

EV CAR RIDE-SHARING SYSTEM IN UPM SERDANG CAMPUS

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LIST OF ABBREVIATIONS

UPM	Universiti Putra Malaysia
EV	Electric Vehicle
COMS	Chotto Odekake Machimade Suisui
TABM	Toyota Auto Body Malaysia
TABJ	Toyota Auto Body Japan
Kyutech	Kyushu Institute of Technology
IDE	Integrated Development Environment
VR	Virtual Reality
OS	Operating System
SMS	Short Message Services
SDK	Software Development Kit
API	Application Programming Interface
GSM	Global System for Mobile Communications
GPS	Global Positioning System
AVD	Android Virtual Device
RAM	Random-access memory
ERD	Entity Relationship Diagram

CHAPTER 1

INTRODUCTION

1.1 Project Background

With the rise of social media that promotes communication among personnel over the internet has stimulate the innovation of utilizing the power of connectivity among them. Among the ideas of sharing information, ride-sharing is one of the promising growing trend for the technology field, and is proven so with the rising of ride-sharing service in all around the world.

As the emergence of sharing economy gradually arise in this modern society, the ride-sharing community and industry are further developing into different segment, where it is divided into driver and driverless ride-sharing. The examples of ride-sharing with driver are Uber and Grab, and the example for driverless ride-sharing would be bike-sharing such as oBike and MoBike. With these real world implementation of the concept of ride-sharing, the sharing economy is proven successful, as it builds up a brand new wave of investment into technology industry.

There is difference of ride-sharing, which could be further categorized into model that supplies both drivers and vehicles, or model that supplies only transportation itself. The example from industries for the model are stated above. The method in running both system is different as well, as the navigation of the transportation are different as the coordination of the supplied vehicle is not mobile if there is no driver present. For this project, the model that only supplies transportation only, will be taken in as the main case of investigation.

With the model being stated, certain function must be carried out so that the coordination and scheduling of the usage time by user could be synchronized, and functional at the same time. By arranging the sequence in manual, everything could be done easily but complicated and time

consuming at the same time. With that, certain intelligent system must be combined into the model to enhance the automation so that manual operation can be replaced. Artificial technologies are one of the exciting technology that is being developed and paid attention on, so that it is able to be placed into the system in making it more intelligent, as well as automating certain tasks which reduces manpower and saves time in general.

In relation to the case in UPM Serdang campus, MyCOMS is a type of electric vehicle that only have one-seated, which provides difficulty in terms of mobility. When the car is being driven to some other place, it is hard to get the car back to original place, unless there is someone who is responsible in returning the vehicles to the desired location at the start. The daily demand of the electric vehicle differs with stations, as the number of student and staff that has different schedule to go to every places in the campus. Thus, the deployment of the vehicle is crucial, as it is best to place the vehicle at stations which has the most traffic at the start of the day, to ensure that it serves its purpose in providing mobility to students and staffs. With this it is hope that the overcrowded and the over-capacity issue of the number of passenger for transportation currently provided.

By combining both model and the technology specified above, it is hoped that it can be transformed into a better and more intelligent system that would benefit users, and the administration at the same time.

1.2 Problem Statement

The issue arise is that time taken in travelling in the campus is high with the public transportation provided that covers the area. With ride sharing among students, it is targeted to solve the over-crowded issue with the limited mode of transportation. Full utilization of networks within the students is expected to generate and create a safe environment and community which makes every ride smooth.

Students, staff and every personnel that is in UPM Serdang campus will face traffic problem, when it comes to peak hour travel, and also certain ad-hoc event and program hosted in the campus. One of the most significant event that adds up to the traffic issue would be annual convocation which will last for a week. And weeks before the convocation ex-students will be returning to the campus in retrieving their graduation robe and to submit documents. This will

even add up to the normal traffic volume. This can be solved if there is a shared network that can be used in coordinating vehicles by demand. User can expect the availability of vehicle and book it in advance, and use it when they need it the most.

The one-seated MyCOMS only has 3 units available for the UPM Serdang Campus. Users must be able to utilize it fully, only through sharing of a pool of same network. The availability and whereabouts of the vehicle must be updated almost instantly to allow everyone in the network to view its status, and decide on the usage of it. Certain limitation to the vehicle must be considered, such as battery level, destination of journey, and usage demand. The vehicle will be useless if there is not enough power to run. The vehicle will have limited source of user if destination of a journey is targeted at remote area of the campus. The vehicle must be placed properly at stations where there is higher demand to serve its purpose.

