

On-Road Car Breakdown Assistant Finder

Mohamad Akmal Zainodin, Hannani Aman*

Faculty of Computer Science and Information Technology,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, MALAYSIA

DOI: <https://doi.org/10.30880/aitcs.2020.01.01.021>

Received 25 October 2020; Accepted 30 November 2020; Available online 30 December 2020

Abstract: A car breakdown on the road can be dangerous to the car or the driver itself. Car trouble can happen anytime, anywhere, and anyone. In this paper, an on-road car breakdown assistant finder is designed to manage the on-road car Breakdown systematically near Parit Raja. Where the mechanic offers a workshop repairing vehicles, selling replacement parts and towing services. This new computerized system is created to be used by them so that it will lighten their burden. This propose project system is a customized web application where a mechanic can be alerted when the customer has urgent requests for car problems. The system allows the customer to send their location and select the services needed. Admin handles and can access the user details as well as the mechanic details. The admin has access to allow/block and view the mechanics. This online mechanic locator reduces customer work and can easily find the mechanics from the area, thus minimizes the customer time and cost. The language that is going to be use is a PHP, XAMPP and MySQL database to develop the system. As for analysis and design phase, a flowchart, Entity Relationship Diagram(ERD), both level 0 and 1 Data Flow Diagram(DFD) and interface design. By developing this system in mission to help a stranded driver in Parit Raja in finding nearest mechanic in the area. This system able the driver to find the nearest mechanic in the area base on their location by using global positioning system.

Keywords: Assistant Finder, GPS Navigation, Car Breakdown

1. Introduction

There is no system currently that able to help the user to find the mechanic in the area, Parit Raja. A car breakdown can occur to happen either sooner or later. A car breakdown can happen anytime and anywhere also, where era people are working hours a day and not checking their car regularly. A car breakdown can be frustrating where the people do not know what to do when they contact the mechanic is unavailable in the area or time. Meantime every person can get help quickly by using this system by finding the nearest registered mechanic within the users. Also, if car trouble happens in an unfamiliar area is quite devastating. In normal circumstances, the user needs to ask help from the locals to find the nearest workshop or mechanic. Moreover, the user needs to call manually to check the availability of the workshop and mechanic. In unfamiliar area, she need to search the workshop physically by walking as example.

On-road car breakdown assistant finder will develop carried out for car breakdown in the area to search the mechanic nearby in the area. The program developed by using a web application with a database server. The modules tested to make sure the functionality and reliability of the system. The user of the system is the driver that in need of help to find the mechanic in their area. On the other hand, the mechanic is a certified mechanic that has registered. Also, the mechanic has been acknowledging by the admin of the system. Next, the admin is the owner of the system where its job to monitor both mechanic and user. After that, will be discussed about the literature of the program. This is where the On-Road Car Breakdown Assistant finder discuss about the technology that uses and study of existing and similar system. Not just that, in the next chapter discusses about the methodology in the development. In this chapter the model and the process are being discussed. Next, the stage where the problem is going to analyze and the design have been made to solve the problem. In these chapter the analysist has been separate into four different diagram which is flowchart, entity-relationship diagram, context diagram and data flow diagram. The chapter where the development of database and interface. This is where the ideas were developing into a reality. Besides, the integration of database and interface. Moreover, testing also being conducted in this chapter. Testing was necessary to ensure the quality and reliability of the program. The final chapter is about the On-road car breakdown assistant finder's advantages, disadvantages, future works and conclusion.

2. Related Works

This section will clarify the literature for the On-Road Breakdown Assistant Finder is a web application development. These are because the writing is required to understand the organized system context to guarantee performance and provide technical or theoretical assistance to the customer. These will address the technology to use in internet programming. The web is a basis for this project, where most users need to communicate with it to navigate the system. Any feature that is necessary for the system can provide by web technology, where the majority of the function offers focused on web technology development. An analysis has been done in technology and both the study of an existing and similar system.

2.1 On-Road Car Breakdown Assistant Finder

The development of the On-Road Car Breakdown Assistant Finder system, the proposed platform of this system, a web application has been recommending for the system. The web application was suitable in this project because it required no installation, reduce business cost, quick and easy updates, low spec pc or smartphone, and others. Moreover, the system also uses a Global Positioning System as known as GPS[1].It was built to locate the users to find the nearest mechanic or workshop toward them with the enhancement of GPS positioning information. Not just that, the system also needs a nearby mechanic finder.

2.2 Technology

A web browser is a technology that used. A web browser is an excellent platform for developing this system with various users, including admin, mechanics, and user (driver). The web browser is capable of giving the specified functionality with high quality. Besides, it provides complete control. Also, internet technology includes other components such as shown in table 1.

Table 1 : Technology used

Technology	Description
JavaScript	<ul style="list-style-type: none"> • code that all text • only able to run in web applications • most popular

Table 1 : conts.

Technology	Description
	<ul style="list-style-type: none"> • has more functionality than others. • used to make an update and modification toward the HTML and CSS.
Hypertext Preprocessor	<ul style="list-style-type: none"> • an open-source general-purpose scripting language • suited for web development • can be embedded into HTML • It is also being used to develop this project's. • enables the code to interact with the server. • allows us to move into and out of PHP mode.
Database MySQL	<ul style="list-style-type: none"> • Database MySQL is an open-source database management system(RDBMS) • base on structured query language(SQL)
Cascading Style Sheets(CSS)	<ul style="list-style-type: none"> • used to shows how the HTML elements are going to show on the screen. • There are three parts of CSS consist of the inline, internal, and external. • Inline is used to style a unique for a single element. • Internal was used to design a single page of the web application. • External used to style multiple pages of web application without needed to code it again on different pages.

2.3 Study of similar and existing system

Based on the research of a similar system, two existing methods, Workshop Locator and Bateriku, have been selected as components for measuring the quality of the On-Road Car Breakdown Assistant Finder development of the system. Workshop Locator and Bateriku are the current systems compared to On-Road Car Breakdown Assistant Finder. Both of this system was selected because the on-road car breakdown assistant finder has both potential competitors. Workshop Locator is a web service that provides a workshop in the nearest of the location request by the user with the help of using google maps and the GPS able to give the distance and location Beside, Bateriku is a system that provides a battery to the on-site car delivery and installation towards car battery faulty. To get the services from the Bateriku system, the user needs to go to the web pages of Bateriku and provides the location of the car faulty. Then select the type of the vehicle and then book the battery in the system.

Base on the research of the existing system is Google Maps[2]. Google Maps has been select because the google maps used in the system to provide necessary information towards the user. Google Maps are the existing systems that are compatible with On-Road Car Breakdown Assistant Finder. Google Maps is a web-based service application[3] that provides detailed information on geographical regions and sites around the world. It was developing by google.

In table 2 shows the comparison between similar and existing systems. A few criteria have been chosen as a benchmark to determine the strength of the web services application that is going to be developed. The following table 2 shows the comparison between the On-Road Car Breakdown Assistant Finder with the other system.

Table 2: Comparison System of Studies

Web Service Application	Google Maps	Bateriku	Workshop Locator	On-Road car breakdown assistant finder
Google Maps Database	Yes	Yes	Yes	Yes
Nearest location	Google Place	MySQL	Google Place, MySQL	MySQL
Different services	No	No	Yes	Yes
Shows information	No	No	No	Yes
Send Request	Yes	Yes	Yes	Yes
Shows rating	No	Yes	No	Yes
Shows Price	Yes	No	No	Yes
Feedback	No	No	No	Yes
	Yes	Yes	Yes	Yes

3. Results and Discussion

A methodology that was going to use in this system is a waterfall methodology[4]. These are where the phase of the system development life cycle must be done first before going to the next stage. With these divide phase able to proceed with the product development one by one[5].

3.1 Waterfall Model Development

A waterfall model is a development process that was the first document in 1970. It was a public documented software development life cycle model(SDLC) that was written by Royce[6]. To a software engineering, it was popular toward a system development life cycle. The waterfall works by is linear and sequential, where each phase has a different goal different from the agile methodology[7]. In waterfall model to finish a project need to complete one stage at a time before going to another step. As for this project, the phases consist of the requirement specification phase, analysis phase, design phase, implementation phase, and Integration and testing accordingly. These shown in Figure 1 waterfall model.

There are several advantages to the waterfall model. It was easy to understand and use. These are where the structure of the waterfall model is simple to be used, where each of the phases must complete going to the next stage. Besides, each of the steps has a clear goal. These are where each of the aspects provides a different special deliverable to a project[8]. Second can determine the purpose of goals in an early stage[8].

