

CAR RENTAL SYSTEM  
WITH RULE BASED TECHNIQUE

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CAR RENTAL SYSTEM  
WITH RULE BASED TECHNIQUE

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for the award of the degree of  
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## **ABSTRAK**

Kajian ini dijalankan untuk mengenal kebangunan sistem kereta sewa dengan teknik berasaskan peraturan. Kajian ini ada 3 objektif iaitu belajar teknik berasaskan peraturan, mereka dan membangun teknik berasaskan peraturan serta menilai prestasi teknik berasaskan peraturan. Kajian ini terdapat 30 orang yang terlibat dalam proses mengumpul keperluan sistem atau pengguna dan proses ujian penerimaan pengguna. Kajian ini memilih teknik berasaskan peraturan untuk membantu pelanggan membentuk senarai kereta yang sesuai dalam system kereta sewa. Sistem kereta sewa ini adalah dibuatkan sebagai aplikasi web untuk memudahkan pengguna mengakses system tersebut dengan pelayur mereka. Terdapat dua laman yang berbeza, yang pertama adalah laman pengguna yang merangkumi teknik berasaskan peraturan untuk membantu pengguna menyewa kereta ideal mereka manakala yang kedua adalah laman pentadbir yang membolehkan kakitangan menguruskan kereta, servis dan penyewaan. Kajian ini menunjuk penambahbaikan dalam pembetulan senarai kereta untuk memenuhi kepuasan pelanggan. Kesimpulannya, teknik berasaskan peraturan membantu sistem kereta sewa yang sedia ada untuk menyampaikan perkhidmatan yang lebih baik untuk pelanggan.



## **ABSTRACT**

This research investigates the development of car rental system with rule-based technique. This research consists of three objective which are to study the rule-based technique, design and develop the rule-based technique and evaluate the performance of rule-based technique. This research is containing 30 participants for the requirement collection and user acceptance testing. This research chooses the rule-based technique to assist the customer on providing the suitable car rental listing in the car rental system. The car rental system is developed as a web application where allows the user easily to access the car rental system through their browser. There are two different interfaces for the user, first is the customer interface which includes the rule-based technique to assist the customer on renting their ideal car while the second is the admin interface which allows the staff to manage the car, service and rental. This research shows the improvement on providing the car rental listing to fulfil the customer satisfaction. Conclusion, the rule-based technique assists the existing car rental system to provide the better services for the customer.

## **TABLE OF CONTENT**

<b>DECLARATION</b>	
<b>TITLE PAGE</b>	
<b>ACKNOWLEDGEMENTS</b>	<b>ii</b>
<b>ABSTRAK</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>TABLE OF CONTENT</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>ix</b>
<b>LIST OF FIGURES</b>	<b>xi</b>
<b>LIST OF SYMBOLS</b>	<b>xiv</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xv</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Introduction	1
1.2 Problem Statement	2
1.3 Objective	3
1.4 Scope	4
1.5 Significance Of Project	5
1.6 Report Organization	5
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>7</b>
2.1 Introduction	7
2.2 Rule Based Technique	7
2.3 Review On Rule Based System	8

2.3.1	Diagnostic Oriented Rockwell Intelligent System (DORIS)	8
2.3.2	Implementation of a Rule-based Expert System for Application of Weapon System of Systems	11
2.3.3	Terengganu Island Recommender System Using Rule-Based Technique	14
2.4	Review Of Different Technique	16
2.4.1	Location-Based Services (LBS)	16
2.4.2	Analytical Hierarchy Process (AHP)	18
2.4.3	Technique For Order Preference By Similarity To Ideal Solution (TOPSIS)	20
2.4.4	Rule Based Technique	23
2.4.5	Fuzzy Logic Technique	25
2.5	Comparison Of Different Technique	28
2.6	Summary Of Comparison Different Techique	31
<b>CHAPTER 3 METHODOLOGY</b>		<b>33</b>
3.1	Introduction	33
3.2	Chosen Methodology	33
3.2.1	Planning Phase	34
3.2.2	Analysis And Design Phase	35
3.2.3	Development Phase	35
3.2.4	Testing Phase	36
3.2.5	Release Phase	36
3.2.6	Feedback Phase	36
3.3	Requirement	36
3.3.1	Constraint And Limitation	37
3.3.2	Software Requirement	37

3.3.3	Hardware Requirement	38
3.3.4	Context Diagram	39
3.3.5	Flowchart	39
3.3.6	Use Case Diagram And Description	41
3.3.7	Activity Diagram	52
3.3.8	Parameter and Rules	53
3.4	Data Design	60
3.4.1	Entity Relationship Diagram	60
3.4.2	Database Dictionary	60
3.5	Proof Of Initial Concept	63
3.5.1	User Login Page	64
3.5.2	User Registration Page	65
3.5.3	Rental Detail Page	66
3.5.4	Customer Car List Page	67
3.5.5	Add-On Services Page	68
3.5.6	Checkout Page	69
3.5.7	Profile Page	70
3.5.8	History Page	70
3.5.9	Feedback Page	71
3.5.10	Admin Home Page	72
3.5.11	Admin Car List Page	73
3.5.12	Admin Add-On Services Page	74
3.5.13	Customer List Page	75
3.5.14	Rental List Page	76
3.5.15	Admin Feedback Page	77
3.5.16	Rental Statistics Page	77

3.6	Testing Plan	78
3.7	Potential Use Of Proposed Solution	78
3.8	Gantt Chart	79
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>80</b>
4.1	Introduction	80
4.2	Implementation	80
	4.2.1 Develop Environment	80
4.3	Result And Discussion	85
	4.3.1 User Acceptance Test (UAT)	85
4.4	User Manual	124
4.5	Conclusion	125
<b>CHAPTER 5 CONCLUSION</b>		<b>126</b>
5.1	Introduction	126
5.2	Development Constraint	127
5.3	Future Work	128
<b>REFERENCES</b>		<b>130</b>
<b>APPENDIX A</b>		<b>132</b>
<b>APPENDIX B</b>		<b>143</b>

## LIST OF TABLES

Table 2.1	Comparison Of Related Works	28
Table 3.1	Constraint And Limitation	37
Table 3.2	Software Requirement	37
Table 3.3	Hardware Requirement	38
Table 3.4	Use Case Description (User Registration)	42
Table 3.5	Use Case Description (Login)	43
Table 3.6	Use Case Description (Manage User Profile)	43
Table 3.7	Use Case Description (Manage Car Detail)	44
Table 3.8	Use Case Description (Manage Add-On Services)	46
Table 3.9	Use Case Description (Manage Rental Detail)	47
Table 3.10	Use Case Description (Select Car)	48
Table 3.11	Use Case Description (Select Add-On Services)	49
Table 3.12	Use Case Description (Checkout)	49
Table 3.13	Use Case Description (Check Report)	50
Table 3.14	Use Case Description (Manage Rating)	51
Table 3.15	Type Of Car	53
Table 3.16	Transmission Type	53
Table 3.17	Engine Capacity	54
Table 3.18	Car Brand	54
Table 3.19	Year Of Car	54
Table 3.20	No Of Seats	55
Table 3.21	Price Per Day	55
Table 3.22	Rules	55
Table 3.23	Customer	61
Table 3.24	Car	61
Table 3.25	Addon	62
Table 3.26	Rentaladdon	62
Table 3.27	Rental	62
Table 3.28	Checkout	62
Table 3.29	Rating	63
Table 3.30	Company	63
Table 4.1	User Position	85
Table 4.2	Understanding Level For Registration Module	86

Table 4.3	Time Spent In Registration Module	87
Table 4.4	Satisfaction With Registration Module	89
Table 4.5	Continue To Login Module	90
Table 4.6	Understanding Level For Login Module	91
Table 4.7	Comfortable With Login Module Design	92
Table 4.8	Satisfaction With Login Module	93
Table 4.9	Continue To Rental Detail Module	94
Table 4.10	Usage Level Of Rental Detail Module	95
Table 4.11	Effective Of The Selection In Rental Detail Module	96
Table 4.12	Time Spent In Rental Detail Module	98
Table 4.13	Continue To Car List Module	99
Table 4.14	Understanding Level For Car List Module	100
Table 4.15	Helpful Of Rating In Car List Module	101
Table 4.16	Time Spent In Car List Module	102
Table 4.17	Continue To Add-On Module	103
Table 4.18	Usage Level Of Add On Module	104
Table 4.19	Understanding Level For Add On Module	105
Table 4.20	Meet Customer Needs In Add On Module	106
Table 4.21	Continue To Checkout Module	107
Table 4.22	Clearly Of Detail Present In Checkout Module	108
Table 4.23	Helpful Of Detail In Checkout Module	109
Table 4.24	Satisfaction With Checkout Module	110
Table 4.25	Back To Rental Detail Module	111
Table 4.26	Understanding Level For History Module	112
Table 4.27	Helpful Of Detail Present In History Module	113
Table 4.28	Amount Of Detail Present In History Module	114
Table 4.29	Clearly Of Detail Present In Profile Module	116
Table 4.30	Easily On Updating Detail In Profile Module	117
Table 4.31	Satisfaction With Profile Module	118
Table 4.32	Recommend To Others	119
Table 4.33	Understanding Level For Car Rental System	120
Table 4.34	Meet Customer Needs With Car Rental System	121
Table 4.35	Comfortable With Design Of Car Rental System	122
Table 4.36	Satisfaction With Car Rental System	123

## LIST OF FIGURES

Figure 2.1	Overview Of Diagnostic Oriented Rockwell Intelligent System (DORIS)	9
Figure 2.2	Rule Structure	10
Figure 2.3	Example of Rule Structure	10
Figure 2.4	Example of List Structure	10
Figure 2.5	“Resource-Platform-Application-User” structure model	12
Figure 2.6	Schematic Depiction Of The Rule-Based Inference Engine	13
Figure 2.7	Rules Format	13
Figure 2.8	Decomposed Rules From A Complex Combination Rule	14
Figure 2.9	Forward Chaining	15
Figure 2.10	Information Displayed In Fleet Management	17
Figure 2.11	User Interface Of The Mobile Application	17
Figure 2.12	AHP Step 1	19
Figure 2.13	AHP Step 2	19
Figure 2.14	AHP Step 3	19
Figure 2.15	AHP Step 4	20
Figure 2.16	Ranking Matrix	20
Figure 2.17	Car With Criteria	21
Figure 2.18	Normalized Data	21
Figure 2.19	Weighted Decision Matrix	22
Figure 2.20	Euclidean Distance ( $S_j$ ) With Result	22
Figure 2.21	Performance Score ( $P_i$ )	23
Figure 2.22	Second Step Of Association Algorithm	24
Figure 2.23	Abbreviation	24
Figure 2.24	Itemset With Support More Than 60	25
Figure 2.25	Rules With 100% Probability	25
Figure 2.26	Boolean Logic vs Fuzzy Logic	26
Figure 2.27	Triangular Membership Function	26
Figure 2.28	Mamdani Method And Membership Function Of Performace Value	27
Figure 2.29	Performance Evaluation	27
Figure 3.1	Agile Model	34
Figure 3.2	Context Diagram	39



Figure 3.3	Flowchart	40
Figure 3.4	Use Case Diagram	41
Figure 3.5	Activity Diagram	52
Figure 3.6	Entity Relationship Diagram	60
Figure 3.7	User Login Page	64
Figure 3.8	User Registration Page	65
Figure 3.9	Rental Detail Page	66
Figure 3.10	Customer Car List Page	67
Figure 3.11	Add-On Services Page	68
Figure 3.12	Checkout Page	69
Figure 3.13	Profile Page	70
Figure 3.14	History Page	70
Figure 3.15	Feedback Page	71
Figure 3.16	Admin Home Page	72
Figure 3.17	Admin Car List Page	73
Figure 3.18	Admin Add-On Services Page	74
Figure 3.19	Customer List Page	75
Figure 3.20	Rental List Page	76
Figure 3.21	Admin Feedback Page	77
Figure 3.22	Rental Statistics Page	77
Figure 3.23	Gantt Chart	79
Figure 4.1	User Interface	81
Figure 4.2	HTML Element In Coding	81
Figure 4.3	Bootstrap In Coding	82
Figure 4.4	Database	83
Figure 4.5	Connect To Database	83
Figure 4.6	MySQL Function In Coding	84
Figure 4.7	Rule-Based Function	84
Figure 4.8	User Position	86
Figure 4.9	Understanding Level For Registration Module	87
Figure 4.10	Time Spent In Registration Module	88
Figure 4.11	Satisfaction With Registration Module	89
Figure 4.12	Continue To Login Module	90
Figure 4.13	Understanding Level For Login Module	91
Figure 4.14	Comfortable With Login Module Design	93

Figure 4.15	Satisfaction With Login Module	94
Figure 4.16	Continue To Rental Detail Module	95
Figure 4.17	Usage Level Of Rental Detail Module	96
Figure 4.18	Effective Of The Selection In Rental Detail Module	97
Figure 4.19	Time Spent In Rental Detail Module	98
Figure 4.20	Continue To Car List Module	99
Figure 4.21	Understanding Level For Car List Module	100
Figure 4.22	Helpful Of Rating In Car List Module	101
Figure 4.23	Time Spent In Car List Module	102
Figure 4.24	Continue To Add-On Module	103
Figure 4.25	Usage Level Of Add On Module	104
Figure 4.26	Understanding Level For Add On Module	105
Figure 4.27	Meet Customer Needs In Add On Module	106
Figure 4.28	Continue To Checkout Module	107
Figure 4.29	Clearly Of Detail Present In Checkout Module	109
Figure 4.30	Helpful Of Detail In Checkout Module	110
Figure 4.31	Satisfaction With Checkout Module	111
Figure 4.32	Back To Rental Detail Module	112
Figure 4.33	Understanding Level For History Module	113
Figure 4.34	Helpful Of Detail Present In History Module	114
Figure 4.35	Amount Of Detail Present In History Module	115
Figure 4.36	Clearly Of Detail Present In Profile Module	116
Figure 4.37	Easily On Updating Detail In Profile Module	117
Figure 4.38	Satisfaction With Profile Module	118
Figure 4.39	Recommend To Others	120
Figure 4.40	Understanding Level For Car Rental System	121
Figure 4.41	Meet Customer Needs With Car Rental System	122
Figure 4.42	Comfortable With Design Of Car Rental System	123
Figure 4.43	Satisfaction With Car Rental System	124

## LIST OF SYMBOLS

DORIS	Diagnostic Oriented Rockwell Intelligent System
LBS	Location-Based Service
AHP	Analytical Hierarchy Process
CI	Consistency Index
CR	Consistency Rate
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
$S_j$	Euclidean Distance
$P_i$	Performance Score
SDLC	Systems Development Life Cycle
UAT	User Acceptance Test
GUI	Graphical User Interface

## LIST OF ABBREVIATIONS

DORIS	Diagnostic Oriented Rockwell Intelligent System
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UAT	User Acceptance Test
GUI	Graphical User Interface

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

In these few years, car become one of the common technologies that able to saw by the people in anywhere. Based on the research done by Avis Budget Group Inc, there are 82% people who had join the survey has the same opinion about owning a car is important and nearly half of the people who own the car in the survey look their car as the ideal transport (Watts, 2019). From the news of The Malaysian Reserves, the adult Malaysian who are willing to give up their car ownership are more than half while relying on the car rental with a long-term. This is due to the value depreciation problem by owning a car and there also some fees need to pay every month such as the car insurances, road tax and the maintenance fee (Yunus, 2019).