1.3 Aim and Objectives

The aim of this project is to develop a fully working secured in campus ride-sharing application.

The objectives of this project are:

1. To design and create an EV ride-sharing application in UPM Serdang campus.
2. To predict station level demand of EV.
3. To evaluate the system design performance.

1.4 Project Scope

The project will be focusing on the development of a ride-sharing Android application. The main mode of transportation which is going to be used in this project would be the Toyota Chotto Odekake Machimade Suisui (COMS), which is later rename as MyCOMS by Universiti Putra Malaysia (UPM), in hopes to promote green technology in the Serdang Campus. The COMS is a single-seated ultra-compact electric vehicle, which carry the meanings of ‘smooth, short rides into town’. Three COMS are received, and it represents the collaboration between UPM, Toyota Auto Body Malaysia (TABM), Toyota Auto Body Japan (TABJ) and also Kyushu Institute of

Technology (Kyutech), Japan. This project will have high similarities of the model of bike-sharing, as the COMS is a single-seated vehicle, and can only be transported whenever there is driver on it.

The proposed mobile application which specially created for mobile device with platform of Android is expected to build to coordinate and monitor the MyCOMS vehicle. It is targeted to provide efficiency for users to manage the booking of the MyCOMS, and also for the administration team to have full time monitoring of the vehicle whenever it is.

1.5 Report Outline

The thesis consists of five chapters, which includes introduction, literature review, methodology, result and discussion, and conclusion.

- Chapter 1 - Introduction to the background of the involved EV which is MyCOMS, and the targeted ride-sharing android application. Problem statements are defined in this chapter. The aims and main objectives of the project are also discussed in the chapter too. Project scope is declared at the end of the chapter.
- Chapter 2 - Literature review of the related research on the ride-sharing industries, including vehicles with driver, and also vehicles that are driverless. The existing ride-sharing application are studied, compared and discussed in this chapter. Main focus of the project which is the ride-sharing android application is discussed in the chapter.
- Chapter 3 - Methodology used in the overall flow, outline and the process of the project. The related materials and equipment such as hardware and software involved: Android devices, Android Studio IDE and MyCOMS are discussed. The architecture of the android system is further explained in this chapter. The emerging idea of developing this ride-sharing application is further discussed in the same section of the chapter.
- Chapter 4 - The result and discussion which shows the screenshot, and also the performance evaluation of the application. The problem faced throughout the application development and project deployment are discussed in this chapter.
- Chapter 5 - Conclusion of the whole project in the last chapter of the thesis. This chapter will includes the application development, the evaluation findings and also the future works possible for the application are discussed in the chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the case study of the operational model of ride-sharing and bike-sharing application will be discuss thoroughly. The existing system of the application will be studied especially on features, limitations, advantages and disadvantages will be discussed throughout this chapter.

2.2 Ride Sharing

Public transportation plays a significant role in daily lives of Malaysian citizens as it connects each other to the desired destination. Some of the most common form of public transportation such as bus, train, taxi and others, where one of the mode has occupancy lesser than 40% which is taxi in the form of vehicle. One of the reasons is that the service and cost of hiring a taxi is not proportional as customer feel there is unfairness in it [1]. Monopolized and bad behavior of driver are also the reason for the low using rate of taxi. As compared to the other transportation, taxi carries the highest mobility and flexibility, with no tracks needed as compared to trains, and wider roads for busses, it is simply the best mode of transportation for short distance around a certain area.

But since the occupancy rate of taxi is low, and special infrastructure needed for trains and bus, families with higher purchasing power can afford to buy a vehicle for daily travelling purpose. With that the cars on the road increases gradually which leads to high traffic on daily commute. Cars are not fully utilize if it carries only one passenger, and leads to the main reason for creating

traffic jam commuting from one place to another. This can be solved by pairing users together with the same destination up to the maximum capacity of the car, the traffic condition could be reduced at least 4 times as compared to the worst case scenario mentioned earlier. But how do people solve that by knowing who is the exact person that has the same destination with the departing location within a close range? Analyzing the field of software development integrating with social media, this is made possible when information is shared on a platform which is to be viewed publicly, and user with high similarity will be known and paired which makes up to solving the case earlier. Crowdsourcing the data would automates the whole process and reduce the effort in exploring potential user in the domain of traffic and transportation [2].