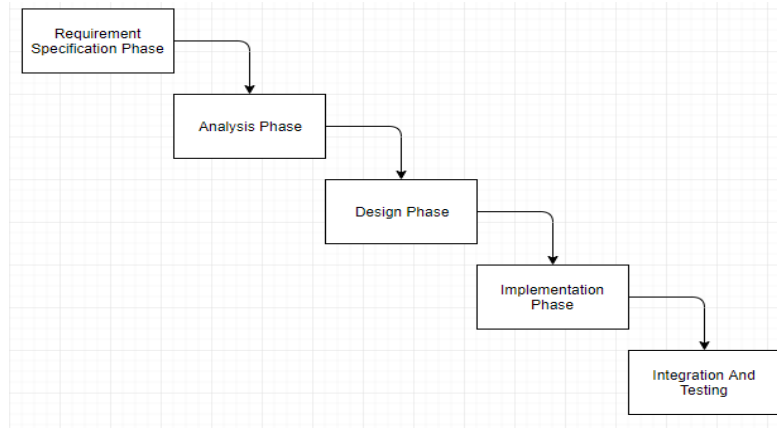


Figure 1: Waterfall Model[5]

3.2 Definition of the Process

The waterfall model consists of a requirement specification phase. Is a phase is focused on gathering the information that requires for these projects. Next is the analysis phase. These are where the system analyses to continue to design stages. After that, the design phase. The design phase was designing the system. Besides that, the Implementation Phase. These are where the development of the system. The final stage is the integration and testing phase. These are where the system brings together and integrates between the database and interface[9]. The phases are explained briefly in Table 3.

Table 3: Waterfall model task

Phase	Task
Requirement Specification	<ul style="list-style-type: none"> • Determine project title • Determine problem statement and objective • Determine Scope • Implementation Gantt Chart • Do Research in Literature Reviews • Determine suitable Methodology
Analysis	<ul style="list-style-type: none"> • Determine project Design Structured • Identify system requirement • Analyst system requirement • Draw Flowchart • Draw Entity Relationship Diagram(ERD) • Draw Context Diagram
Design	<ul style="list-style-type: none"> • Draw Data Flow Diagram • Design Interface • Design Database
Implementation	<ul style="list-style-type: none"> • Develop Database • Develop Interface
Integration and testing	<ul style="list-style-type: none"> • Integrate each system • Alpha Testing • Beta Testing

4. Results and Discussion

In the stage are analysis and design. The stage where the problem is going to analyze and the design have been made to solve the problem. In these chapter the analysisist has been separate into four

different diagram which is flowchart, entity-relationship diagram, context diagram and data flow diagram.

4.1 Analysis

In this chapter, the analysis and design chapter are conducted. There are many views in the analysis. One of the essential elements is to meet the user requirement. These are designed to ensure that the web is developed can meet the user's requirements. The issues are found in the review. It acts as a guide for the creation of a web application of high quality. Besides, work was carried out in the evaluation process of the web application. These are for finding the strengths and weaknesses of the developed web application. Next, the structured that is going to be used in the design phase is using the flowchart, Entity-Relationship Diagram (ERD), context diagram, and both level 0 and 1 Data Flow Diagram (DFD). It helps to simulate how data is generally connected, and are especially useful for developing a relational database.

4.2 Discussions

The flowchart of the analysis of the on-road car breakdown assistant finder divided into three, which is admin, driver, and mechanic[10]. The admin consists of start to login then selecting from driver, mechanic, and feedback. The driver is used to manage the user account where the admin can view driver before delete or update before it can be logged out. The admin also can manage mechanic. It is where the admin can view the mechanic then selecting verify for the first time view before it can proceed to select delete, update, allow or block. The admin also can view feedback given by the respective users (mechanic and driver). These are where the mechanic able to view the feedback given by the users. (Appendix A)

Next is the driver. The driver starts then it starting from login. If the driver does not have an account, the driver needs to register himself into the system before it can be logged in into the system. Once login, the driver able to view details before it can be deleted or update their information. To request the service, the driver needs to select the services either to find the nearest mechanic, battery, towing, or tires. Then it can proceed in into the map where the driver needs to put their location before the system able to locate the mechanic near to them. Thus driver able to send the request to users. The users were able to give feedback and rating before logout from the system (Appendix A).

As for mechanic, the mechanic started from login the same as the driver if they do not have an account they need to register themselves into the system. After that, they can select to view their detail before deciding to delete or update their information after that location, where it was used to put their current location. The mechanic also able to display services where it was used to view the services that were request toward them before they can decide to reject or accept them. All of these can be done after the admin has verified the mechanic. After that, they can provide feedback of their own toward admin. It was to provide a platform for them to provide inquiry before the mechanic able to logout from the system (Appendix A).

4.1.1 Entity Relationship Diagram (ERD)

ERD is a graphical representation of the entities. Also, it represents their relationship with each other[11]. The diagram consists of three entity admin, driver, and mechanic. Meanwhile, the system consists of the system of the program, which is the On-Road Car breakdown assistant finder. The relationship that was connecting them consists of nouns (Appendix B).

4.1.2 Context Diagram

A context diagram is to describe and explain the computer system's parameters. These defines data streams between the system and external entities[12]. The context diagram consists of three entities

which is admin, driver, and mechanic. Meanwhile, the relationship between the entity and the system is consists of nouns (Appendix B).

4.1.3 Context Diagram

Data Flow Diagram System (DFD) for describing a method or system data stream (normally an information system). In addition, the DFD provides information on each entity's outputs and inputs and the process itself[13]. The data flow diagram have six process and two sub process. The process consists of login, register, manage contact, Service, price and give feedback. The sub process consists of manage contact and services. The manage contact consist of update, verify and allow/block. Besides, the services consist of request service, select services, and locate workshop (Appendix B). Summarization of method Process used is describe in Table 4.

Table 4: Describing method Process

Process	Process Name	Description
1.0	Login	This process enable user to log in into the system
2.0	Register	This process enable user to register into the system
3.0	Manage Contact	This process enable user to manage their information
3.1	Update	This process enable user to update their information
3.2	Allow/Block	This process enable admin to allow or block the users
3.3	Verify	This process enable admin to verified the workshop locations
4.0	Services	This process enable driver to select the request service
4.1	Request Service	This process enable user to request the service
4.2	Select Service	This process enable user to select the provided services
4.3	Locate Workshop	This process enable the system to matching the location between users and mechanic
5.0	Price	This process enable mechanic to provide price to be viewed to driver
6.0	Give Report	This process enable user to give feedback to admin

4.2 Interface Design

There are two types of design phase. The design phase consists of interface design and database design. The interface design is a tool allowing users to navigate the system thoroughly[14]. It has been used to demonstrate that the web application is user-friendly. Therefore, the interface design is essential for users to be able to use the app and learn how to use it effectively. The interface design were separate between users where all the design shows in different section which consist of admin, driver and mechanic consistently.

5. Results and Discussion

This chapter explains the process of development propose project. In this chapter where the development of database and interface. This is where the ideas was develop into a reality. Besides, the integration of database and interface. This is where the database and the interface integrated with each other. Moreover, testing also being conducted in this chapter. Testing was necessary to ensure the quality and ratability of the program.

5.1 Implementation

Also, the Implementation Phase are where the system develops. Where the phase of requirement, analysis, and design has to be well understood, it is where the code is written for the project to be realized. Every implementations interface can be refer in Appendix C.

5.2 Testing

Testing is a phase where the system developed functionally. Testing is needed to ensure the system's credibility. Testing is crucial to software development because the testing determines the software quality. The purpose of testing to find the defect, bug, error that the programmer may create while developing the software.

5.3 Test Traceability Testing

Test Traceability Matrix [15] the test traceability matrix On-Road Car Breakdown Assistant Finder. The modules are available in users consist of admin, mechanic, workshop and driver. The traceability is registration, login, view users, view, send location, verify location, nearby mechanic, request, report and price.

5.4 Module Test Cases

The On user register modules, logins, view users, send location and verify location, select service, nearby mechanic, request report and price, module test cases are performed. This test is intended to determine the expected results and results of the tests.

5.5 Summary

As for summary this chapter discussed about few topics. The first topic is implementation of the program. This is where the idea turn into real world application. On the other hand, the second part is the testing part. This is one of important of building the system, where it was used to test the developed program to ensure it quality of the program to check the program can be used or not. The testing were separate into two which is Test Traceability Matrix and Module Test Cases.

6. Conclusion and Future Works

The conclusion regarding the on-road car breakdown assistant finder discussed in this chapter. Both the benefits and disadvantages discussed in this chapter. Besides, it suggests some recommendations to improve system usability. The summary will conclude that project at the end of this chapter.

