor	Mali-G51 MP4
Chipset	Hisilicon Kirin 710
Operating System	EMUI 8.2
Ram	4.0GB
Internal Storage	128GB

Table 2: Hardware Description

Computer for coding with at least 8gb RAM

This computer will be use to code the application. Since Android Studio need heavy RAM usage, to code the mobile application will require the computer to have at least 8gb of RAM to use the SDK and the mobile emulator.

Description	**Requirements**
Processor	Intel® Core™ i7-4720HQ CPU@ 2.60 GHz 2.59GHz
Graphic processor	Mali-G51 MP4
Operating System	Windows 10
Ram	8.00GB
Hard Drive	1TB HDD
System Type	64-bit Operating System, x64-based processor

Table 3: Software requirement

4.3 User Requirements

To further understand the requirement for the application, user requirement was collected. User requirements will allow user of the application to explain requirement of the application to the developer. With the user requirements, it explain user needs, what user does with the system and what activities users must be able to perform.

User Stories
As a user, I want to be able reserve parking lot before I reach the school so that I can secure a parking space.
As a user, I want to pay my parking fee using time-based payment so that everyone will have the same chances of getting a parking space.
As a user, I want to check number of parking lot left in a zone so that I could save trouble from deciding park at which parking zone.
As a user, I want to know where my parking lot located so that I can easily get to that place faster when I park for my car.
As a user, I want to remind myself where my parking lot located at so that I won't have to waste time looking for my car and walk straight to my car.
As a user, I want to view my parking history so that I can get back information of my previous parking.
As a user, I want to confirm my parking lot so that I won't park to a parking lot which belong to others.

Table 4: User Stories

4.4 Timeline

Project Task	Project Week																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Planning																					
Forming project title through discussion with supervisor																					
Researching with existing mobile application																					
Analysis																					
Identifying project background																					
Identifying project problem statement																					
Literature review of existing system																					
Creating system functionality comparison table																					
Identifying project objective																					
Identifying project scope																					
Identifying project innovation and contribution																					

Design																				
Identifying the methodologies used in project																				
Creating system design using diagrams																				
Design System framework																				
Implementation																				
Start coding the system and create a basic prototype																				
Improve prototype incrementally																				
Test the system																				
Deploy the system																				
Documentation																				

Table 5: Gantt Chart

4.5 Implementation

4.5.1 Google Firebase

Not like the usual SQL database where it uses SQL to store each data in columns and rows of a table. Cloud Firestore is NoQSL, each data that are store in documents and collections format. Each document contains a set of key-value pairs which can be use when retrieving data. Cloud Firestore is optimized for storing large collections of small documents. The documents data are similar to JSON format but limited to size 1MB.