These sharing economy business is built not only on the technology advancement, but also in a sense of “trust” among each other [3]. The sharing of object among strangers solely rely on trust, is the key of success to the service provided, and it can be provided with a little help from technology. Building of platform ease the communication among each other. Tracking of whereabouts and usage rate can be monitored and viewed, in order to prevent unwanted events to happen. User will not be easily affected by words and saying from another user, and instead it will be affected by mainly the service provider’s performance and reputation [4].

2.3 Bike Sharing

Since the operational concept of the Android application of MyCOMS is roughly similar to bike sharing system, the case studies done by researchers will be discussed in this section to further differentiates the difference comparing to ride-sharing application. According to Shaheen, bike sharing system is currently one of the transportation system in major cities, in solving congestion problem, as well as the ‘last mile problem’ which can be further defined as the distance between home and the transit station, which can be too far to walk [5]. Most of the big cities are using bike sharing as the solution for users in commuting between places where transit station is not available. Ricci has stated that bike sharing has a network of bicycles which spread across an area of strategically positioned ‘bike sharing station’, which can be used by user for point-to-point journey purpose in a period of time [6].

With the reference made, the similarities is shown between bike sharing and MyCOMS application, where both of the application involves deployment of vehicles at stations, and allow users to book and use it for a period of time, for point-to-point travel purposes. However the downside of both application is that the vehicles would require rebalancing every day, as the demand will differs according to the factors based on the stations. The demand will fluctuate based on several aspect such as the weather, time of travel, location of station, population of station and etc., where every element plays important role in affecting the usage level of the application.

In order to rebalance the vehicle deployment, example and reference are taken from bike sharing model. Several research were done in predicting the demand as rebalancing of vehicles is always an issue for the service provider, with various method used. To avoid wastage of manpower in providing mobility in allocating the cars at the desired location, artificial intelligence system is adapted into the system. According to Syed, their study in forecasting bike demand using fuzzy interference mechanism has proved that the un-optimized fuzzy interference system can outperform un-optimized traditional feed forward neural network, and concludes that simple fuzzy interference based prediction is sufficient [7]. Author also uses input parameters such as weather, holidays and number of user. Randomize of input is first done, and the system is run 5 times to ensure that the data obtain is accurate and consistent. This paper shows that the prediction using fuzzy logic is feasible, and is not limited only to using neural network for forecasting purpose.

Other than that, user's trip can be predicted as well according to the research which based on the fuzzy logic based trip generation model [8]. The prediction on user's trip is important as it affect the demand level of each station in a whole. A notification can be sent to user as an alert of vehicle availability if the prediction data matched with the real-time data. A similar research on the user's journey prediction is done as well [9] train predict. It predicts the passenger flow on journey from station to station. From it the traffic management can be done effectively as it helps in providing mobility to the vehicle in reaching stations which have high demand. This paper models the flow with fuzzy logic, adding features of passenger demand to the mode of transportation [10].

With the high number of bicycle in a network of bike sharing system, a group of researcher did simulation optimization, to make sure that resources of bike sharing are shared and used equally [11]. A proper data retrieved from the network can be mined and analyzed for future

transportation improvements [12]. Collaboration between modes of transportation will improve the strength and weakness of each other, which brings more benefits to the users.

However comparing on the artificial intelligence method that are involved in prediction, several researchers have use different method such as planning algorithm and searching algorithm [13] [14]. Fuzzy logic will be used for this application as the data and number of input which the system has to deal with, is not complicated compared to the large network node in bike sharing system. Simple system for daily prediction require several input is suffice.

2.4 COMS

COMS is a single seated electric vehicle that is designed and manufactured by Toyota. According to the specification obtained from Toyota Auto Body Japan's Corporate Social Responsibility Report 2013, COMS is a fully electric powered vehicle, that uses lead battery which can supply mileage of 50km per charge. COMS is able to run at a maximum speed of 60km per hour, and it has noises which is generated at below 71dB at acceleration, and even lower at 65dB when it is constantly running [15]. It is targeted to serve user that would like to make short trip easier and more convenient. COMS has been deployed in several region of Japan, aiming to reduce carbon emission, as well as navigating through the narrow roads in most area of Japan. Its performance has won itself a Nikkei MJ Outstanding Award, which further strengthens its identity among community.

Researchers have used COMS in various field, which ranges from entertainment field to safety autonomous featured ride on the road. A virtual reality (VR) system is modeled based on motion car, which in this case COMS was used as the platform [16]. The COMS was deployed as a motion platform, where it provides simulated motion sensation to the VR user with autonomous driving. User will control the car with VR controller and headset, where vision through the headset will feel the motion when the car is synchronized. It is mentioned that COMS is used as it is easy to control and modify, which allow the developer to create more enhancement on the vehicle with the application of the technology.