While researching about car rental, the researcher found out that the first car rental service provided was start from a bicycle shop in the earlier of 1900s. After few years from that which in year 1912, Sixt, a German company start their first rental with three cars and this has a quick expanded (Jeniffer, 2020). Until now, the car rental service had already expanded and able to find in any places. At the earlier of the car rental services, all the process are manually process by people and the customer will need to visit the car rental company for booking a car with the manager. But once the digitalization has been commonly used by the company, the manual process will not need at future.

Digitalization refers to enable the digital technique in the business process. Digitalization will provide opportunity for the business process to increase their productivity and revenue through the digital technique. That means the business which apply the digitalization will be able to improve the business process by giving an efficient service. In Malaysia, many businesses have used the digitalization for their business

which also include the car rental company. The car rental company who applies the digitalization able to move their business process from a traditional method to the online method. The digitalization will help their customer to save the time and cost to get the car rental services while the company also able to save their time on getting the sales report and the management for each car.

A normal digitalization is not enough to provide an efficiency service for the customer because there are multiple cars are listing for the customer and the customer will need to take time to find their ideal car. So, in order to solve this kind of problem, the automate technique is needed for the system and currently automate technique also provide in most of the business in Malaysia. The researcher has selected the rule-based technique to enhance the product listing issue of the existing car rental system. Rule-based technique is an automate technique that implement the artificial algorithm on managing a better selection that suitable with the customer requirement. A car rental system which applies the rule-based technique able to provide a better car rental listing for the customer and this able to help the customer to spend the least time on selecting their ideal car for rent.

The artificial intelligent field of Malaysia is still in improvement process, there are still many existing systems need to get the enhancement with artificial intelligent. So, this project is planned to enhance the existing car rental system to ensure the system is improving on providing the efficiency car rental services to the customer while providing a better car rental listing which able to fulfil the customer requirement. The successful of this project also able to create a step on the improvement in artificial intelligent field of Malaysia.

## **1.2 Problem Statement**

The existing car rental system has provided the better car rental services for the customer but there also having some problem that are still existing in the current car rental system and the problem that are not fulfil the user requirement.

Firstly, as conventional car rental process will waste the time of the customer because it requires the customer to find where the company has provided the car rental

services. Example, the tourism who come to Malaysia will need to find the car rental company by themselves and this waste their travel time.

Next, customer is having the problem in looking a suitable car that match with their destination type in the current existing car rental system. The existing car rental system is collecting the pickup and pick down place of the customer and not collecting the destination places of the customer due to the customer privacy, but to provide a better car rental listing for the customer searching their ideal car to rent, the destination type should be included for helping the customer to searching a car that are suitable to the destination type. Example, the customer destination might be mountain, then the Toyota Hilux will be the good choice but if the customer didn't have any knowledge about which car is suitable for the destination, they might choose other car that might have issue when going to the mountain.

In the current existing car rental system, the customer also having the issue while searching the suitable car. While searching a suitable car, the customer will be looking for the suitable parameter of the car that are match with their requirement, but the customer always have to take some time to look for the parameter that match with their purpose. Example, the customer is finding a Toyota car which able to go mountain but the top list only shows those Toyota car for the flat road, then the customer have to scroll down the list until the car is found and this waste customer's time.

Above is the problem in customer view, while in the system view, the existing car rental system has a limited technique on providing the suitable car rental listing for the customer due to only using the normal algorithm in the car rental system. So, rule-based had been created to solve the problem. Rule-based will collect the estimated parameter from the customer and provide a better car rental list which able to fulfil the parameter that collected from the customer while the customer also able to take least time on searching their ideal car.

### **1.3 Objective**

In this session, the objective of this project is create based on the problem meet. The objectives are:

- To study the rule-based technique for car rental system
- To design and develop the rule-based technique for the car rental system
- To evaluate the performance of rule-based technique for the car rental system based on user acceptant test

#### **1.4 Scope**

This part recorded the scope of the report which need to be focus had been separated into three which are:

##### 1. Customer Scope

- Customer able to manage their personal detail
- Customer able to book the car from the system
- Customer able to manage their requirement

##### 2. Company Scope

- Company able to manage the car detail
- Company able to get the sales report on everyday

##### 3. System Scope

- System should collect the personal detail of customer
- System allows the customer to book the car they selected
- System will create a better car rental list based on customer requirement
- System should display the updated detail of the car



- System should provide the sales report for company
4. Development Scope
- Use PHP as programming language on development process
  - Implement the rule-based approach for automate technique
  - 30 users in acceptant test

### **1.5 Significance Of Project**

This project provides one of the suitable artificial intelligent algorithms to enhance the product listing of existing car rental system by collecting the requirement from the user and use the requirement with the selected artificial intelligent algorithm to provide a better car rental list that is match with customer requirement. With enhancing the existing car rental system through the rule-based technique has improve the efficiency of the car rental system and allow the customer to find their ideal car easily and in a short time. This enhancement also shows the professional of the car rental company on providing the efficiency car rental service to their customer. In artificial intelligent field of Malaysia also able to get the improvement and show Malaysia is having it step on the advance country.

### **1.6 Report Organization**

There are 5 chapter recorded in this report. Chapter 1 record the overview of the project which include the introduction, problem statement, objective, scope, significance of project and the report organization.

Chapter 2 record the literature review for the project. This will review the existing system to compare and analyst between the selected existing system.

Chapter 3 record the methodology of the project which include the project management framework, project requirement, proposed design, data design, proof of initial concept, testing plan and the potential use of the proposed solution.

Chapter 4 record the result and discussion after the development of the car rental system. There will provide a user acceptance form to the user to record their experience. An user manual will provide for the user in order to assist user step by step on using the feature of the system.

Chapter 5 record the conclusion of the project which contain the constraint meet by the researcher during the project period and the future work from the research.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The literature review will review on the technique that had been selected by the researcher to make the improvement for the existing car rental system. The researcher also reviews to related works about the car rental systems are developed with different techniques. The researcher will do the analysis to these related works and compare this related work with the technique used, function, strength, weakness, advantage and disadvantage. The comparison between the related works able to give an assistant to the researcher on developing the needs of the car rental system. In these reviewing process, the researcher able to get more information about the weakness of the existing car rental system and make an improvement on the weakness to provide a better car rental service to the customer. However, the strength and advantage of the existing car rental system should be able to remain the function when the car rental system is created.

#### **2.2 Rule Based Technique**

Rule based technique is a technique use the domain-specific knowledge to solve the specific problem. Rule based technique is focus on two elements which are rules and facts because rule-based technique will through the rules and facts to evaluate and manipulate the data (Doe, 2020). So, rule-based technique is required to collect a large amount of facts and rules for the data evaluation and manipulation. Rule based technique show the automation process while the system uses the set of rules and facts that to make the deduction and choices. Rule based technique uses the if statement to set as the rules for making the deduction and choices. Example, IF x happen THEN y will be proceeded.

Because rule-based technique also known as an automate technique, so it also considers as artificial intelligent but only the simplified form of artificial intelligent.

There are two types of rule-based techniques which are forward chaining and backward chaining. The forward chaining is a data driven technique which will use the data to make decision for reaching the goals while the backward chaining will start from the goal to find out the facts that needed on reaching the goal. Example for the forward chaining is the breath first search and backward chaining is the depth first search. Comparing to the performance, backward chaining able to get the result faster than forward chaining.

In this project, the rule-based technique has been selected to improve the existing car rental system. This is because the existing car rental system have the limited technique on providing the car rental listing which able to match the user requirement. So, with the rule-based technology, the car rental system will be based on the set of rules and facts that collected from stakeholder's requirement to provide a better car rental listing that able to match with customer requirement. The listing process also is done by automate because it just based on the set of rules and facts to do the deduction and select the better choice for the customer.

## **2.3 Review On Rule Based System**

This section will show the system that implemented with the rule-based technique. The description of the system shows in this section will be able to assist the researcher and the reader of the report to get more information about the implementation of the rule-based technique in a system.

### **2.3.1 Diagnostic Oriented Rockwell Intelligent System (DORIS)**

Diagnostic Oriented Rockwell Intelligent System (DORIS) is an expert system which applied the rule-based technique to assist the diagnostic system on the fault diagnostic process. Diagnostic Oriented Rockwell Intelligent System (DORIS) provide

the recommended expert solution on assisting the diagnostic system to reduce the time used on fault diagnostic process.

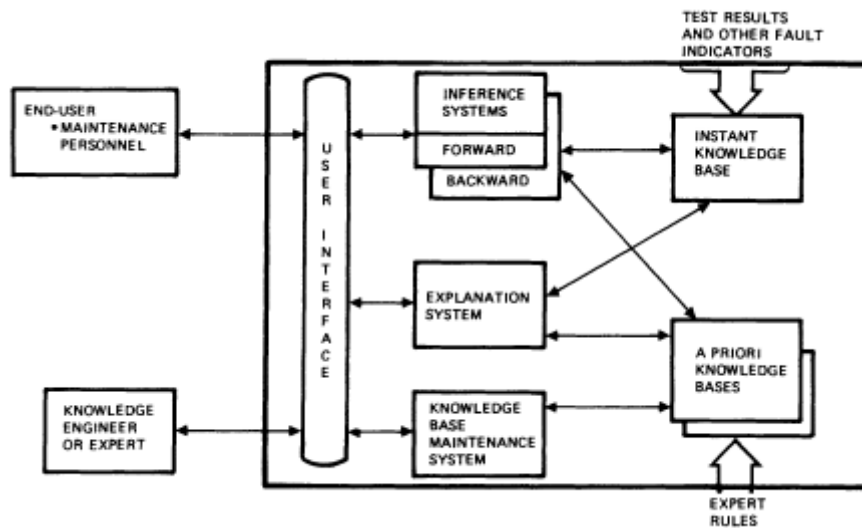


Figure 2.1 Overview Of Diagnostic Oriented Rockwell Intelligent System (DORIS)

Diagnostic Oriented Rockwell Intelligent System (DORIS) is also a production rule system which implement a set of rules or facts in the system and select the recommendation result to display for the user(Davis, 1986). Diagnostic Oriented Rockwell Intelligent System (DORIS) will interact with the user by asking the question to the user for collect the answer and then output the recommend advice for the user. Diagnostic Oriented Rockwell Intelligent System (DORIS) required a high knowledge on the field because the system need the knowledge bases to recommend an expert advice for the user to solve their problem. The knowledge bases of Diagnostic Oriented Rockwell Intelligent System (DORIS) consist of two different partitions of knowledge.

The first partition of knowledge is apriority knowledge base. Diagnostic Oriented Rockwell Intelligent System (DORIS) will collect the answer get from the user and send the answer to the rule structure to find the suitable rule for getting the recommend advice to the user. The rule structure in the system is using the form of IF-THEN as figure 2.2 shown on below.

```

((if (condition #1) . . (condition #n))
 (then ((certainty #1) conclusion #1) . .
        ((certainty #m) conclusion #m)))

```

Figure 2.2 Rule Structure

The rule structure is used to prove the conclusion is true while the fact of the condition in the IF statement must true. In order to prove the conclusion is true, there might need multiple of condition to show the fact of the truth. The condition is combined into the IF statement by using the logical operators “AND”, “OR” and “NOT”. An example of rule from documentation of DORIS is shown in the figure 2.3.

```

((if (and (two consecutive bits fail in
          Test 1 Section 2)
         (the voltage at Pin 1A greater
          than 5 volts))
 (then ((.75) Card 3 is bad)))

```

Figure 2.3 Example of Rule Structure

Next, another partition of knowledge that contain in the Diagnostic Oriented Rockwell Intelligent System (DORIS) is the instant knowledge base. Instant knowledge base will store multiple facts for the current problem in the list structure of the system and each fact will located with their own factor that cause the problem. The system will use the list structure to evaluate the problem and then prove the truth for the condition and conclusion for the problem. Example of the list structure is show in figure 2.4.

```

((( .5 ) Card 5 is good )
 (( .75 ) Card 3 is bad )
 (( 1.0 ) The voltage at Pin 1A greater
         than 5 volts )
 (( 1.0 ) Two consecutive bits fail
         Test 1 Section 2 ))

```

Figure 2.4 Example of List Structure

Diagnostic Oriented Rockwell Intelligent System (DORIS) consist of two types of technique used by inference system and both of the technique are stand alone for each other. First is the forward chaining where the system will start from the fact of current problem to provide the recommend advice. The system will start on searching the rule that contain the condition which match with the current problem to prove the conclusion is true. Once the rule has been triggered, the conclusion from the rule will be used as the

new fact of problem in the instant knowledge base to trigger other rules. This rule triggered process will loop until the system fail to find the rule to trigger and all the result from the triggered rule will display to the user.

The second inference system is the backward chaining which work opposite function than the forward chaining. The backward chaining will begin from the goal which mean the backward chaining will find the facts which prove for the goal. The backward chaining will search for the rule that result a conclusion that able to prove the truth of the goal. If the system gets the unknown condition, then the system will set the condition as the subgoal and use the recursive backward chaining to find the matched conclusion to prove the truth of the subgoal. If the system didn't find any rules that have the matched conclusion to prove the subgoal, the system will direct ask the truth from the user and the user able to reply the truth with three parameter, "yes", "no" and "unknown". The results will display for the user once all the subgoal and the goals have been proven true after the process.

Diagnostic Oriented Rockwell Intelligent System (DORIS) able to lead the user to get more understanding on the rules through the explanation system and the expert also allowed to update the rules in the knowledge base to improve the system. The user will be given a normal menu in natural-like language and then the system will convert it into the internal rule representation in order to proceed the fault diagnostic process.

### **2.3.2 Implementation of a Rule-based Expert System for Application of Weapon System of Systems**

Application of weapon system of system is built with a teaching and simulation system which implement the rule-based inferences engine for assist the military commander on using the weapon system with a better planning. In the improvement on military science and technology, military weapon system confrontation becomes the primary form of warfare (Yang et al., 2013). By comparing to the real combat, virtual battlefield is more recommended for the military training. This is due to the dangerous of the military might happened in the real combat the virtual battlefield can also be able to assist the military to improve their decision-making capacity.

Weapon system of system has been done with various research by multiple people. Example, simulation method based on Petri-nets for evaluating the capacity of weapon system of system by considering the probability and resource conflicts (Zhao et al., 2009), system framework for weapon system of system using an engineering method (Qing-song et al., 2011), cost evaluation model based on characteristics and principles of weapon system of system (Guang-zhi, 2011) and then the military exploratory and analysis tools for handle the uncertainty in weapon system of system. Even there are various research but none of them able to assist the military commander to improve themselves on make good use the weapon system (Yang et al., 2013).