6.1 Advantages

There are a few advantages to the on-road car breakdown assistant Finder. The first advantages of the system being able to locate the workshop location near the Parit Raja. One of the advantages is that the driver can easily and quickly find a workshop. With the location, the user can find the workshop around the users. Next, the system also provides a service where they can call a mechanic to fix the problem of the car, ask for a battery if they have an empty car battery, they can also use the tyres service to change tyres. Additionally, there is also a tower where necessary.

5.2 Disadvantages

There an inconvenience when there are advantages to the system. There are a few disadvantages to this system. Can't users specify their tires, such as the size of their tires, type of tires, tires' thickness. There is also no auto-routing in the system. The mechanic needs to use his knowledge to get to the location. Also, the system does not have a notification system that tells the mechanic that they are being requested at present. They need to continue monitoring the system.

5.3 Recommendation

To the completion of the system. A recommendation to add notification helping the mechanic alert the driver to the requested service. Next, the routing process, where the system should automatically route towards the users after accepting the request. Furthermore, specify the request. These is where the

driver can select a gear to repair their car. After that, a different Novice Driver interface and function. These are useful where the driver has little knowledge about automobiles.

5.4 Summary

For the summary, the final chapter is about the On-road car breakdown assistant finder's conclusion and future works. It also includes the advantages and disadvantages of the system. The section also suggests a recommendation where it can be used to enhance system quality. It can be said that the system meets users ' needs while also achieving the main objective.

7. Conclusion

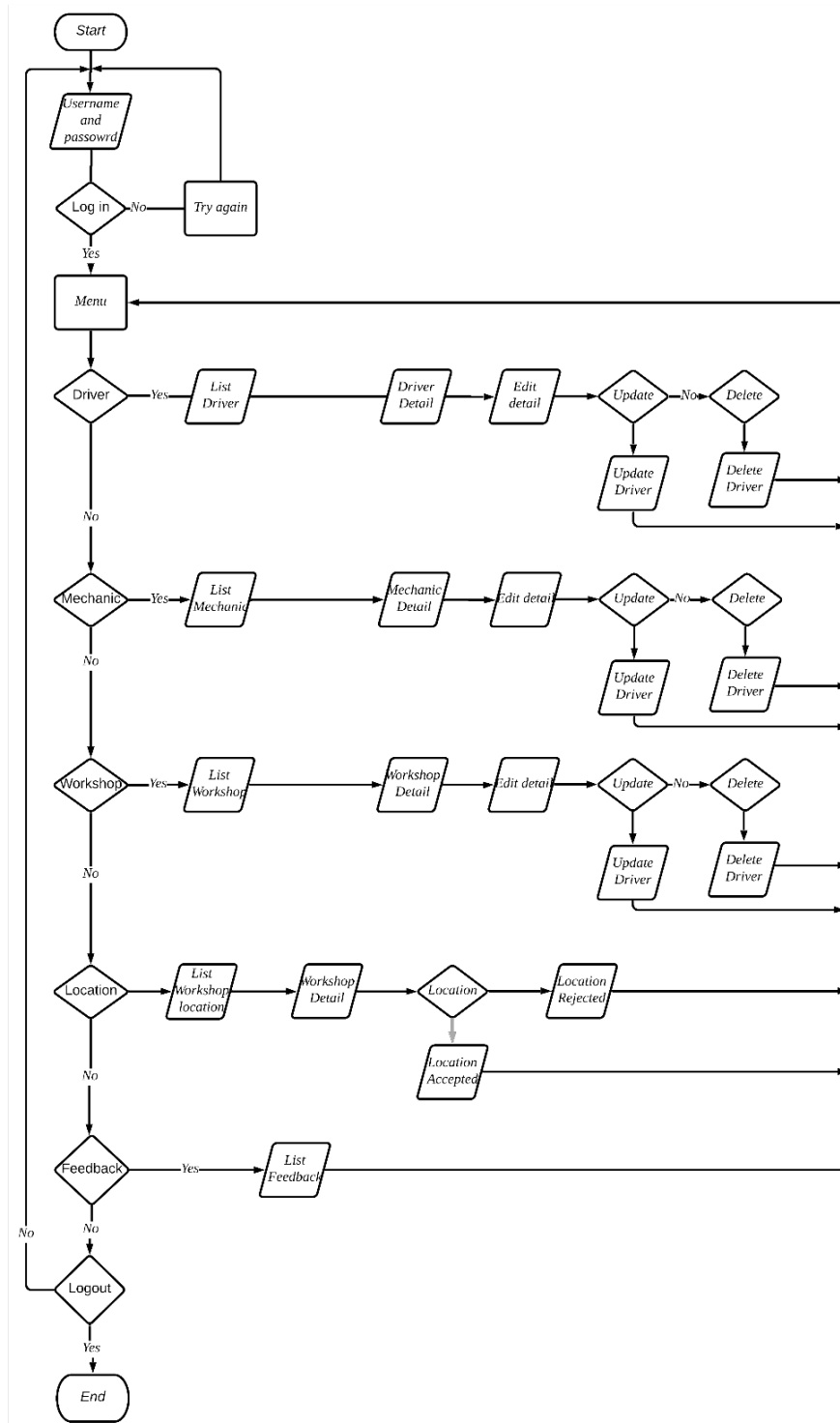
As for the conclusion, this report is about solution On-Road Car Breakdown Assistant Finder. These are where the background of the studied has been conducted. Not just that, a similar and existing system have been considered where there is consist of two similar systems and one existing system. After that, the methodology of this system has been conducted and discussed. The methodology that are used are waterfall methodology. These are where each process has been analyzed. Also, each of the processes has been describing the output of the process. Besides the analyses are describe in diagram; flowchart, Entity-Relationship Diagram (ERD), context diagram, and both data flow diagram level 0 and level 1 was used. Not just that, the interface has been designed to help explain the system. All of the discussion has been conducted to develop the system into the real world. It also includes the advantages and disadvantages of the system. The section also suggests a recommendation where it can be used to enhance system quality.

Acknowledgement

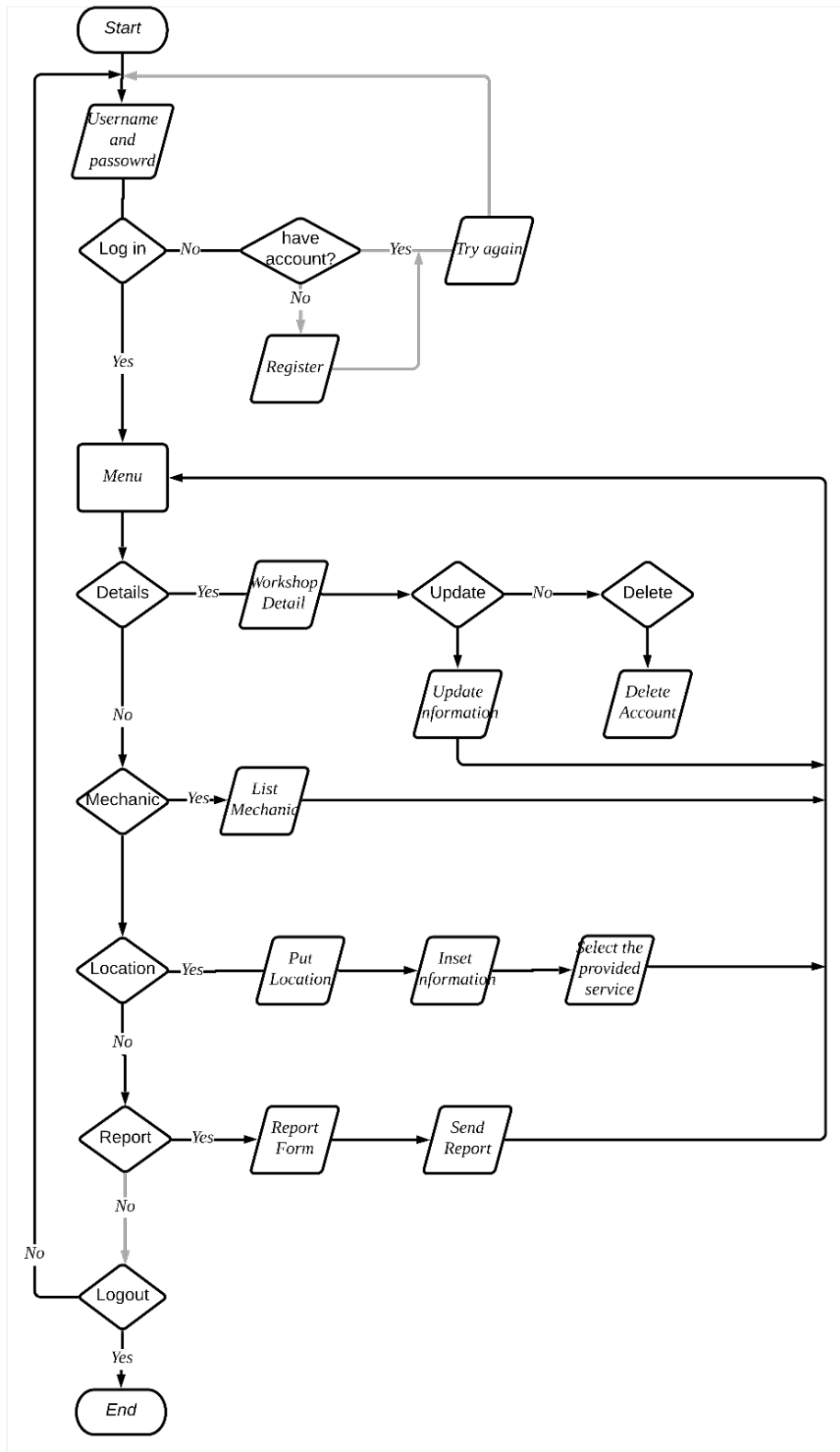
The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support and encouragement throughout the process of conducting this study.