Another group of researchers have tried to utilize communication between vehicles by programming the vehicles to undergo platooning among each other [17]. By having platooning

and communication established among COMS, it is effective to notify users on availability, and enhance security features as the vehicles can communicate with each other. Safe distance are maintained with this features installed, data can be retrieved for analysis on the driver's driving behavior. With the autonomous driving system developed from the past, this feature can be installed on COMS to provide more mobility around the campus [18]. Single-seated MyCOMS has a limitation where it will have limited access when it is being driven to location which is not populated. The vehicle is not able to be used by people from other station, if there is no one to drive it from a remote station. The deployment of vehicle every morning can be scheduled automatically with autonomous driving, in arranging starting location of MyCOMS at a more strategic location.

The battery level can be monitored and tracked as previous researcher has done the research in tracking and managing the electric demand and usage for electric vehicle [19]. With this feature the battery level can be monitored and even predicted daily, in order for the vehicle to function properly throughout the day without having issue of user is stuck in the middle of the journey due to low battery level. A total number of trips can be counted and predicted in advance based on the daily real-time data, and is then charged to prevent the stated issue to happen.

2.5 Android

Android is the software package chosen for developing the MyCOMS system, where it includes several main components, such as operating system (OS), hardware drivers, middleware, and core applications [20]. The preferred programming language for Android was previously Java, and it is now officially supporting Kotlin and Java from an official statement from Google [21].

2.5.1 Android Architecture

The architecture can be divided into 4 levels, which are Application, Application Framework, Libraries and Android Runtime, and Operating System.

Level 1 - Application

This layer has a set of core application provided from the android develop and support team, which includes maps, email, SMS, calendar, default web browser and others. This layer provides interaction between user and the machine. Customized software application can be used here for interaction between users too. It is the top most layer of the architecture, and can be written in Java or Kotlin programming language.

Level 2 - Application Framework

This layer has multiple Activity Views which is helpful in developing and building an application. It includes grids, lists, Buttons, MapView and etc., which can be embedded easily into application with certain lines of code.

Level 3 - Libraries and Android Runtime

This layer is the third layer and it has a set of libraries which has most of the functionality in the core libraries of Java programming language.

Level 4- Operating System

This layer implies that Android is run on a Linux Kernel, where it uses several services such as memory management, security, network stack and etc. This layer serves as the interaction phase between the hardware and the software in the machine.

Figure 2.5.1 shows the overall architecture level as explained as above.

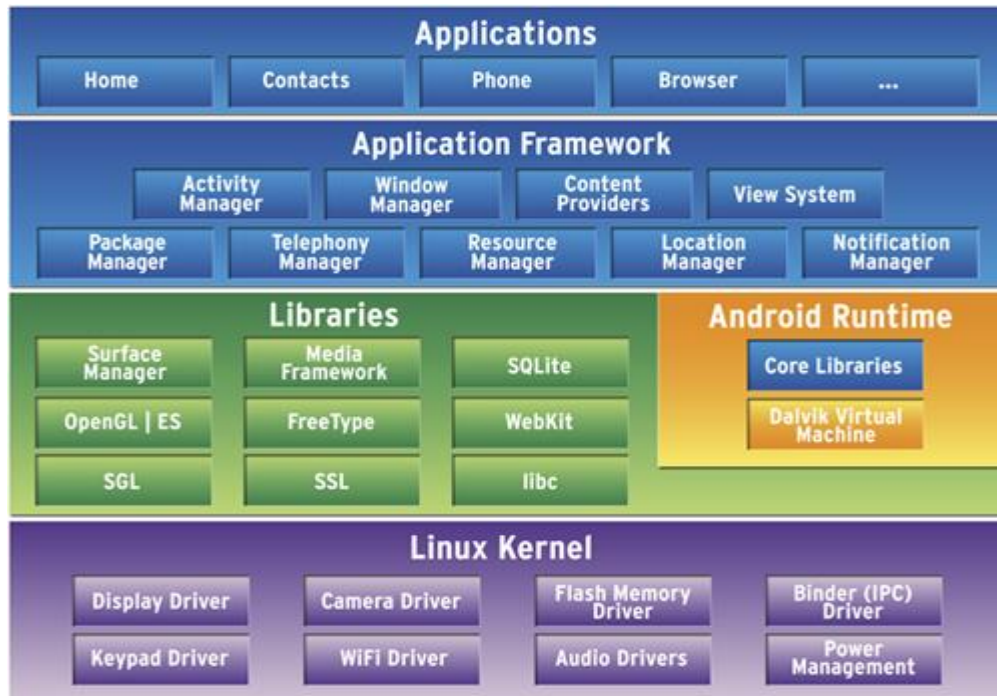


Figure 2.5.1: Android System Architecture

2.5.2 Android Application Development

Android application will be built using Android Software Development Kit (SDK) and Android Studio Integrated Development Environment (IDE). The IDE has all the tools required, and has support from the official Android developing team on plugin and software updates.