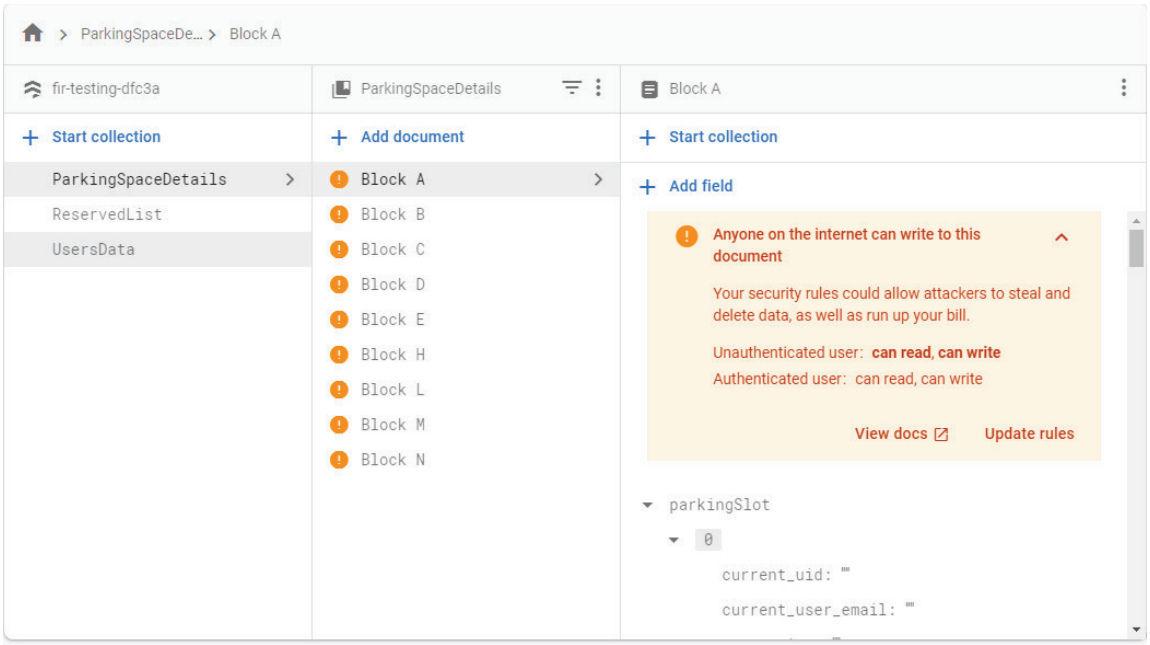

Figure 4-0-2: Google Firebase

4.5.2 Android Studio

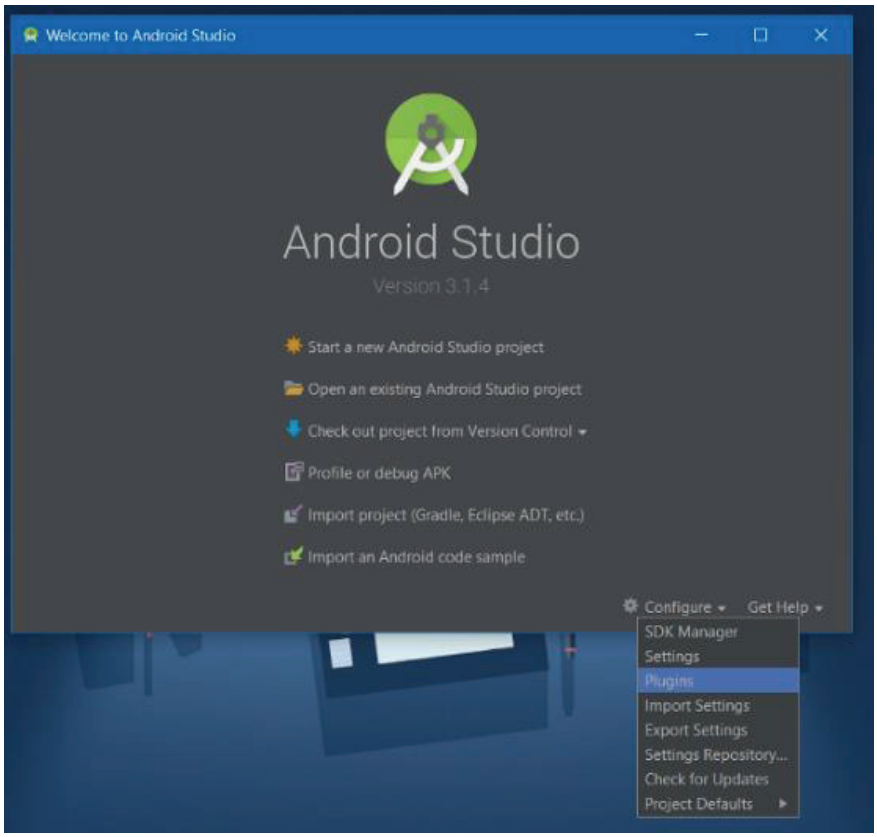

Figure 4-0-3: Android Studio install plugin

To install flutter plugin to the android studio. At the bottom setting, click configure then choose plugins.