The teaching and learning system is implemented with the distributed architecture which purpose to share the resources with other connected system in the local network. All the basic information is such as the knowledge base and model are stored in the server database. The “Resource-Platform-Application-User” structure model also introduce in the system for the reuse of simulation resources as shown in figure 2.5. Each layer in the structure model perform their own function on the system while the platform layer is the core function for the system.

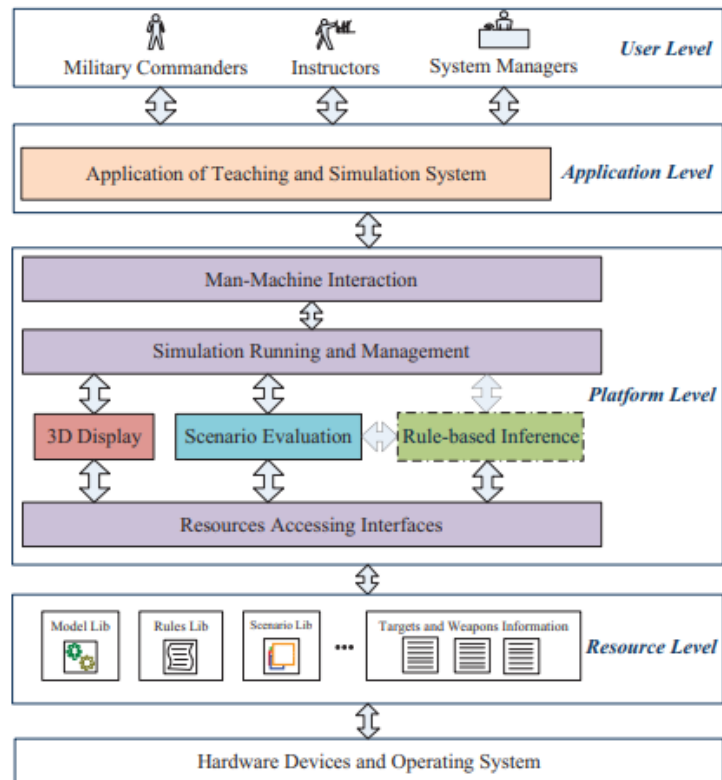


Figure 2.5 “Resource-Platform-Application-User” structure model



The teaching and learning system also consider as the rule-based expert system because it consists of three relevant components in the system which are the rules component, rule base inference engine and the working memory as shown in figure 2.6. The parameter that input in the working memory will used as the fact for the inference engine while the knowledge base is store as rules in the rule components. In the inference engine, the pattern matcher is function for match the input parameter with the rules and assign the priority for the rules into the agenda and then the execution engine function to operate the rules based on the priority of it.

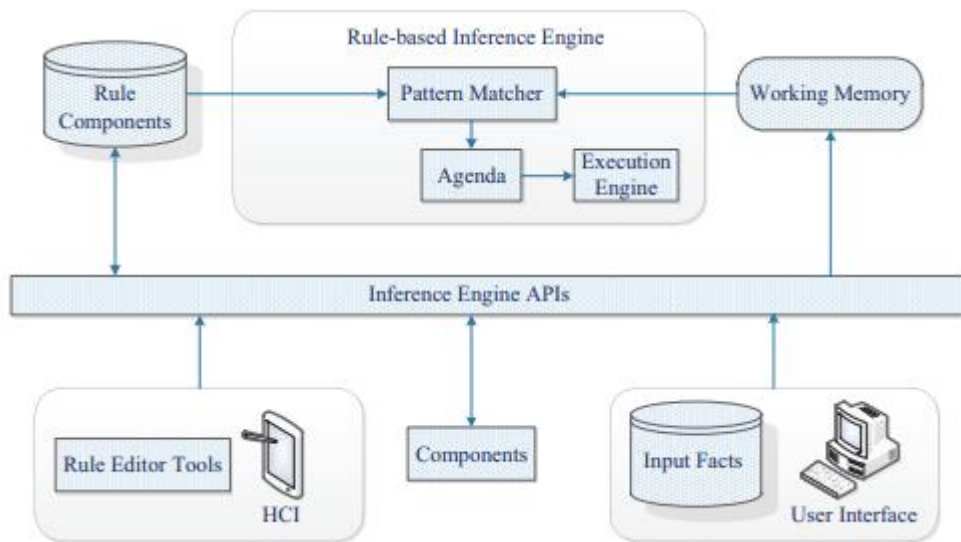


Figure 2.6 Schematic Depiction Of The Rule-Based Inference Engine

In the application of weapon system of system, there are five categories of rules which are target-matching rules, environment-matching rules, performance-constraint rules, equipment-combination rules and evaluation-analysis rules. These rules are using the similar format for the production rules as shown in the figure 2.7. The format is the form of “condition → action” which means when the condition is triggered, then the action for the specific condition will be happened.

$$\text{IF } x_1 \text{ AND } x_2 \text{ AND } \dots \text{ AND } x_n \text{ THEN } Y_1 \text{ OR } Y_2$$

Figure 2.7 Rules Format

The expert rules mostly contain the “or”(V) to make exception and with the “and”(Λ) to make the combination. But the aim for the research is simpleness the system, so there “or”(V) rules should be separate with the “and”(Λ) rules to make the rules

inference process simpler and the system might more efficient on rules inference process. The example for simplifies the rules is shown in the figure 2.8.

Rule Counter	Specific Decomposed Rule
1	$x_1 \wedge x_2 \rightarrow Y_1$
2	$x_3 \rightarrow Y_1$
3	$x_1 \wedge x_2 \rightarrow Y_2$
4	$x_3 \rightarrow Y_2$

Figure 2.8 Decomposed Rules From A Complex Combination Rule

The application of weapon system of system is implementing the virtual reality for the virtual battlefield. This action is to improve the users' sense of immersion and interactivity significantly while the rule-based implemented in the system assist the military commander to improve their decision making to the weapon system.

### 2.3.3 Terengganu Island Recommender System Using Rule-Based Technique

Terengganu Island Recommender System is a tourism recommender system where function on recommend the suitable places for the tourist. The area that focused by the system is all the places that are located in Terengganu. The recommender system is function in the information filtering where the recommender system will filter the information based on the user requirement (Rosdi, 2018).

Commonly, there are two type of rule-based system which is forward chaining and backward chaining. In the research, the recommender system implements the forward chaining inference engine for the rule searching where the rules are executed for finding out the goals. The rules in the recommender system are created based on the IF (condition) THEN (action) structure. This means the when the condition of the rule is triggered, then the rule will fire the action for execute.

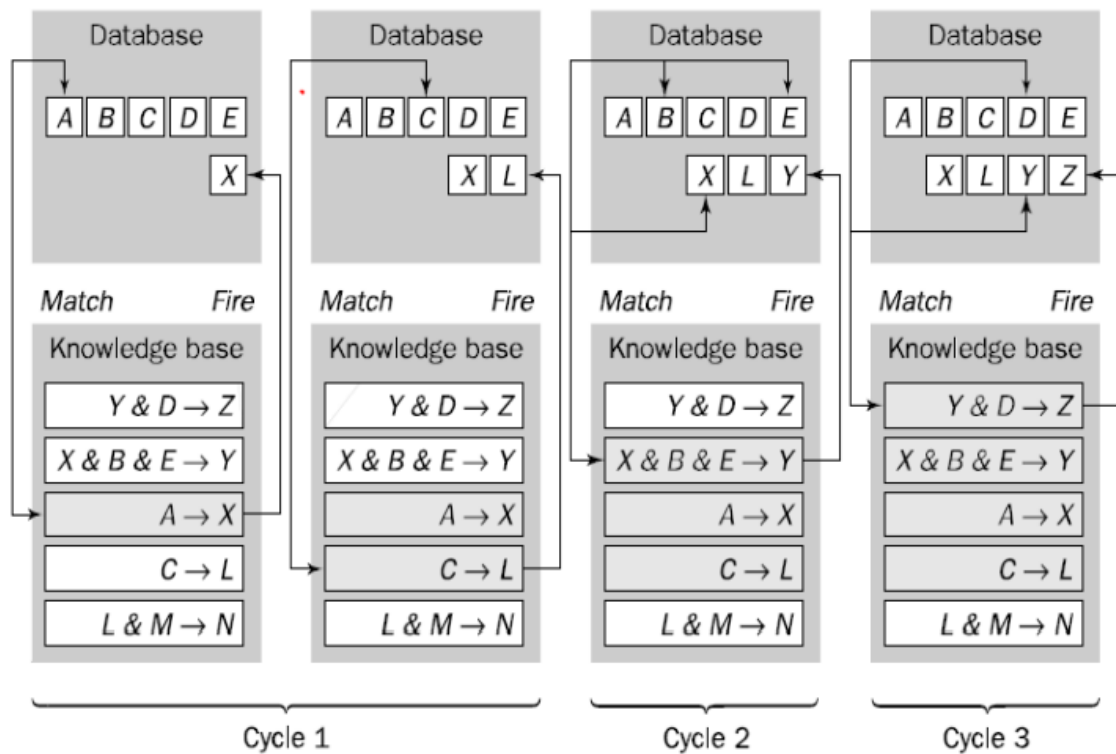


Figure 2.9 Forward Chaining

The recommender system executes the inference process for the rules is shown in figure 2.9. Based on the figure 2.9, there are five rules are provided in the knowledge base. The inference engine will execute the first input in the database which is “A” to find the matched rule and fire the “X” into database. After that, it will continue to second input which is “B” but there are no rules that able to fire because the rules exist in the knowledge base is require the not only “B” but also “E” which haven’t get by the inference engine to execute the rule. But when there all the input “X”, “B” and “E” has been recognise by the inference engine, then the inference engine will be able to execute the rules where this is shown in the cycle 2 of figure 2.9.

The Terengganu Island Recommender System with the implementation of rule-based technique able to improve the decision-making process and provide a quality result for satisfied the user requirement. The system also able to provide the information faster and display a shorter list which are more satisfied to the user requirement.

## **2.4 Review Of Different Technique**

This section will describe the related work with different techniques used on it. There are five different techniques able to use on the car rental system to provide a quality service which are Location-Based Services (LBS), Analytical Hierarchy Process (AHP) and Technique For Order Preference By Similarity To Ideal Solution (TOPSIS), Rule Based Technique and Fuzzy Logic.

### **2.4.1 Location-Based Services (LBS)**

Location-based services (LBS) is a technique used to provide the nearest services to the customer based on the location of the customer. Location-based service currently is the common technology used on any tracking application which track the user real time location to provide the relatable information such as data or advertisement to the user. Based on the research, the car rental system which uses the location-based services able to provide a quality car rental service to the customer (Dessie, 2015). Car rental service with location-based services will use Global Positioning System (GPS) in the mobile devices to track the real time location of the customer, then analysis the real time location of the customer to provide the nearest car rental service in a short time.

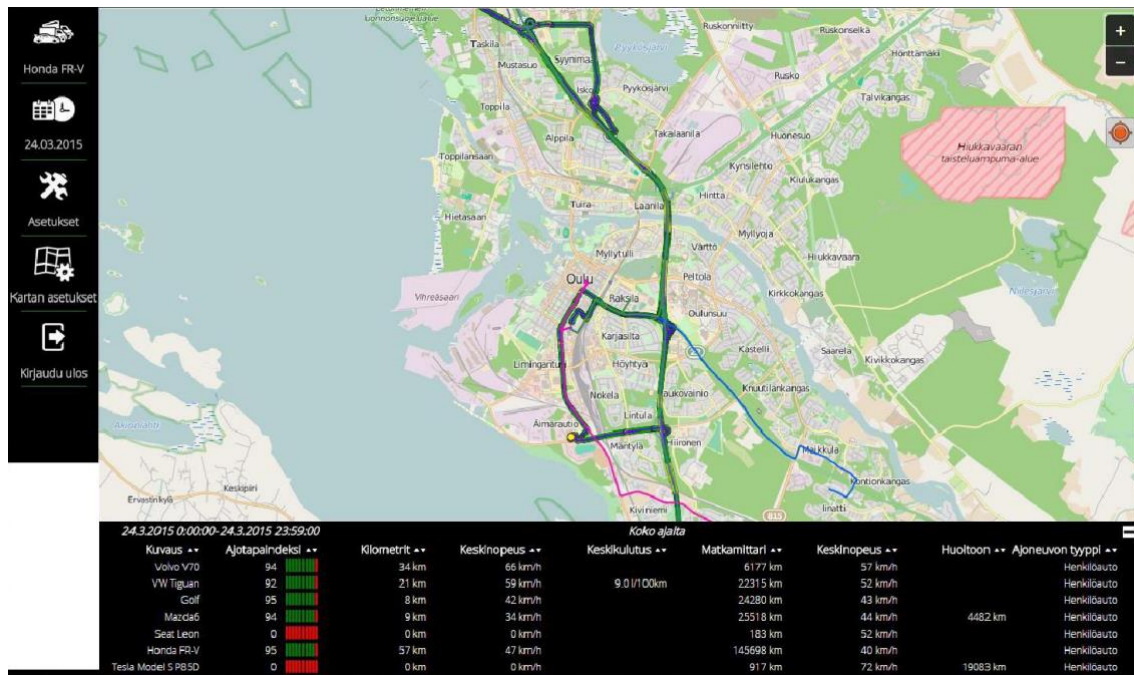


Figure 2.10 Information Displayed In Fleet Management

Based on figure 2.10, there show the information displayed in the fleet management of the system. The fleet management display various type of car with the related information.

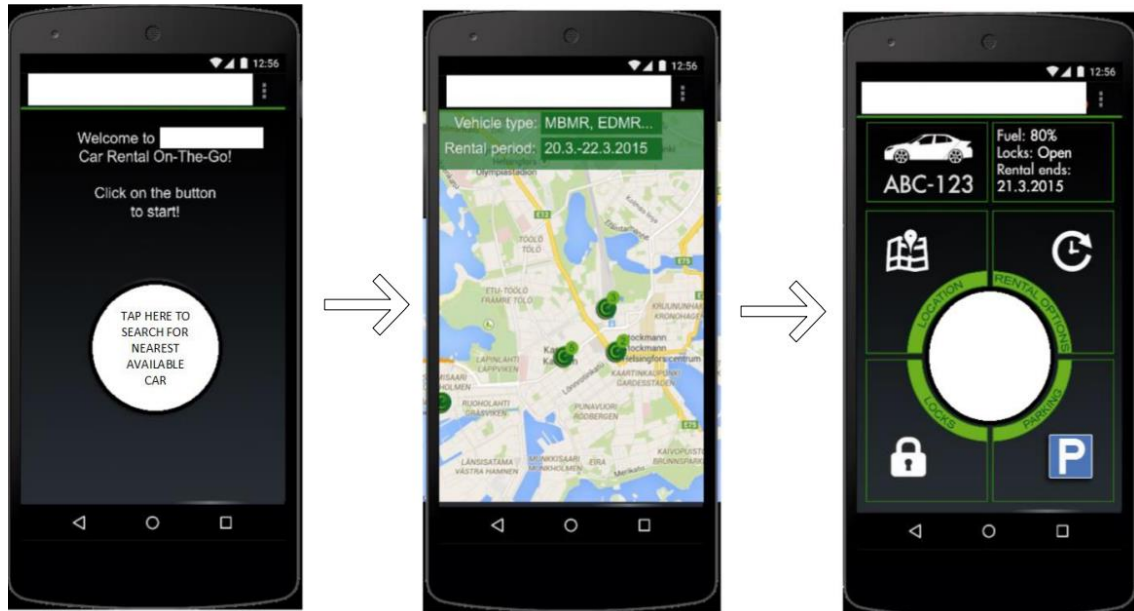


Figure 2.11 User Interface Of The Mobile Application

Based on 2.11, there show the user interface of the car rental system in the mobile application. Where firstly the user will need to tap the circle button to search the nearest available car to rent. After that, the user will lead to a map interface. The user location and the available car location will display on the map and the user might be able to select

the car. After the selection, the user will lead to the car detail page which display all the related car detail to the user.