SDK provides software packages, software framework, sample code and application software development tools. It has Application Programming Interface (API) and tools provided for development of application for Android platform with the use of Java and Kotlin programming language. Basic tools such as debugger, libraries, emulator, documentation and etc. are included in the SDK.

2.6 Google Map

Google has released the API, which is developed to allow interaction between google services with internet content into web or mobile application. It acts as a black box, in receiving input of user, and process it, and is able to return the query with a Street view scene.

Researcher have use the combination of Google Maps together with GSM modem, in providing tracking and locating services of vehicle [22]. Usage of smartphone which has both of the function, will allow the tracking and locating vehicle for monitoring purpose more convenient. According to this paper, the vehicle fleet management system can be polished with the tracking using GPS [23]. A software is created for the tracking purposes as data is retrieved from the real-time update of the system. The system can be even be more advance with the implantation of GPS system on a System-On-Chip, and built in into the vehicle [24]. The same tracking method is also applied in this project, and it is fully deployed to evaluate the system performance [25].

2.7 Review of Similar Application

2.7.1 oBike

oBike originates from Singapore, provides the security features between user and the bicycle, by having the user to scan QR code via the oBike app or enter the bike ID found on the bike. The application also allow bike booking, and is reserved under the user's name for at most 10 mins. The sign up process requires phone number, and requires the user to allow permission on location so that nearest oBike can be found on the map via the oBike app. Payment can be done via Credit and Debit cards, and more payment option will be available later. It also has the Bluetooth technology to allow the users in locating the bicycle for a higher accuracy, and to identify the bicycle if there is a lot of them.

2.7.2 MoBike

Mobike that originates from China, has a lot similarities in terms of application as compared to oBike. The difference between these two companies is that the location of deployment is different, and the infrastructure of the bicycle is different as well. The

application allow user to book for 15 minutes, and is able to view the final location of bicycle when the trip is ended.

2.8 Summary

As outlined in the previous section, there are several application that can be referred to, and the features in it such as QR code scanning, Bluetooth location detecting and GPS location identifying can be adapted into MyCOMS application. The overall architecture of the developing structure of Android is explained and outlined to have more insight on the functionalities of the components. Several studies on the ride sharing and bike sharing system is done, and is relatable to MyCOMS application as it requires sharing of vehicles and time of usage optimized between desired users. Therefore, a hybrid version of ride-sharing which is MyCOMS application is needed in order to tackle the targeted vehicle, and improve the overall deliveries to the users.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The main ideas to be carried out, development process and cycle, hardware and software needed will be discussed in this chapter.

This project is targeted to create a ride-sharing application in Android, which is suitable for staffs and students in UPM Serdang campus, in travelling in between faculties and major location point using MyCOMS. This application will be developed using Android OS, and will be installed in an Android smartphone or tablet.

The project development cycle is represented graphically in figure 3.1, as it shows the overall flow of the project is developed.

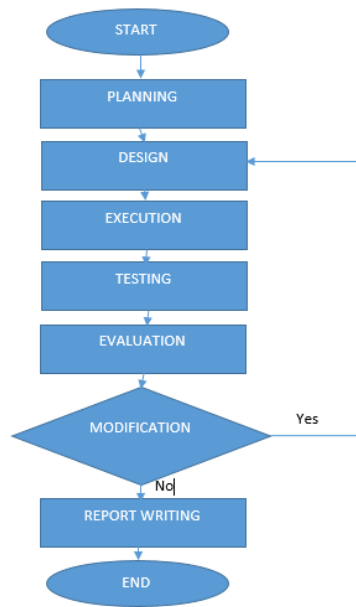


Figure 3.1: The flowchart of the proposed project

The first stage of the project is to carry out planning. It is carefully plan and a scope of work is detailed out in order to efficiently handle the project. Problem statement, aim and objectives are identified so that goal is clearly defined, and the project will be stay focus on track through the process of development. Timeline and Gantt chart is drawn in order to track and plan the project progress in order to complete it within the given time period.