Appendix A

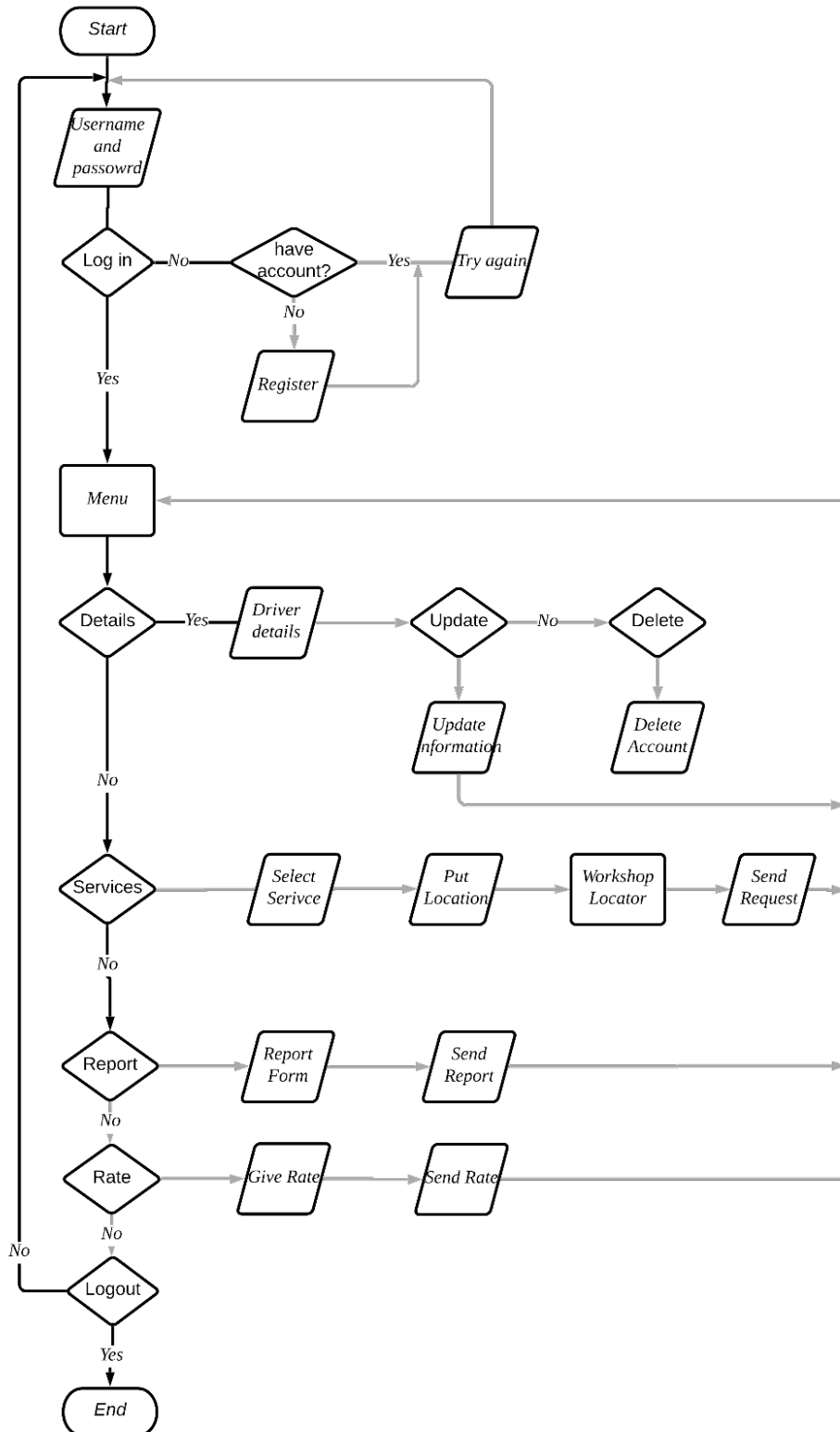
Flow chart for Admin



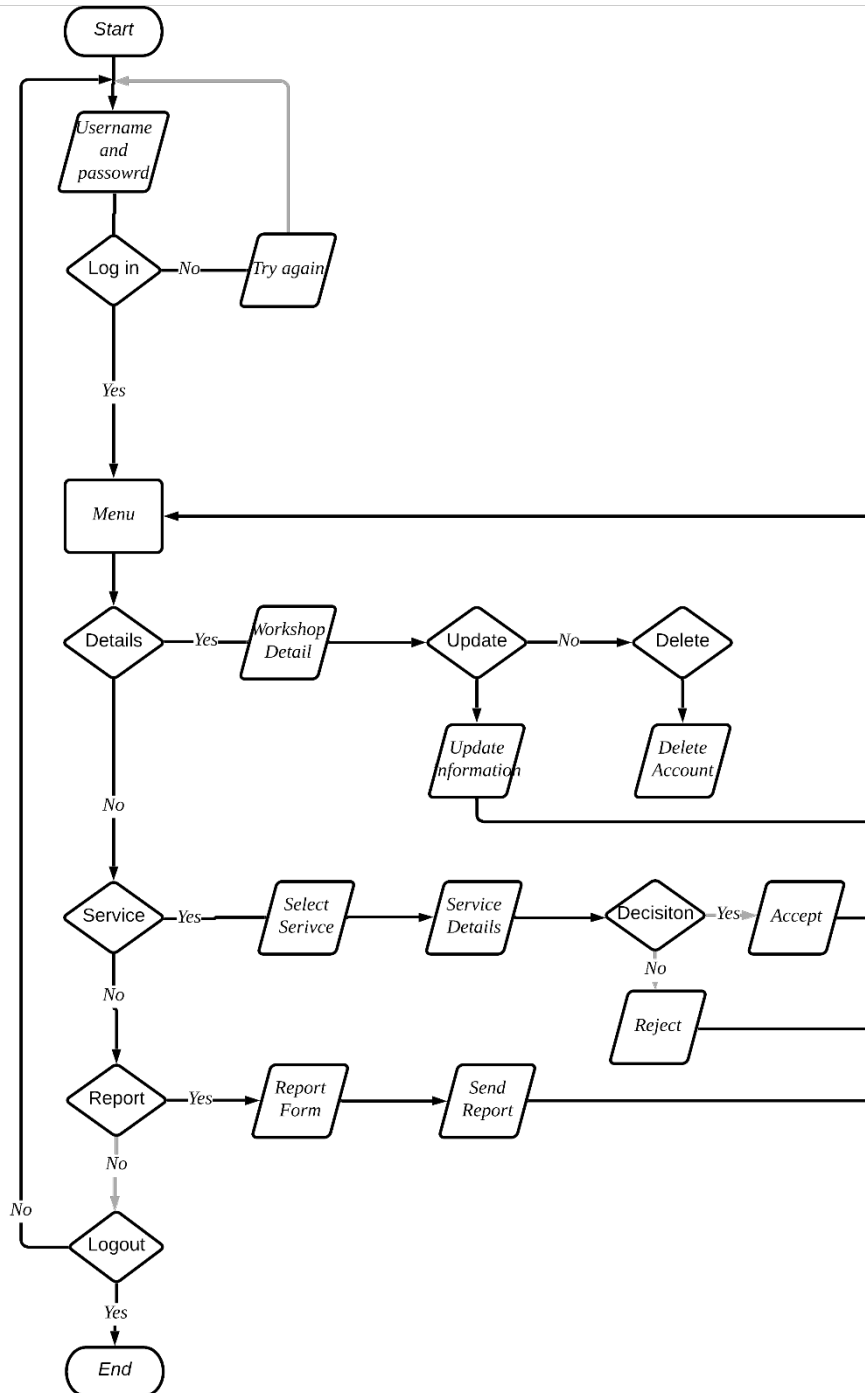
Flow Chart for Workshop



Flow Chart for Driver

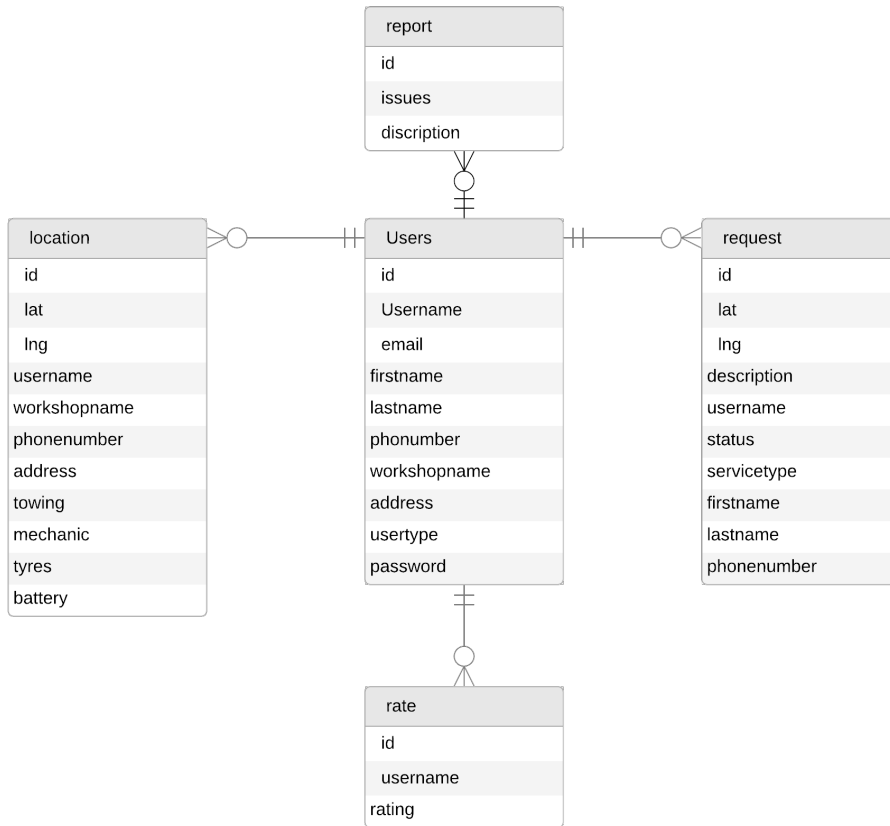


Flow Chart for Mechanic

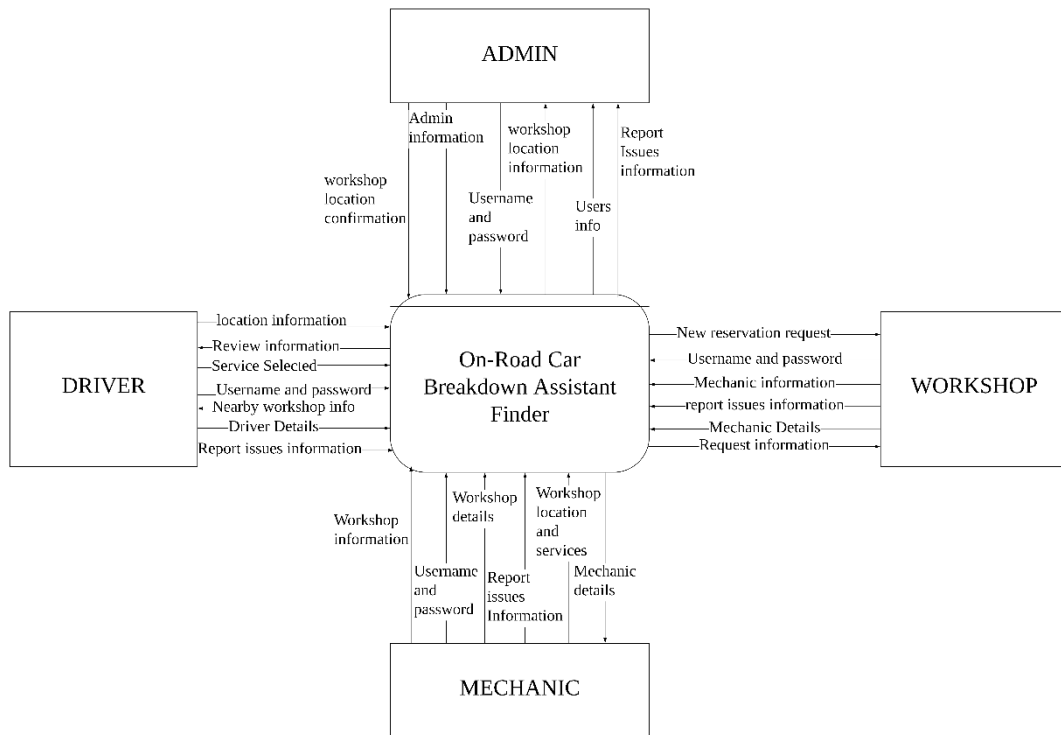


Appendix B

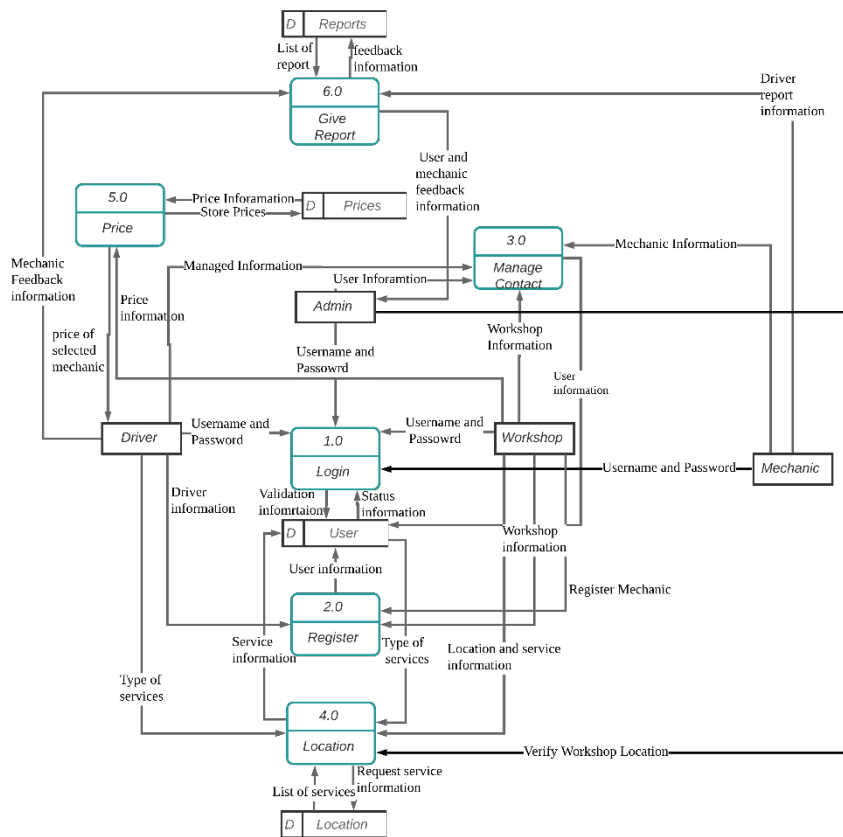
System's Entity Relationship Diagram



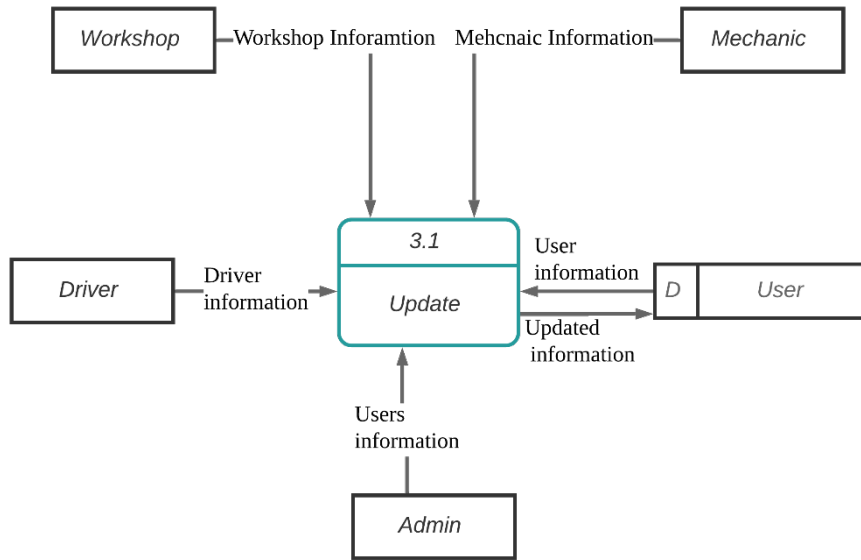
Context Diagram



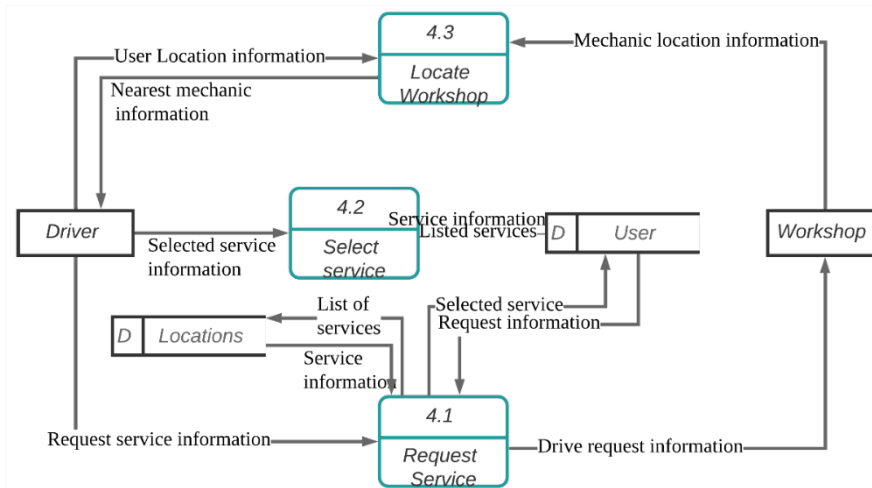
Data Flow Diagram(DFD) Level 0



Data Flow Diagram (DFD) Manage Contact Level 1

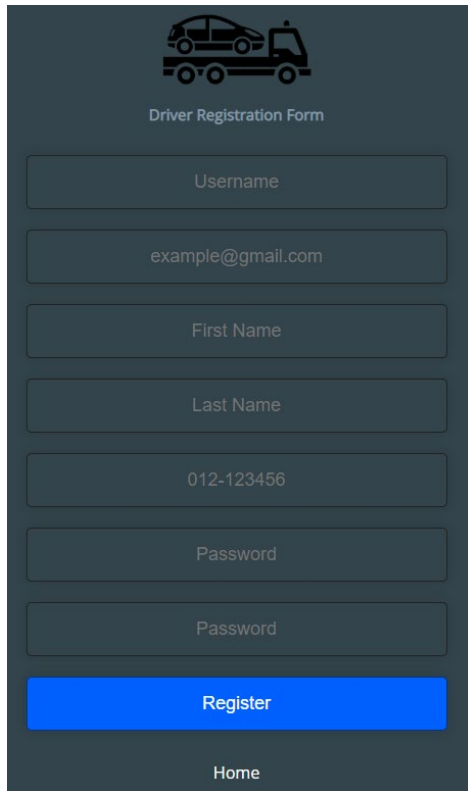


Data Flow Diagram (DFD) Services Level 1



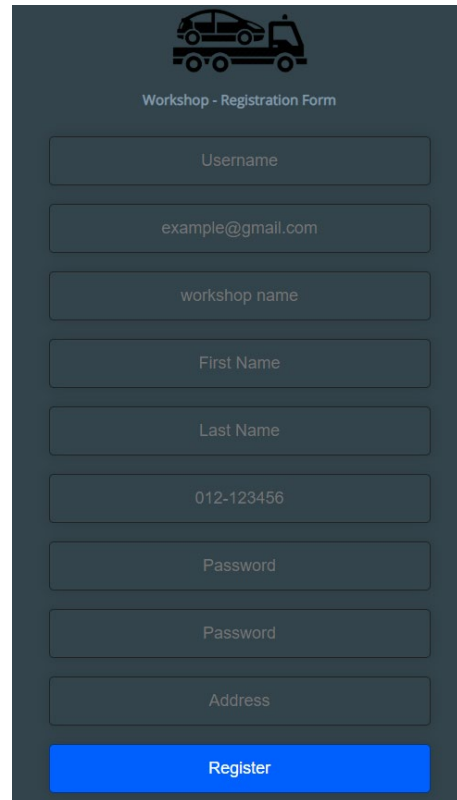
Appendix C

Driver Registration Form Interface



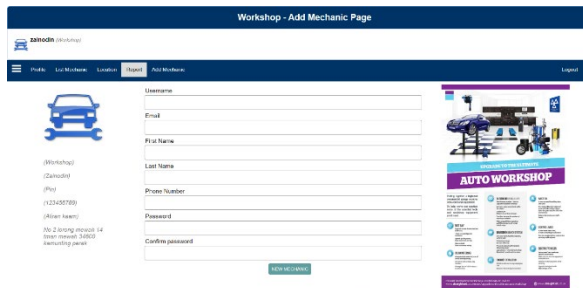
The Driver Registration Form interface features a dark blue background with a white car and truck icon at the top. Below the icon is the title "Driver Registration Form". The form consists of several input fields: "Username" (with the placeholder "example@gmail.com"), "First Name", "Last Name", "Phone