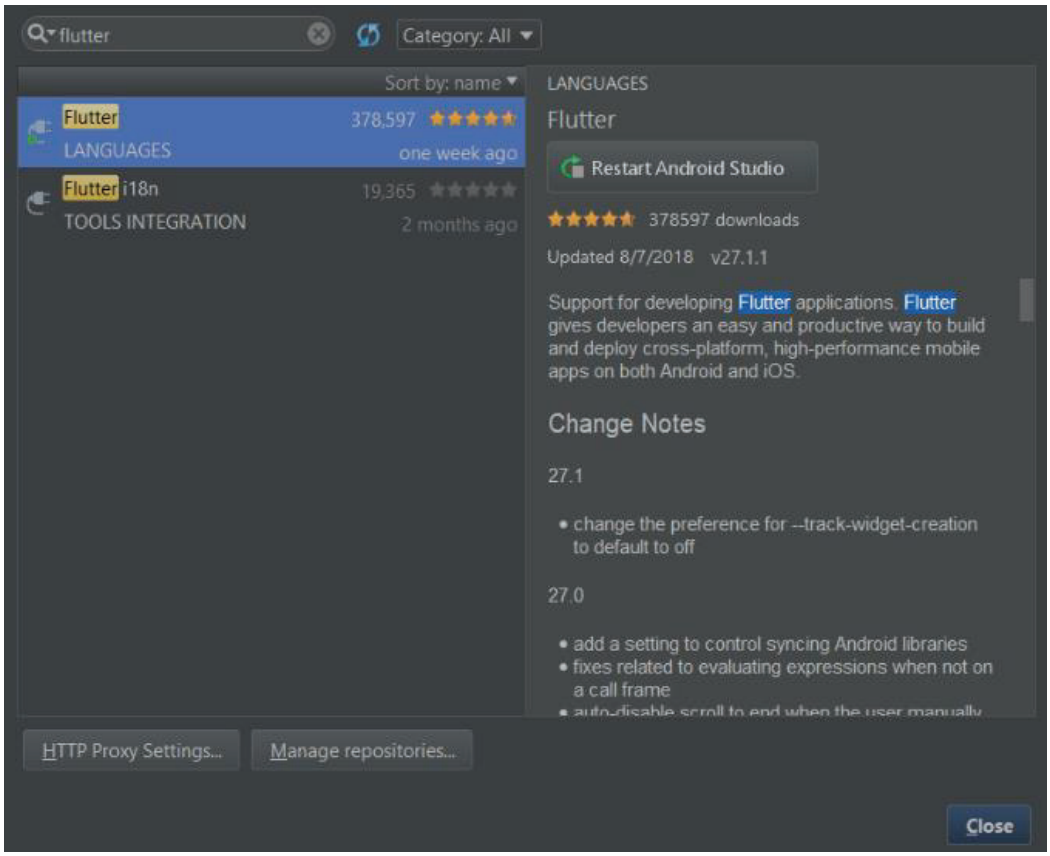

Figure 4-0-4: Search for flutter plugin

At the top search bar, search for flutter and choose install.

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.fyp.campus_parking_application">


    <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
<!--    <uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />-->
    <uses-permission android:name="android.permission.CAMERA" />
    <uses-permission android:name="android.permission.INTERNET" />