After the goals are set, design is carried out together with the teams that is involved with the MyCOMS application development project. Rounds of discussion and decision have been made in order to achieve the targeted functionality of the application. Based on that, the software and hardware requirement are discussed and decided. Choices of programming language and IDE is done, which is Java as the main language of development, on Android Studio, which to deploy the Android application on an Android compatible devices.

During project implementation, the application will be installed on devices, and real time data must be captured in order to evaluate the system performance. Testing and debugging is done to ensure that minimal bug activity is supervised. If there is no modification to the project, it will advance to the last stage where it is discussion of result and conclusion.

3.2 Software and Hardware Requirement

The software required for this project is Android Studio and Adobe Experience Design. The following section explains the roles of having these software for the development for the project.

3.2.1 Software Required

3.2.1.1 Android Studio

Android Studio is an open source IDE and free software which is released by Google, mainly targeted for developers which aims to create application for Android platform. It has pre-installed library, sample code, tools and etc. required in creating an application. It has workspace and extendible plug-ins available to allow customization for Java application development.

3.2.1.2 Adobe Experience Design (Adobe XD)

Adobe XD is a user experience design software developed by Adobe Systems. It is a pay to use software, and offers 7 days of free trial. It allow users to do design and customization on the user interface of an application, and allow the interface to be modelled into an application with limited function of interface. It supports vector design and wire framing, and allow users in creating simple interactive click-through prototypes.

3.2.1.3 Android Virtual Device (AVD)

AVD is a built-in emulator by Android Studio, which allow users to create a mock Android device without having it in real life. Customizable RAM, OS and pixel setting can be done to simulate the created application before deploying it on the real-time devices. It is used in testing and debugging phase of the project as the codes must be tested out frequently to check the functionality, and several model of Android devices can be tested in order to know the flaw of the software before deploying it on market.

3.2.2 Hardware Required

For the project, computer and smartphone is a must as it is the basic tools needed in developing the application. MyCOMS electric vehicle will be involved once the application is ready to deploy, in order to get real time data to evaluate the system performance.

A system block diagram is shown as in Figure 3.2.2.1 in order to visualize the relationship between each component. It is illustrate as below.

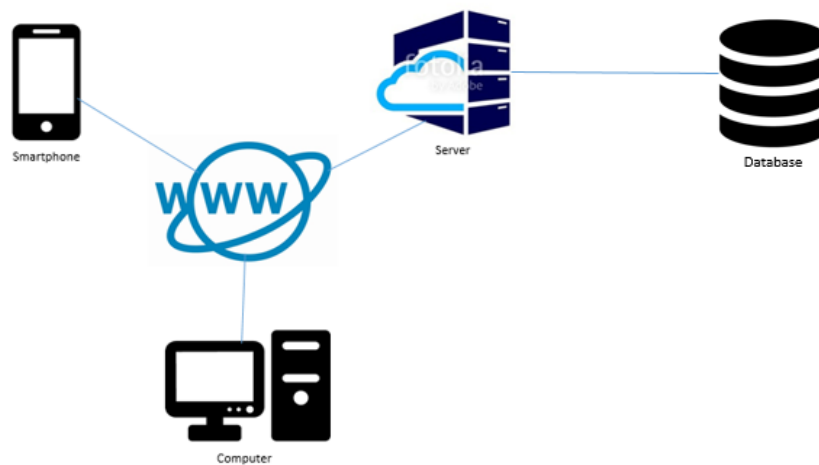


Figure 3.2.2.1: System block diagram of the project.

The application will be linked to computer and database through internet and server. User will be using the application, while the administrator is able to view the activity through the server, and analyses the data through the database. This step is important as it allow the administrator to evaluate the system performance.

3.3 Application Design and Development

For the design of the application, a flow of required function is detailed, with the targeted group of users. The flow is represented in Figure 3.3.1.