Number" (with the placeholder "012-123456"), "Password", and a second "Password" field. A prominent blue "Register" button is located at the bottom of the form, and a "Home" link is positioned below it.

Workshop Registration Form Interface



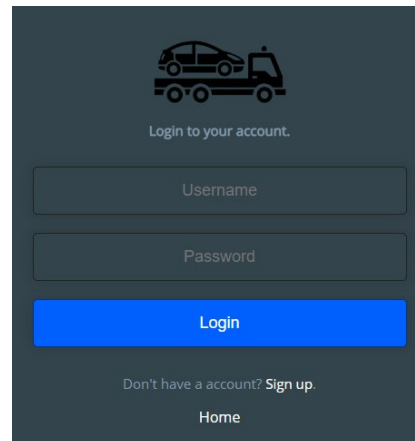
The Workshop Registration Form interface has a dark blue background with a white car and truck icon at the top. The title "Workshop - Registration Form" is centered below the icon. The form includes input fields for "Username" (with the placeholder "example@gmail.com"), "workshop name", "First Name", "Last Name", "Phone Number" (with the placeholder "012-123456"), "Password", another "Password" field, and "Address". A large blue "Register" button is at the bottom, with a "Home" link below it.

Registration form for the mechanic



This screenshot shows a web browser interface for "Workshop - Add Mechanic Page". The page has a white background with a blue header. On the left, there is a car icon and a sidebar with a "Add Mechanic" button. The main content area contains a registration form with