    <!-- io.flutter.app.FlutterApplication is an android.app.Application that
         calls FlutterMain.startInitialization(this); in its onCreate method.
         In most cases you can leave this as-is, but you if you want to provide
         additional functionality it is fine to subclass or reimplement
         FlutterApplication and put your custom class here. -->
    <application
        android:name="io.flutter.app.FlutterApplication"
```

Figure 4-0-5: Required Permission

First fill in every details or information, including permission for the device, preferred directory to install, suitable theme name, screen resolution and screen orientation.

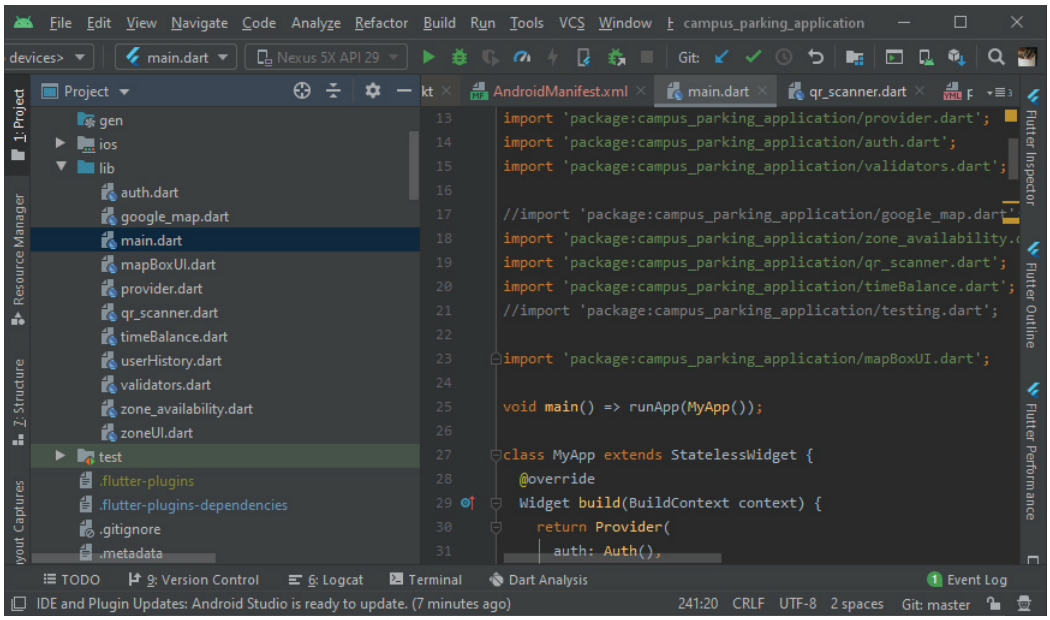

Figure 4-0-6: Correct dart file location

Secondly, ensure all the flutter dart file located at the side window. If needed turn on debugging mode to look for error. Click on play button to activate debug process.

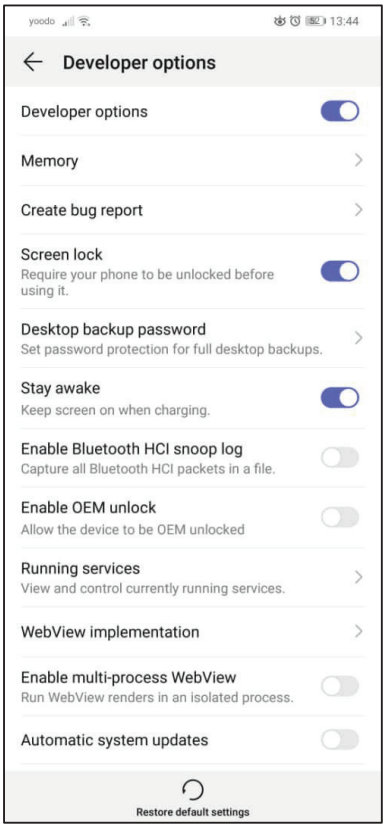

Figure 4-0-7: Mobile Developer Options

Thirdly, make sure the debugging mode inside user device has been enabled otherwise developer will not able to access the device. Connect the device with computer using suitable cable.

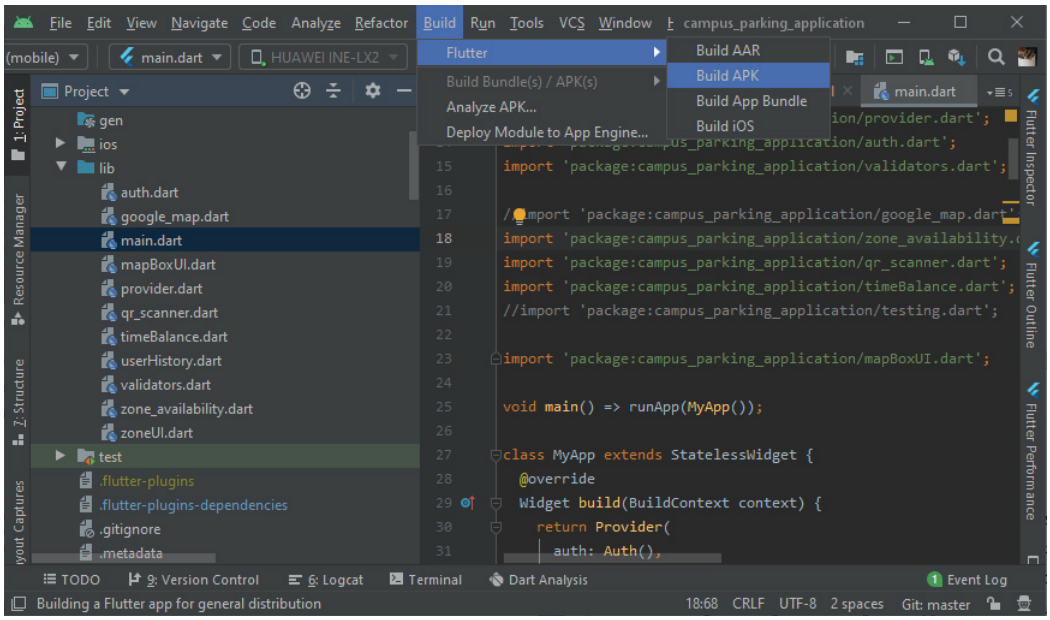

Figure 4-8: Build Apk

If the project has been done, click on Build dropdown list and choose Build APK. This will generate Android installation file that can be published to any Android store market such as Google Play store and Huawei AppGallery.

Chapter 5: System Testing

When the system successfully to be implemented, system testing needs to be done to uncover any errors before allowing user to use the application. Few types of testing will be done to make sure the system is free from error when before allow user to use. Types of testing will be functional testing, unit testing and integration testing. Before integrate into application, all these testing must check carefully.

5.1 Unit Testing

Unit testing is used to test individual unit coding part of the system when test plan is made based on specific module. Unit test is use to reduce the number of bugs that exist inside the module and making sure module work as expected with all the possible inputs. In this project, every input of the users will be test using unit testing and to make the application work as expected. Every form will be test using input of valid, invalid and null value. Errors found in this progress will be resolved right away by the designer. This will ensure the input data is in right format with free of error when passing data to the database. Furthermore, this will also ensure accuracy and data integrity to be guaranteed.

5.1.1 Unit Testing 1: Login to the application

Testing Objective: To ensure the login form work correctly

No	Event	Attribute and Value	Expected Result	Result
1	Authenticate user login after click "Login" button on login form with correct input data.	Login Email: clouds1997@gmail.com Password: ngkahweng	Successfully log into the main page.	Pass
2	Authenticate user login after click "Login" button on login form with incorrect password input data.	Login Email: clouds1997@gmail.com Password: wrongpw	Failed to log into the main page.	Pass
3	Authenticate user login after click "Login" button on login form with incorrect email input data.	Login Email: wrongemail@mail.com Password: ngkahweng	Failed to log into the main page.	Pass
4	Authenticate user login after click "Login" button on login form with null email input value.	Login Email: null Password: ngkahweng	Show input required for the email form.	Pass
5	Authenticate user login after click "Login" button on login form with null password input value.	Login Email: clouds1997@gmail.com Password: null	Show input required for the password form.	Pass

Table 6: Unit Testing: Login into the application

5.1.2 Unit Testing 2: Create Account

Testing Objective: To ensure the create account form work correctly

No	Event	Attribute and Value	Expected Result	Result
1	Authenticate user login after click "Create Account" button on login form with correct input data.	Login Email: test@gmail.com Password: ngkahweng	Successfully to create account	Pass
2	Authenticate user login after click "Create Account" button on login form with incorrect password input data.	Login Email: test@gmail.com Password: wrongpw	Failed to create account	Pass
