

PETRONAS Pit Stop Mobile Application

by

Muhammad Fauzan Bin Mohd Idrus

15945

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Business Information System)

MAY 2015

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

PETRONAS Pit Stop Mobile Application

By

Muhammad Fauzan Bin Mohd Idrus

A project dissertation submitted to the
Business Information System Programme
Universiti Teknologi PETRONAS
In partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
(BUSINESS INFORMATION SYSTEM)

Approved by,

(Dr Ahmad Sobri Bin Hashim)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

May 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgement, and that the original work contained herein have not been undertaken or done by unspecified sources or persons

MUHAMMAD FAUZAN BIN MOHD IDRUS

ABSTRACT

PETRONAS Pit Stop Mobile Application is an Android-based application to be used on smartphones. The problem discovered behind development of this mobile application to be caused by consumers' difficulties in determining the right lubricant to match with their vehicles and lack of knowledge in lubricant area. In conjunction with the problem discovered, the objective of this project is to identify the criteria for selecting the right lubricant for a specific type of vehicles. The other objectives are to develop Android-based application called PETRONAS Pit Stop will incorporate all elements that have been identified and to evaluate the application in terms of user acceptance. It is designed to create awareness on importance of selecting the right lubricant oil for vehicles in order to increase engine and vehicle performance. For this purpose, PETRONAS Pit Stop Mobile Application will act as knowledge-based application to provide users with lubricant oil recommendation that match with user specific type of vehicles in Malaysia and also helps to save favorite vehicles and set reminder for the vehicle components. Android operating system (OS) is chosen as the platform for this application because Android is proven to be efficient, easy access and also the uses of this application are diverse for all types of android smartphones. In terms of methodology, Rapid Application Development (RAD) methodology will be applied because of short time frame to complete this project which is 28 weeks. Phone Gap software is used in developing the application prototype and will be tested by using Samsung Galaxy S5 smart phone. Functionality testing has been conducted to 5 respondents in order to test the functionalities of this mobile application based on the requirement collected during Analysis and Design phase in Rapid Application Development (RAD) model. User Acceptance Testing (UAT) also has been conducted to 15 respondents who owned vehicles, motorcycles and heavy duty vehicles have been randomly selected to performance User Acceptance Testing (UAT), mainly staffs and students from Universiti Teknologi PETRONAS (UTP) in order to ensure that this application does actually meet the essential user requirements.

ACKNOWLEDGEMENT

“Praise to Allah, the most Gracious and the most Merciful”

First and foremost, I would like to express my deepest gratitude to Allah who gave me the strength to face all of the challenge and problems throughout the final year journey. I would like to express my deepest appreciation and gratitude to the following people who help me in completing the whole Final Year Project.

First of all, I would like to offer my sincere gratitude to my supervisor, Dr Ahmad Sobri Bin Hashim who has guided and assisted me throughout my Final Year Project with patience and knowledge whilst allowing me to work in my own way. Although with a tight schedule as a lecturer and coordinator of Final Year Project course, he still offers his valuable time to assist me in completing the whole project even during office hour. I

Besides, I would like to thank to all the parties and friends involved who are willing to assists me in completing the research survey and also system evaluation. These responses helped me a lot in acquiring as much data and information as possible. Additionally, I would like to thank to Mr. Abdul Jalal Bin Abdul Jalil from PETRONAS Lubricant who are willing to provide me with all the data and information in order for me to complete the project.

Other than that, special acknowledgement to the Computer Information Sciences (CIS) department for managing and give students opportunity to do this individual project as well as to enhance our knowledge and skills.

Last but not least, I would like to thank my parents who always giving me the moral support along the completion of my final year project. Without their support, I would not make it this far in completing the whole final year project.

Table of Contents

| | |
|---------------------------------------------------------------------------------------------|-----------|
| Chapter 1: Introduction | 1 |
| 1.1 Background of Study | 1 |
| 1.2 Problem Statement | 3 |
| 1.2.1 Consumer have difficulties in determining the lubricant | 3 |
| 1.2.2 Lack of knowledge in lubricant area | 3 |
| 1.3 Objective | 4 |
| 1.4 Scope | 4 |
| 1.5 Relevancy of Project | 5 |
| 1.6 Feasibility of Project Within the Scope and Time Frame | 5 |
| Chapter 2: Literature Review | 8 |
| 2.1 Introduction | 8 |
| 2.2 Lubricant | 8 |
| 2.3 Global Lubricant Oil Industry and Demand | 8 |
| 2.4 Importance of Adopting/Adapting Certain Marketing Strategy to Market Lubricant | 11 |
| 2.5 Importance of ICT/IS as One of Strategies to Market Lubricant Industry | 13 |
| 2.6 Existing System/Application | 13 |
| 2.7 Summary | 17 |
| Chapter 3: Research Methodology | 20 |
| 3.1 Development Methodology | 20 |
| 3.2 System Architecture | 28 |
| 3.3 Gantt Chart | 30 |
| 3.4 Tools and Equipments | 31 |
| Chapter 4: Result and Discussion | 32 |
| 4.1 Criteria of Selecting the Right Lubricant | 32 |
| 4.2 System diagram | 32 |
| 4.2.1 Activity Diagram | 32 |
| 4.2.2 Class Diagram | 34 |

| | |
|---------------------------------------------------------------|-----------|
| 4.3 Final Prototype | 36 |
| 4.3.1 Mobile Application Information | 37 |
| 4.3.2 Mobile Application Function | 39 |
| 4.4 Functionality Testing | 44 |
| 4.5 User Acceptance Testing (UAT) | 49 |
| Chapter 5: Conclusion and Recommendation | 50 |
| 5.1 Conclusion | 50 |
| 5.2 Recommendation | 51 |
| References | 52 |
| Appendix | 54 |
| Appendix 1: Interview Questionnaire | 54 |
| Appendix 2: User Acceptance Testing (UAT) Questionnaire | 55 |
| Appendix 3: User Acceptance Testing (UAT) Result | 56 |
| Appendix 4: Coding of the Application | 62 |

LIST OF FIGURES

| | | |
|--------------------------------------------------------------------------|----|----|
| Figure 1: Percentage of Lubricant Demand for 2000 and 2013 | 11 | |
| Figure 2: SWOT Analysis for Lubricant Manufacturing Company in Iran | | 12 |
| Figure 3: Aral Lubricant Interface | 14 | |
| Figure 4: Shell miGarage Interface | 15 | |
| Figure 5: Mobil AU Interface | 16 | |
| Figure 6: Rapid Application Development Methodology | 21 | |
| Figure 7: System Architecture | 28 | |
| Figure 8: Gantt chart | 30 | |
| Figure 9: Activity Diagram | 32 | |
| Figure 10: Class Diagram | 34 | |
| Figure 11: Prototype Main Screen | 37 | |
| Figure 12: Main Function Flowchart | 39 | |
| Figure 13: Application Main Page | 41 | |
| Figure14: Select Vehicle Interface | 41 | |
| Figure 15: Select Brand Interface | 42 | |
| Figure 16: Select Engine Interface | 42 | |
| Figure 17: Select Option Interface | 42 | |
| Figure 18: Recommendation Page Interface | 42 | |
| Figure 19: My Pit Stop Login Interface | 43 | |
| Figure 20: Reminder Page Interface | 43 | |
| Figure 21: Set Date Interface | 43 | |
| Figure 22: Functionality Test Result | 47 | |
| Figure 23: User Acceptance Testing (UAT) Result | 49 | |
| Figure 24: Gender Result | 56 | |
| Figure 25: Profession Result | 56 | |
| Figure 26: Age Result | 57 | |
| Figure 27: Vehicle Result | 57 | |
| Figure 28: Functionality Performance Result | 58 | |

| | |
|--------------------------------------------------|----|
| Figure 29: GUI Design Result | 58 |
| Figure 30: User Friendliness Result | 59 |
| Figure 31: Operational Performance Result | 59 |
| Figure 32: Application Concept's Result | 60 |
| Figure 33: Lubricant Recommendation Result | 60 |
| Figure 34: Save Time and Cost Result | 61 |
| Figure 35: Track Vehicle Components Result | 61 |
| Figure 36: Code 1 | 62 |
| Figure 37: Code 2 | 62 |
| Figure 38: Code 3 | 63 |
| Figure 39: Code 4 | 63 |
| Figure 40: Code 5 | 64 |
| Figure 41: Code 6 | 64 |

LIST OF TABLES

| | |
|---------------------------------------------------------------------------------|----|
| Table 1: Comparative Study of Functionality for Lubricant Mobile Application... | 17 |
| Table 2: Advantages and Disadvantages of Lubricant Mobile Application | 18 |
| Table 3: Functional Requirement 1 | 24 |
| Table 4: Functional Requirement 2 | 24 |
| Table 5: Functional Requirement 3 | 24 |
| Table 6: Functional Requirement 4 | 25 |
| Table 7: Non-Functional Requirement 1 | 25 |
| Table 8: Non-Functional Requirement 2 | 25 |
| Table 9: Main Page Button | 38 |

CHAPTER 1

INTRODUCTION

1.1 Background of Study

PETRONAS (Petroliam Nasional Berhad) is a Malaysian oil and gas company which is wholly owned by Malaysian Government. PETRONAS is the corporation which is vested with the entire oil and gas resources and is entrusted with responsibility of developing and put values to these resources. PETRONAS Lubricant International (PLI) is a global lubricant manufacturing and marketing arm of PETRONAS where it offers full range of high quality automotive and industrial products. Apart from that, it is also the technical resource behind PETRONAS Technical Partnership to MERCEDES AMG PETRONAS Formula One Team. Their role is to design, develop and deliver the Fluid Technology Solution.

This PETRONAS Pit Stop Mobile Application aims to provide consumers and workshops with a knowledge-based mobile application in which it can help them to identify the right lubricant recommendation for specific type of vehicles in Malaysia including description of lubricant, customer advice, customer benefit, application of lubricant, lubricant specifications and health safety environment. Besides, this application also helps our target users to save their favorite vehicles and set reminder for the vehicle components. By developing this mobile application, it is believed that it may help consumer to create awareness on the importance of lubricant oils on how to improve the engine and vehicles performance.

We always need something electronic in our hands as a devices to connect with people, interact with people through social network, email and others. In general, mobile application is the application that can run on the smart phones, tablets and other mobile devices while smart phone is a multifunctional device that not only communicates but it helps people to learn, earn and have fun (Clark, 2015). Previously, mobile phones are commonly used as a medium for making call and sending text to communicate to others. As the technology improves, the functions of smart phones changes rapidly where smart phones can be used for social networking, education, financial, knowledge-based, Android games and others. In fact, people nowadays preferably spend most of the time with smart phones rather than personal computer for their work task, leisure and others.

Price of smart phones and smart devices would not be an issue anymore nowadays. In the market, the price of the best smart phones we can get as low as RM 600 to as expensive up to RM 3600 in Malaysia. Therefore, it can be concluded that our target users to use this application can afford to buy and have at least a smart phone or smart devices, as the price of smartphones and smart devices depreciate because of wide range of offerings in market by producer.

This project target users are user who own car and any workshops in Malaysia. Consumers and workshops in Malaysia can use this mobile application in order to create their awareness on importance of matching the right lubricant oil with their specific type of vehicles including technical and safety data sheets as well as improve their engine and vehicles performance through information given.

1.2 Problem Statement

1.2.1 Consumer have difficulties in determining the right lubricant to match with their vehicles

Selection of proper lubricant is critical to vehicle performance (Sander, 2009). In order to determine the right lubricant to match with specific type of vehicles is the most crucial element for consumers. Oil is blood of car. Oil will circulate through the engine and cools the parts that cannot get near the water jacket. If the wrong type of lubricant chosen, engine will be in the high risk of increased wear, corrosion and formation of blockage in the engine. Thus, it will cost consumers a high cost of maintenance and can lead the engine to be broken.

Significant: this free download Android application is developed as a knowledge-based mobile application to help consumers and any workshops in Malaysia to recommend the right lubricant oil to match with their specific type of vehicles including description, customer advice, customer benefit, and application, specifications and health safety environment of vehicles for their user's references. In parallel, this mobile application helps target users to keep their engine in a good condition based on the information given.

1.2.2 Lack of knowledge in lubricant area

Lack of knowledge in lubricant area may lead to misuse of lubricant for both the quantity and quality of lubricant used (Kojima, Brandon & Shah, 2000). Not all of target users have enough knowledge in lubricant oils area as they are busy with the daily works and activities. However, the author might think that knowledge in lubricant oils area is actually mandatory for them as their general knowledge. When we talk about lubricant oils for vehicles, few elements will involves including change of oil, topping up the engine oil, choice of lubricant oil and others.

Significant: This application is developed to provide our target users with general knowledge of lubricants oil including description, customer advice, customer benefits, applications, specifications and health safety environment for specific type of vehicles as for their references. Users of PETRONAS Pit Stop mobile application can save their own vehicles and track their important dateline on few elements such as check brake pads, change fuel filter, change oil filter, check tyre pressure finance payment, insurance, road tax and service through My Pit Stop functionality.

1.3 Objective

In conjunction with above problem statement, this project is aimed to:

- a) To identify the criteria for selecting the right lubricant for specific type of vehicles in Malaysia
- b) To develop Android-based application called PETRONAS Pit Stop that will incorporate all elements that have identified
- c) To evaluate the application in terms of user acceptance

1.4 Scope

To fulfill the project objectives and ensure the project to be realistic, both objectives and all the requirements necessary are combined to complete this project. By properly defining the scope of the project would benefit the author complete this project within the time frame. Due to the time constraint, the author is expected to focus only for “Lube-Match” functionality and “My Pit Stop” functionality. However, the other functionality of this mobile application will comes later. The scopes of this project are breakdown into 4 items:

- a) Content
 - Information knowledge for lubricant oil that match with specific type of vehicles including technical and safety data sheets

- My Pit Stop functionality will consists of few elements covered from change brake pads, change fuel filter, change oil filter, check tyre pressure, finance payment, insurance, oil change interval, road tax and service, where user can set the dateline and set as reminder according to elements they are selected.
- b) Platform
- Running on Android platform
- c) Target user
- Consumers and workshops in Malaysia

1.5 Relevancy of Project

By developing this mobile application, it will contribute to the Malaysian community on importance of lubricant oil as well as help target users to identify the right lubricant oil that match with their specific type of vehicles. Second point that the author would like to highlight is that the ability of this mobile application to set and track the dateline of vehicle's elements through "My Pit Stop" functionality. Therefore, the relevancy of this project is that PETRONAS PitStop is relevant to developed and help to create awareness for target users on importance of lubricant oils selection for their vehicles' engine.

1.6 Feasibility of Project Within the Scope and Time Frame

Before starting the initial phase of the study, the feasibility study is required in order to ensure the research is possible and smooth the development stage of this study. Feasibility study is being separate in 5 categorize as below:

Technical Feasibility

From the author technical point of view, this study is feasible. The technical part of this study begins in the prototypes cycle stage which consists of 3 sub-stages such as develop, demonstrate and refine where this study is expected to developed a mobile application for target users who owned vehicles and any workshops in Malaysia. It consists of two major functions which help the target users and workshops to identify the right lubricant recommendation to match with the specific types of vehicles and helps to set the reminder on vehicles components for further action. Technically, this mobile application is possible to develop as the author has the programming knowledge and learn from the internet.

Economic Feasibility

It is expected that the development cost for this mobile application will be low. As the author already equip with good hardware and software, no direct material cost will be incur and keep the cost for the development low.

Organizational Feasibility

In the pre-research, the study shows that there is some weakness the author identified on the user's side in determines the right lubricant for specific type of vehicles. With the increasing trend of using smart phone throughout the world, the author would expect that this study and development of this mobile application will be supported by the target users.