fields for "Username", "Email", "First Name", "Last Name", "Phone Number", "Password", and "Confirm password". A green "Add Mechanic" button is at the bottom of the form. On the right, there is a promotional banner for "AUTO WORKSHOP" with various service details.

Login page




The Login page has a dark blue background with a white car and truck icon at the top. Below the icon is the text "Login to your account.". The form contains two input fields: "Username" and "Password". A large blue "Login" button is centered below the fields. At the bottom, there is a link "Don't have an account? Sign up." and a "Home" link.

Verification workshop location Interface

Admin - Approve Workshop Location

admin (Admin)
logout

Profile Approval Workshop Mechanic Driver Issues Add Admin



(Admin)
(Admin)
(Administrator)
(0123456789)

Map Satellite

username zainodin ✓

First Name zainodin ✓

Last Name pin ✓

Phone Number 123456789 ✓

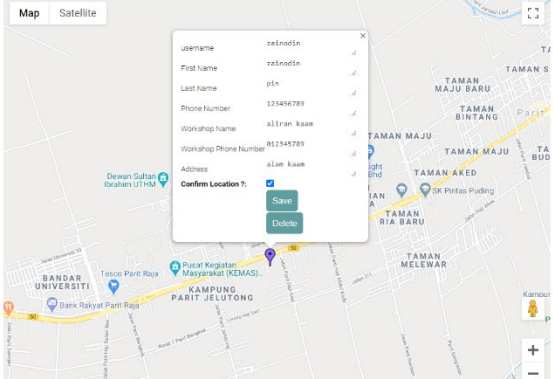
Workshop Name alliran kaan ✓

Workshop Phone Number 0123456789 ✓

Address aLek kaan ✓

Confirm Location?