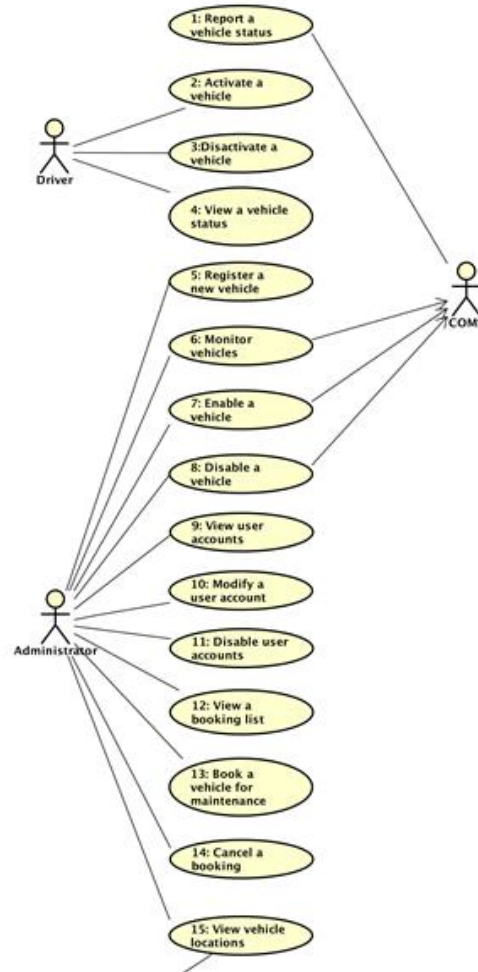


Figure 3.3.1: Use case diagram for the application.

Firstly, the main screen of the application will prompt user input of identify, such as matric number and password for security purposes. New sign up user will have to register themselves, while registered user have to log in just once, unless the user log out after every session. The application will have selection where user is able to book the vehicle and check the availability with real-time synchronization of database. Once the booking is done, user will be able to start the application as a navigation application, where it will route between the starting and the ending point of the trip. System will alert the user if the route is detected to be out of course from the targeted location. Abnormal activity of the application by user will be recorded and uploaded to the database for reference purposes.

3.3.1 Firebase Database

Firebase is an online database that is released by Google, to allow more control of Android application. This database allow android application to store and synchronize data in real time. Firebase allow encryption of 2048-bit SSL for the protection of the data. It has custom authentication and access control for developers to suit their application development specification.

Firebase can be used in cross platform development, such as iOS, Android and also Web development. User will need to sign up an account in Firebase, the API can be easily embedded into the application and to create connection to the server. Firebase saves time as it does not require extra scripting on server-side.

Figure 3.3.1.1 shows the entity relationship diagram between the elements in the database.

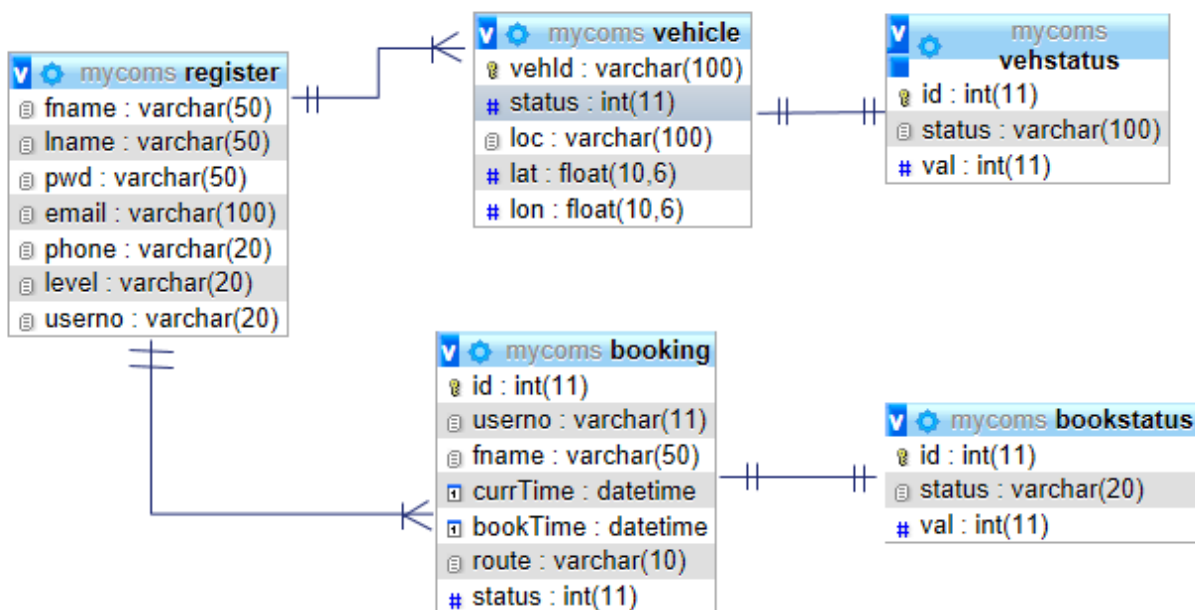


Figure 3.3.1.1 Entity Relationship Diagram

3.4 Testing and Debugging

AVD emulator will play important role for this stage of development. It will allow the application development process into easier and more convenient. Customization of Android

devices can be done so that developer can predict and observe the errors that might happen if the application is deployed real-time.