Scope Feasibility

The area of research is basically cover in Malaysia, but due to the time constraints and to save tome for data collection, this study will only be focus on the research in the Seri Iskandar, Perak. Besides, the focus on the research will be focus on the

target users' behavior in choosing the lubricant for their vehicles as well as the effect on performance of particular vehicles. In order to gather this information, the author has conducted the interview with some of the staffs and students from Universiti Teknologi PETRONAS (UTP).

Time Feasibility

The feasibility of my project within the time frame by focusing on the requirement planning and prototyping as well as to start at least develops a preliminary interface. Further with development phase, the development of this mobile application will be using web-based language through Phone Gap software and the database software that will be used is Firebase. With the month provided, it is expected every activities can be done according to the timeline.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In general, lubricant is a substance introduced to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generated when surfaces move. Most important function of lubricants is to reduce of friction and wear and in some cases; the relative movement of two bearing surfaces is only possible if a lubricant is present (Mang, 2007). In terms of components inside lubricant oils, on average account about 90% of lubricant consumption, which consist of about 93% base oils and 7% chemical additives and other components (between 0.5% and 40%). For automotive industries, engine lubricant plays an important role to reduce the internal friction between piston and shear of moving mechanical parts to further improve the engine performance and efficiency.

Besides, long term corporate strategies is also a part of key element for lubricant manufacturers which mainly focused on oil quality and diversification of products and services in line with meeting the customer requirements, standards, rules and regulations at national and international level. The strategy plan system of companies is implemented by major investment projects caused by a number of factors such as location of area, tax incentives, land cost, construction cost and other major factors that might involve (Ciopi, 2010).

2.2 Lubricant

The main purpose of lubricant oil is to reduce friction between surfaces in mutual contact, where lubricant oil works as fluids to reduce the heat generated when the surfaces moves as well as lubricant oil will acts as transmitting forces, transport the foreign particles and also as a heating and cooling surfaces. Besides, lubricant also is required to perform varieties of protective and functional jobs so as to provide hydrodynamic film between moving components including heat dispensing, suspending contaminants, acid neutralization and preventing corrosion (Sivarao et al, 2012). All equipment's used lubricant oil such as machinery and engines require lubricant oil to work efficiently and effectively in order to prevent them from break down, overheat, explode as well as to avoid accidents from happening. Another factor that would consider in order for lubricant oil to work efficiently and effectively is oil replacement. Typical lubricant oil can sustain between 5,000 km to 10,000 km mileage depending the type of used by consumers (Sivarao et al, 2012). Therefore, it is important for consumers to keep alert on oil replacement depending on consumer's type of used because without frequent oil changes, dirt and sludge will occupy the engine. Hence, the dirty oil will not lubricate the moving parts as fresh oil will and can lead to serious damage on the engine.

2.3 Global lubricant oil industry and demand

Worldwide, there are 1380 lubricant manufacturers ranging from larger to small. As for 2007, there are about 180 of lubricant manufacturers contribute to national and multinational companies engaged in manufacturing lubricants and 1200 independent lubricant companies mainly focus on the manufacturing and marketing lubricants and put lubricants as their main business. For national and multinational companies they focus only on high volume lubricants such as engine, gear and hydraulic oils.

Lubricant manufacturer in the world and Europe has about 297 plants in 27 countries (Mandakovic, 2011). However, the main disadvantage is that this estimation not mentions the existing producers in Croatia (as this research for Croatia). After all, in Croatia have total of 13 manufacturers of lubricants and related products and consists of two major manufacturers which are INA Company and Patting Company. In addition, study for market strategy in Central and Eastern Europe shows that there are two major oil market players: Austrian OMV Company, Hungarian MOL Company and LUKOIL, a Russian Company. Their investment strategies and policies contributed to decisive extent lead to the development and consolidation of oil industry in countries of Central and Eastern Europe. Basically, LUKOIL Company produced the lubricants for engine oils, transmission oils, gear oils, hydraulic oils, and oils for turbines, compressors and bearings.

High performance of lubricants product are the key elements that must be produced by lubricant manufacturers in order to meet the current demand of industry. For example, in 1996, manufacturer of Volkswagen for Golf vehicle demanded a mandatory replacement for oil after 1 year and mileage of 15000 km. From 2010 the mandatory replacement for vehicle of the same class allows the replacement after mileage of 30000 km or 2 years. Some of the factors for performance characteristics of lubricants dominating and great influencing activity of lubricants in the world and in Croatia and wider region (Mandakovic, 2011). The factors are use of materials, stronger specifications and new tests, request for minor leakage, longer service life, greater efficiency of machine vehicle, better filtration systems and oil fill controls, improved oxidation and thermal stability, improved corrosion protection and application of new additive technologies for use of base oils. Reasons of the factors are because of new modern petrol engines that increased the power, speed as well as efficiency and new modern diesel engines have improved direct injection system, optimized system with supercharging and compressor system.

Pie chart below shows percentage of lubricant demand for Asia Pacific, Middle East, Africa, Western Europe, Eastern Europe, Latin America and North America. Based

on the pie chart, Asia Pacific has account for the highest lubricant demand in 2013 which is 42% (Gosalia, 2014)

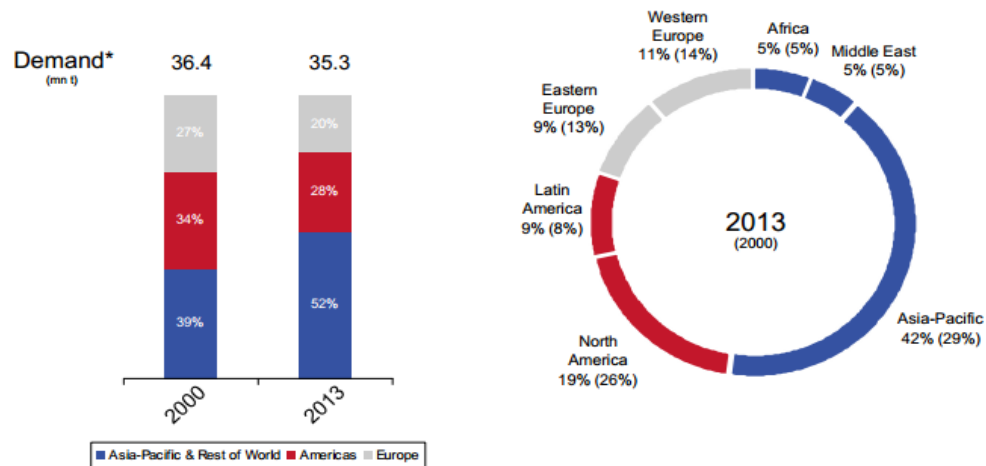


Figure 1: Percentage of Lubricant Demand for 2000 and 2013

Sources from:

http://www.fuchsoil.de/fileadmin/fuchs_upload/pdf_addons/CSR/ICIS_2013_London_Key_NoteApu_Gosalia_FUCHS_PETROLUB_SE.pdf

In facts, highly demanded of lubricant market in Asia-Pacific, Africa, Middle East and South America lead PT.XYZ Company to improve their brand image through co-branding with SAS Company who is known as one of the local oil company in Spain. According to (Adipurwa, F.G.P., & Nasution, R.A., 2012), they study the co-branding strategy through joint venture of PT>XYZ company and SAS company to improve their brand image into the international level. This is also one of the strategies where the company analyze the market trend of lubricant, hence come out with business strategy in order to improve their business up to international level.

2.4 Importance of adopting/adapting certain marketing strategy to market lubricant

Marketing strategy provides an organization, for this case is lubricant industry to provide further estimation of environmental changes as well as the preparation for

lubricant industry to react towards changes. Marketing is activity, set of institutions and processes for creating; communicating, delivering and exchanging offerings that provide value for customers, clients and society in general (Varadarajan, 2009). These strategies will act as the organization’s tools to be used in order to reach long-term goals. Therefore, the marketers will play their important role to identify all the strategic plans for the organization. However, not all strategies will be selected as part of organization strategies. Therefore, strategic analysis is used to select only desired strategies in line with organization goals (Sagheai & Fazayeli, 2012). In order to select strategy, there will be 3 steps involves which are creating strategy, evaluation strategy and also evaluation strategy (Sagheai & Fazayeli, 2012).

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><u>STRENGTH</u></p> <ul style="list-style-type: none"> • High quality • Good customer trust • Having engine oil standards • Exempt from tax due to exports • Using one-solution software to handle stock, accounting and sales | <p><u>WEAKNESS</u></p> <ul style="list-style-type: none"> • Lack or marketing and advertisement • Dominating low profit wholesales instead of focus on high profit retail sales • Not reach full production capacity due to lack of used in oil supply |
| <p><u>OPPORTUNITY</u></p> <ul style="list-style-type: none"> • Possibility of purchasing new machines to eliminate last production step • Expanding market up to international level • Gasoline price increase due to removal of subsidies | <p><u>THREAT</u></p> <ul style="list-style-type: none"> • Lack of commitment from used oil providers to supply raw materials • Lack of specific laws for buying/selling used oil • Lack of reputation of product brand in market • International sanctions |

Figure 2: SWOT Analysis for Lubricant Manufacturing Company in Iran

(Sagheai & Fazayeli, 2012)

Company or organization may use the marketing strategy method as their approach to identify and evaluate their strength and weakness as well as use their business opportunity to overcome threats. As stated by (Mwaawaru, 2009), marketing can lead the organization to decide in building its focus on satisfaction of its target customers, increase sales growth and revenue as well as competitive advantages. Therefore, this marketing strategy might drive the lubricant company to sustain in market, offer product differentiation and also generate higher revenue.

2.5 Importance of ICT/IS as one of strategies to market lubricant industry

According to (Kundishora, 2010), ICTs are referring to the technologies that are used to collect, store, edit and communicate the information in various form. Information and Communication Technology (ICT) acts as an automation of process, controls and information production using computers, telecommunication and software to optimize the running activities (Agbolade, 2011). It has been proven that ICTs give very positive impact towards industries where it results in improvement to the market competitiveness of products and services.

2.6 Existing system/application

For this technology comparative study, the author managed to get three existing mobile application that related to lubricant oil. Comparative research will identify the value and effectiveness, outline central problems and overcome the problems by identifying the solution (Mills et al., 2006). Based on this technology comparative study, the author will explain the functions of each existing mobile application and integrate best out of the best functional requirement to be used to develop PETRONAS Pit Stop Mobile Application.

1. Aral Lubricant Mobile Application

Aral Lubricant mobile application will provides to the independent workshop and consumers who are interest in using technology to use Aral products. Aral Lubricant Mobile Application provides their independent workshops and end consumers with up to date product and safety data sheets, product catalogue with latest approvals and specifications, oil guide with search function, self-explanatory image and technology videos and some overview of advertising materials. The most important function od Aral Lubricant mobile application is to provide the independent workshops and end consumers with the right lubricant oil for the specific vehicle.

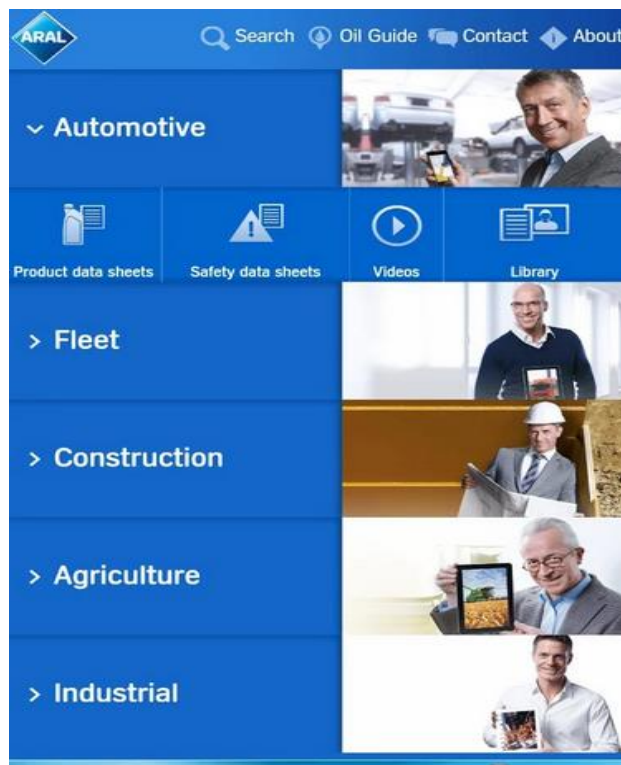


Figure 3: Aral Lubricant Interface

2. Shell miGarage Mobile Application

Shell has launched its own mobile application as Shell miGarage where the mobile application can store dates for services and checkups when it will send push notifications (Lepitak, 2014) Shell miGrage mobile application main objective is to provide consumers vehicles and equipment maintenance where consumers may add their vehicles and equipment to own garage to keep track of reminders relating to consumers vehicles or machines. This will ensure consumers do not miss important deadlines or legal obligations relating to maintenance and upkeep of vehicles or machines under consumer's control. Besides, Shell miGarage also provides their consumers other functionality such as to identify the right lubricant oil for specific vehicles or machine through "Shell LubeMatch", email recommendation directly from mobile device, last searched functionality, miGarage, news and promotion for user to keep up to date with all the latest Shell lubricant products.



Figure 4: Shell miGarage Interface

3. Mobil AU Mobile Application

Mobil AU mobile application is owned by Mobil Australia Company used by world's leading lubricant suppliers as their online marketing strategy to help sell their products to equipment owners and service workshop in the region of Asia Pacific. The main feature of this mobile application is NetLube, in which it helps to match equipment manufacturer's lubricant with latest lubricant products. Owners and service may choose the specific type of vehicle, manufacturer, model of the vehicle, compartment of vehicle and the mobile application will help them to by recommend the details of specific lubricant oil match with their characteristics.