Save



GUIDELINE

The requested location (purple marker) appear on the map

Click to view the details

Thick confirm location and click save

The workshop location already been approved when marker turn to red


Click the delete button to remove from the map

User Workshop for Admin View

Admin - List Workshop

admin (Admin)
logout

Profile Approval Workshop Mechanic Driver Issues Add Admin



(Admin)
(Admin)
(Administrator)
(0123456789)


USERNAME	EMAIL	FIRST NAME	LAST NAME	PHONE	ACCOUNT STATUS	UPDATE	ALLOW	BLOCK
zainodin	zainodin@gmail.com	zainodin	pin	123456789	allow	<input type="button" value="update"/>	<input type="button" value="allow"/>	<input type="button" value="blocked"/>

User Driver for Admin view

Admin - List Driver

admin (Admin)
logout

Profile Approval Workshop Mechanic Driver Issues Add Admin



(Admin)
(Admin)
(Administrator)
(0123456789)


USERNAME	EMAIL	FIRST NAME	LAST NAME	PHONE	ACCOUNT STATUS	UPDATE	ALLOW	BLOCK
razhim	razhim@gmail.com	razhim	shid	12345789	allow	<input type="button" value="update"/>	<input type="button" value="allow"/>	<input type="button" value="blocked"/>

User mechanic for admin view

Admin - List Mechanic

admin (Admin)
Logout

Profile Approval Workshop Mechanic Driver Issues Add Admin



(Admin)
(Admin)
(Administrator)
(0123456789)


USERNAME	EMAIL	FIRST NAME	LAST NAME	PHONE	ACCOUNT STATUS	UPDATE	ALLOW	BLOCK
akmal95	akmal@gmail.com	akmal	zainodin	123456789	hid	update	allow	blocked

User mechanic for workshop view

Workshop - List Mechanic Page

zainodin (Workshop)
Logout

Profile List Mechanic Location Report Add Mechanic



(Workshop)
(Zainodin)
(Pin)
(123456789)
(Aliran kaam)
No 2 lorong mewah 14
tman mewah 34600
kamunting perak


USERNAME	EMAIL	FIRST NAME	LAST NAME	PHONE	ACCOUNT STATUS	UPDATE	ALLOW	BLOCK
akmal95	akmal@gmail.com	akmal	zainodin	123456789	hid	update	allow	blocked

All registered workshop in the system near parit raja

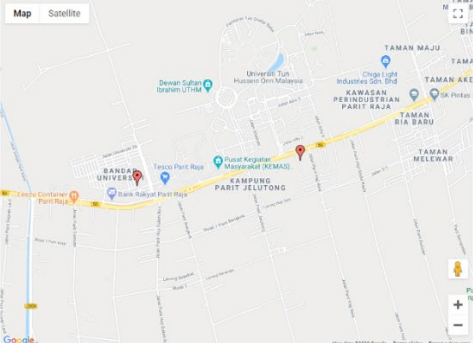
Driver - Request Tyres Page

nazhim (Driver)
Logout

Profile Request Report



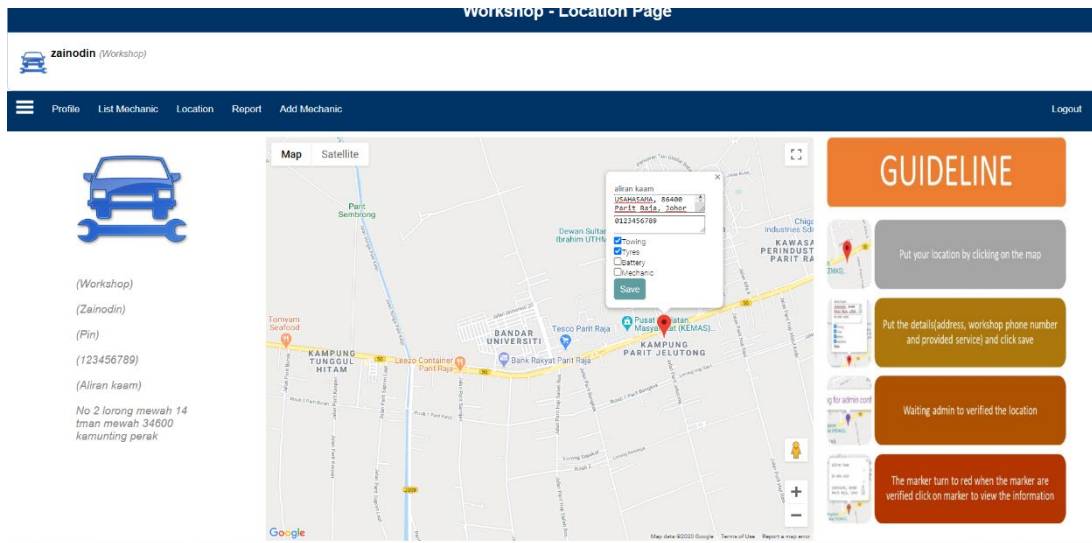
(Driver)
(Nazhim)
(Tohid)
(12345789)



Guideline

- Click on the map your location/ right click to remove it
- Click the marker and put the description(optional) and click Save
- Location saved wait for approval
- Select workshop(red marker) and request a service
- The marker turn to blue when the requested have been accepted by the mechanic

Workshop selecting two services towing and tyres.



Workshop that provide battery services

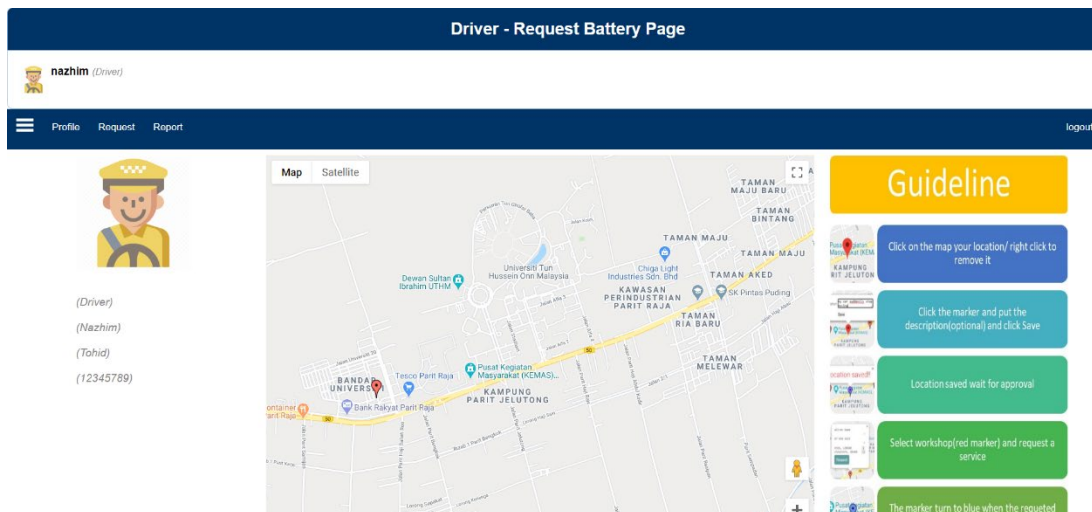
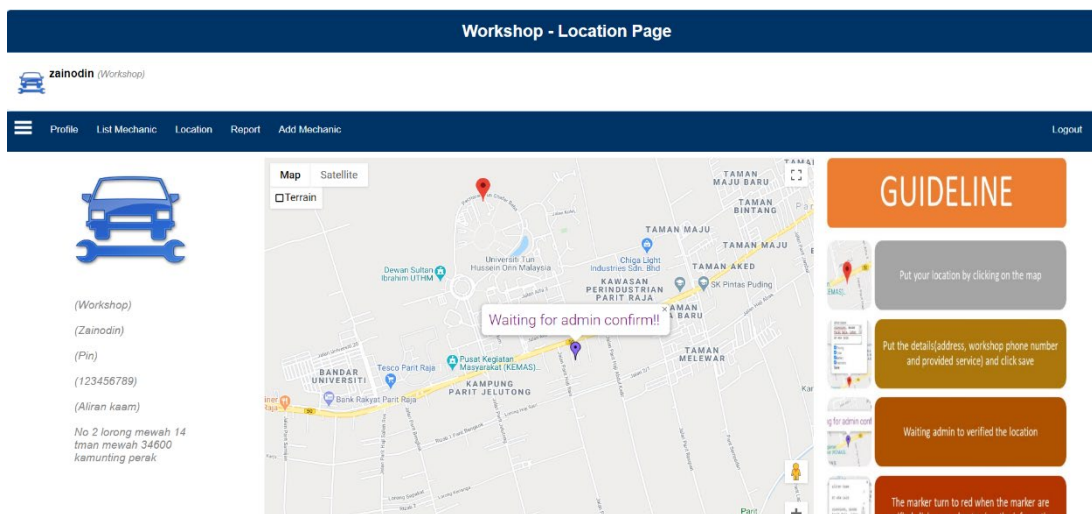
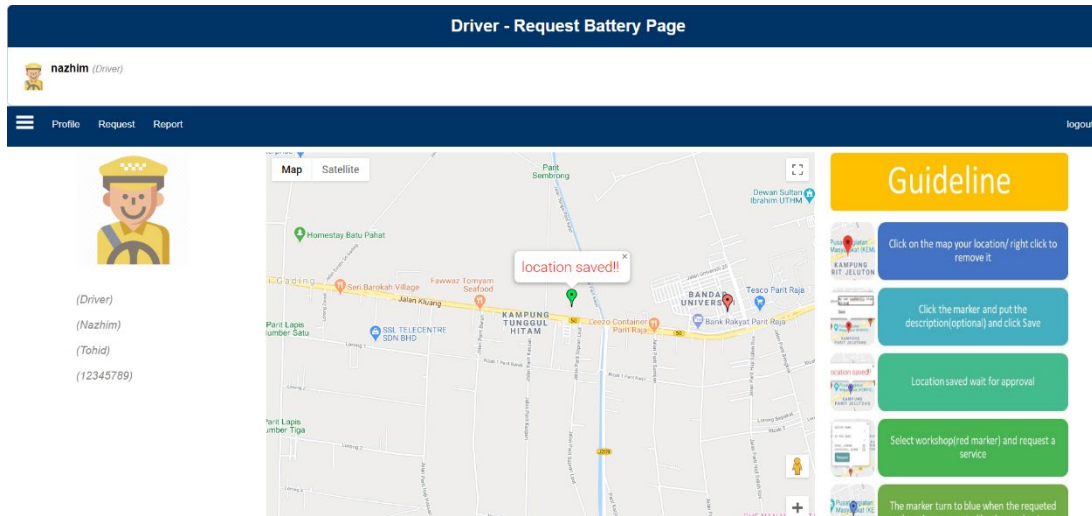