For final stage of the development, application will be tested on several Android devices such as Samsung J7, and emulated device in terms of resolution.

3.5 System Requirement

3.5.1 Functional Requirement

System is defined by a group of functions which is required to run. A system requirement consists of functional and non-functional requirements which has constraints to the design and implementation.

Below shows the table in displaying functional requirements, labelled by ID.

Table 3.5.1.1: Functional Requirements.

ID	Description	Explanation
FR1	Users must be able to sign up.	The user must be able to sign up with relevant matric number, name, email and password.
FR2	Users must be able to sign in.	The user must be able to log in using matric number and password.
FR3	Users must be able to log out from the system.	The user must be able to log out from the session.
FR4	Users must be able to change their profile details.	The user must be able to change profile details such as password, email, name and matric number (if there is no duplicate).

FR5	System must provide error recognition message.	System must be able to generate error message when one of the log in, log out, and sign up process encounters error.
FR6	Users must be able to book a ride.	User must be able to view availability of ride and book it.
FR7	Users must be able to cancel a ride.	User must be able to remove the booking from the ride list.
FR8	Users must be able to launch the driving mode of the ride.	User must be able to start the tracking and monitoring features of the application.
FR8	Users must be able to end the driving mode of the ride.	User must be able to end the tracking and monitoring session.
FR9	Users must be able to launch emergency contact.	User must be able to get in touch with administration team in case any emergency happens.
FR10	Users must be able to view the location of vehicle.	User must be able to see the current whereabouts of the vehicle to decide on booking.
FR11	System must be able to generate error message.	System must be able to recognize faulty process throughout the launching of application.

3.5.2 Non-Functional Requirement

A non-functional requirement of a system will define what a system will do, but not the way the system will do it. Several parameters such as system performance requirement, design constraint and software quality attributes are one of the example of non-functional requirement.

The system's related non-functional requirements are given below:

Table 3.5.2.1: Non-Functional Requirements.

ID	Description	Explanation
NFR1	The graphic user interface should be user friendly, and maintain a style for all screens.	The buttons, menus and layout should maintain the same design for all screens so that user will not be confuse with different design of buttons.
NFR2	Notification message should be display clear and concise to the user.	System will display message in pop up window in informing user.
NFR3	The application must not be affected by bugs, and will inform user on wrong steps taken using the application.	System must be checked in possible of bugs, and only be released when no harmful bugs are found.
NFR4	The application will have fast response time.	The system should provide operation and react to instruction very fast.

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APPENDICES

PROJECT GANTT CHART SEMESTER 1 2017/2018

No	Activity	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Project Design and Planning -Determine the best UI/UX for the application with the related functions and features.														
2.	Project Technology Decision Making -Research on the best technology in applying the functions and features into reality. -Constantly check the compatibility between structure and technology used.														
3.	Task breakdown -Breaking down project into smaller parts to track the progress.														
4.	Proposal Completion - Literature review - Finding relevant technical papers and sources for reference - Methodology - Project management														
5.	Project Execution and Testing - Carry out testing phase weekly to ensure module done par with the functionality designed for the site.														
6.	Project report and presentation preparation - Prepare slides relevant to the topic - Report submission.														

PROJECT GANTT CHART SEMESTER BREAK 2017/2018

No	Activity	Week				
		1	2	3	4	5
1.	Project Execution and Testing - Carry out testing phase weekly to ensure module done par with the functionality designed for the site.					
2.	Algorithm Debugging and Simulation Testing -Test the algorithm with regression. - Constantly check the functionality by modelling case and running simulation.					
3.	Project report and presentation preparation - Collect data for the remaining chapter. - Prepare slides for the upcoming presentation session.					

PROJECT GANTT CHART SEMESTER 2 2017/2018

No	Activity	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Application Testing -Alpha testing and Beta testing for the application. -Performance measurement based on user's activity.														
2.	Project Modification -Modify the project based on user's feedback.														
3.	Project Report Completion - Literature review - Result and discussion -Abstract - Methodology - Project management														
4.	Project Report Submission. -Prepare presentation slide and poster.														
5.	Project presentation preparation - Prepare slides relevant to the topic														
6.	Apply for Copyright - Prepare necessary document for the application.														