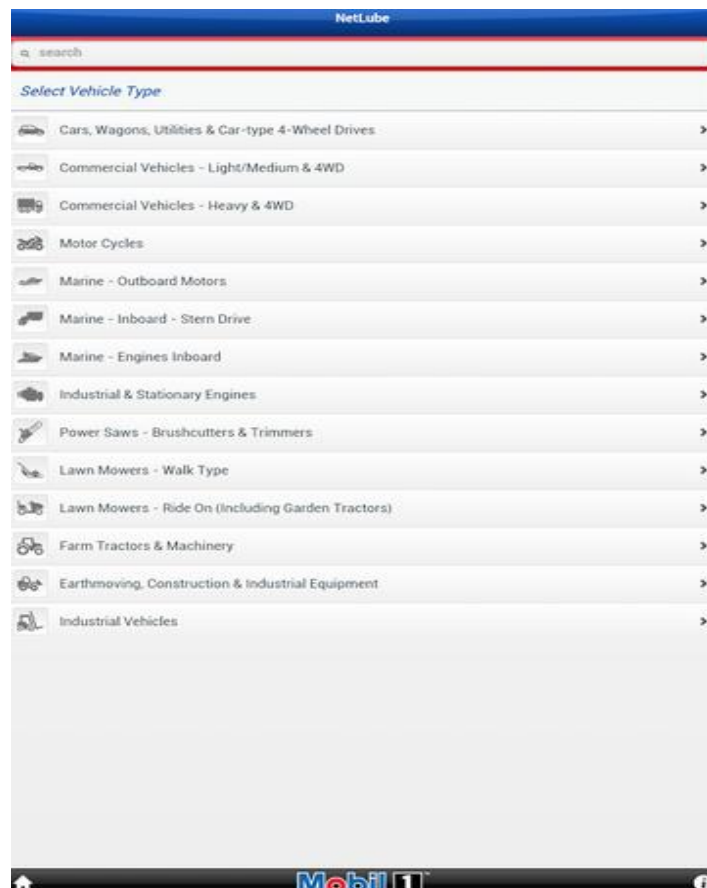


Figure 5: Mobil AU Interface

2.7 Summary

Based on the existing comparative study between three types of lubricant mobile application, the summary of all three mobile applications are provided in the table below:

Table 1: Comparative Study of Functionality for Each Lubricant Mobile Application

| Functionality | Lubricant Mobile Application | | |
|------------------------------------------------------|------------------------------|-------------------|----------|
| | Shell miGarage | Aral Lubricant | Mobil AU |
| LubeMatch | / | / | / |
| Quick search functionality | / | / | / |
| Last search functionality | / | X | X |
| News & promotions functionality | / | X | X |
| Question & recommendation functionality | / | / | X |
| Up to date product & safety data sheet functionality | X | / | X |
| Own garage functionality | / | X | X |
| Built in LED flash functionality | / | X | X |
| Information resource (image or videos) functionality | / | / | / |

Table 2: Advantages and Disadvantages of Mobile Application

| Mobile Apps | Latest Updated | Advantages | Disadvantages |
|--------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shell miGarage | April 22, 2014 | Can assist consumers to choose the right lubricant for their specific vehicles/machinery and consumers can save their favorite vehicle/machinery to keep track of reminder. It really help consumer to understand vehicle/machinery lubrication requirement. | The disadvantages that the author identifies based on user comments is this mobile application not update regularly. For example, no new vehicles launched in last 3 years in the list and not all models are covered in the list. |
| Aral Lubricant | December 17, 2014 | Can assist consumer to choose the right lubricant for their specific vehicles/machinery including product data sheets, safety data sheets, videos and library as for consumer's reference. | This mobile application display only basic information for specific lubricant that matches to specific vehicles/machinery. Besides, some of the functionalities are not functioning well. |
| Mobil AU | October 2, 2014 | Can assist consumers to choose specific lubricant match with their equipment/vehicle | Provides limited information about lubricant that match for consumer's specific vehicle to consumers |

Based on this technology comparative study and advantages and disadvantages of these three lubricant mobile application, the author concluded that all three types of lubricant mobile application has the same main objective which is to provide independent workshop and end-consumers identify their right lubricant to match with the specific vehicle or machinery. However, what makes these three mobile application differences are the functionality offers to end-consumers and independent workshops. By doing comparative study on functionalities between all three existing lubricant application available in the Google Store, the author decided to pick two main functional requirements to be included in PETRONAS Pit Stop Mobile Application which are Lubricant Match functionality and My Pit Stop functionality. In conclusion, the author believes that PETRONAS PitStop Mobile Application will help PETRONAS Lubricant to market their product as well as to remain their existing customers and attract new customers to use PETRONAS lubricant products in Malaysia.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Development Methodology

(Hameed and Oudah, 2014) claimed that system development methodology is a complete guidelines for developer to follow in order to complete all the activities in the system development. Development of mobile applications is a process of making application for mobile devices. Therefore, in order to develop mobile application for this project, the author chose one of the modern methods of development methodology to develop this mobile application which is Rapid Application Development (RAD). (Marius, 2010) stated that Rapid Application Development is end to end development life cycle in which it is based on premise that most of the part of IT applications are obtained in the less time than the others software solutions. Rapid Application Development offers the developer to quick response to business needs, risk control, documentation to the end product and also short development of time.

The author chose Rapid Application Development (RAD) as the development methodology in completing this project, after considering few factors. The reason of choosing Rapid Application Development (RAD) are to reduce development time, increases reusability of components, quick initial reviews occurs and encourages customer feedback. Due to the time constraints given to develop and complete this project which is 28 weeks, the author decided to choose Rapid Application Development (RAD) as the development methodology by focusing more on prototyping phase.

Rapid Application Development consists of 4 phases:

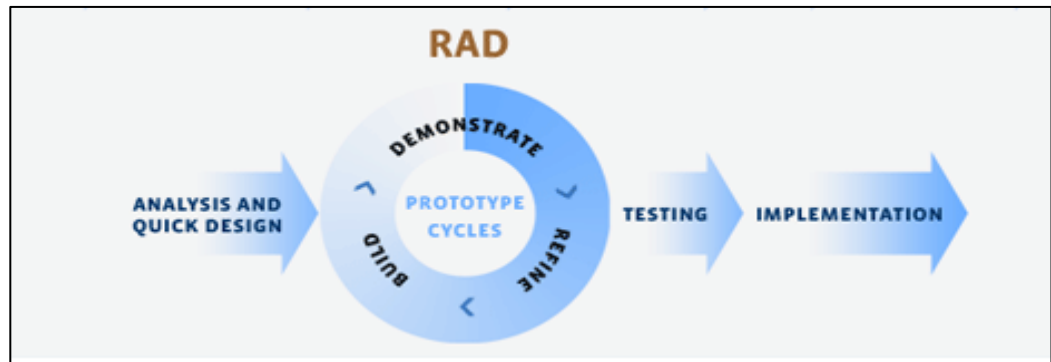


Figure 6: Rapid Application Development Methodology

Source from: Rapid Application Development. Retrieved March 1, 2015, from <http://www.testingexcellence.com/rapid-application-development-rad/>

Another research methodology that the author will use is pragmatic approach research. Pragmatic research approach is based on qualitative and quantitative research to collect information and results. Interview has been conducted to collect the results during testing phase in Rapid Application Development (RAD) phase. Few questions prepared by the author for collection data purposes and to understand what our target users' needs and wants in lubricant area.

Based on the interview, it is believed that our target customers have difficulties in determining the right lubricant that matches with specific types of vehicles. In terms of choices of engine oil, they realize that it was very important to select the right lubricant for their vehicles. In fact, if they chose the wrong lubricant for their vehicles, it will lead the engine at risk of increased wear, corrosion and formation of blockages in the engine and minimize the engine performance.

In terms of vehicle maintenance (change of brake pads, change of fuel filter, oil change and other components), road tax, insurance and finance payment, some of

our target users are not aware of due date to change their vehicle components, road tax, insurance and finance payment. For example, our target users might change engine oil before end of oil change intervals and some of them said after end oil change intervals. The best idea of change of oil intervals is before the end of oil change interval indicated by the manufacturer. However, there were some of them change engine oil after the end of oil change intervals in which it may affect the performance of engine and vehicles and worse case it may involve high cost of maintenance.

However, major concerned here is how our target users can have the specific information of lubricant that match with their specific type of vehicles. Previously, they only find the related lubricant information from internet, magazine and some of them went to nearest workshop, which it may involve cost and travelling and time.

Based on the results from the pragmatic research approach, it is believed that these results can be used for enhancement of the mobile applications according to needs of the user and our respondent's ready to use this mobile application once it was ready to use by them.

This project mainly uses Rapid Application Development (RAD) methodology, therefore, the author will explain in details the project activities based on each phase in Rapid Application Development (RAD) methodology. Four phases in Rapid Application Development (RAD) will be discussed in the next section.

a) Analysis and quick design

Analysis and quick design phase would require the author to list out any ideas of project and select a project topic as the Final Year Project title. Next step would require the author to identify the problem and objective of the project prior to the project title. Based on observation and comment from

users from other lubricant mobile application, the author found the user who owns car having problem to find the right lubricants for their vehicles, especially user who are using PETRONAS Lubricant. Other problem that the author identifies is there will be some possibilities where user chose the wrong type of PETRONAS lubricant oil for vehicles, caused by lack of knowledge in lubricant area. With that, the author came out with an idea to develop mobile application, called as PETRONAS Pit Stop mobile application that can help our target users with the right lubricants recommendation that match with specific type of vehicle used in Malaysia including description, applications, specifications, customer benefits, health safety environment and PDF file for them to get further information on recommended lubricant. Study on project background and do preliminary research works are important elements in this phase to gather all the information and study the trend within the scope of lubricant industry. Study on project background and do preliminary research works would require the author to find at least 15 articles related to the project title and summarize them in 5 pages. Once all requirements collected, next step will be drafting the literature review.

In terms of prototype, simple but meaningful prototype will be built upon complete collection of all the required requirements pertaining to the subject of project. Prototype can be developed by using many types of open sources and software provided in the internet such as Phone Gap, Android Studio and others. Therefore, the author would like to categorized type of requirements consist of functional and non-functional requirement. Functional requirement, in general, it should capture the intended behavior of the system. This behavior may be expressed as services, tasks, or a function of the system is required to perform (Malan & Bredemeyer, 2001). Meanwhile, non-functional requirement, in general, is requirements include constraints and qualities (Malan & Bredemeyer, 2001). Functional and non-functional requirement of application will be describe as follow:

- **Functional requirements**

After completed gathering all the required information by conducting interview and through observation, the author has been identify the business requirement for the prototype. All the requirements will be presented in the table below:

Table 3: Functional Requirement 1

| | |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function | Lubricant Match Functionality |
| Area | Functional requirement (target users) |
| Description | This application should be able to recommend the lubricant based on the elements previously selected by the user including description, application, specifications, customer benefit, health safety environment and also PDF file for users to get more information on recommended lubricant |

Table 4: Functional Requirement 2

| | |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function | My Pit Stop Functionality |
| Area | Functional requirement (target users) |
| Description | This application should be able to save user's favorite vehicles, stores date for service and check-up for vehicles components and also set the reminder |

Table 5: Functional Requirement 3

| | |
|-------------|---------------------------------------------------------------------------------------------------------------------|
| Function | Login Page for My Pit Stop Functionality |
| Area | Functional requirement (target users) |
| Description | This application should be able authorized user with registered username and password to login into the application |

Table 6: Functional Requirement 4

| | |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Function | Sign up for My Pit Stop Functionality |
| Area | Functional requirement (target users) |
| Description | If new user wants to have an account to login for My Pit Stop functionality, new user should sign up by entering their new username and new password |

- **Non-functional requirement**

Table 7: Non-Functional Requirement 1

| | |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Function | Run in Android platform |
| Area | Non-functional (developer) |
| Description | Android based smart phone are more popular among our target users, so the priority will be given to Android for application development |

Table 8: Non-Functional Requirement 2

| | |
|-------------|-----------------------------------------------------------------------------------------------|
| Function | Alert |
| Area | Non-functional (target users) |
| Description | Provide alert in terms of duplicate username and password and wrong password entered by users |

For non-functional requirement, this mobile application should focus on usability of the application. Usability is the ease of use and learnability of human-made object. The author should develop this application in simple and ease of use by user. When this application is simple and eases to use, this application will be more efficient for user to use it with less time taken to open, made selection and view the lubricant match details. As our target user will be in different level of expertise in using this application, therefore, this application should be built as user-friendly application. Thus, issues in use

the application will not be raised because the application is easy to use and manage especially for first time user.

b) Prototype cycles (Develop, Demonstrate and Refine)

- **Develop**

Prototype is a first or preliminary version of device from which other forms are developed. Phone Gap and Firebase will be used to develop this prototype. All the functional requirements collected during Analysis and Quick Design phase will be used as the guidelines to develop this prototype.

- **Demonstrate**

Demonstration of prototype will be done to target users and workshops nearby once the prototype completely developed. This is to let target users to play around with the application environment. This stage also will help the developer to collect user comments and future enhancements will made based on that.

- **Refine**

During refine phase, the author has to ensure that all functional and non-functional requirements aligned with the prototype. For example, Lubricant Match functionality is not included during the prototype development. Therefore, the author must repeat stages in prototypes cycles which are develop, demonstrate and refine the prototype.

For prototyping phase, few activities will be involved such as designing system architecture, construct activity diagram, construct class diagram, identify tools and equipment will be use, prototype development, developing user interface and coding mobile application. System architecture, use case

diagram, class diagram and tools and equipment used to develop the application has been explain in details in Chapter 3 (Research Methodology) and Chapter 4 (Result and Discussion). Phone Gap is an open source web application and it allows the author to create software applications for Android operating system (OS). To complete the prototyping phase, the author chose Phone Gap for prototype development, developing user interface and coding for mobile application.

c) Testing

In the third stage, once the prototype has been developed. The application needs to undergo 4 types of testing such as unit test, integration test, system test and also user acceptance test. Unit testing, integration testing and system test will test the application from the smallest to the whole functionality of the system. User acceptance test (UAT) will be the last step in testing phase where users test the software to make sure it can handle required tasks in the real world scenarios. After all the testing phase has completed, all errors and user comments will be taken for future improvement of the prototype.

d) Deployment

Implementation phase will be the final phase in the Rapid Application Development (RAD) methodology. This phase will require the author to collect all the testing results and do some improvement on the prototype. Therefore, PETRONAS Pit Stop will be ready to use by target users and workshops in Malaysia.

3.2 System Architecture

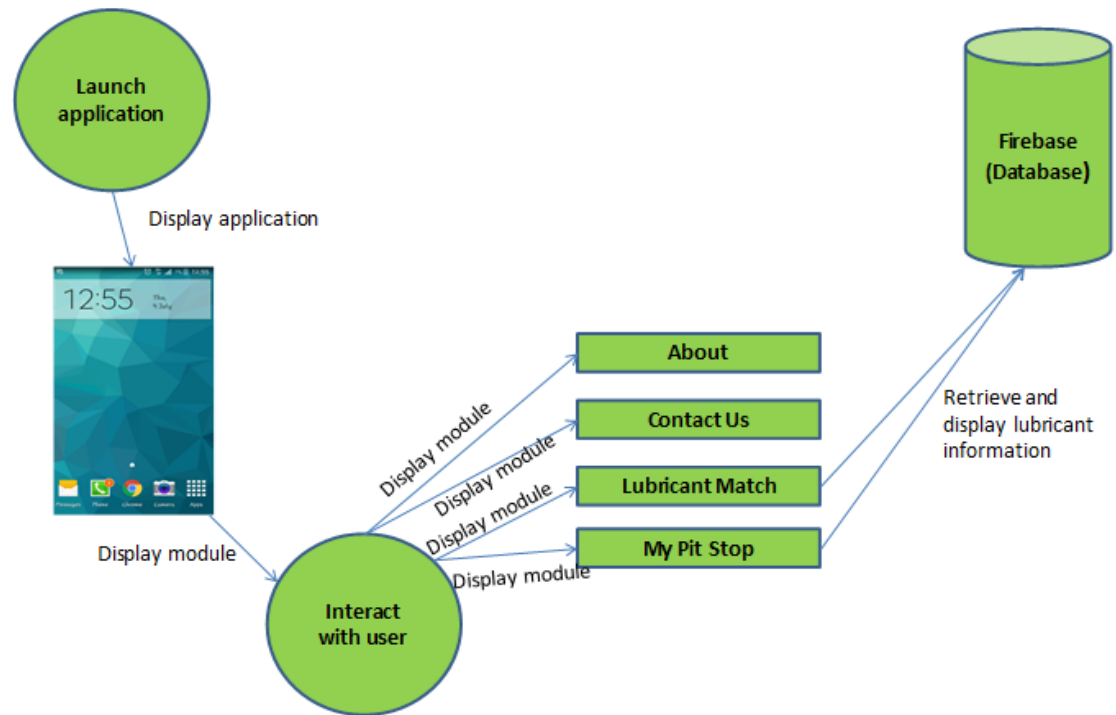


Figure 7: System Architecture

System architecture is a conceptual model that defines the structure, behavior and flow of the system. Figure above shows the flow of the PETRONAS Pit Stop mobile application which comprise of few components such as launch application, interact with user, 4 modules (About, Contact Us, Lubricant Match, My Pit Stop and database (Firebase)). As the user launches the application, user will be directed to the home page of the mobile application. Once user successfully enters the application, there will be four main applications available at the main pages which are About, Contact Us, Lubricant Match and My Pit Stop. For About and Contact Us modules, both only display the description of this mobile application and detail of developer. For Lubricant Match module, user will have to select vehicle, select brand, select engine and select options. Once all the requirement has been completed by user, lubricant recommendation page will display according to elements that previously selected by the user including description, application, customer benefit, specifications and health safety environment. For My Pit Stop module, user can save their favorite

vehicles and set reminder for user's vehicle components as well as to store dates of services and check-up for vehicle components. Upon finishing user can exit the application by clicking on exit button.