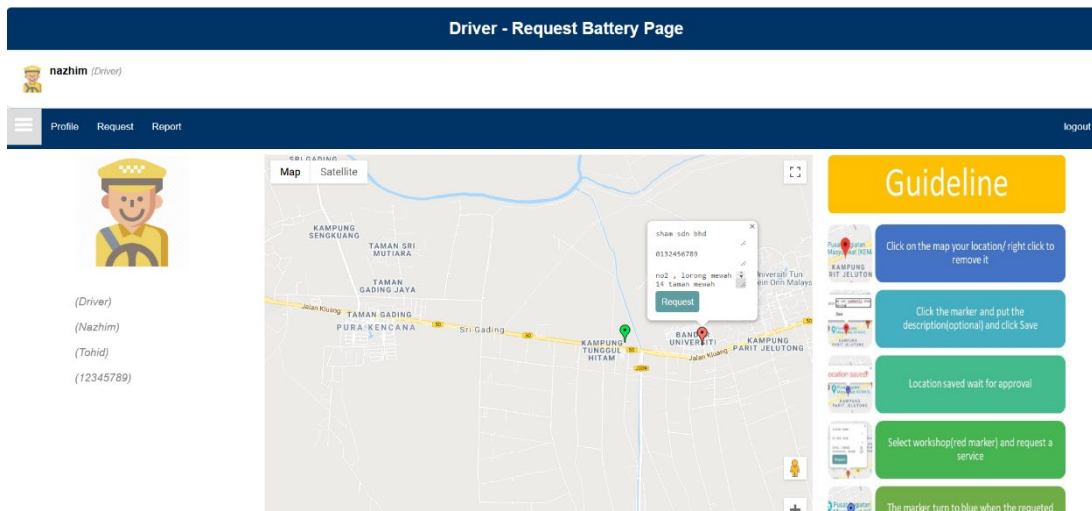
Figure 5.53 show saved a location for workshop



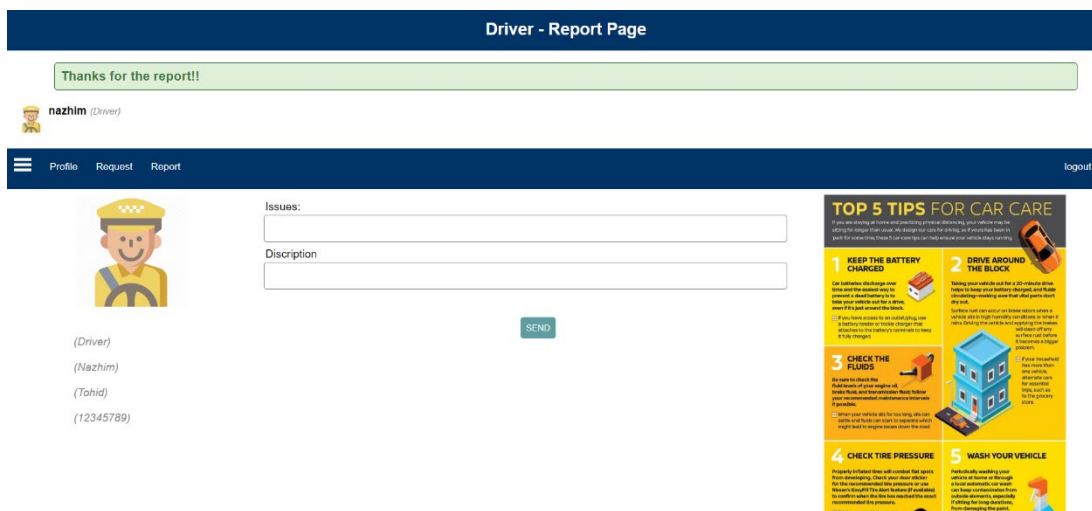
Saved a location for driver



Sending a request




Sending issues report




Admin review the issues

Admin - Issues Page



(Admin)
(Admin)
(Administrator)
(0123456789)

USERNAME	ISSUES	DESCRIPTION	ACTION
hachin	There are nothing	There are nothing problem so far..	RESOLVE



References

- [1] J. L. Awange, “The global positioning system,” in *Environmental Science and Engineering (Subseries: Environmental Science)*, 2012.
- [2] M. Purvis, J. Sambells, and C. Turner, *Google Maps Applications with PHP and Ajax From Novice to Professional*. 2006.
- [3] A. Ankolekar *et al.*, “DAML-S: Web Service description for the semantic Web,” in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 2002, doi: 10.1007/3-540-48005-6_27.
- [4] D. Hughey, “The Traditional Waterfall Approach,” *University of Missouri*. 2017.
- [5] N.d., “SDLC Waterfall Model,” *Tutorialspoint*, 2013.
- [6] N. B. Ruparelia, “Software development lifecycle models,” *ACM SIGSOFT Softw. Eng. Notes*, 2010, doi: 10.1145/1764810.1764814.
- [7] M. McCormick, “Waterfall and Agile Methodology,” *MPCS Inc*, 2012.
- [8] H. Barry, “What is Waterfall model- advantages, disadvantages and when to use it?,” *Istqba Exam Certification*, 2012. .
- [9] R. Pressman, “Software Engineering Seventh Edition,” *Metod. waterfall*, 2015.
- [10] N. A. Govoni, “Flowchart,” in *Dictionary of Marketing Communications*, 2012.
- [11] R. J. Wieringa, “Entity-Relationship Diagrams,” in *Design Methods for Reactive Systems*, 2003.
- [12] S. Burge, “The Systems Engineering Tool Box,” *Chart*, 2011.
- [13] R. J. Wieringa, “Data Flow Diagrams,” in *Design Methods for Reactive Systems*, 2003.
- [14] V. Mauger, “Interface,” in *The Routledge Companion to Video Game Studies*, 2014.
- [15] R. Saltini and R. Akkerman, “Testing improvements in the chocolate traceability system: Impact on product recalls and production efficiency,” *Food Control*, 2012, doi: 10.1016/j.foodcont.2011.07.015.