3	Authenticate user login after click "Create Account" button on login form with incorrect email input data.	Login Email: test@mail.com Password: ngkahweng	Failed to create account	Pass
4	Authenticate user login after click "Create Account" button on login form with null email input value.	Login Email: null Password: ngkahweng	Show input required for the email form.	Pass
5	Authenticate user login after click "Create Account" button on login form with null password	Login Email: test@gmail.com Password: null	Show input required for the password form.	Pass

	input value.			

Table 7: Unit Testing 2: Create Account

5.1.3 Unit Testing 3: Top Up Time

Testing Objective: To ensure able to top up time for parking

No	Event	Attribute and Value	Expected Result	Result
1	Fill in the form with "character"	Top Up Form: "abfis"	Automatically remove non numeric data	Pass
2	Fill in the form with "symbol"	Top Up Form: "@%$^"	Automatically remove non numeric data	Pass
3	Fill in the form with "number"	Top Up Form: "143"	Successfully top up reservation time	Pass

Table 8: Unit Testing 3: Top Up Time

5.1.4 Functional Testing 1: Login with different account

Testing Objective: To ensure user login their personal account

No	Event	Attribute and Value	Expected Result	Result
1	Login as clouds1997@gmail.com user.	Login Email: clouds1997@gmail.com Password: ngkahweng	Login as clouds1997@gmail.com	Pass
2	Login as test@mail.com user.	Login Email: test@mail.com Password: ngkahweng	Login as test@mail.com	Pass

Table 9: Functional Testing 1: Login with different account

5.1.5 Integration Testing

Integration Testing will be performed both functional testing and unit testing have a result of with free of error. This module will integrate with other part of the modules or the main application. Both unit testing and functional testing are repeated in a loop until no more module exist in system and make sure all module in the system is performing accurately.

5.2 Verification Plan

The aim of verification plan is to test the application whether it successfully met the completeness of the project. It required developers to find out any possible of inputs and come out with its expected output. After that, both expected output and actual output will determine the level of completeness of the project.

Launch Parking Application		
Input	Expected Output	Actual Output
Click on application icon	Display animated splash screen.	Displayed
	Main menu interface will be displayed within 4 seconds.	Displayed around 3 seconds
	Display login page if not authorize yet.	Displayer login page.

Table 10: Launch Parking Application

Main Menu Layout		
Input	Expected Output	Actual Output
Click on 'Park Car' Button	Switch from main menu page to Zone Availability page	Displayed
	Number of parking lot left will be displayed.	Displayed with correct number.
	Name of each parking zone will be displayed.	Displayer with correct zone name
Click on 'Check Balance' button	Switch from main menu page to Balance page.	Displayed

	Balanced of the user will be displayed	Displayed with correct number.
	Fast top up button will be displayed.	Displayed
Click on 'Parking History' button	Date of parking will be displayed.	Displayed
	Time of parking will be displayed.	Displayed
	Parking zone will be displayed.	Displayed
	Status of the parking zone will be displayed	Displayed
Click on 'Scan and Verify Park'	Switch from main menu page to QR camera scanner page.	Displayed

Table 11: Main Menu Layout

Zone Availability layout		
Input	Expected Output	Actual Output
Click on either zone button	Switch from zone availability layout to Zone page	Displayed
	Parking lot that is available appear green	Displayed with green box.
	Parking lot that is unavailable appear red	Displayed with red box.
	The user's reserved parking lot will appear in yellow	Displayed with yellow box.
	Cancel Reservation button will appear in grey and not pressable when user currently did not reserve parking lot.	Displayed in grey color and not pressable.
	Cancel Reservation button will appear when user currently did reserve parking lot	Displayed

Table 12: Zone Availability layout

Zone layout		
Input	Expected Output	Actual Output
Click on either parking lot button	When user with no parking reservation, Confirmation message will pop out.	Displayed
	When user with parking reservation, cancel reservation message will appear.	Displayed
Click on 'Cancel Reservation' button	When user with no parking reservation, nothing will happen.	Nothing Happen