3.3 Gantt Chart

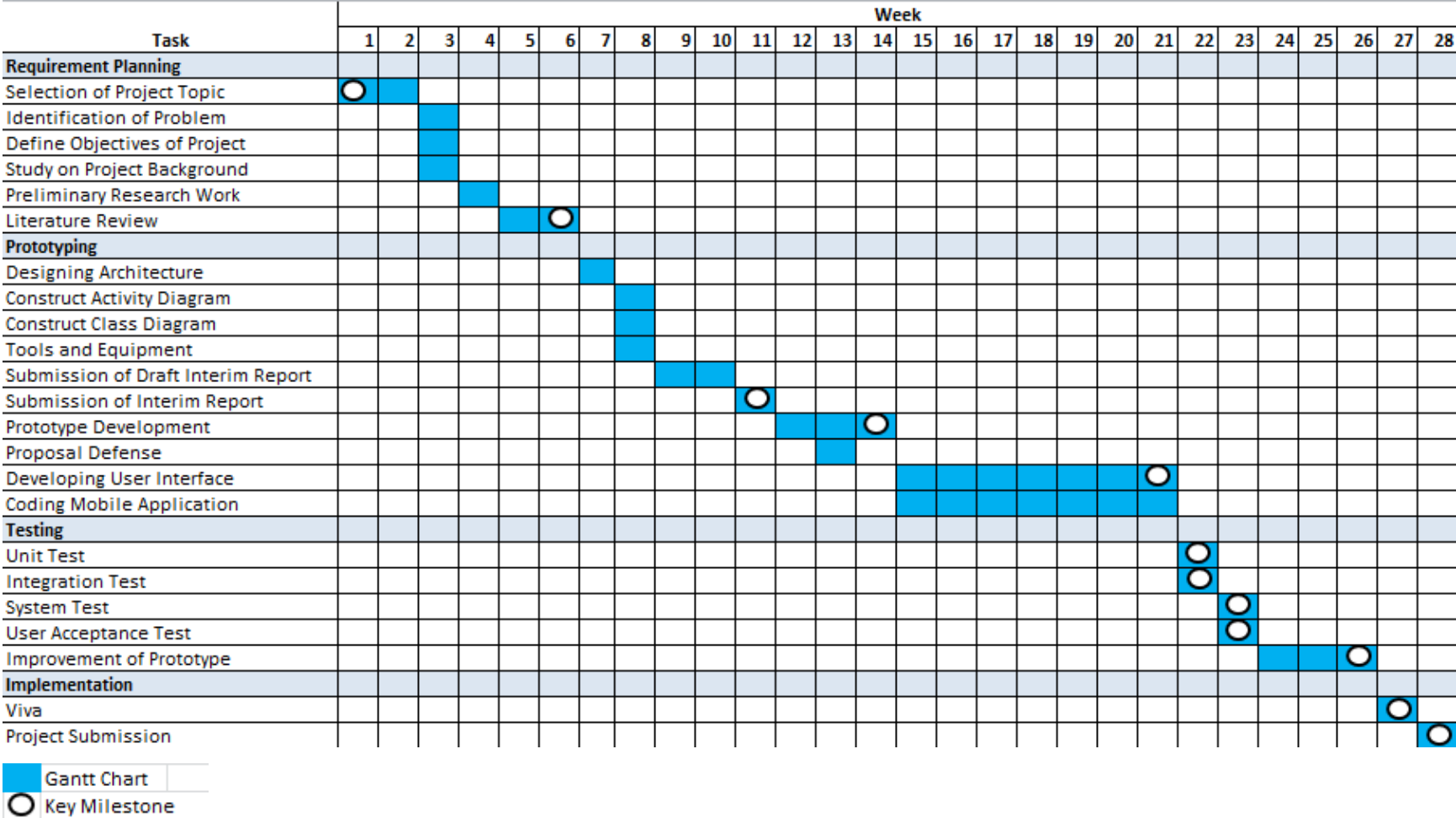


Figure 8: Gantt chart

3.4 Tools and Equipment

The tools and equipment used for this project are:

1. Software

- **Proto.io** used to design interface of mobile application and screenshot before mobile application is being developed.
- **Phone Gap** used to build mobile applications for mobile devices using JavaScript, HTML5 and CSS3, instead of relying on platform-specific API.
- **Firestore** used to power the application backend, including data storage, user authentication, static hosting and more.

2. Hardware

- **Laptop HP 430** used for development of this mobile application and used for any documentation purposes
- **Android Smartphone (Samsung Galaxy S5)** for mobile application testing

3. Programming Language

- **HTML**
- **CSS**
- **JavaScript**
- **jQuery**

CHAPTER 4

RESULT AND DISCUSSION

4.1 Criteria of Selecting the Right Lubricant

In line with the first objective of this mobile application which is to identify criteria for selecting the right lubricant for specific type of vehicles in Malaysia, few elements that the author has been identified to fulfill the requirement are select vehicle, select brand, select option and finally the application will display the lubricant recommendation prior to the criteria selected by our users.

4.2 System Diagrams

4.2.1 Activity Diagram

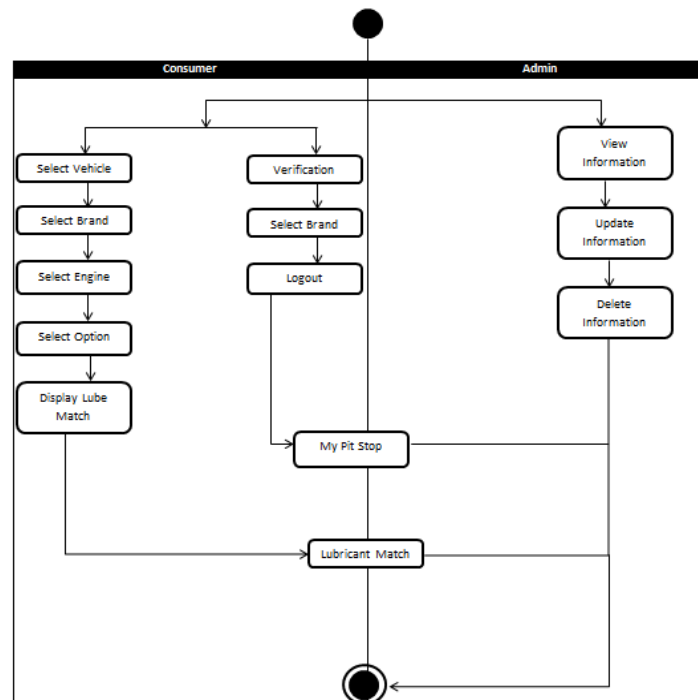


Figure 9: Activity Diagram

Activity diagram consist of activities, states and transitions between activities and states (Felici, 2001). Activities diagram above shows the overall system of PETRONAS Pit Stop where it included mobile application, Firebase and Phone Gap. Two main actors will involve which are consumer and admin. Both have their own workflow for this application. For consumers who are this using mobile application, they can choose between two main functionalities of this application to use which are Lubricant Match functionality and My Pit Stop functionality. For Lubricant Match functionality, consumers are mandatory to follow all the process before the application can provide them with suggested lubricant that match with their specific type of vehicles. Based on the diagram above, some of the process flow involved in Lubricant Match functionality are by select vehicle type, select brand, select engine, select options (vehicles cc) and once completed all the process, lubricant recommendation will be displayed to target users. Another main functionality for this application is My Pit Stop functionality. Purpose of My Pit Stop functionality is to allow our target users to save their favorite vehicle and save the date for vehicle components as a reminder. The business process involved basically login and verification on user's side, select brand of car, set the date and logout. For admin, their role is to manage the mobile application and they will be able to view information, update information and delete the information.

4.2.2 Class Diagram

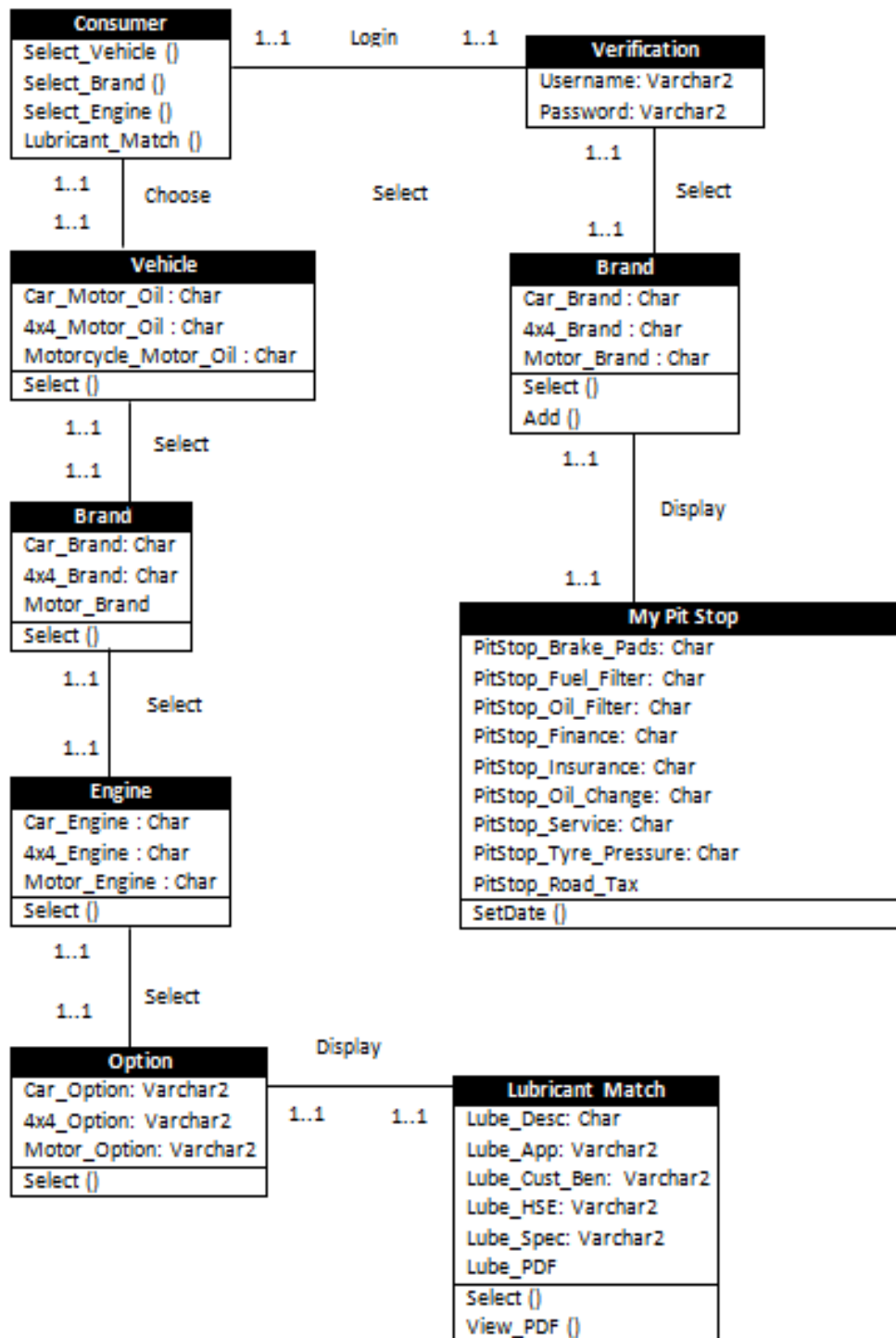


Figure 10: Class Diagram

Based on the class diagram above, it shows the static structure diagram that describes the structure of this mobile application by showing application classes, attributes, operations and relationships between objects.

Notes:

- Consumer will be the main actor to use this mobile application.
- Consumer does not have any specific attributes in order to access to this mobile application, except for My Pit Stop functionality where consumer need to have authorized username and password to login into the function.
- Consumer class has behavior that allow them to select vehicle, select brand, select engine, select option and lubricant recommendation will be displayed based on the result selected by the consumer
- Each consumer can select only a vehicle, brand, engine, option and consumer cannot skip any of the steps before the information being displayed.
- Once complete all operations, lubricant match functionality will displayed all the information prior to the selected type of vehicles consists of lubricant description, lubricant recommendation, lubricant specification, lubricant application, customer benefit, health safety environment and PDF file for consumer to get further information on lubricant.
- Once consumer successfully login to My Pit Stop functionality, consumer will be able to save their favorite car and set the dateline for vehicle components as reminder.

4.3 Final Prototype

For final prototype, the functional requirement of each prototype will be analyze and tested. Functional requirement for mobile application is identified and final prototype was built by using Phone Gap and Firebase for the development of this application.

Mobile application prototype is early models of particular application usually design to meet and test the functional requirement of application as discuss during the phase of Rapid Application Development (RAD). Pictures below shows screenshots captured of prototype developed by using Phone Gap. This prototype is design for Samsung Galaxy S5 model with Lollipop Operating System.

The prototype will be discussed further in two sections:

1. Mobile Application Information
2. Mobile Application Function

4.3.1 Mobile Application Information

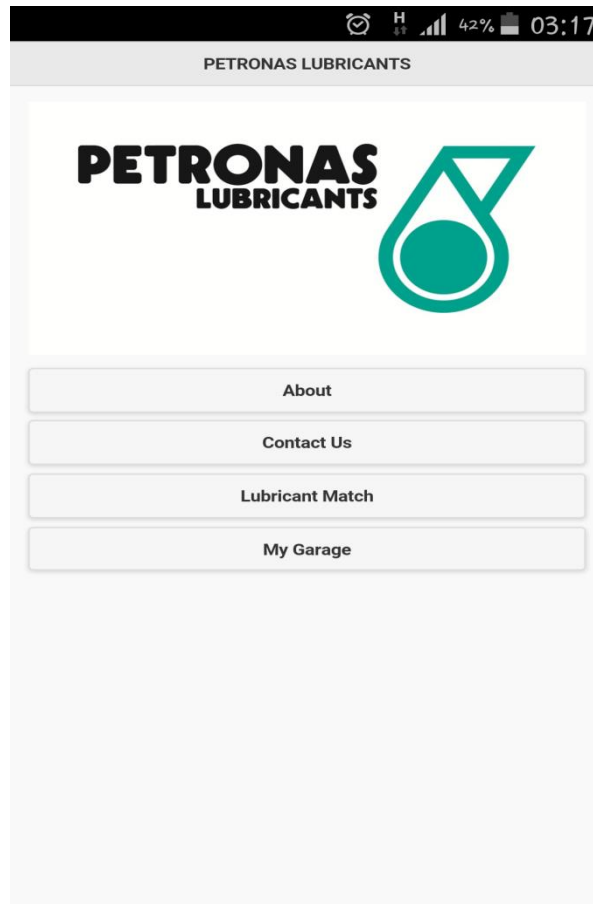


Figure 11: Prototype Main Screen

Table 9: Main Page Button

| Functions | Expected Role |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| About Button | Shows the description of this mobile application |
| Contact Us Button | If user have any inquiries, user can directly contact person |
| Lubricant Match Button | Lubricant Match functionality helps to find the right lubricant oil that match with user type of vehicles including description, customer advices, customer benefits, application, specifications and health safety environment for lubricant oil. For further information, user can view the information by clicking on the PDF file |
| My Pit Stop Button | My Pit Stop functionality helps user to save their favorite vehicles and track vehicles component by setting the dateline as reminder |