Currently, the location-based services (LBS) is a common technique implement in any system because to provide a better service, the location of the user will need to identified to provide the related services.

#### **2.4.2 Analytical Hierarchy Process (AHP)**

Analytical Hierarchy Process (AHP) is a decision-making technique used to analysis the complex decision and solve the decision problem with ranking the result. Analytical hierarchy process had been used to identify the car rental factors that customer will more focus on while renting a car (Koul et al., 2020). An evaluation survey about evaluates each factor with another factor in pair will be done by the customer. The result of the evaluation survey done by the customers will assigned as the weightage for each pair factors and the weightage will used to calculate the priority among several car rental factors for ranking which car rental factors is the customer considered.

Analytical Hierarchy Process (AHP) consist of four step to result a ranking with different parameters. For the first step, the system will define the criteria of factors that are consider by the customer while booking a car with the function shown at the top of figure 2.12. The bottom function in figure 2.12 is used to evaluate the matrix  $n \times n$  which contain the comparison of the criteria from the set C which is the function at top of the figure 2.12.

$$C = \{C_j | j = Model, Condition, \dots Late Fee\}$$

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{18} \\ a_{21} & a_{22} & \cdots & a_{23} \\ a_{31} & a_{22} & \cdots & a_{33} \\ a_{41} & a_{42} & \cdots & a_{48} \end{bmatrix}$$

Figure 2.12 AHP Step 1

For the step 2, the assessment of the 'pairwise-comparison' between the criteria is show with the function of  $a_{ji}$  in figure 2.13 when the criteria  $j$  is more important than criteria  $i$ .

$$a_{ji} = 9 \text{ and } a_{ij} = 1/9 (a_{ij} \neq 0, a_{ii} = 1, a_{ji} = 1/a_{ij}).$$

Figure 2.13 AHP Step 2

While in the step 3, the system will divide the column entries with the sum of the column to get a normalized matrix model while each row is used to calculate the average of priority. The priority of the element is determined when the largest eigenvalue  $\lambda_{\max}$  consist of the principal eigenvector  $w$  of matrix  $A$  which shown in figure 2.14.

$$Aw = \lambda_{\max} w$$

Figure 2.14 AHP Step 3

Next is step 4 where this step will check for the consistent of response matrix. There are two equations are used in this step which is Consistency Index (CI) and Consistency Rate (CR) where Consistency Index (CI) will used with RI to calculate Consistency Rate (CR) where the matrix of RI might be the size of the criteria. The equation of Consistency Index (CI) and Consistency Rate (CR) are shown in figure 2.15.

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

$$CR = \frac{CI}{RI}$$

Figure 2.15 AHP Step 4

Once finish step 4, the system will retrieve the Consistency Rate (CR) that is not more than 0.1. If the Consistency Rate (CR) is more than 01, then there some change needed in the response for getting a better the ratio. After that, the weightage of each criterion is shown based on the customer consideration while the priority of the criteria also will be ranked as shown in the figure 2.16.

Factors	Weightage	Rank
Car's condition	0.153574	3
Car Model	0.194620	1
Price consciousness	0.188769	2
Discounts	0.142970	4
Security Deposits	0.076618	7
Inclusions	0.085455	6
Innovative services	0.098705	5
Late fee	0.059290	8

Figure 2.16 Ranking Matrix

Analytical Hierarchy Process (AHP) assists the customer to find out the weightage of each criterion based on their consideration while they are going to rent a car. This result is not only suitable to a customer but also other customer because the response is collected from the public but not only a person for the calculation.

### 2.4.3 Technique For Order Preference By Similarity To Ideal Solution (TOPSIS)

Technique For Order Preference By Similarity To Ideal Solution (TOPSIS) is another decision making technique function to select and ranking the alternatives where using the distance as measurement. In the research(Mohd Rusli, 2020), Technique for



Order Preference by Similarity to Ideal Solution has been selected on develop the car rental system to provide the efficient car rental services.

Firstly, the Technique For Order Preference By Similarity To Ideal Solution (TOPSIS) will need some criteria and in the research there are three criteria which is the price, rating and number of seats as shown in figure 2.17. The performance value also needs to be calculated for each criteria using the formula  $\sqrt{E Xn^2}$ .

Attribute/ Criteria	Price	Rating	Number of seats
Car 1	250	5	5
Car 2	200	3	4
Car 3	300	4	7
Performance Value	438.75	7.07	9.49

Figure 2.17 Car With Criteria

Next, the data for each criterion will need to be normalized. This will require the data of each criterion divide with the associated performance value. The result of the normalized data is shown in figure 2.18.

Attribute/ Criteria	Price	Rating	Number of seats
Car 1	0.57	0.71	0.53
Car 2	0.46	0.42	0.42
Car 3	0.68	0.57	0.74
Performance Value	438.75	7.07	9.49

Figure 2.18 Normalized Data

After that, the weighted decision matrix will need to get by assign the weightage. So, let the weightage of price = 0.5, number of seats = 0.2 and rating = 0.3 where the total of weightage must be 1. The weightage of each criterion will used to multiply with normalized data to get the weighted decision matrix and the result shown in figure 2.19.

Attribute/ Criteria	Price	Rating	Number of seats
Car 1	0.28	0.213	0.106
Car 2	0.23	0.126	0.084
Car 3	0.34	0.171	0.148
Vj+	0.23	0.213	0.148
Vj-	0.34	0.126	0.084

Figure 2.19 Weighted Decision Matrix

In figure 2.19, there are two addition variable which is Vj+ and Vj- where Vj+ is the best ideal solution for each criterion while the Vj- is the worst ideal solution for each criterion. Both of the variable will used to calculate the Euclidean Distance (Sj) with the equation shown in the top of figure 2.20 while the result show below it.

$$S^+ = [\sum_{j=1}^n (V_{ij} - V^{+j})^2]^{0.5}$$

$$S^- = [\sum_{j=1}^n (V_{ij} - V^{-j})^2]^{0.5}$$

Attribute/ Criteria	Price	Rating	Number of seats	Sj+	Sj-
Car 1	0.28	0.213	0.106	0.07	0.11
Car 2	0.23	0.126	0.084	0.11	0.1
Car 3	0.34	0.171	0.148	0.12	0.08
Vj+	0.23	0.213	0.148		
Vj-	0.34	0.126	0.084		

Figure 2.20 Euclidean Distance (Sj) With Result

Once the data of Euclidean Distance (Sj) are got, the performance score (Pi) will need to be calculated for finding the priority of each car on select to rent. The performance score (Pi) is required to used the equation  $P_i = S_j / (S_j^+ + S_j^-)$  to calculate. Once the performance score (Pi) is calculated, there a ranking to rank the car to identify which car are most suitable to rent with those selected criteria. The result of the performance score (Pi) with ranking is shown in figure 2.21.

Attribute/ Criteria	Sj+	Sj-	Sj+ (+) Sj-	Pi	Rank
Car 1	0.07	0.11	0.18	0.61	1
Car 2	0.11	0.1	0.21	0.48	2
Car 3	0.12	0.08	0.2	0.4	3

Figure 2.21 Performance Score (Pi)

The car rental system which uses Technique for Order Preference by Similarity to Ideal Solution able to provide assistant for customer on making decision with several criteria by ranking the result where the best choice will show on top of the listing (Mohd Rusli, 2020).

#### 2.4.4 Rule Based Technique

Rule based technique is a technique used on a system to provide the expert advice for the user based on several rules that written in the system algorithm. The rules are created based on the knowledge get by the engineer or from the expert, so rule base also known as knowledge base. Rule based technique is one of the popular approaches for performing the data mining through the machine learning (Fürnkranz, 1997).

In the research about the data mining on test data of Physical Health Standard, the rule-based technique has been used for the data mining process in order to assist the student to find the factor that influence their score in certain sport (Yu, 2009). The expert might take some mistake by searching on the information but data mining able to fix this problem where it will search all the data in the database even it is the hidden data also won't miss one of it.

Data mining in will go through the association rules to search for the relevant data from the large data set even the data is hidden in the data set. There are two steps used in the association algorithm for the data mining. First step is to search for the frequent itemset in multiple iteration. In the first iteration, the size will set to 1 for all the frequent itemset and then the algorithm passing through the dataset for calculate the subitem of each item. The algorithm will set the size to 2 for the created candidate itemset in the

second iteration and then it will proceed the process same as first iteration but only the target of itemset has change to the candidate of itemset. When the end of second iteration, the algorithm will choose the candidate itemset as the frequent itemset of size 2 while the subitem is less than the Minimum\_Support. The iteration will continue for the algorithm with increment in the size value until the Minimum\_Support is not found by the itemset.

Next, the second step of the association algorithm is creating the association rules through the frequent itemset. The algorithm to create the qualified association rules is show in the figure 2.22 with the algorithm that increase the speed for the process.

*For each frequent itemset f, generate all the subset x and its complimentary set:  
 $y = f - x$   
 If  $Support(f)/Support(x) > Minimum\_Probability$ ,  
 then  $x \Rightarrow y$  is a qualified  
 association rule with probability =  $Support(f)/Support(x)$   
 If a, b, c  $\Rightarrow$  d has probability lower than the minimum probability, rule a, b  $\Rightarrow$  c, d doesn't have enough probability neither.*

Figure 2.22 Second Step Of Association Algorithm

For the data mining on test data of Physical Health Standard, first will create the abbreviations for the attribute that will be involved as figure 2.23. Then the mining structure will be created in next step where the data mining algorithm will be chosen and the data source will select the Physical Health Standard data. In this research, the total score is used for “Prediction” while other parameter is used for “Input”.

Origin words	Abbreviation
total score	TS
vital capacity	VC
grip strength	GS
standing long jump	SLJ
step test	ST

Figure 2.23 Abbreviation

There contain two results from the data mining process on the test data of Physical Health Standard. The first results show the itemset that contain the subitem more than 60 with the size of 1 which display is the figure 2.24.

support	size	itemset
104	1	TS = 77.9 - 83.05
93	1	ST = 63.6 - 68.8
87	1	ST = 56.9 - 63.6
76	1	VC = 3963.9 - 4999.7
74	1	GS = 40.4 - 49.6
74	1	SLJ = 154.3 - 176.6
73	1	VC = 2838.2 - 3963.9
64	1	GS = 28.4 - 40.4

Figure 2.24 Itemset With Support More Than 60

Another result from the data mining process show the rules that contain a 100% of probability that after the sorting process from 141 rules and it is display in figure 2.25.

P	I	Rule
1	1.06	VC=2003.3-2838.2, SLJ=176.6-214.4 -> TS<68.8
1	0.61	ST>= 85.4, SLJ<154.3 -> TS>= 87.1
1	0.61	VC < 2003.3, SLJ=176.5-214.4 -> TS>= 87.1
1	0.59	GS < 28.4, VC = 3963.9-4999.7 -> TS=68.8-77.9
1	0.58	SLJ>=231.4, GS=28.4-40.4 -> TS=83.1-87.1
1	0.53	ST>=85.4, GS>=55.2 -> TS=83.1-87.1
1	0.53	ST>=85.4, VC=2003.3-2838.2 -> TS=83.1-87.1
1	0.22	ST>=85.4, SLJ=176.6-214.4 -> TS=77.9-83.1
1	0.22	VC=2003.3-2838.2, SLJ=214.4-231.4 -> TS=77.9-83.1
1	0.22	GS=49.6-55.2, SLJ=154.3 -> TS=77.9-83.1
1	0.22	ST>=85.4, VC<2003.3 -> TS=77.9-83.1
1	0.22	ST=68.8-85.4, VC<2003.3 -> TS=77.9-83.1
1	0.22	GS>=55.2, VC=2838.2-3963.9 -> TS=77.9-83.1
1	0.22	ST=68.8-85.4, GS>=55.2 -> TS=77.9-83.1
1	0.22	ST=68.8-85.4, SLJ<154.3 -> TS=77.9-83.1

Figure 2.25 Rules With 100% Probability

The result from the data mining process on the test data of Physical Health Standard show the influence factor to the total score of those students is standing long jump. From this research, this shows the rule-based technique work in the data mining process to provide the factor of the problem in order to help the user on planning for the solution of the problem.

#### 2.4.5 Fuzzy Logic Technique

Fuzzy Logic is a technique used on making a decision by proving the truth of a solution. Fuzzy logic is not same as the Boolean Logic which only consist of numeric option which is 0 and 1. This is because there are lot of things in this world cannot only

use two options to decide for the conclusion. So, Lofti Zadeh has proposed the fuzzy logic theory which show the decision is able to make from a range between the true and false but not only true and false. The example for different between the Boolean Logic and Fuzzy Logic is shown in Figure 2.26.