	When user with parking reservation, cancel reservation message will appear.	Displayed

Table 13: Zone layout

Balance layout		
Input	Expected Output	Actual Output
Click on 'TopUp' button	The value in form will be added into the balance.	Displayed with correct number.
Click on '15m' button	Balance time remaining will add 15minutes.	Displayed with correct number.
	When user with parking reservation, cancel reservation message will appear.	Displayed

Table 14: Time Balance layout

Parking History layout		
Input	Expected Output	Actual Output
Click on 'Flash On' button	Will turn out mobile flash light.	Flash light turned on.
Click on 'Front Camera'	Change camera from fore camera to front camera.	Change to front camera
Click on 'Pause'	Will capture the picture moment in shown in the screen.	Capture of picture is pause
Click on 'Resume'	Went back normal mode pause to resume.	Capture of picture is resume.

Table 15: Parking History layout

Chapter 6: Conclusion

6.1 Project Achievements

From the verification plan and testing operation in chapter 5.2, the actual output of the parking actual outputs of the parking application are getting good results as manage to reached all expected outputs and fulfilled the project objectives. In the end, this project manages to helps the parking management system with the parking recommendation which reduce the traffic on the road by guiding user to a parking zone with more number parking lot available. Besides that, reservation method allow user to book the parking lot beforehand and give user a parking confirmation. Other than that, payment system will give all the user equal chance getting the parking space. This will also prevent user hogging the parking space where they do not have any task on hand. Furthermore, this application will give user visibility where it can know the number of parking space left in the zone. This will let user know the current situation in the parking zone and plan their parking area beforehand.

6.2 Project Review

The aim of this mobile parking application is to let students and staff get equally chance of obtaining parking lot. Everyone can use the parking lot without bidding the car sticker which only allow specific user to use the parking lot. Besides that, users will be able to know the availability of a parking zone and number of parking lot left in the zone beforehand which greatly enhance the management system in campus. Furthermore, to fix the traffic congestion problem where user might block the road when waiting for parking lot to be available, recommendation of nearby parking zone is implemented into this application so that user can go to nearby parking zone instead of waiting at the side of the road.

6.2.1 Project Strengths

This proposed parking application uses QR code to confirm the parking space that user reserved which prevent user park to the wrong parking space. This idea is new and novelty as parking application found in the market store do not use this method.

6.2.2 Project Limitation

Although the parking application permit user reserved parking space, but other user might violate the system by park their car without using the application which will affect the correctness of the parking application.

6.3 Implementation Issues and Challenges

In this project there are several technical challenges experience along the way. First and foremost, some development tools are need to figures out before project can be proceed. Primary, there are many platforms of integrated development environments (IDE) such as Android Studio, Visual Studio, Eclipse and Netbeans that needed to take into account. Platform of Netbeans IDE and Eclipse IDE are old and required extra plugin to integrate into the system when developing mobile applications. Ever since year 2016, Google announced that they are no longer providing support to these plugins which make them harder to implement into the system. Between Android Studio and Visual Studio, Android Studio is appraised as the best IDE platform among all IDE platform.

Furthermore, there are two type of mobile operating system, android operating system and iOS which are mostly use in Malaysia. By taking into consideration of user ability to use the proposed application into their respective mobile, flutter operating system is chosen to be use in this project. Since flutter is able to code both android operating system and iOS in a single language, it can provide both android and iOS user respective apk to install.