4.3.2 Mobile Application Function

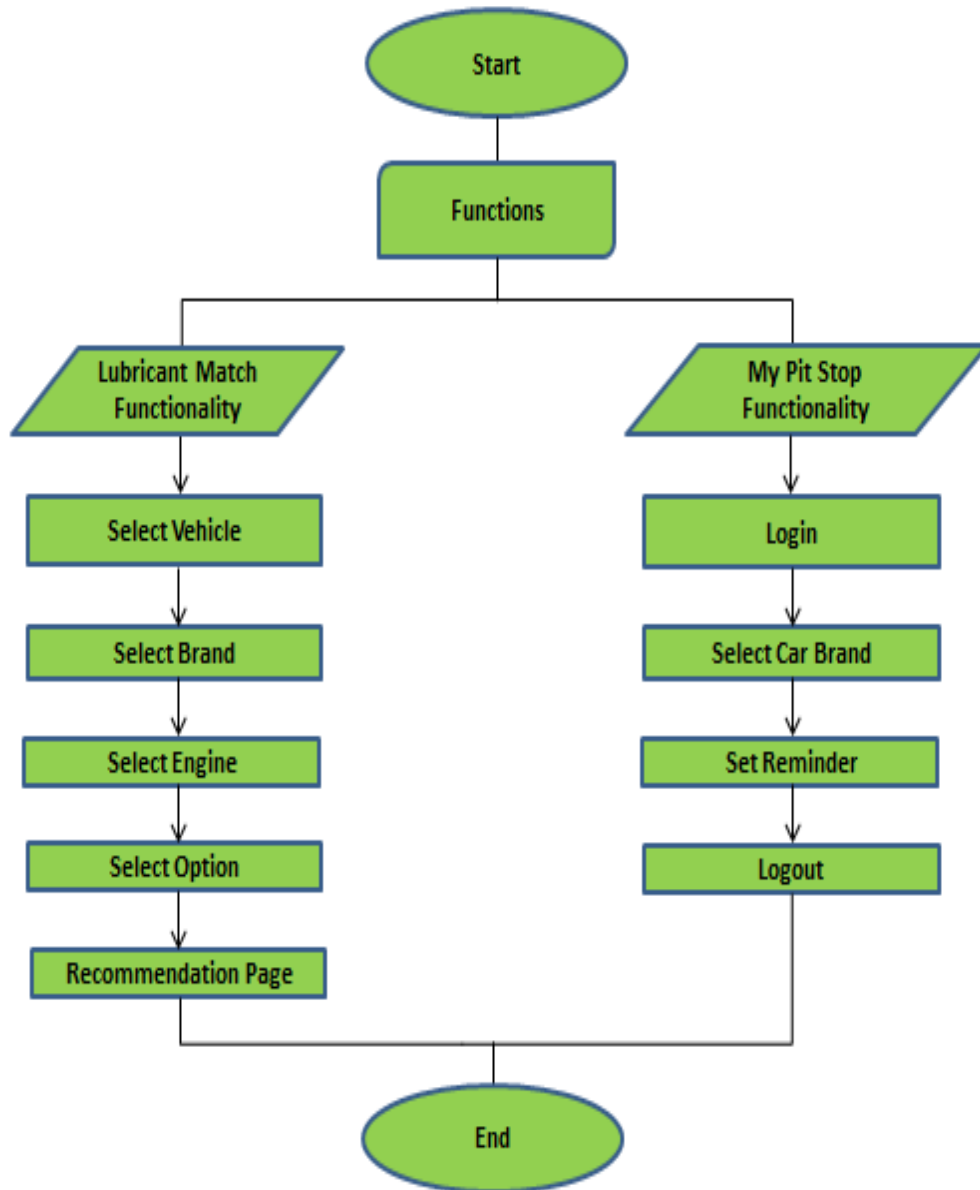


Figure 12: Lubricant Match Flowchart

The flowchart above shows the main function of this application which is Lubricant Match functionality and My Pit Stop functionality.. Once user launches the application, there will be 4 buttons available for user to select. LUBRICANT MATCH button and MY PIT STOP button are the main

functionality of this application which provides users recommendation of lubricant oils to match with their specific type of vehicles and help target users to manage vehicles components by setting the dateline as a reminder.

Once users click on LUBRICANT MATCH button, user will be directly to the next interface which is SELECT VEHICLE. . Here, users will be given list of vehicles and have to select one of the vehicles before proceeding to the next interface. It is mandatory for users to select a vehicle before proceed to the next page.

Then, SELECT BRAND interface will appear and here users have to select one of the brands given. List brand of vehicles are list out based on the vehicles used in Malaysia only as the scope of this project only focusing in Malaysia. In is mandatory for users to select one of the brand given before proceed to the page.

Then, SELECT ENGINE interface will appear and users have to select one of the engine option given before proceeded to the next page. Next, SELECT OPTION interface will appear as users have to select their vehicles cc. All the steps are mandatory for users to select based on user's preference. Otherwise, user unable to finish the process, thus, it will effect on recommendation page and reminder page to not working.

After complete all the process, the last interface will be displayed is RECOMMENDATION PAGE. Here, based on the all the selections made by user previously, the application will displayed the result for lubricant oil recommendation that match for user specific type of vehicles such as description, application, customer benefits, specification, health safety environment and PDF.

For My Pit Stop functionality, an authorized user with valid username and password able to login into this functionality. However, for the new user to be able to login into the functionality, they can have their own username and

password by signing up from the application. Next, user has to select their car brand before proceed to the reminder page. There were 9 elements available in the reminder page and user has to set the dateline of each element as a reminder. Once user has completed all the process, the can exit from the My Pit Stop functionality by clicking on logout button on the top left of the application

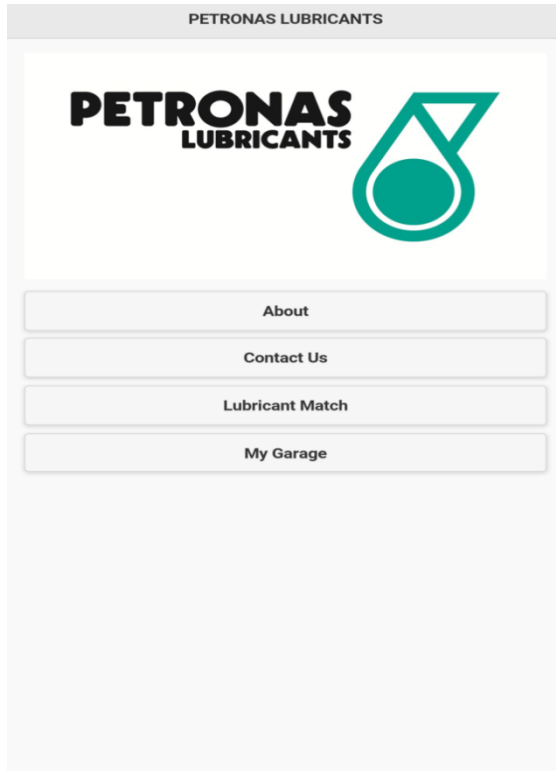


Figure 13: Application Main Page

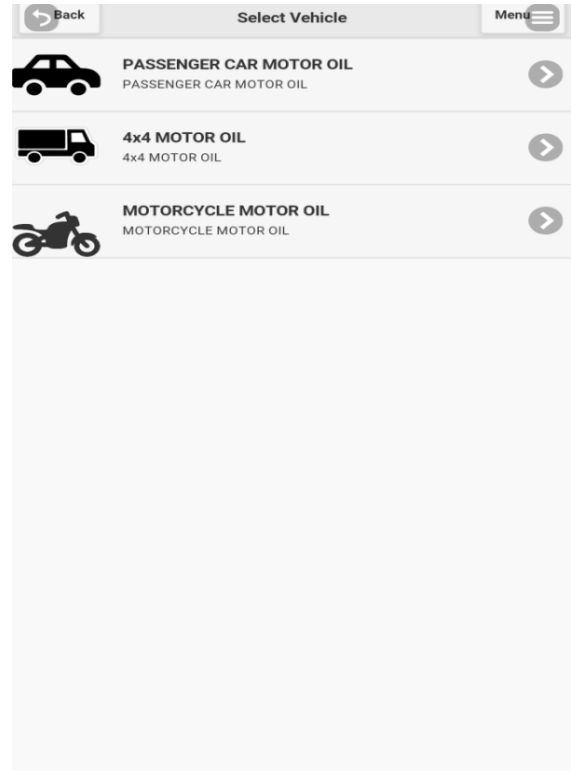


Figure 14: Select Vehicle Interface

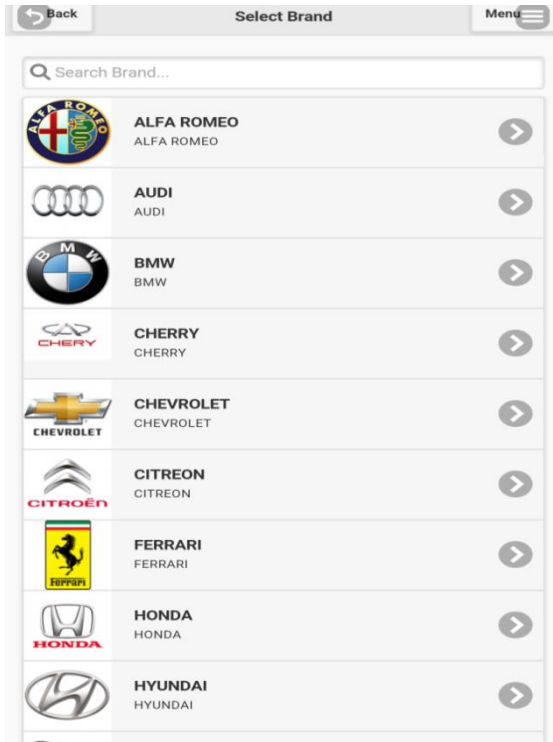


Figure 15: Select Brand Interface

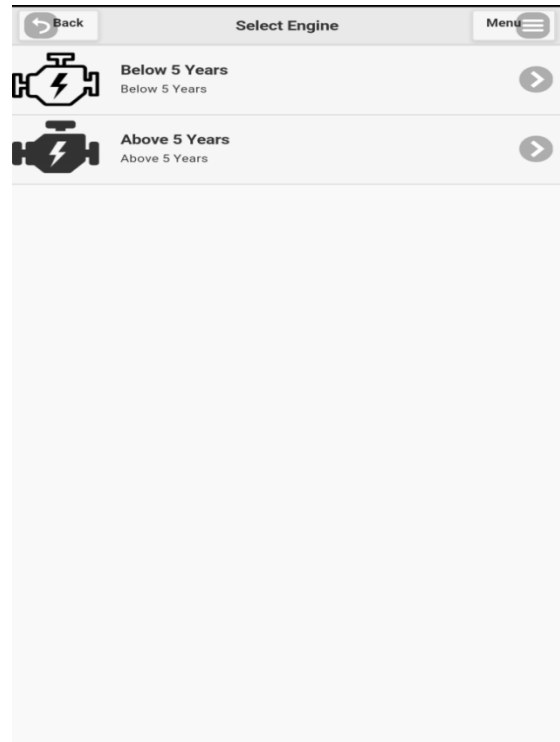


Figure 16: Select Engine Interface

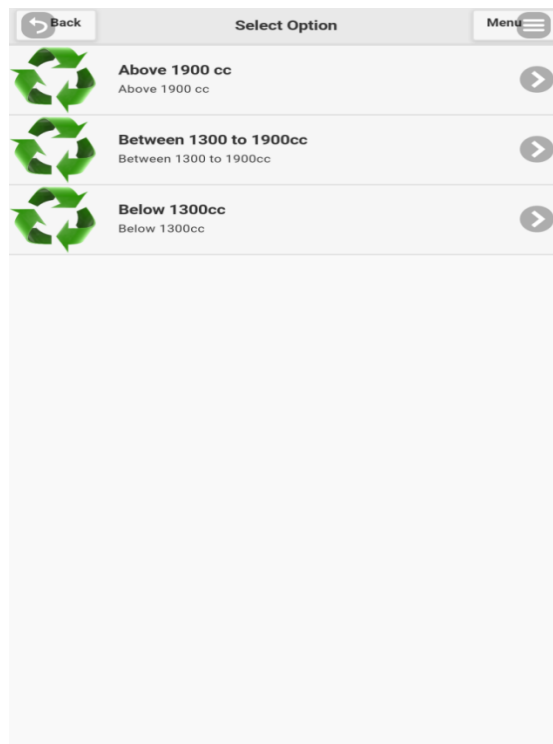


Figure 17: Select Option Interface

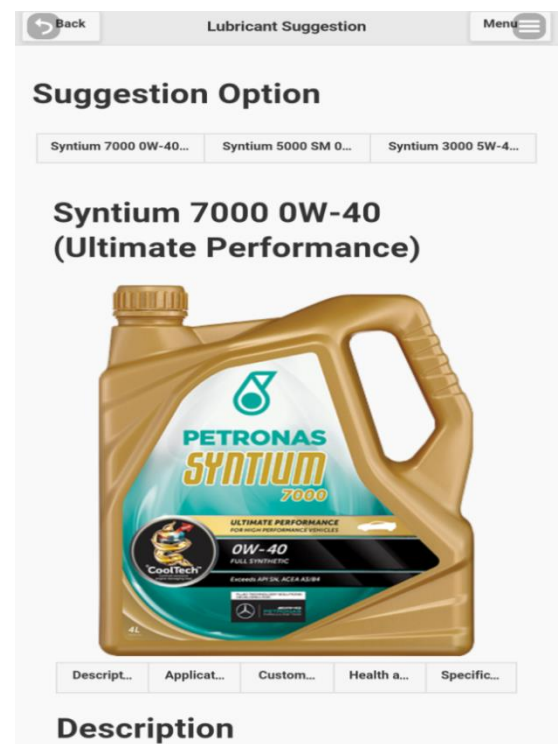


Figure 18: Recommendation Page

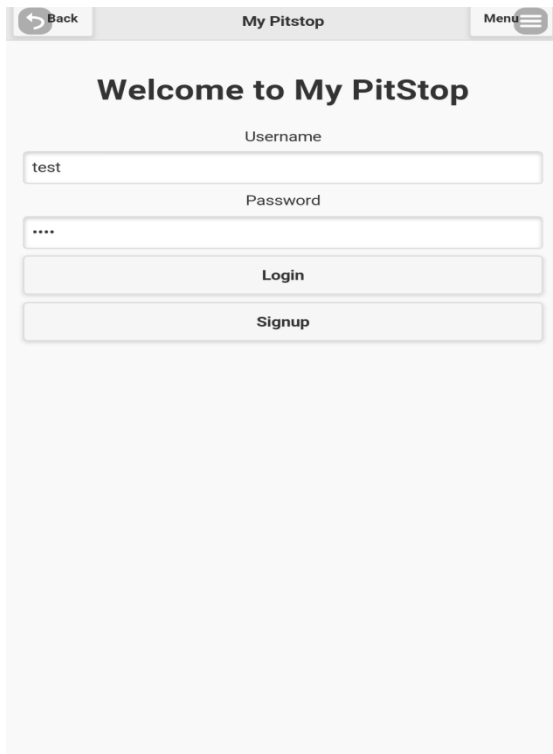


Figure 19: My Pit Stop Login

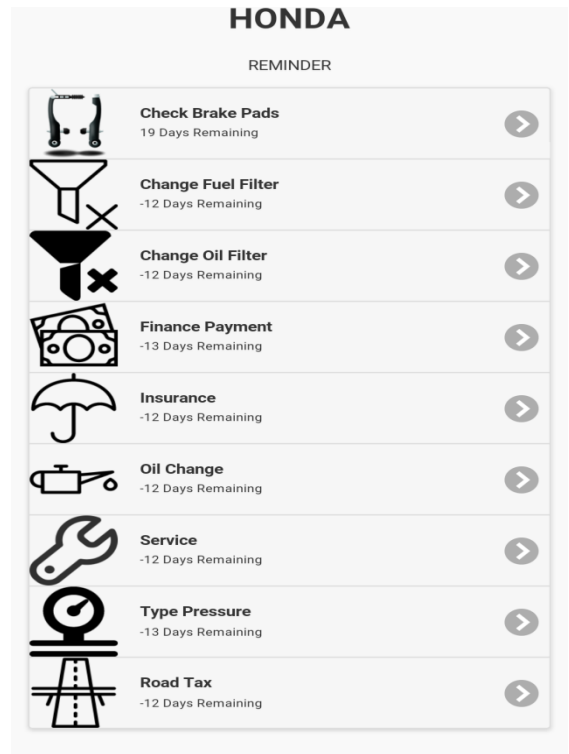


Figure 20: Reminder Page



Figure 21: Set Date Page

4.4 Functionality Testing

The purpose of the system is to check the functionalities of this mobile application based on the requirement. Table 13 shows the data of each functions of PETRONAS Pit Stop.