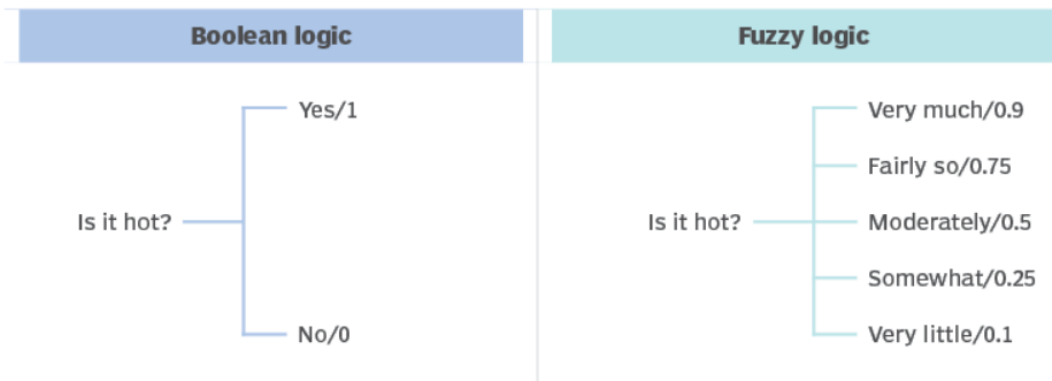


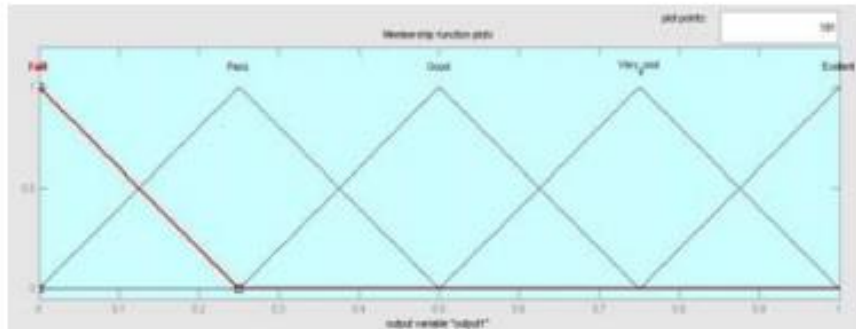
Figure 2.26 Boolean Logic vs Fuzzy Logic

Fuzzy logic is one of the famous machine learning that implement on a system to do the evaluation. In the research of application used to evaluate the performance of academic students, Fuzzy Logic has been implemented to calculate performance of student academic with the result from three examination. The result of three examination will use as the input for the parameter inside the triangular membership function that shown in figure 2.27.

$$Triangular(x, a, b, c) = \begin{cases} 0 & x < a \\ \frac{x-a}{b-a} & a \leq x \leq b \\ \frac{c-x}{c-b} & b \leq x \leq c \\ 0 & x > c \end{cases}$$

Figure 2.27 Triangular Membership Function

The application has used the Mamdani inference system to create graph of the membership function which show the performance value of the student academic after the fuzzified process. The method uses in the Mamdani inference system and the membership function for performance value is shown in the figure 2.28.



$$\mu_C(y) = \text{Max}_K \left[ \text{Min} \left[ \mu_A(\text{input}(i)), \mu_B(\text{input}(j)) \right] \right]$$

$$k = 1, 2, 3, 4, \dots, r$$

Figure 2.28 Mamdani Method And Membership Function Of Performace Value

Next, the Mamdani Fuzzy Decision Technique has been used to calculate the performance value from the examination score of each student that had been fuzzified by the means of membership function and the result is shown in figure 2.29.

N0	Fuzzy1	Practical Exam	Performance
1	0.439	93	0.668
2	0.233	13	0.220
3	0.355	64	0.492
4	0.329	18	0.339
5	0.249	65	0.395
6	0.302	92	0.566
7	0.196	17	0.236
8	0.723	75	0.750
9	0.754	62	0.750
10	0.22	21	0.246
11	0.653	71	0.693
12	0.796	89	0.790
13	0.913	40	0.651
14	0.427	77	0.660
15	0.790	83	0.763
16	0.302	90	0.568
17	0.487	65	0.611
18	0.209	34	0.246
19	0.695	70	0.689
20	0.496	65	0.641

Figure 2.29 Performance Evaluation

From the result show in the figure 2.29, the Fuzzy Logic display the performance value for the academic of each student in a value of decimal and there not only 0 and 1. This research about the Fuzzy Logic gives an efficient information about the performance

of the student in their academic give the school an idea to manage their planning for the student. Fuzzy Logic Technique able to provide the efficient information but also able to be implemented in other technique such as Rule Based Technique. This implementation can improve the efficiency and the performance for the rule-based system because Fuzzy Logic able to assist the rule-based system to reduce the deduction process for certain rules by avoid the checking in irrelevant rules(Jafari Petrudi et al., 2013).

## 2.5 Comparison Of Different Technique

In this session, the related works will be compared with several criteria in a table. The criteria that used to compared between the related works are technique, strength, weakness, advantage and disadvantage.

Table 2.1: Comparison Of Related Works

<b>Author</b>	Solomon Dessie, (2015)	Saroj Koul, CSN Venkata Datta & Rakesh Verma, (2020)	Nur Ilya Najwa Binti Mohd Rusli, (2020)
<b>Title</b>	Designing a New Car Rental Service Using Location- Based Services	Car Rentals’ Knowledge and Customer Choice	Car Rental System Using Technique For Order Preference By Similarity To Ideal Solution (TOPSIS)
<b>Technique</b>	Location-Based Services (LBS)	Analytic Hierarchy Process (AHP)	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
<b>Function</b>	Location-based services will track the user real time location to provide the relatable services	Analytic Hierarchy Process will analysis the complex decision and solve the decision	Technique for Order Preference by Similarity to Ideal Solution will select and ranking the



		problem with ranking the result	alternatives by using the distance as measurement
<b>Strength</b>	Location-based services able to provide the nearest car rental service based on the user location	Analytic Hierarchy Process able to focus on every criterion because it uses the hierarchical structure	Technique for Order Preference by Similarity to Ideal Solution able to solve multiple criteria with a quick process
<b>Weakness</b>	The system is requiring the real time tracking system such as Global Positioning System (GPS) to get the location information of the user.	Analytic Hierarchy Process only provide pairwise comparison for the criteria	Technique for Order Preference by Similarity to Ideal Solution only suitable while the alternative is not strongly varied
<b>Advantage</b>	The customer able to receive the car rental service in the short time	Analytic Hierarchy Process create a car rental list which is universally match with most customer needs	The car rental system able to display the car rental list in rank that match with the customer desire
<b>Disadvantage</b>	There only provide the nearest location service but other criteria such as prices might not be suitable to user.	Need to collect a large amount of initial data to analysis the decision	An addition criterion might make a big change on the ranking of car rental list

<b>Author</b>	Lan Yu, (2009)	Seyyed Hossein Jafari Petrucci, Maryam Pirouz & Behzad Pirouz, (2013)
<b>Title</b>	Association Rules based Data Mining on Test Data of Physical Health Standard	Application Of Fuzzy Logic for Performance Evaluation Of Academic Students
<b>Technique</b>	Rule Based Technique	Fuzzy Logic Technique
<b>Function</b>	Rule Based Technique used the rules which also known as the knowledge bases to provide the expert advice	Fuzzy Logic Technique used to evaluate the data with more accurate information and not only true and false but the range between 0 and 1.
<b>Strength</b>	Rule Based Technique able to provide an expert advice that can assist the user in the current problem	Fuzzy Logic Technique is flexible to implemented with other technique
<b>Weakness</b>	Rule Based Technique required a high knowledge in the field	Fuzzy Logic Technique required much time for the testing and validation process
<b>Advantage</b>	Rule Based Technique is ease to implement to a system because there are not much algorithm than other machine learning	Fuzzy Logic Technique able to code with less data because it able to learn from the result
<b>Disadvantage</b>	Rule Based Technique is limited to learn from the result for the current problem	Fuzzy Logic Technique might output an inaccurate result because it mostly works with the data that is inaccurate

## **2.6 Summary Of Comparison Different Techique**

From the comparison of those technique, the Location-Based Services (LBS), Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Rule Based Technique and Fuzzy Logic Technique have the difference in their function, strength, weakness, advantage and disadvantage.

Each technique has their own function to the assist a system gets a better performance or provide a better service. By only comparing the function of each technique, the fuzzy logic might provide more accurate information after the evaluation process. However, sometime the fuzzy logic also might result an inaccurate information because fuzzy logic is commonly used to work with inaccurate data and this may result fuzzy logic learn the accurate data but also the same time learn the inaccurate data.

After comparing not only the function but with the strength, weakness, advantage and disadvantage, researcher might say that rule-based technique is more useful on provide the better services and performance. Rule based technique not like fuzzy logic where rule-based technique limited on learning but give the benefit for the system by provide the accurate data based on the rules and facts created in the system. The rules and facts created in the system are mostly based on the knowledge get by the developer or an expert in the field. However, fuzzy logic has a limited rules and other rules will need to learn from inference the data.

Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is not like the rule-based technique and fuzzy logic technique implement the rules in their algorithm. Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are collect the information such as criteria for the report to used for the equation in those technique. The equation will result the priority for each criterion to ranking the criteria for result the advice for the customer.

Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are required a high understand in math to develop the related equation for system on calculate the priority of each criterion. Compare with

rule-based technique, rule-based technique is able to avoid using any equation in algorithm but only implement the knowledge base for the customer. However, fuzzy logic also will implement some calculation in the algorithm to let the system learn and inference the inaccurate data.

For Location-Based Services (LBS), this technique uses the third-party extension such as GPS to track the real time location of the customer to provide the reliable services. This is the common technique use in the application nowadays such as food ordering system and grab system but without the third-party extension to track the location, the system might not function. So, mostly those application implements this technique will also the customer to provide the input text to input their address.

In the car rental system, Location-Based Services (LBS) able to help the customer to find the company to rent the car quickly and near but mostly car rental company has provided the pickup service for the customer where the customer only needs to input the address to pickup the car and then the company will send to the address. This made the Location-Based Services (LBS) become useless but only able to track the user current location.

As conclusion, the rule-based technique is more useful than other technique while comparing with the function, strength, weakness, advantage and disadvantage. The rule-based technique provides the car rental system with a simple form of artificial intelligent system on assist the customer on the selection of the car listing automatically.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

The methodology creates a view for the researcher about the car rental system before start to develop the car rental system. This view is evaluated from the Systems Development Life Cycle (SDLC) model that chosen by the researcher on developing the car rental system and the essential requirements that are gathered from the stakeholders. The methodology gives an assistant for researcher to know about the processes that needed when developing the car rental system and the essential function of the car rental system needed to provide a car rental service which is suitable to the stakeholder's requirement.

#### **3.2 Chosen Methodology**

The Systems Development Life Cycle (SDLC) has been used to build a structured approach for the systems development. Systems Development Life Cycle (SDLC) able to assist the researcher on develop a car rental system which is reliable and ease to maintain. Systems Development Life Cycle (SDLC) also provide the information about the essential function that the car rental system should provide to the customer. There are multiple of Systems Development Life Cycle (SDLC) model able to choose for develop the system. However, the agile model might be the better choice for developing the car rental system.

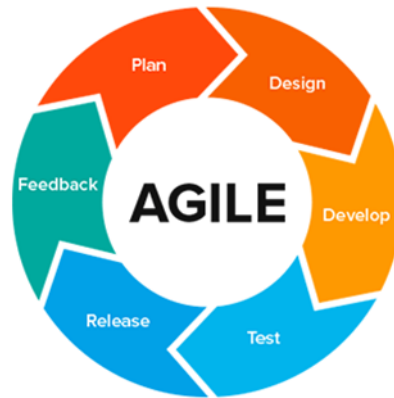


Figure 3.1 Agile Model

Agile model is an iterative and at the same time also an incremental, so this able to assist on developing the features of the car rental system to the best on each phase and iterative. Agile model also provides the flexibility for any changes made from the feedback that provided by the stakeholders. There are 6 phases involve in the agile model, which are planning phase, design phase, develop phase, testing phase, release phase and feedback phase. After the feedback phase, if there any improvement should implement on the system will start again for another iteration with these six phases.

### 3.2.1 Planning Phase

In the planning phase, the researcher will start on analysis the problem exists in current environment and having a discussion with supervisor about the technique that able to solve the problem. After discussion, the title and purpose of the project is decided. Then, the information gathering process will proceeded. The stakeholders should be identified in this phase to collect the requirements. The requirements from the stakeholders are collect using the interview and observing method. The objective and the scope of the project will be created based on the requirement get from the stakeholders. The researcher also done the research on the rule-based technique to get more understanding on the rule-based technique to provide the car rental listing. The review process on the existing car rental system and related works also includes in this phase by doing the observation, analysis and comparison to understand the existing weakness that found in the existing car rental system for making the improvement in this project. The

process in this planning phase will change on each iteration because each iteration phase will consist of difference issue from the feedback phase to be solve.

### **3.2.2 Analysis And Design Phase**

In analysis and design phase, the prototype and early design of the car rental system will be designed as the evidence of early work. The flowchart, context diagram, use case diagram, activity diagram, and entity relationship diagram will be created to show the process flow of the car rental system. Database dictionary also will be created in this phase to identify the data that are needed to include in the car rental system. This phase also involves in creating the rules that need to be used to provide a better car rental listing for the customer. But to create the rules, the parameters are needed. So, the parameters that needed to be used in creating the rules will need to be identified to ensure the parameter give an impact on providing a better car rental listing for the customer. The rules will use the IF statement to confirm with the parameter and display the suitable car rental listing to the customer based on the rules set on the IF statement. The potential use of the rule-based technique in the car rental system also record in the report to show the benefit to the existing car rental system, customer and the company. The testing planning such as the User Acceptance Test (UAT) also needed to identify in this phase for an earlier preparation. Gantt Chart also created to show the timestamp of each activity that are involved while the project is proceeding. The suitable programming language will be selected to development the car rental system.

### **3.2.3 Development Phase**

In development phase, coding process for the car rental system will start. The interface of the car rental system will be created using the selected programming language. Each feature on each interface is created based on the diagram and data that designed in the design phase. The graphical user interface (GUI) created in this phase to hide the process to the back by show a better view for the user.

### **3.2.4 Testing Phase**

In the testing phase, the system will be tested before the release. Any error and bug found in this phase allow the researcher to make any maintenance on the error and bug before release the final version of the car rental system to the public. The researcher will create a user acceptant test form which function to collect the user feedback based on each feature in the car rental system and researcher will based on the user acceptant test form to improve and fix the error before the final version of car rental system.

### **3.2.5 Release Phase**

In the release phase, this means the final version of the car rental system had been created. The error and bug had been fixed in a minimum and the car rental system is able to release to the public. The car rental system will release to the public through any advertising platform to provide the car rental service for more people.

### **3.2.6 Feedback Phase**

In feedback phase, the user of the car rental system will be able to give their opinion on the features of the car rental system. Any new error and bug that are not found before the release phase will report by the user in this phase. Then, these feedbacks will be use on the next iteration to fix the existing problem.

## **3.3 Requirement**

In this session, the requirements that are needed to develop the car rental system will be recorded in this report. The requirement able to provide the assistant on the development of car rental system by providing a suitable car rental service for the customer. There are multiple requirements had been collected which are functional requirement, non-functional requirement, constraint and limitation, hardware requirement, software requirement and user requirement. Some of these requirements will record with the suitable diagram to show the flow of the system and some



requirement is state in a set of rules that needed for the rules-based technique to provide a better car rental listing for the car rental system.

### 3.3.1 Constraint And Limitation

The table below is recorded with constraint and limitation that has been met by the researcher while processing the project.

Table 3.1 Constraint And Limitation

<b>Constraint and Limitation</b>	<b>Description</b>
Schedule	The time given to develop the car rental system is limited within a year.
Budget	The budget of the researcher to develop the system is limited.
Quality	The quality of the car rental system might not provide with the best but with the better.

### 3.3.2 Software Requirement

The table below record the software needed to use when preparing for the report and the development tools for develop the car rental system.