On the other hand, issues face in this application will be lacks of packages to be implement to the application. Since flutter is new to the market, its communities consider average and some feature like Google Direction unable to implement to this application. Implementation of google direction or MapBox was proposed. Guiding

module like navigation that guide user from their location to the targeted parking zone when the user choose low number of parking lot. Unfortunately, due to the reason of current flutter lacks of develop package, therefore it is not possible to implement guiding feature to this application.

Since it is using dart language. Thus, time is needed to learn this language when developing this application.

6.4 Future Work

There some improvement can be made in the future. First and foremost, change the login authentication method to using UTAR email and password. The current account can be created by anyone who manage to get a copy of the application or created through someone mobile phone with the application. This means that someone might able to created an account use that to authenticate into the system. This will create issues of unauthorize user which do not belong to the campus using this application.

Secondly, the current parking application layout does not look pleasant to the user. Buttons, animations, golden ratio of the screen can be applied to the application to make the application look more appealing and attracting to the user. Dull and bland layout of the application will annoy user and user might abandon using this application due to this problem.

Next, since project normally required data to perform some kind of system. Therefore, collecting data are important for projects. The users parking data are collected into the database could be used to perform analysis on it. It can greatly contribute to others project by providing data of the user to the campus.

Finally, by making use of the data collected from the user, algorithm like prediction of parking space available and prediction of user behavior can be done. By using these algorithms, a better and advance system where user can approximate know the time left until the next parking space available can implement into the system.

6.5 Conclusions

In current world, most of the parking application are using high technology and expensive device to show the availability of the parking zone to the user but in some area these devices might not suitable to implement on the parking site. Therefore, hopefully through this project enable developer to solve this problem by implement Quick Response (QR) code instead.

This project has the features of showing the number of available parking slot in zone and Graphical User Interface (GUI) of the parking area to the user. This will allow user to gain prior knowledge of the parking slot availability and interact with the interface which is easy to understand.

The main challenge of this project is to implement map guidance feature which Flutter haven't include this feature to the system yet. Thus, map guidance feature will be done in the future project.

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Mobile Application for Parking Lot Management at University Campus

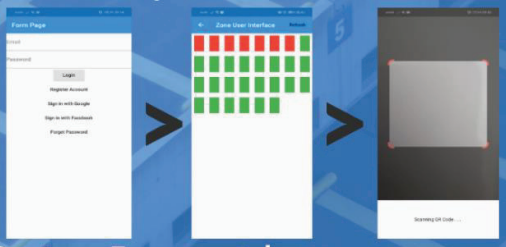
Introduction

To develop a campus parking system with mobile application.

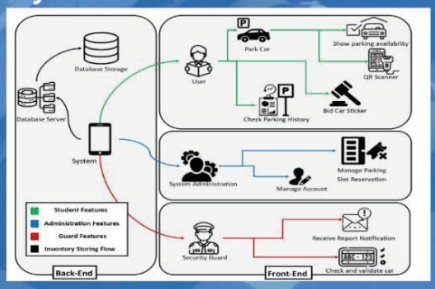
Discussion

1. To implement QR code on the parking application.
2. Improvement parking effectiveness.
3. Reduce the time wastage on parking.

Preliminary Work



System Framework



Conclusion

-Introduce cost saving method.
-User have better time management.
-Admin easier to manage the parking area.
-Reduce posibility of coming late.

Mobile Parking Application

Developer by:
Ng Kah Weng

Project Supervisor:
Ts. Dr. Liew Soung Yue

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
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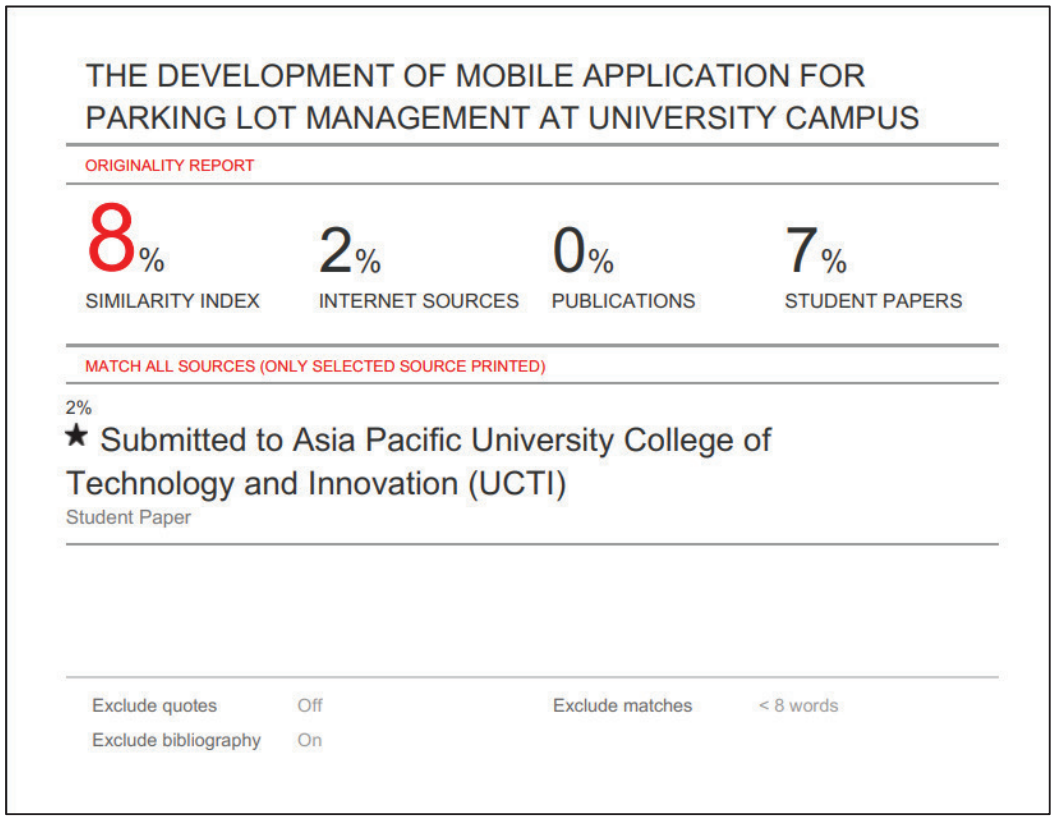

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Signature of Supervisor

Name: Liew Soung Yue

Date: 24/4/2020

Signature of Co-Supervisor

Name: _____

Date: _____

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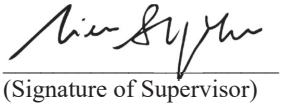
FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	15ACB06335
Student Name	NG KAH WENG
Supervisor Name	Ts Dr Liew Soung Yue

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Front Cover
√	Signed Report Status Declaration Form
√	Title Page
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
NA	Appendices (if applicable)
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.  (Signature of Student) Date: 23 March 2020	Supervisor verification. Report with incorrect format can get 5 mark (1 grade) reduction.  (Signature of Supervisor) Date: 24/4/2020

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 1,2
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Fixed existed in the application where it receives the wrong data and incorrect data storing method.

2. WORK TO BE DONE

Implement map guiding feature.

3. PROBLEMS ENCOUNTERED

Firebase authenticate service expired and need to renew.

4. SELF EVALUATION OF THE PROGRESS

Need to make sure the system takes the correct data.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 3,4
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Search for navigation of map package to be implement into the flutter application. Found few packages that could be apply into the flutter. Check packages documentation to understand the usage and how to use it into the application. Try to apply to the application but the result was only Google map without the guiding feature.

2. WORK TO BE DONE

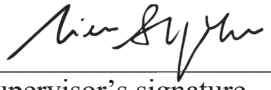
Search for map which direct user to the targeted location package

3. PROBLEMS ENCOUNTERED

Flutter community is too small. Hard to find solution for showing widget.

4. SELF EVALUATION OF THE PROGRESS

Too focus on a single feature which lead to not having too much progress on the project.



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 5,6
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Continue searching for the map guiding feature. Found another one package provided by MapBox. Understand their documentation and test them using project system. Register MapBox requirement for using their service. MapBox provide navigation for the user.

2. WORK TO BE DONE

Implement MapBox navigation into the system and guide user to the targeted parking zone.

3. PROBLEMS ENCOUNTERED

Use latitude and longitude and guide user to the targeted location.

4. SELF EVALUATION OF THE PROGRESS

Not enough knowledge of Flutter coding method. Need keep on refering to the internet.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 7,8
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Application now can navigate to the destination location after some code changes. Added Splash Screen to the application.

2. WORK TO BE DONE

Complete process of parking a car needs to be done.

3. PROBLEMS ENCOUNTERED

Bug found during making parking reservation. When user reserved parking space, close and reopen the application, it doesn't open.

4. SELF EVALUATION OF THE PROGRESS

Should not spend time on animation which wasted some time

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 9,10
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Fixed reservation problem and implemented the time balance to the application. Where user will deduct time once they reserve parking space until reservation cancel or run out of time.

2. WORK TO BE DONE

Method to top up user parking time

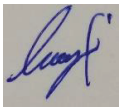
3. PROBLEMS ENCOUNTERED

MapBox doesn’t start when pressed.

4. SELF EVALUATION OF THE PROGRESS

Time spend on the project is not enough.

Supervisor’s signature



Student’s signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3, Y3	**Study week no.:** 11,12
Student Name & ID: Ng Kah Weng 15ACB06335	
Supervisor: Ts Dr Liew Soung Yue	
Project Title: THE DEVELOPMENT OF MOBILE APPLICATION FOR PARKING LOT MANAGEMENT AT UNIVERSITY CAMPUS	

1. WORK DONE

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

Completed the whole process of parking a car. Added parking time top up feature and Show user parking history.

2. WORK TO BE DONE

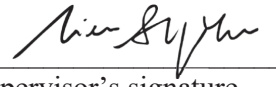
Find alternative for the map guiding feature.

3. PROBLEMS ENCOUNTERED

MapBox provided faces some error therefore need to find alternative solution.

4. SELF EVALUATION OF THE PROGRESS

Need work harder on the project.



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