Table 13: Functionality Testing for Mobile Application

| Functions | Expected Outcome | Testing | Testing Result | | Remark |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------|----------------|---------|-------------------------------------------------|
| | | Frequency | Success | Failure | |
| “About” button | Navigate to about page | 5 | 5 | 0 | |
| “Contact Us” button | Navigate to contact us page | 5 | 5 | 0 | |
| “Lubricant Match” button | Navigate to Lubricant Match page | 5 | 5 | 0 | |
| “My Pit Stop” button | Navigate to My Pit Stop page | 5 | 5 | 0 | |
| “Select Vehicle” dropdown menu | Display 3 categories of vehicle (passenger car motor oil, 4x4 motor oil and motorcycle motor oil) | 5 | 5 | 0 | |
| “Select Brand” dropdown menu (for passenger car motor oil) | Display 27 types of brand for passenger car motor oil | 5 | 4 | 1 | Fail due to slow processing image from database |
| “Select Brand” dropdown menu (for 4x4 motor oil) | Display 7 types of brand for 4x4 motor oil | 5 | 5 | 0 | |
| “Select Brand” dropdown menu (for motorcycle motor oil) | Display 19 types of brand for motorcycle motor oil | 5 | 4 | 1 | Fail due to slow processing image from database |

| | | | | | |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|------------------------------------------------|
| “Select Engine” dropdown menu (for passenger car motor oil) | Display two types of engine which are below 5 years and above 5 years | 5 | 5 | 0 | |
| “Select Engine” dropdown menu (for 4x4 motor oil) | Display two types of engine which are below 5 years and above 5 years | 5 | 5 | 0 | |
| “Select Engine” dropdown menu (for motorcycle motor oil) | Display two types of engine which are 4 stroke engine and 2 stroke engine | 5 | 5 | 0 | |
| Lubricant recommendation page | This page will display lubricant that match with specific type of vehicle. It also display the description, applications, customer benefits, specifications and health safety environment for the particular lubricant | 5 | 4 | 1 | Fail due to JavaScript error |
| PDF button | User will be able to view the PDF by clicking on the button | 5 | 1 | 4 | Fail due to unable to go back to the main page |
| “My Pit Stop” login page | This page will contain username textbox, password textbox and two buttons which are login and signup | 5 | 4 | 1 | Fail due to JavaScript error |
| “My Pit Stop” welcome page | “Welcome to My Pit Stop” label | 5 | 5 | 0 | |
| Alert (password) – When password entered by user is wrong | Alert will pop up | 5 | 5 | 0 | Rename alert name |

| | | | | | |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|----------------------|
| Alert (login) – When username already exists in the database | Alert will pop up | 5 | 5 | 0 | Rename alert name |
| Welcome page for My Pit Stop | Once user successfully login to the My Pit Stop page, it will navigate to another page where user have to choose vehicle brand and add as their own vehicle | 5 | 5 | 0 | |
| “My Pit Stop” main page | Consists of nine elements: <ul style="list-style-type: none"> • Check brake pads • Change fuel filter • Finance payment • Insurance • Oil change • Service • Tyre pressure • Road tax | 5 | 5 | 0 | |
| Calendar | User has to set the date for every element. Days remaining from the current date will be display below each of the elements | 5 | 5 | 0 | |
| “Logout” button | Return to the “My Pit Stop” login page | 5 | 5 | 0 | |
| “Menu” button | Return to the application main page | 5 | 5 | 0 | |

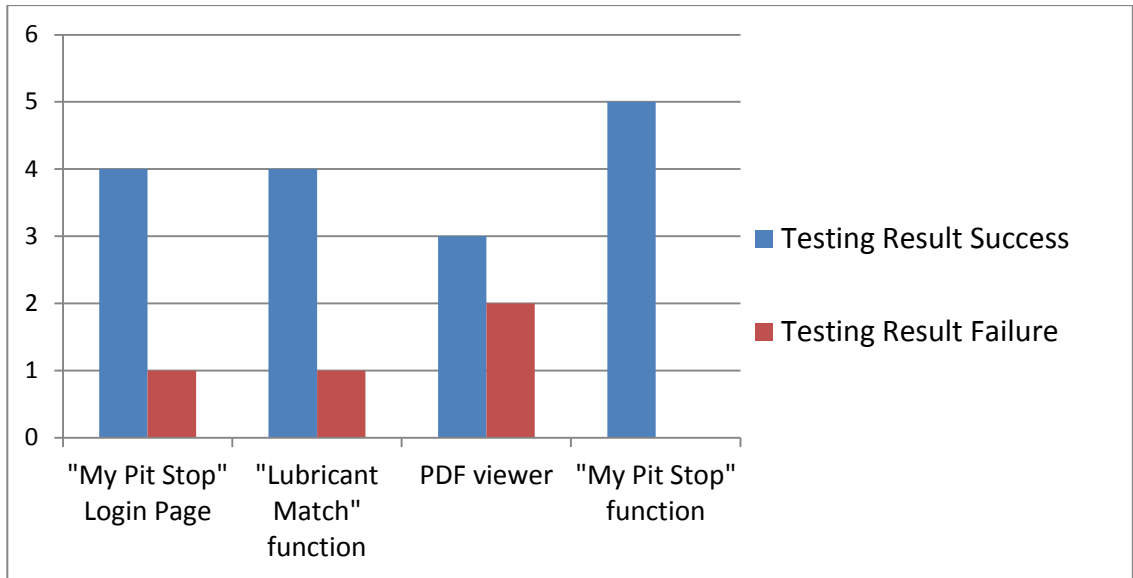


Figure 22: Functionality Test Result

Figure 18 illustrates the result for the functionality testing from 5 respondents. The test are focused on four major functionality such as “My Pit Stop” login page, “Lubricant Match” function, “My Pit Stop” function and PDF Viewer. There were some failure occur during the testing session due to JavaScript error, back button not functioned as planned and slow retrieved of image from the database. The most successful functionality goes to “My Pit Stop” function as all our respondents rate as success and the least successful functionality goes to PDF Viewer. The problem raised for PDF Viewer where user cannot went back to the main page of application after successfully view the PDF file caused by malfunction of back button.

4.5 User Acceptance Testing (UAT)

User Acceptance Testing (UAT) is a key feature of project to implement new systems, mobile applications or process. In line with the purpose of User Acceptance Testing (UAT) which is to ensure that the new systems, mobile applications or process does actually meet the essential user requirement, User Acceptance Test (UAT) will be test by our target users for evaluation of PETRONAS Pit Stop Mobile Application. Main features that are being tested by the users of application are:

- Gender
- Profession
- Is there any consistency in the theme used on this mobile application?
- Do you have a car?
- Do you understand the concept of this mobile application?
- How do you rate the functionality of the mobile application in terms of performance?
- How do you rate the graphical user interface design of this mobile application?
- How do you rate the mobile application in terms of user friendliness?
- How do you rate the operational performance of this mobile application?
- Does this mobile application help users to easily get the lubricant recommendation for the specific types of vehicle?
- Does this application help users to save cost and time of travel to get the information on lubricant recommendation?
- Does this application help users to track the vehicle components by setting the dateline as a reminder?

15 people who owned vehicles, motorcycles and heavy duty vehicles have been randomly selected to perform the testing, mainly staffs and students from Universiti Teknologi PETRONAS (UTP). Targeted users will be provided with PETRONAS Pit Stop Mobile Application setup on developer's Samsung Galaxy

S5 to test this application. After the testing, users are required to fill in the questionnaire as shown in Appendix 2 and details graphs for User Acceptance Testing (UAT) will be displayed Appendix 3.

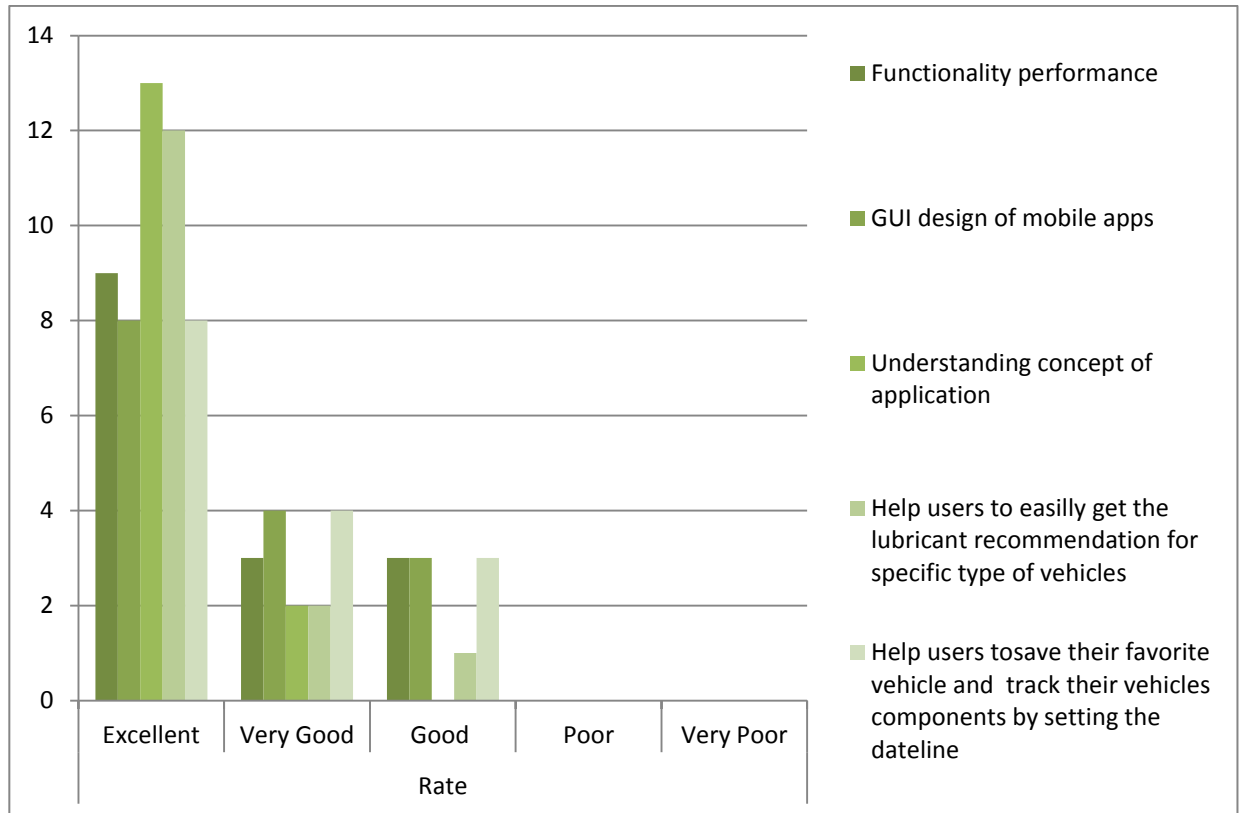


Figure 23: User Acceptance Testing (UAT) Result

Figure 19 illustrates the result of the User Acceptance Testing (UAT) from 15 respondents. The User Acceptance Testing (UAT) are focused on five main elements such as functionality performance, GUI design of mobile application, understanding concept of application, help users to easily get the lubricant recommendation for specific type of vehicles and helps users to save their favorite vehicles and track vehicles components by setting the dateline. The highest rating recorded is “Excellent” and the lowest rating recorded is “Very Poor”. Refer to Figure 19, they are no “Poor” and “Very Poor” result recorded from our respondents and it is believed that all the respondents felt this application very useful, beneficial and can be accepted by them.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

PETRONAS Pit Stop Mobile Application is developed to help our target users who owned vehicle and workshop in Malaysia to determine the right lubricant that match with specific type of vehicles in Malaysia and help them to save their favorite vehicles and set reminder for their vehicle components. In line with the first objective of this project, the criteria involved for selecting the right lubricant for specific type of vehicles are type of vehicles (passenger car, motorcycle and heavy duty), brand of vehicles, type of engine (above 5 years and below 5 years) and type of options (above 1900 cc, between 1300 cc to 1900 cc and below 1300 cc). Once target users fulfill all the business process, only then the application will displayed the lubricant recommendation based on their selection.

Based on all the requirement gathering including functional requirement and non-functional requirement collected during Analysis and Design phase, the author develop this mobile application by incorporate all the elements that have been identified. Class diagram and activity diagram are designed to show the workflow activities and actions of this application as well as to show the static structure diagram that describes the structure of mobile application.

After the final prototype completed, the author will evaluate this application in terms of user acceptance and functionality, in line with the third objective of this application. For functionality testing, 5 respondents involved in the testing session in

order to evaluate the functionality based on the requirement gathering during Analysis and Design phase in Rapid Application Development (RAD). For User Acceptance Testing (UAT), they were 15 respondents involved during the session where they were provided with PETRONAS Pit Stop Mobile Application setup on developer's Samsung Galaxy S5 to test this application. Overall, it is believed that this mobile application can be very beneficial, useful and easier for our target users to use and learn to get the information about lubricant.

5.2 Recommendation

In future, this mobile application has a lot of improvements that can be done especially by adding functionalities for this application. Improvements in future as well as adding new functionalities for PETRONAS Pit Stop Mobile Application will help this application more complex, reliable and interesting for target users to use. Future recommendation and new functionality of this mobile application are as follows:

1. "Online Buying" functionality
2. "Nearest Dealer" functionality
3. "Dashboard" functionality

Based on the future recommendation and new functionality that can be added in future, this mobile application basically helps our target users to help our target users order and buy PETRONAS lubricant products directly from the dealer. Next recommendation that can be added is "Nearest Dealer" functionality. This feature will help our target users to get information about nearest dealer nearby for them to purchase PETRONAS lubricant products. For "Dashboard" functionality, it will help our customers to get the latest news on lubricant, reward offers by provider and others.

REFERENCES

Adipurwa, F.G.P., & Nasution, R.A. (n.d.). *The Proposal of Co-Branding Strategy PT.XYZ and SAS in Automotive Sector in Spain Market to Increase PT.XYZ Reputation in International Market* (School of Business and Management, Institut Teknologi Bandung, Indonesia).

Agbolade, O. K.(2011). Information and Communication Technology and Banks Profitability in Nigeria, Australian Journal of Business and Management Research.

Ciopi, M.O. (2010). LUKOIL's Market Strategy in Central and Eastern Europe.*Petroleum-Gas University of Ploiesti Bulletin, Economic Sciences Series*.

Clark, J. F.(2015). History of Mobile Application, MAS 490: Theory and Practice of Mobile Applications.