Table 3.2 Software Requirement

<b>Software</b>	<b>Description</b>
Visual Studio Code	The software will be used on coding for the car rental system
Xampp	The software will used as the web server and database software for the car rental system
Google Chrome Browser	The software will used to search for any resource that are able to give an assistant for the research on this report

Microsoft Word	The software will used to create the documentation of the project
Diagram.net	The software will used to draw all the diagrams

### 3.3.3 Hardware Requirement

The table below record the hardware needed when process the project.

Table 3.3 Hardware Requirement

<b>Hardware</b>	<b>Description</b>
Laptop	The hardware is required for access and use the software
Phone	The hardware is used as backup for the documentation

### 3.3.4 Context Diagram

The figure below shows the context diagram about the data flow between the car rental system with the customer, rule and company.

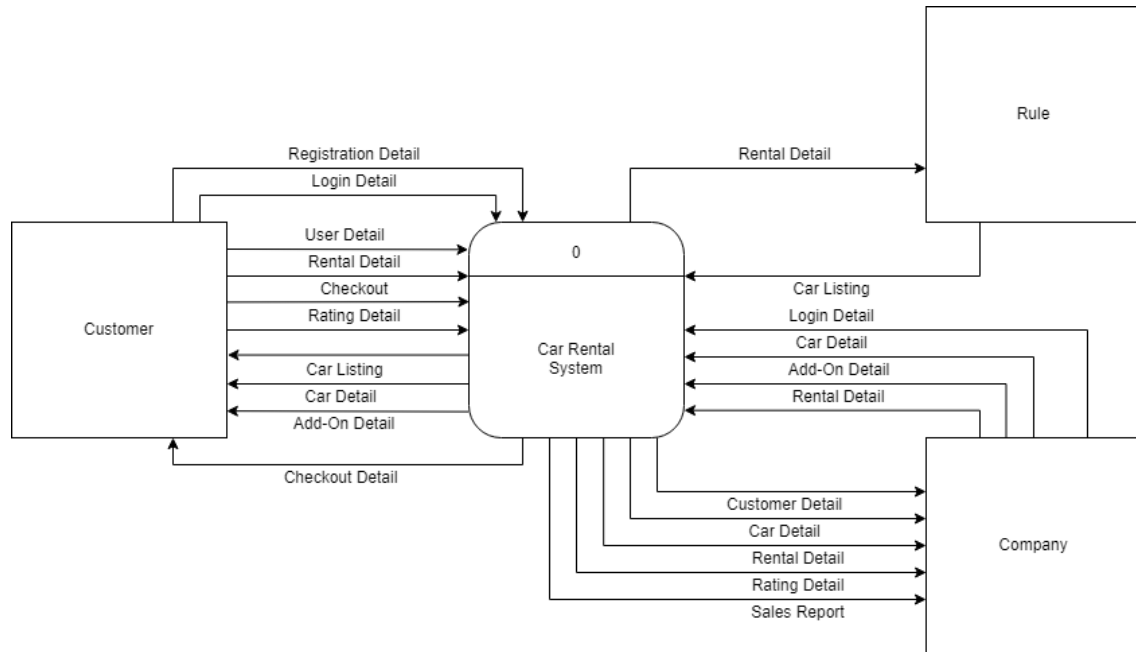


Figure 3.2 Context Diagram

### 3.3.5 Flowchart

Figure below show the flowchart of the car rental system which contain all the process of the car rental system will be involved.

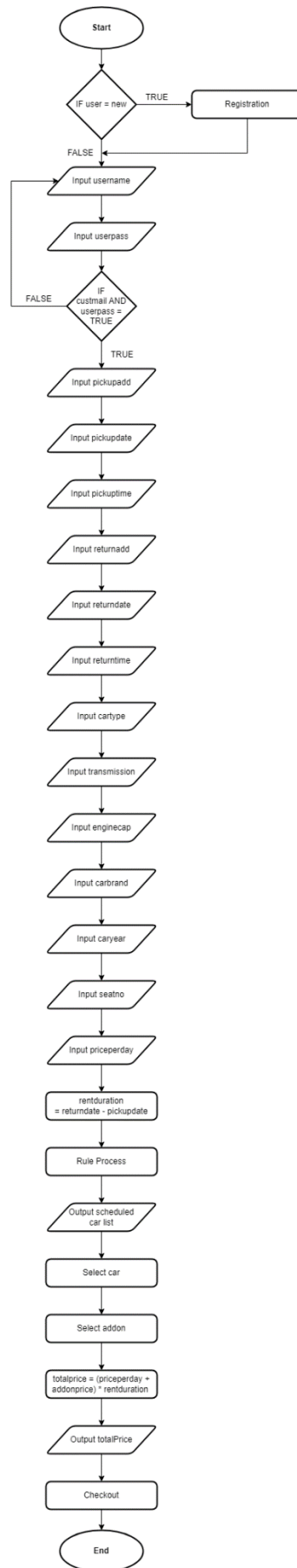


Figure 3.3 Flowchart

### 3.3.6 Use Case Diagram And Description

The figure below display the use case diagram of the car rental system. Each module is recored in the use case diagram to show the activities that able to done in the car rental system.



Figure 3.4 Use Case Diagram

Table 3.4 Use Case Description (User Registration)

<b>Use Case ID</b>	userRegistration1
<b>Brief Description</b>	This use case provides the customer to register their account with the necessary detail before login to the car rental system.
<b>Actor</b>	This use case is used by customer.
<b>Pre-Condition</b>	Customer should be the first time access this website, all detail of the customer is real and the connection with the internet is stable.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered the user registration page of the car rental system.</li> <li>2. Customer able to insert their personal detail such as name, identity card number, date of birth, email address, phone number, home address, username and password.</li> <li>3. Customer clicks the “Register” button.</li> <li>4. Car rental system check any used personal detail from the server [<b>E1: User Detail Used</b>].</li> <li>5. Car rental system will store all the customer detail to the server.</li> <li>6. Car rental system display the login page.</li> <li>7. The use case ends.</li> </ol>
<b>Alternative Flow</b>	-
<b>Exception Flow</b>	<p><b>E1: User Detail Incorrect</b></p> <ol style="list-style-type: none"> <li>1. Customer or company enter the used identity card number, email address, phone number or username.</li> <li>2. Car rental system display the error message.</li> <li>3. The use case continues to step 2 in basic flow</li> </ol>
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system record the customer detail to the server</li> <li>- Customer able to login the car rental system</li> </ul>

Table 3.5 Use Case Description (Login)

<b>Use Case ID</b>	login1
<b>Brief Description</b>	This use case provides the customer and company login to the car rental system by insert the username and password for access more available feature of the car rental system.
<b>Actor</b>	This use case is used by customer and company
<b>Pre-Condition</b>	Customer and company should open their associated login page, customer also required to register their personal detail to car rental system before login.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer or company has entered their associated login page of the car rental system.</li> <li>2. Customer or company able to insert their username, password and user type for login to car rental system.</li> <li>3. Customer or company clicks the “Login” button.</li> <li>4. Car rental system will check the username, password and user type. [E1: User Detail Incorrect]</li> <li>5. Car rental system display the next associated page.</li> <li>6. The use case ends.</li> </ol>
<b>Alternative Flow</b>	-
<b>Exception Flow</b>	<p><b>E1: User Detail Incorrect</b></p> <ol style="list-style-type: none"> <li>1. Customer or company enter the incorrect username, password or user type.</li> <li>2. Car rental system display the error message.</li> <li>3. The use case continues to step 2 in basic flow</li> </ol>
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Customer and company success login to the car rental system.</li> <li>- Customer and company can use the feature of the car rental system.</li> </ul>

Table 3.6 Use Case Description (Manage User Profile)

<b>Use Case ID</b>	manageUserProfile1
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<b>Brief Description</b>	This use case provides the customer to edit their personal detail such as name, identity car number, date of birth, email address, phone number, home address, username and password in the car rental system.
<b>Actor</b>	This use case is used by customer.
<b>Pre-Condition</b>	Customer must login to the car rental system to use this function.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer enter the user profile page of the car rental system.</li> <li>2. Customer able to edit (<b>A1: Edit Customer Detail</b>) the personal detail such as name, identity car number, date of birth, email address, phone number, home address, username and password in car rental system</li> <li>3. Customer clicks the “Confirm” button.</li> <li>4. Car rental system store the name, identity car number, date of birth, email address, phone number, home address, username and password in car rental system.</li> <li>5. Car rental system display the next associated page.</li> <li>6. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<p><b>A1: Edit Customer Detail</b></p> <ol style="list-style-type: none"> <li>1. Customer will key in the new name, identity car number, date of birth, email address, phone number, home address, username or password.</li> <li>2. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system record the updated customer detail to the server</li> <li>- Customer receives update success message.</li> </ul>

Table 3.7 Use Case Description (Manage Car Detail)

<b>Use Case ID</b>	manageCarDetail1
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<b>Brief Description</b>	This use case provides the company to manage the car detail such as add, edit and delete the car in the car rental system.
<b>Actor</b>	This use case is used by company
<b>Pre-Condition</b>	Company must login to the car rental system and in the admin car list page.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the company has entered admin car list page of the car rental system.</li> <li>2. Company able to add (<b>A1: Add Car Detail</b>), delete (<b>A2: Delete Car Detail</b>) and edit (<b>A3: Edit Car Detail</b>) the car list in the car rental system</li> <li>3. Car rental system display the admin car list page with updated car list.</li> <li>4. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<p><b>A1: Add Car Detail</b></p> <ol style="list-style-type: none"> <li>1. Company presses the “Add Car” button.</li> <li>2. Company enters the car detail page.</li> <li>3. Company inserts the car detail such as car image, car name, type of car, car brand, transmission type, year of car, engine capacity, no of seats and car price.</li> <li>4. Company press “Confirm” button.</li> <li>5. Car rental system store the car detail.</li> <li>6. The use case continues to step 3 in basic flow</li> </ol> <p><b>A2: Delete Car Detail</b></p> <ol style="list-style-type: none"> <li>1. Company presses the “Remove” button.</li> <li>2. Car rental system delete the car detail.</li> </ol> <p><b>A3: Edit Car Detail</b></p> <ol style="list-style-type: none"> <li>1. Company presses the “Edit” button.</li> <li>2. Company enters the car detail page.</li> </ol>

	<ol style="list-style-type: none"> <li>3. Company changes the car detail such as car image, car name, type of car, car brand, transmission type, year of car, engine capacity, no of seats or car price.</li> <li>4. Company press “Confirm” button.</li> <li>5. Car rental system store the car detail.</li> <li>6. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	- Car rental system display the updated car list

Table 3.8 Use Case Description (Manage Add-On Services)

<b>Use Case ID</b>	manageAddOnServices1
<b>Brief Description</b>	This use case provides the company to manage the add-on services detail such as add, edit and delete the add-on services in the car rental system.
<b>Actor</b>	This use case is used by company
<b>Pre-Condition</b>	Company must login to the car rental system and in the admin add-on services list page.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the company has entered admin add-on services list page of car rental system.</li> <li>2. Company able to add (<b>A1: Add Add-On Services</b>), delete (<b>A2: Delete Add-On Services</b>) and edit (<b>A3: Edit Add-On Services</b>) the add-on services list in the car rental system</li> <li>3. Car rental system display the admin add-on services list page with updated add-on services.</li> <li>4. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<b>A1: Add Add-On Services</b> <ol style="list-style-type: none"> <li>1. Company presses the “Add Services” button.</li> <li>2. Company enters the add-on service detail page.</li> <li>3. Company inserts the add-on services detail such as service name, service description and service price.</li> <li>4. Company press “Confirm” button.</li> </ol>

	<ol style="list-style-type: none"> <li>5. Car rental system store the add-on service detail.</li> <li>6. The use case continues to step 3 in basic flow</li> </ol> <p><b>A2: Delete Add-On Services</b></p> <ol style="list-style-type: none"> <li>1. Company presses the “Remove” button.</li> <li>2. Car rental system delete the add-on service.</li> </ol> <p><b>A3: Edit Add-On Services</b></p> <ol style="list-style-type: none"> <li>1. Company presses the “Edit” button.</li> <li>2. Company enters the add-on service detail page.</li> <li>3. Company changes the car detail such as service name, service description or service price.</li> <li>4. Company press “Confirm” button.</li> <li>5. Car rental system store the add-on service detail.</li> <li>6. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	- Car rental system display the updated add-on services

Table 3.9 Use Case Description (Manage Rental Detail)

<b>Use Case ID</b>	manageRentalDetail1
<b>Brief Description</b>	This use case provides the customer to manage the rental detail such as pickup date, pickup time, return date, return time, type of car, transmission type, car brand, year of car, no of seats and price per day in the car rental system.
<b>Actor</b>	This use case is used by customer
<b>Pre-Condition</b>	Customer must login to the car rental system.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered rental detail page of the car rental system.</li> <li>2. Customer able to add (<b>A1: Add Rental Detail</b>) the rental detail in the car rental system</li> <li>3. Customer clicks the “Confirm” button</li> <li>4. Car rental system will store the rental detail.</li> </ol>

	<ol style="list-style-type: none"> <li>5. Car rental system proceed the rule process to find the suitable car list.</li> <li>6. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<p><b>A1: Add Rental Detail</b></p> <ol style="list-style-type: none"> <li>1. Customer inserts the rental detail such as pickup address, pickup date, pickup time, return address, return date, return time, type of car, transmission type, engine capacity, car brand, year of car, no of seats and price per day in the car rental system.</li> <li>2. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system store the rental detail.</li> <li>- Car rental system display the associated car list.</li> </ul>

Table 3.10 Use Case Description (Select Car)

<b>Use Case ID</b>	selectCar1
<b>Brief Description</b>	This use case provides the customer to the car from the provided car list in the car rental system.
<b>Actor</b>	This use case is used by customer
<b>Pre-Condition</b>	Customer must login to the car rental system and input the rental detail.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered customer car list page of the car rental system.</li> <li>2. Customer able to select the car shown in the car list</li> <li>3. Customer clicks the “Rent” button</li> <li>4. Car rental system will display confirmation message.</li> <li>5. Customer clicks the “Confirm” button</li> <li>6. Car rental system record the car detail.</li> <li>7. Car rental system display the add-on services page.</li> <li>8. The use case ends.</li> </ol>
<b>Alternative Flow</b>	-
<b>Exception Flow</b>	-

<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system record the car detail.</li> <li>- Car rental system display the selected car detail in add-on services page.</li> </ul>
-----------------------	--

Table 3.11 Use Case Description (Select Add-On Services)

<b>Use Case ID</b>	selectAddOnServices1
<b>Brief Description</b>	This use case provides the customer to add the add-on services in the car rental system.
<b>Actor</b>	This use case is used by customer
<b>Pre-Condition</b>	Customer must login to the car rental system, insert the rental detail and select the car.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered add-on services page of the car rental system.</li> <li>2. Customer able to add (<b>A1: Add Add-On Services</b>) the add-on services in the car rental system</li> <li>3. Customer clicks the “Confirm” button</li> <li>4. Car rental system display the confirmation message.</li> <li>5. Customer clicks the “Confirm” button</li> <li>6. Car rental system will record the add-on services detail.</li> <li>7. Car rental system display the checkout page.</li> <li>8. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<b>A1: Add Add-On Services</b> <ol style="list-style-type: none"> <li>1. Customer clicks the “Add” button.</li> <li>2. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system store the add-on services detail.</li> <li>- Car rental system display the correct selected car and total prices in checkout page.</li> </ul>