Felici, M. (2011). Activity Diagrams.

Gosalia, A. (2014). *To Sustain Ability in the Global Lubricants Industry* Presented at the 1th ICIS Worlds Base Oils & Lubricants Conference, London).

Hameed, A., & Oudah, A. (2014). Improved Methodology for Mobile Commerce Applications. *International Journal of Software Engineering and Its Applications*,8(8), 29-42.

Kojima, M., Brandon, C., & Shah, J. J. (2000). *Improving urban air quality in South Asia by reducing emissions from two-stroke engine vehicles* (No. 21911). World Bank.

Kundishora. S (2010) Ministry of Information Communication and Technology (MICT) (2010) Strategic plan 2010-2014. Harare, Zimbabwe

Lepitak, S. (2014). *Shell re-launches lubricants App as Shell miGarage to Notify Vehicle Owners of Key Dates*. Retrieved from The Drum Online website <http://www.thedrum.com/news/2014/01/15/shell-relaunches-lubricants-app-shell-migarage-notify-vehicle-owners-key-dates-0>.

Mandaković, R. (2011). THE KEY INFLUENCES ON THE CROATIAN MARKET OF LUBRICANTS AND MARKETS IN THE REGION. *goriva i maziva*, 50(4), 307-316.

Malan, R., & Bredemeyer, D. (2001). Functional requirements and use cases. *Bredemeyer Consulting*.

Mang, T. (2007). Lubricants and their market. *Mang, T. and Dresel, W*, 1-6.

Marius, P. O. P. A. (2010). Audit Process during Projects for Development of New Mobile IT Applications. *Informatica Economica*, 14(3), 34-46.

Mills, M., Van de Bunt, G. G., & De Bruijn, J. (2006). Comparative research persistent problems and promising solutions. *International Sociology*, 21(5), 619-631.

Mwaawaru, S. (2009). Marketing Strategy in Terms of Promotion and Communication for Energy Drinks in Ghana. Case Company: Sinebrychoff Brewery.

Saghaei, M., & Fazayeli, L. (2012). STRATEGIC PLANNING FOR A LUBRICANT MANUFACTURING COMPANY. *Australian Journal of Business and Management Research Vol*, 1(10), 18-24.

Sander, J. Water Contamina on: Management of Water During The Lubricant Life Cycle.

Sivarao, S., Abdul Rahim, S., Haeryip, S., Yuhazri, Y., Sivakumar, D. M., & Tan, C. (2012). Promising Techniques of Automotive Engine Lubrication Oil Monitoring.

System—A Critical Review towards Enhancement. *The International Journal of Engineering And Science*, 1(2), 228-233.

Varadarajan, R. (2010). Strategic marketing and marketing strategy: domain, definition, fundamental issues and foundational premises. *Journal of the Academy of Marketing Science*, 38(2), 119-140.

Appendix 1: Interview Questionnaire

1. Do you own a smartphone?
2. Do you own a car?
3. What brand do you prefer for your engine oil?
4. Do you know that the choice of engine oil so important?
5. How do you determine the right lubricant recommendation match with your specific type of vehicles?
6. How often you change your engine oils?
7. If there is PETRONAS Pit Stop Mobile Application, would you download and use it?

Appendix 2: User Acceptance Testing (UAT) Questionnaire

User Acceptance Form

Title : PETRONAS Pit Stop Mobile Application

Developer : Muhammad Fauzan Bin Mohd Idrus

Student ID : 1545

Programme : Business Information System

1. Gender :
2. Age :
3. Profession :
4. Do you have at least a vehicle:

| No | Topic | Excellent | Very Good | Good | Poor | Very Poor |
|----|---------------------------------------------------------------------------------------------------------------------------|-----------|-----------|------|------|-----------|
| 1 | How do you rate the functionality of the mobile application in terms of performance? | | | | | |
| 2 | How do you rate the graphical user interface design of this mobile application? | | | | | |
| 3 | How do you rate the mobile application in terms of user friendliness? | | | | | |
| 4 | How do you rate the operational performance of this mobile application? | | | | | |
| 5 | I do understand the concept of this application | | | | | |
| 6 | I found this mobile application help users to easily get the lubricant recommendation for their specific type of vehicles | | | | | |
| 7 | I believe this application help users to save cost and time of travel to get information on lubricant recommendation | | | | | |
| 8 | I believe this application help users to track their vehicles components by setting the dateline of vehicle components | | | | | |

Appendix 3: User Acceptance Test (UAT) Result

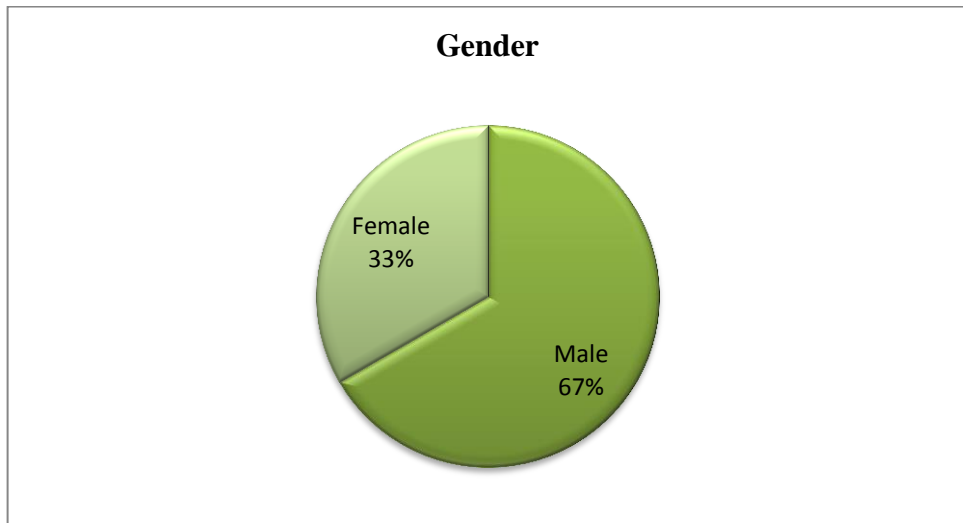


Figure 24: Gender Result

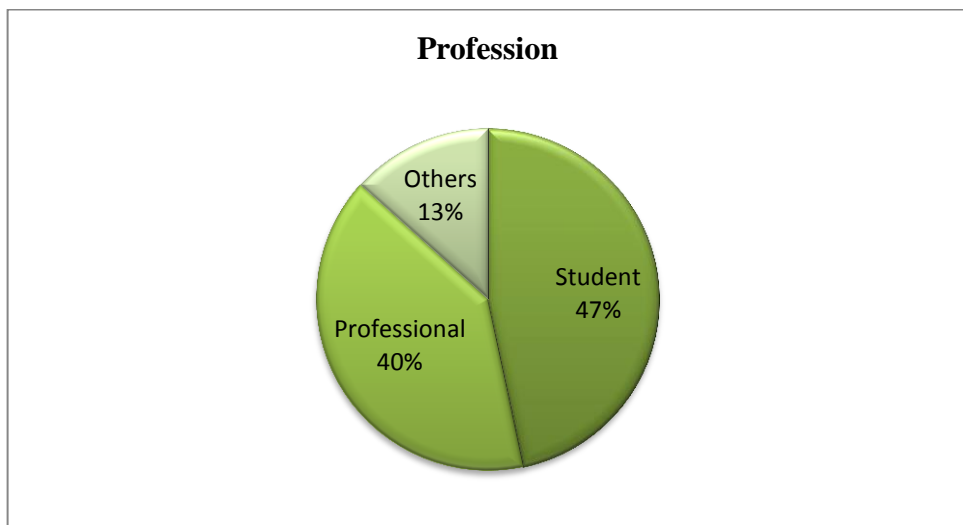


Figure 25: Profession Result

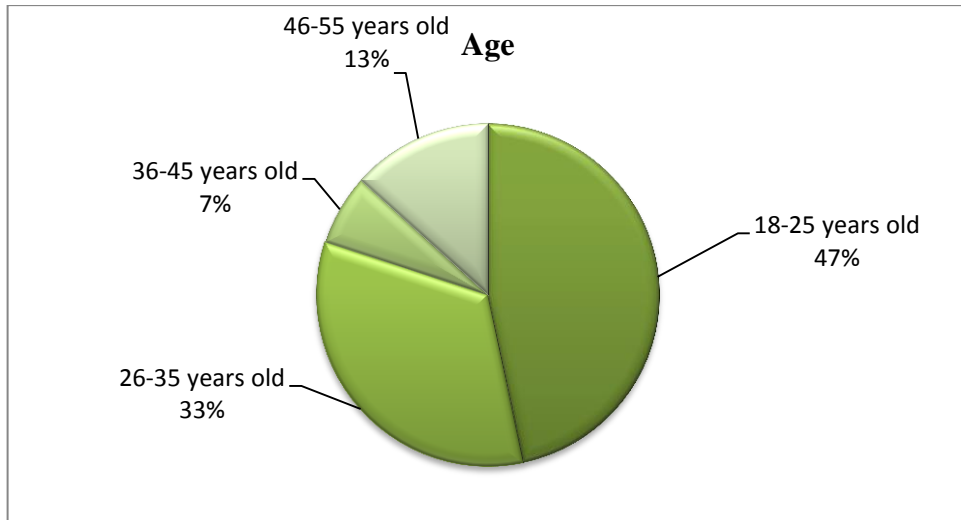


Figure 26: Age Result



Figure 27: Vehicle Result

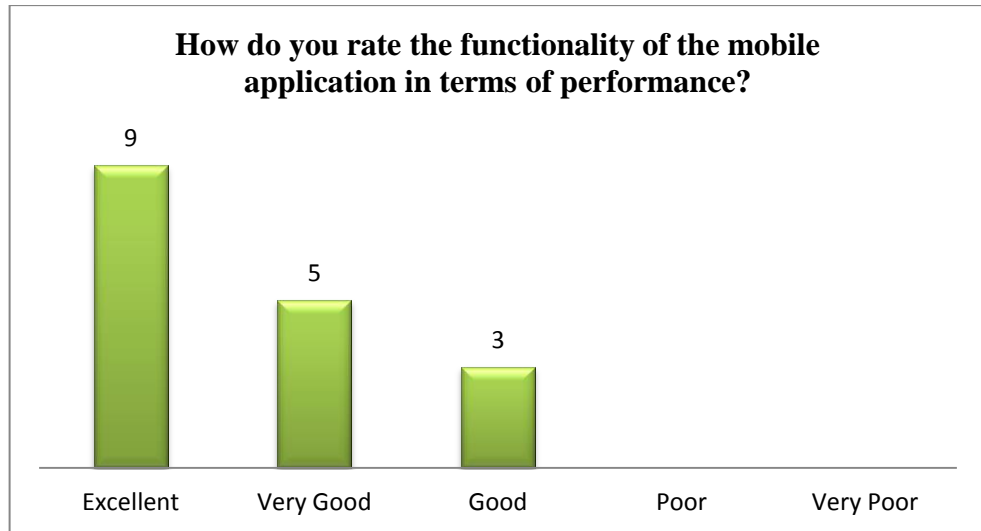


Figure 28: Functionality Performance Result

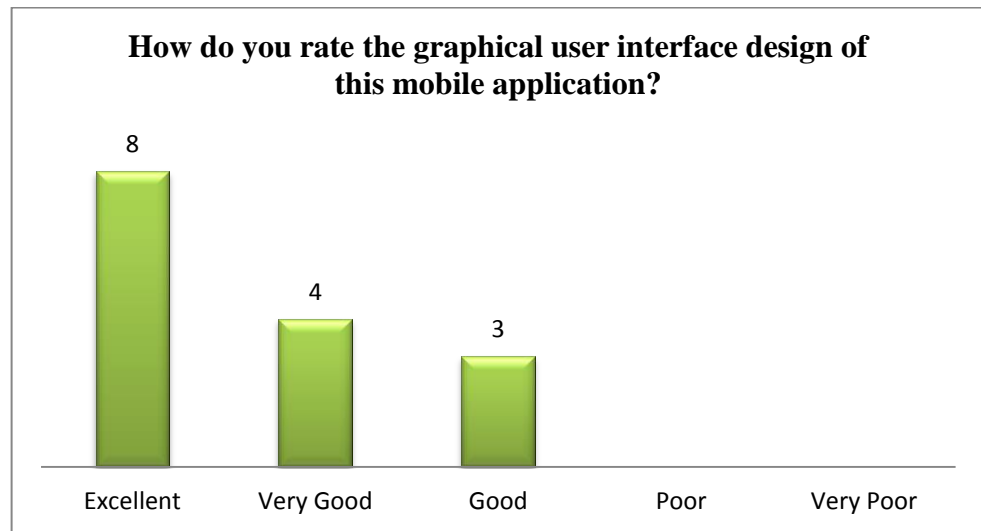


Figure 29: GUI Design Result

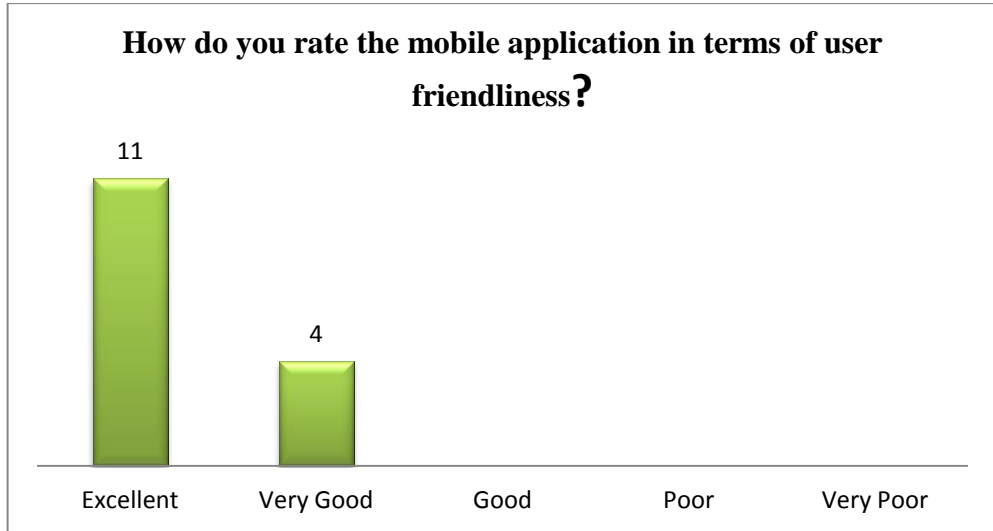


Figure 30: User Friendliness Result

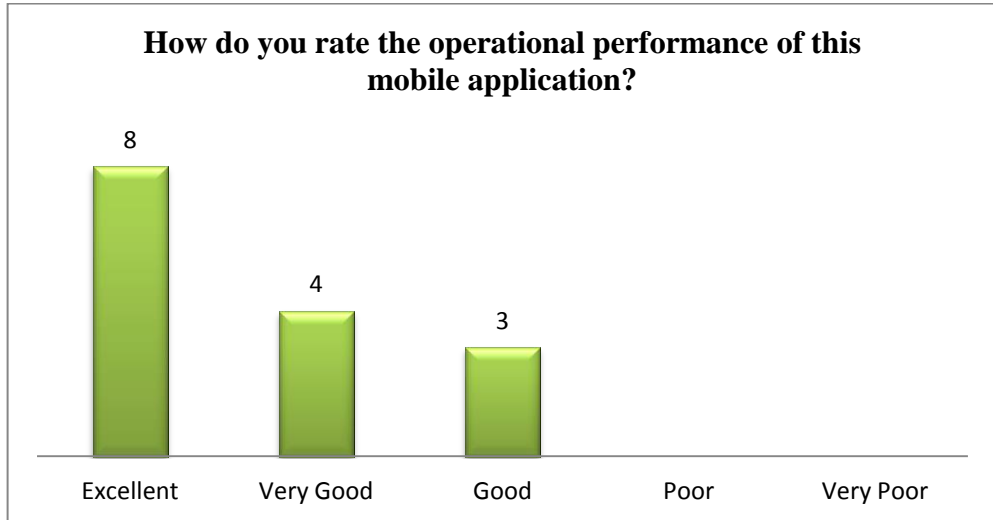


Figure 31: Operational Performance Result

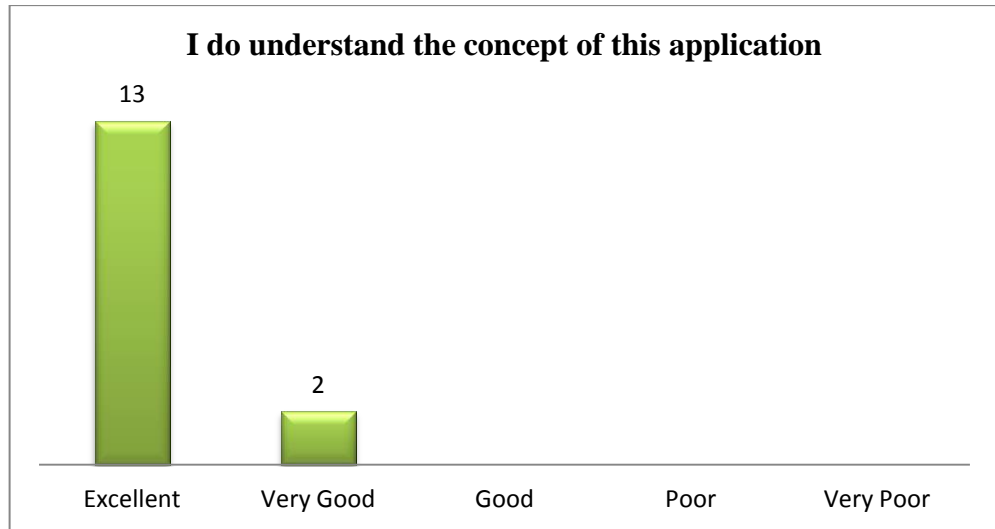


Figure 32: Application's Concept Result

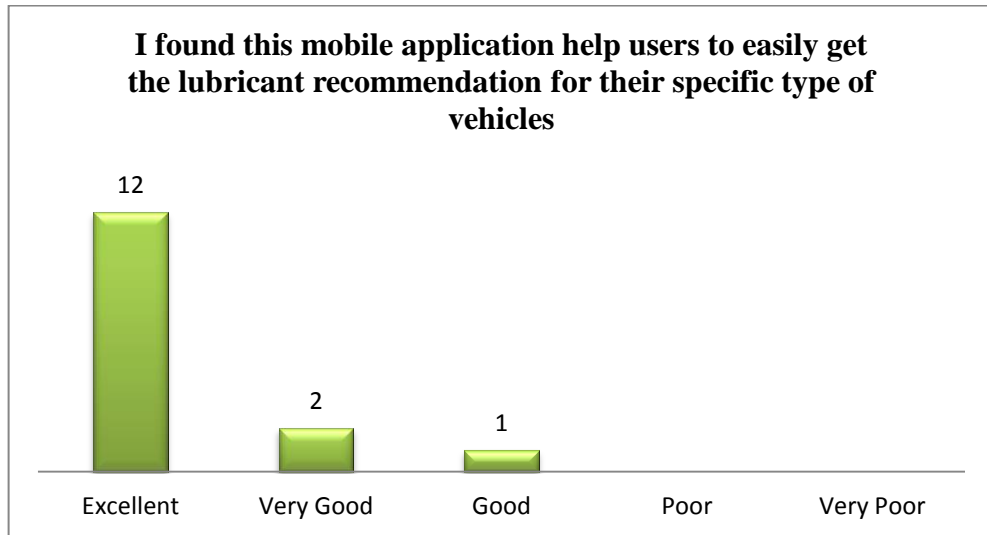


Figure 33: Lubricant Recommendation Result

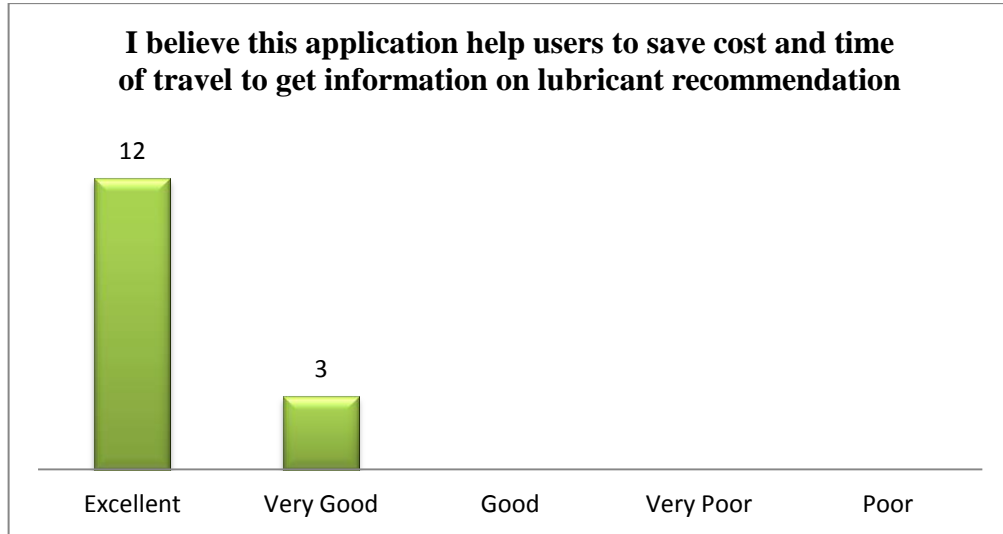


Figure 34: Save Time and Cost Result

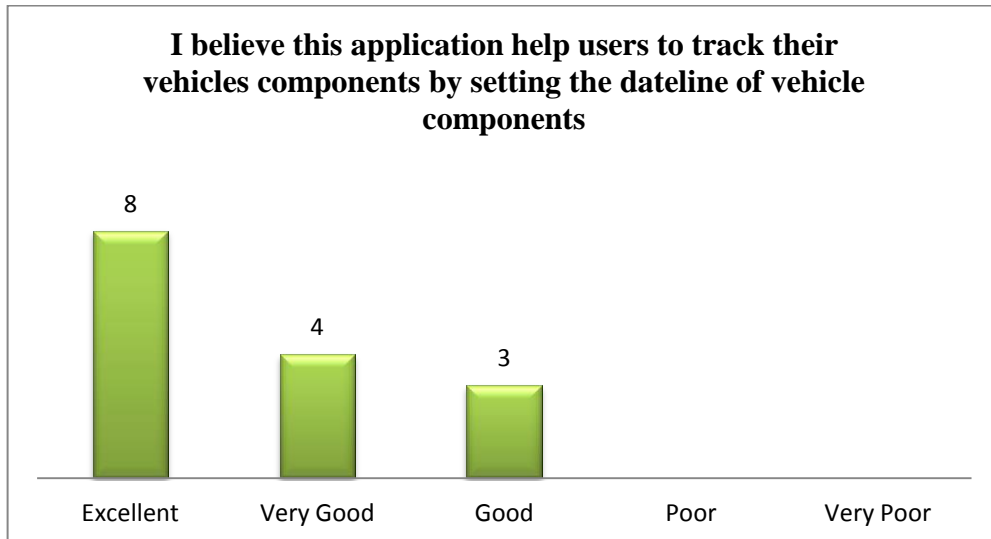


Figure 35: Track Vehicle Components Result

Appendix 3: Coding of the Application

```
var myFirebaseRef = "https://petronas-lubricants.firebaseio.com/";

var doneVehicleType = false;
var vehicleType = new Array();
vehicleType = ["PASSENGER CAR MOTOR OIL", "4x4 MOTOR OIL", "MOTORCYCLE MOTOR OIL"];
imagevehicletype = ["typevehicle1.png", "typevehicle2.png", "typevehicle3.png"];

var doneVehicleBrand = false;
var motorcycle = new Array();
motorcycle = ["APRILIA", "BMW", "BUELL", "CAGIVA", "COMEL", "DEMAK", "DUCATI", "HARLEY DAVIDSON", "HONDA", "KAWASAKI", "LAVERDA", "MODENAS", "MOTO GUZZI", "NAZA", "SUZUKI", "T
var fourbyfour = new Array();
fourbyfour = ["FORD", "ISUZU", "LAND ROVER", "MITSUBISHI", "NISSAN", "SSANGYONG", "TOYOTA", ];
var cars = new Array();
cars = ["ALFA ROMEO", "AUDI", "BMW", "CHERRY", "CHEVROLET", "CITREON", "FERRARI", "HONDA", "HYUNDAI", "JAGUAR", "KIA", "LEXUS", "MAZDA", "MERCEDES", "MITSUBISHI", "NAZA", "NISS
imagecars = ["car0.png", "car1.png", "car2.png", "car3.png", "car4.png", "car5.png", "car6.png", "car7.png", "car8.png", "car9.png", "car10.png", "car11.png", "car12.png", "c
imagemotorcycle = ["motor1.png", "motor2.png", "motor3.png", "motor4.png", "motor5.png", "motor6.png", "motor7.png", "motor8.png", "motor9.png", "motor10.png", "motor11.p
imagefourbyfour = ["lorry1.png", "lorry2.png", "lorry3.png", "lorry4.png", "lorry5.png", "lorry6.png", "lorry7.png"];

var doneVehicleEngine = false;
var engineCarLorry = new Array();
engineCarLorry = ["Below 5 Years", "Above 5 Years"];
imageengine = ["engine2.png", "engine1.png"];
var engineMotor = new Array();
engineMotor = ["4 Stroke", "2 Stroke"];
imageenginemotor = ["motorengine4.png", "motorengine2.png"];

var doneCCSelection = false;
```

Figure 36: Code 1

Figure 36 describe on how the author set the container object that holds a fixed number of values of a single type. The author used array to set the variables for Type of Vehicle, Brand, Engine, Option, Lubricant Recommendation and others.

```
function about() {window.location.hash = "#about";}
function contact() {window.location.hash = "#contact";}
function gotoMyGarage() {window.location.hash = "#garage"}

function gotoVehicleType(){
  if(doneVehicleType === false){
    for(var x=0; x < vehicleType.length; x++){$('<li><a data-transition="slidefade" onclick="gotoBrand(&#39;'+x+'&#39;)"><a onClick="gotoEngineSelection(&#39;'+x+'&#39;)"><img src="./img/'+image
    }
    doneVehicleBrand = true;
  }
}
```

Figure 37: Code 2

Figure 37 describe on how each elements of lubricant selection by using for loop.

```

function gotoSuggestion(type_id) {
    selectionOptCC = type_id;

    if(selectionOptType == "0") //car
    {
        //new
        if(selectionOptEngine == "0")
        {
            if(selectionOptCC == "0") //alert("high cc"):
            {
                suggestOpt0 = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 8, 0, 0, 0, 0, 0, 0, 0, 0];
                suggestOpt1 = [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 9, 1, 1, 1, 1, 1, 1, 1, 1];
                suggestOpt2 = [2, 2, 2, 2, 2, 2, 14, 2, 2, 2, 14, 14, 2, 14, 2, 10, 2, 2, 2, 2, 14, 2, 14, 2, 2];
            }
            else if(selectionOptCC == "1")//alert("mid cc")
            {
                suggestOpt0 = [0, 0, 0, 11, 11, 11, 0, 11, 11, 11, 0, 0, 0, 11, 11, 8, 0, 11, 11, 11, 0, 11, 0, 0, 0];
                suggestOpt1 = [4, 4, 12, 12, 12, 2, 12, 12, 12, 2, 2, 1, 2, 12, 2, 12, 9, 1, 12, 1, 12, 2, 12, 1, 1, 1];
                suggestOpt2 = [2, 2, 2, 13, 13, 16, 13, 13, 16, 16, 2, 16, 13, 16, 13, 10, 2, 13, 2, 13, 16, 13, 16, 2, 2];
            }
            else if(selectionOptCC == "2")//alert("low cc"):
            {
                suggestOpt0 = [5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 8, 5, 5, 5, 5, 5, 5, 5, 5];
                suggestOpt1 = [6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 9, 6, 6, 6, 6, 6, 6, 6, 6];
                suggestOpt2 = [7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 10, 7, 7, 7, 7, 7, 7, 7, 7];
            }
        }
    }
}

```

Figure 38: Code 3

Figure 38 shows how lubricant recommendation will display based on the index set by the author after all the element in selecting the lubricant has been fulfill by the user

```

function getLubricantInfo() {
    doubleBack();
    for(var x=0; x < lubricant.length; x++)
    {
        var counter = 0;
        var Ref = new Firebase(myFirebaseRef + "/" + x);
        Ref.on("value", function(snapshot, prevChildKey) {
            var newPost = snapshot.val();
            lubName[counter] = newPost.name;
            lubLink[counter] = newPost.links;
            imageLink[counter] = newPost.image_link;
            descPoint1[counter] = newPost.desc.point1;
            descPoint2[counter] = newPost.desc.point2;
            descPoint3[counter] = newPost.desc.point3;
            custBenPoint1[counter] = newPost.cust_ben.point1;
            custBenPoint2[counter] = newPost.cust_ben.point2;
            custBenPoint3[counter] = newPost.cust_ben.point3;
            custBenPoint4[counter] = newPost.cust_ben.point4;
            custBenPoint5[counter] = newPost.cust_ben.point5;
            custBenPoint6[counter] = newPost.cust_ben.point6;
            custBenPoint7[counter] = newPost.cust_ben.point7;
            appPoint1[counter] = newPost.application.point1;
            appPoint2[counter] = newPost.application.point2;
            appPoint3[counter] = newPost.application.point3;
            hsePoint1[counter] = newPost.hse.point1;
            hsePoint2[counter] = newPost.hse.point2;
            hsePoint3[counter] = newPost.hse.point3;
        });
    }
}

```

Figure 39: Code 4

Figure 39 show on how lubricant recommendation page will be displayed including description, specification, application, customer benefit, customer advice and health safety environment.


```

function calculateDays(currentDate)
{
    var dateNow = new Date();
    var difference_ms = currentDate - dateNow;
    difference_ms = difference_ms/1000;
    var seconds = Math.floor(difference_ms % 60);
    difference_ms = difference_ms/60;
    var minutes = Math.floor(difference_ms % 60);
    difference_ms = difference_ms/60;
    var hours = Math.floor(difference_ms % 24);
    var days = Math.floor(difference_ms/24);
    return days;
}

```

Figure 40: Code 5

Figure 40 displayed the code for calculating days in “My Pit Stop” functionality

```

function accountLogin() {
    retrieveUserData();
    var username = "";
    var pass = "";
    var found = false;
    var message = "";
    var passBool = false;
    username = document.getElementById("username").value;
    pass = document.getElementById("password").value;
    for(var x = 0; x<email.length; x++)
    {
        if(username === email[x] && pass === password[x])
        {
            found = true;
            passBool = true;
            userID = x;
            break;
        }
        else if (username === email[x] && pass !== password[x])
        {
            found = true;
            passBool = false;
            message = "wrong password"
        }
        else if(username !== email[x])
        {
            found = false;

```

Figure 41: Code 6

Figure 41 shows the code for login page in “My Pit Stop” functionality. Only authorized username and password can enter to this functionality. For the new customers, they will need to sign up in order to have their own username and password.