Table 3.12 Use Case Description (Checkout)

<b>Use Case ID</b>	checkout1
--------------------	-----------

<b>Brief Description</b>	This use case provides the customer review their checkout detail in the car rental system
<b>Actor</b>	This use case is used by customer
<b>Pre-Condition</b>	Customer must login to the car rental system, insert the rental detail and select the car.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered checkout page of the car rental system.</li> <li>2. Customer able to review the customer detail and the rental detail in the car rental system.</li> <li>3. Customer clicks the “Confirm” button.</li> <li>4. Car rental system display confirmation message.</li> <li>5. Customer clicks the “Confirm” button.</li> <li>6. Car rental system send the rental detail to the company.</li> <li>7. The use case ends.</li> </ol>
<b>Alternative Flow</b>	-
<b>Exception Flow</b>	-
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Customer receives a rental success message.</li> <li>- Company receives the rental detail</li> </ul>

Table 3.13 Use Case Description (Check Report)

<b>Use Case ID</b>	checkReport1
<b>Brief Description</b>	This use case provides the company to approve or cancel the rental after retrieve the report of the rental detail in the car rental system.
<b>Actor</b>	This use case is used by company
<b>Pre-Condition</b>	Company must login to the car rental system.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the company has entered rental list page of the car rental system.</li> <li>2. Company able to approve (<b>A1: Approve Rental</b>) or cancel (<b>A2: Cancel Rental</b>) the rental detail in the car rental system</li> </ol>

	<ol style="list-style-type: none"> <li>3. Car rental system display the updated rental list.</li> <li>4. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<p><b>A1: Approve Rental</b></p> <ol style="list-style-type: none"> <li>1. Company clicks the “Approve” button.</li> <li>2. The use case continues to step 3 in basic flow</li> </ol> <p><b>A2: Cancel Rental</b></p> <ol style="list-style-type: none"> <li>1. Company clicks the “Cancel” button.</li> <li>2. The use case continues to step 3 in basic flow</li> </ol>
<b>Exception Flow</b>	-
<b>Post Condition</b>	<ul style="list-style-type: none"> <li>- Car rental system display the updated rental list.</li> <li>- Car rental system display the updated statistics.</li> </ul>

Table 3.14 Use Case Description (Manage Rating)

<b>Use Case ID</b>	manageRating1
<b>Brief Description</b>	This use case provides the customer to add the rating for their rental history in the car rental system.
<b>Actor</b>	This use case is used by customer
<b>Pre-Condition</b>	Customer must login to the car rental system, rented a car and send back the car to complete the rental.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. This use case begins after the customer has entered history page of the car rental system.</li> <li>2. Customer able to add (<b>A1: Add Rating</b>) the rating of each rental in the car rental system</li> <li>3. Car rental system display the history page with updated rental lists.</li> <li>4. The use case ends.</li> </ol>
<b>Alternative Flow</b>	<p><b>A1: Add Rating</b></p> <ol style="list-style-type: none"> <li>1. Customer clicks the “Rate And Comment” button.</li> <li>2. Company enters the rating page.</li> <li>3. Company inserts the rating and comment.</li> <li>4. Company press “Confirm” button.</li> </ol>

	<ul style="list-style-type: none"> <li>5. Car rental system store the rating detail.</li> <li>6. The use case continues to step 3 in basic flow</li> </ul>
<b>Exception Flow</b>	-
<b>Post Condition</b>	- Car rental system store the updated rental lists.

### 3.3.7 Activity Diagram

The activity diagram below shows the activities that will happen on the lanes of the customer, car rental system and the company.

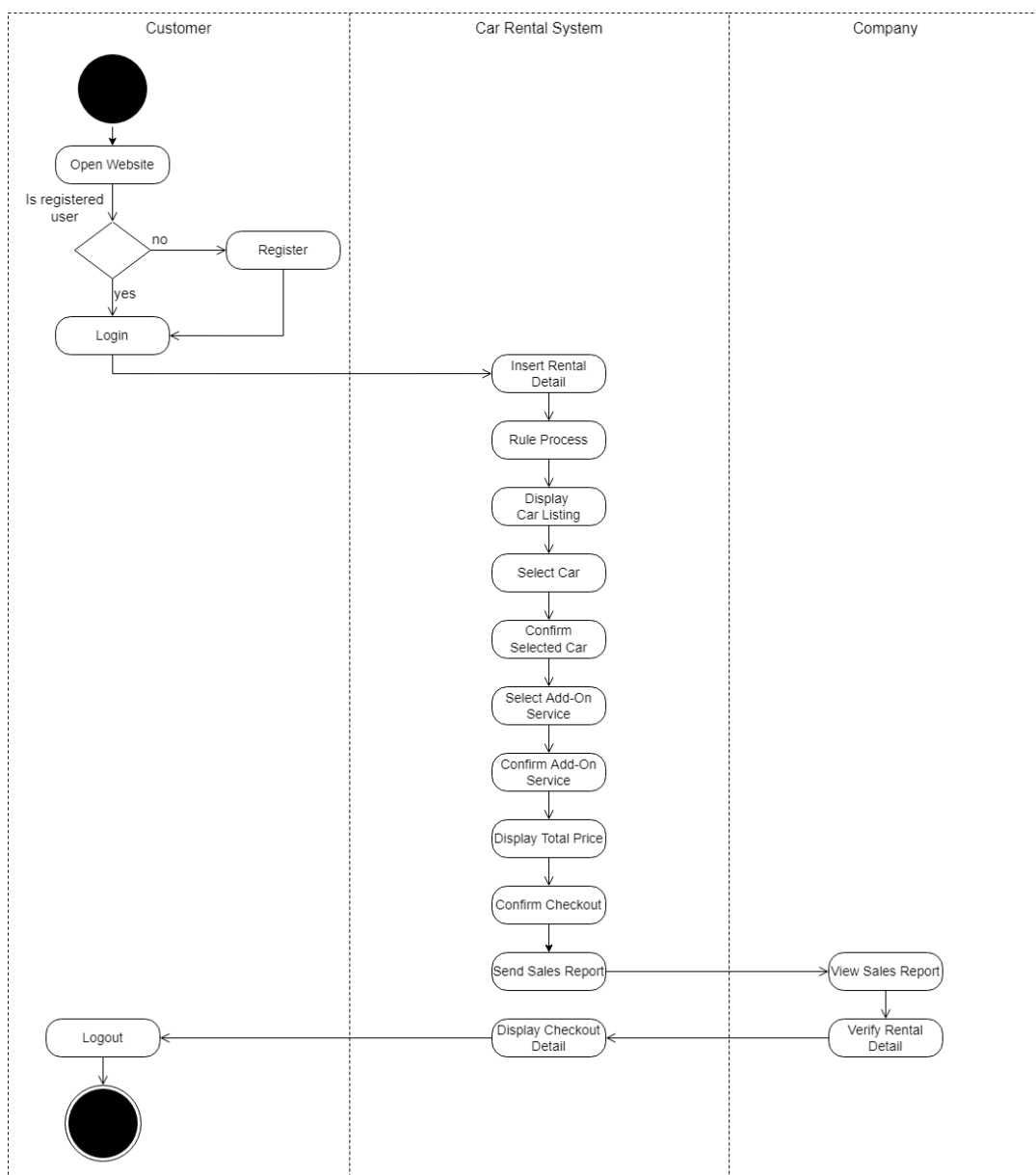


Figure 3.5 Activity Diagram



### 3.3.8 Parameter and Rules

The rule-based technique that use in this project will need to contain some rules that needed for process a suitable car listing for the customer to ensure that their time able be saved without trouble on finding their ideal car one-by-one. Before creating the rules, the research will need to collect the parameters that are mostly used by the user of the car rental system to find their ideal car.

Table 3.15 Type Of Car

<b>Type Of Car</b>	Sedan
	SUV
	Hatchback

Based on table 3.13, the first parameter is the type of car. There is multiple type of car involve in a brand such as sedan, SUV and hatchback and each type of car this is made for the user to fulfil requirement. Example of Perodua, the Perodua Bezza is the type of sedan that able to provide a convenience driving experience for the user because the Perodua Bezza is light and have a clearer vision for car turning. For Perodua Aruz, it is a type of SUV which have a big body but there gives much advantage like better safety, able to hold more item in the car and have an engine that able to climb for the hill. For Perodua Myvi, this is the most famous car in Malaysia and it is the type of hatchback, Perodua Myvi give a strong engine with a friendly price while the size of the car also small and light, so this made the Perodua Myvi have a powerful speed.

Table 3.16 Transmission Type

<b>Transmission Type</b>	Automatic Transmission (AT)
	Manual Transmission (MT)

Based on table 3.14, the second parameter is the transmission type. The transmission type can be different in automatic transmission and manual transmission. Most of the car today use the automatic transmission because this type of transmission provides a better driving experience while the driver no need to face the problem like the engine died because of driver mistake. But some driver are still willing to using the manual transmission for some car because manual transmission will need the driver to

control their speed while the automatic transmission is control automatically by the car system.

Table 3.17 Engine Capacity

<b>Engine Capacity</b>	1.0
	1.2
	1.3
	1.5
	1.6
	1.8
	2.0
	2.5

Based on table 3.15, the third parameter is engine capacity. The engine capacity will influence the performance of every car but each type of car had their limited engine capacity for them. This is because the engine capacity depends on the car's purpose. Example, a larger car which require more power will need a higher engine capacity while the smaller car which require less power will only need their minimum engine capacity.

Table 3.18 Car Brand

<b>Car Brand</b>	Local
	Overseas

Based on table 3.16, the fourth parameter is car brand. Not like the century before, the car brand currently in this world is much than a person fingers and car brand have their own advantage and disadvantage. In more generally said by people, most people will separate all the car brand to two which is local and oversea. Example of Proton, Proton is a local car brand where the car of Proton is still cheap while compared to overseas car brand and the quality of Proton also good but there also got some problem where the age of the car might give a big influence for the Proton car than other brand.

Table 3.19 Year of Car

<b>Year of Car</b>	2018
	2019
	2020

Based on table 3.17, the fifth parameter is the year of car. The year of car will show the age of the car and this might influence the value of the car while the

functionality of the car also will not much better than the latest version. Example, the Proton Saga which made in 2018 compare with Proton Saga made in 2020, the latest Proton Sage will might have a better value than previous version because the value of the car will drop each year and the functionality of the latest version of the Proton Saga might not be able to be seen in the previous version.

Table 3.20 Number Of Seats

<b>Number Of Seats</b>	5
	7

Based on table 3.18, the sixth parameter is number of seats. A larger car might contain more seat than a smaller car because the size of the car contains a better capability. Mostly the number of seats of the car is 5 and 7.

Table 3.21 Price Per Day

<b>Price Per Day</b>	>RM500
	<RM500

Based on table 3.19, the seventh parameter is price per day. Most of the person in this world will firstly look for the price before choosing the product. A person is willing to spend a minimum price to get the cheaper product than the expensive product because some cheaper product might have the same function as the expensive product.

Table 3.22 Rules

<b>Rules</b>	<b>Description</b>
1	IF sedan AND at AND 1.3 AND local AND 2018 AND 5 AND <RM500 THEN car list "Proton Saga, Perodua Bezza"
2	IF sedan AND mt AND 1.3 AND local AND 2018 AND 5 AND <RM500 THEN car list "Proton Saga, Perodua Bezza"
3	IF sedan AND at AND 1.5 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Honda City"
4	IF sedan AND mt AND 1.5 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Honda Civic"
5	IF sedan AND mt AND 1.8 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Honda Civic"

6	IF sedan AND at AND 2.0 AND overseas AND 2018 AND 5 AND <RM500 THEN car list “Toyota Camry”
7	IF sedan AND at AND 1.0 AND local AND 2019 AND 5 AND <RM500 THEN car list “Perodua Bezza”
8	IF sedan AND mt AND 1.0 AND local AND 2019 AND 5 AND <RM500 THEN car list “Perodua Bezza”
9	IF sedan AND at AND 1.3 AND local AND 2019 AND 5 AND <RM500 THEN car list “Proton Saga, Perodua Bezza”
10	IF sedan AND mt AND 1.3 AND local AND 2019 AND 5 AND <RM500 THEN car list “Proton Saga, Perodua Bezza”
11	IF sedan AND at AND 1.5 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Honda City”
12	IF sedan AND mt AND 1.5 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Honda Civic”
13	IF sedan AND mt AND 1.8 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Honda Civic”
14	IF sedan AND at AND 2.5 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Toyota Camry”
15	IF sedan AND at AND 1.0 AND local AND 2020 AND 5 AND <RM500 THEN car list “Perodua Bezza”
16	IF sedan AND mt AND 1.0 AND local AND 2020 AND 5 AND <RM500 THEN car list “Perodua Bezza”
17	IF sedan AND at AND 1.3 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Saga, Perodua Bezza”
18	IF sedan AND mt AND 1.3 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Saga, Perodua Bezza”
19	IF sedan AND at AND 1.5 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Honda City”
20	IF sedan AND mt AND 1.5 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Honda Civic”
21	IF sedan AND mt AND 1.8 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Honda Civic”

22	IF sedan AND at AND 2.5 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Toyota Camry”
23	IF suv AND at AND 1.8 AND local AND 2018 AND 5 AND >RM500 THEN car list “Proton X70”
24	IF suv AND at AND 2.0 AND overseas AND 2018 AND 5 AND >RM500 THEN car list “Mazda CX-5”
25	IF suv AND mt AND 2.0 AND overseas AND 2018 AND 5 AND >RM500 THEN car list “Subaru XV”
26	IF suv AND at AND 2.5 AND overseas AND 2018 AND 5 AND >RM500 THEN car list “Mazda CX-5”
27	IF suv AND mt AND 2.5 AND overseas AND 2018 AND 5 AND >RM500 THEN car list “Nissan Terra”
28	IF suv AND at AND 1.5 AND local AND 2019 AND 5 AND >RM500 THEN car list “Perodua Aruz”
29	IF suv AND at AND 1.8 AND local AND 2019 AND 5 AND >RM500 THEN car list “Proton X70”
30	IF suv AND at AND 2.0 AND overseas AND 2019 AND 5 AND >RM500 THEN car list “Mazda CX-5”
31	IF suv AND mt AND 2.0 AND overseas AND 2019 AND 5 AND >RM500 THEN car list “Subaru XV”
32	IF suv AND at AND 2.5 AND overseas AND 2019 AND 5 AND >RM500 THEN car list “Mazda CX-5”
33	IF suv AND mt AND 2.5 AND overseas AND 2019 AND 5 AND >RM500 THEN car list “Nissan Terra”
34	IF suv AND at AND 1.5 AND local AND 2020 AND 5 AND >RM500 THEN car list “Perodua Aruz”
35	IF suv AND at AND 1.8 AND local AND 2020 AND 5 AND >RM500 THEN car list “Proton X70”
36	IF suv AND at AND 2.0 AND overseas AND 2020 AND 5 AND >RM500 THEN car list “Mazda CX-5”
37	IF suv AND mt AND 2.0 AND overseas AND 2020 AND 5 AND >RM500 THEN car list “Subaru XV”

38	IF suv AND mt AND 2.5 AND overseas AND 2020 AND 5 AND >RM500 THEN car list "Nissan Terra"
39	IF suv AND mt AND 2.5 AND overseas AND 2018 AND 7 AND >RM500 THEN car list "Nissan Terra"
40	IF suv AND at AND 1.5 AND local AND 2019 AND 7 AND >RM500 THEN car list "Perodua Aruz"
41	IF suv AND mt AND 2.5 AND overseas AND 2019 AND 7 AND >RM500 THEN car list "Nissan Terra"
42	IF suv AND at AND 1.5 AND local AND 2020 AND 7 AND >RM500 THEN car list "Perodua Aruz"
43	IF suv AND mt AND 2.5 AND overseas AND 2020 AND 7 AND >RM500 THEN car list "Nissan Terra"
44	IF hatchback AND at AND 1.0 AND local AND 2018 AND 5 AND <RM500 THEN car list "Perodua Axia"
45	IF hatchback AND mt AND 1.0 AND local AND 2018 AND 5 AND <RM500 THEN car list "Perodua Axia"
46	IF hatchback AND at AND 1.5 AND local AND 2018 AND 5 AND <RM500 THEN car list "Perodua Myvi"
47	IF hatchback AND mt AND 1.5 AND local AND 2018 AND 5 AND <RM500 THEN car list "Perodua Myvi"
48	IF hatchback AND at AND 1.2 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Kia Picanto"
49	IF hatchback AND at AND 1.5 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Honda Jazz"
50	IF hatchback AND mt AND 1.6 AND overseas AND 2018 AND 5 AND <RM500 THEN car list "Peugeot 208 GTi"
51	IF hatchback AND at AND 1.0 AND local AND 2019 AND 5 AND <RM500 THEN car list "Perodua Axia"
52	IF hatchback AND mt AND 1.0 AND local AND 2019 AND 5 AND <RM500 THEN car list "Perodua Axia"
53	IF hatchback AND at AND 1.3 AND local AND 2019 AND 5 AND <RM500 THEN car list "Proton Iriz, Perodua Myvi"

54	IF hatchback AND mt AND 1.3 AND local AND 2019 AND 5 AND <RM500 THEN car list “Proton Iriz, Perodua Myvi”
55	IF hatchback AND at AND 1.5 AND local AND 2019 AND 5 AND <RM500 THEN car list “Perodua Myvi”
56	IF hatchback AND mt AND 1.5 AND local AND 2019 AND 5 AND <RM500 THEN car list “Perodua Myvi”
57	IF hatchback AND at AND 1.6 AND local AND 2019 AND 5 AND <RM500 THEN car list “Proton Iriz”
58	IF hatchback AND mt AND 1.6 AND local AND 2019 AND 5 AND <RM500 THEN car list “Proton Iriz”
59	IF hatchback AND at AND 1.2 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Kia Picanto”
60	IF hatchback AND at AND 1.5 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Toyota Yaris”
61	IF hatchback AND mt AND 1.8 AND overseas AND 2019 AND 5 AND <RM500 THEN car list “Renault Megane RS”
62	IF hatchback AND at AND 1.3 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Iriz”
63	IF hatchback AND mt AND 1.3 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Iriz”
64	IF hatchback AND at AND 1.6 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Iriz”
65	IF hatchback AND mt AND 1.6 AND local AND 2020 AND 5 AND <RM500 THEN car list “Proton Iriz”
66	IF hatchback AND at AND 1.5 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Toyota Yaris”
67	IF hatchback AND mt AND 2.0 AND overseas AND 2020 AND 5 AND <RM500 THEN car list “Hyundai i30”

Based on table 3.20, the rules are created based on the parameters that have been collected. The rules will use the IF statement to ensure the specific parameters are meet with the rules based on the table 3.20 and then output the car list based on the rule that is match with the parameters that have been selected by the customer.

### 3.4 Data Design

In the data design session, the database for the car rental system will be design and create in entity relationship diagram with the data dictionary. The data will be use on collecting the customer rental detail and display the data on the related interface. The database is important because this can assist the system provide the efficiency rental services without asking the customer to waste their time to repeat input the same data.

#### 3.4.1 Entity Relationship Diagram

The Entity Relationship Diagram will give a clear picture about the process of the database run behind the car rental system.

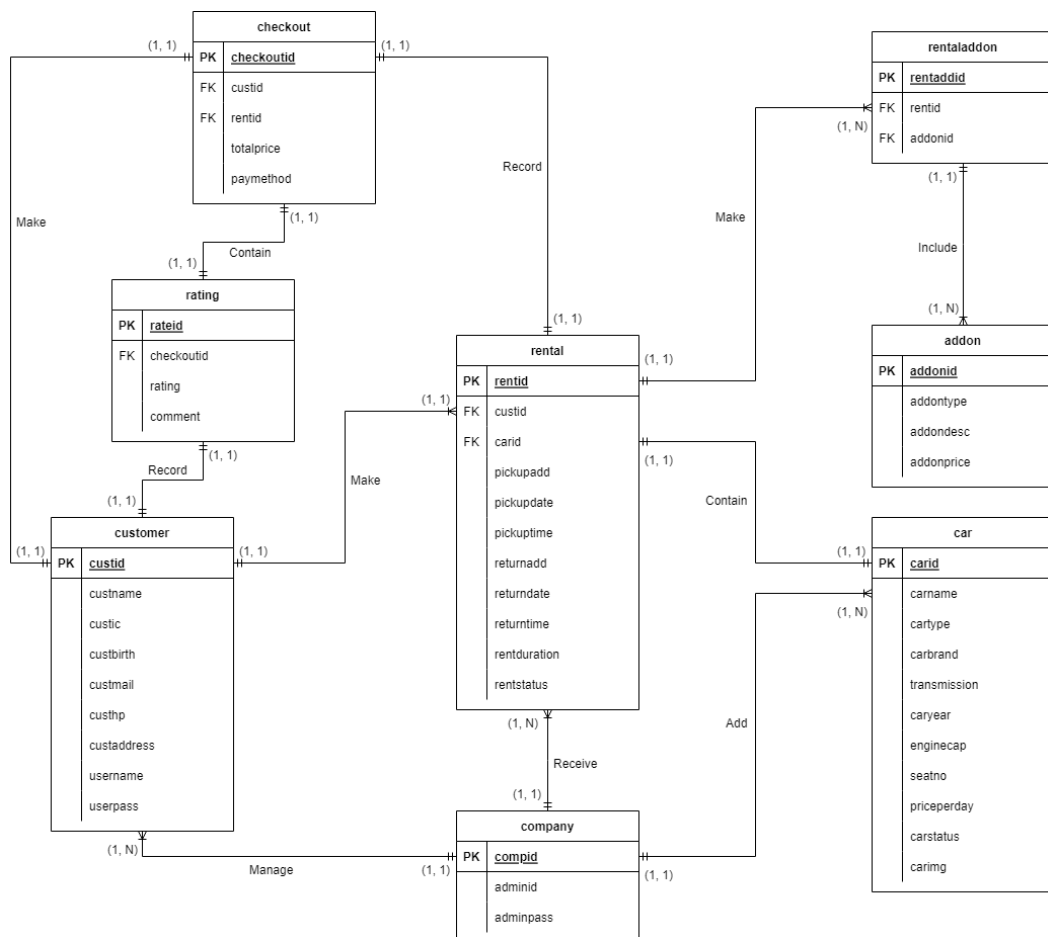


Figure 3.6 Entity Relationship Diagram

#### 3.4.2 Database Dictionary

In this session, the database for the system is create based on the table below. Each table show the different data that will be collected from the car rental system.



Table 3.23 Customer

Field Name	Description	Data Type	Constraint
custid	Customer ID	INT (15)	PK, NOT NULL
custname	Customer Name	VARCHAR2 (50)	
custic	Customer IC Number	VARCHAR2 (15)	
custbirth	Customer Birth	DATE	
custmail	Customer Email	VARCHAR2 (50)	
custhp	Customer Phone Number	VARCHAR2 (50)	
custaddress	Customer Address	VARCHAR2 (100)	
username	Customer Username	VARCHAR2 (50)	
userpass	Customer Password	VARCHAR2 (50)	

Table 3.24 Car

Field Name	Description	Data Type	Constraint
carid	Car ID	INT (15)	PK, NOT NULL
carname	Car Name	VARCHAR2 (50)	
cartype	Type of Car	VARCHAR2 (50)	
carbrand	Car Brand	VARCHAR2 (50)	
transmission	Transmission Type	VARCHAR2 (50)	
caryear	Year of Car	INT (15)	
enginecap	Engine Capacity	INT (15)	
seatno	Number of Seats	INT (15)	
priceperday	Price Per Day	INT (15)	
carstatus	Car Status	VARCHAR2 (50)	
carimg	Car Image	VARCHAR2 (50)	

Table 3.25 Addon

Field Name	Description	Data Type	Constraint
addonid	Add-On ID	INT (15)	PK, NOT NULL
addontype	Add-On Type	VARCHAR2 (50)	
addondesc	Add-On Description	VARCHAR2 (50)	
addonprice	Add-On Price	INT (15)	

Table 3.26 Rentaladdon

Field Name	Description	Data Type	Constraint
rentaddid	Rentaladdon ID	INT (15)	PK, NOT NULL
rentid	Rental ID	INT (15)	FK
addonid	Add-On ID	INT (15)	FK

Table 3.27 Rental

Field Name	Description	Data Type	Constraint
rentid	Rental ID	INT (15)	PK, NOT NULL
custid	Customer ID	INT (15)	FK
carid	Car ID	INT (15)	FK
pickupadd	Pick Up Address	VARCHAR2 (100)	
pickupdate	Pick Up Date	DATE	
pickuptime	Pick Up Time	VARCHAR2 (50)	
returnadd	Return Address	VARCHAR2 (100)	
returndate	Return Date	DATE	
returntime	Return Time	VARCHAR2 (50)	
rentduration	Rental Duration	INT (15)	
rentstatus	Rental Status	VARCHAR2 (50)	

Table 3.28 Checkout

Field Name	Description	Data Type	Constraint
------------	-------------	-----------	------------

checkoutid	Checkout ID	INT (15)	PK, NOT NULL
custid	Customer ID	INT (15)	FK
rentid	Rental ID	INT (15)	FK
totalprice	Total Price	INT (15)	
paymethod	Payment Method	VARCHAR (50)	

Table 3.29 Rating

Field Name	Description	Data Type	Constraint
rateid	Rating ID	INT (15)	PK, NOT NULL
checkoutid	Checkout ID	INT (15)	FK
rating	Rating	VARCHAR2 (50)	
comment	Comment	VARCHAR2 (100)	

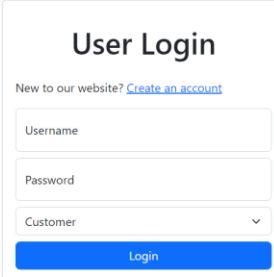
Table 3.30 Company

Field Name	Description	Data Type	Constraint
compid	Company ID	INT (15)	PK, NOT NULL
adminid	Admin ID	INT (15)	FK
adminpass	Admin Password	VARCHAR2 (50)	FK

### 3.5 Proof Of Initial Concept

This session shows the earlier design of each interface that are involve in the car rental system and the functionality that are contain by the interface also will be explained based on the image of the earlier interface design.

### 3.5.1 User Login Page



The image shows a user login form titled "User Login". At the top, it asks "New to our website?" with a blue link "Create an account". Below this are three input fields: "Username", "Password", and "Customer" (a dropdown menu). At the bottom is a blue "Login" button.

Figure 3.7 User Login Page

In user login page, the user will need to insert their username and password with their user type before accessing the car rental system to get the car rental services. From the figure 3.7, there are two text field provide separately for the username and password while a selection field for the user to choose their user type. As the words wrote in the text field, the label of Username provides the text field for user to input their username while the text field which label as Password let user input their password. For the new user who does not have the account, the “Create an account” link beside the text “New to our website?” able to lead the new user to registration page for register an account before login to the system. Once the customer has input their username and password, the user will need to choose their user type and then click on the “Login” button to access the car rental system.

### 3.5.2 User Registration Page

Car Rental System

### User Registration

Already have an account? [Login](#)

Full Name  
Enter your name...

Identity Card Number  
Enter your identity card number...

Date Of Birth  
dd/mm/yyyy

Email Address  
Enter your email address...

Phone Number  
Enter your phone number...

Home Address  
Enter your home address...

Username  
Enter your username...

Password  
Enter your password...

[Reset](#) [Register](#)

Figure 3.8 User Registration Page

In the User Registration Page, the new customer will be required to insert all their detail such as their name, identity card number, date of birth, email address, phone number and home address to ensure they are the real person. They also need to input the username and password for their account as authentication when login to the car rental system for enjoy the services. Once all the detail has been done insert, the customer will need to press the “Register” button to save all their detail to the car rental system server. Car rental system will check either is there any used personal information in the database, if get the used in the database and error message will send to user to insert again their new personal detail. The “Reset” button provide the quick clear function for the user to clear all the detail that type in the form. If the exist user wrong click to the registration page, the user able to click the link which state as “Login” beside the text “Already have an account” to proceed to the login page.

### 3.5.3 Rental Detail Page

Car Rental System Profile History Logout

### Rental Info

Please Insert And Select Your Rental Information!!!

Enter your pick up address...

Pickup Date: 01/12/2022 Pickup Time: 12:00 AM

Enter your return address...

Return Date: 02/12/2022 Return Time: 12:00 AM

Click to Select Type Of Car

Click to Select Transmission Type

Click to Select Engine Capacity Of Car

Click to Select Car Brand

Click to Select Year Of Car

Click to Select Number Of Seat

Click to Select Price Per Day

[Start Searching](#)

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Figure 3.9 Rental Detail Page

In the rental detail page, the user will need to input their pickup address and return address in the text field given while the pickup date, pickup time, return date and return time will need the customer to click to select the suitable date and time. In order to operate the rule-based technique, there are some parameters that need to be collected from the customer. Below the rental detail, there are 7 parameters will be provided with the selection bar which is the type of car, transmission type, engine capacity, car brand, year of car, number of seat and price per day. The selection bar for each parameter contains multiple choices and the customer will only need to choose one of the choices from the option list for each parameter. Once the customer has input all the needed rental detail, there are provided a “Confirm” button at the bottom to let the customer confirm with the rental detail and then the choices for each parameter will send to the rule-based function to proceed for the next interface.

### 3.5.4 Customer Car List Page

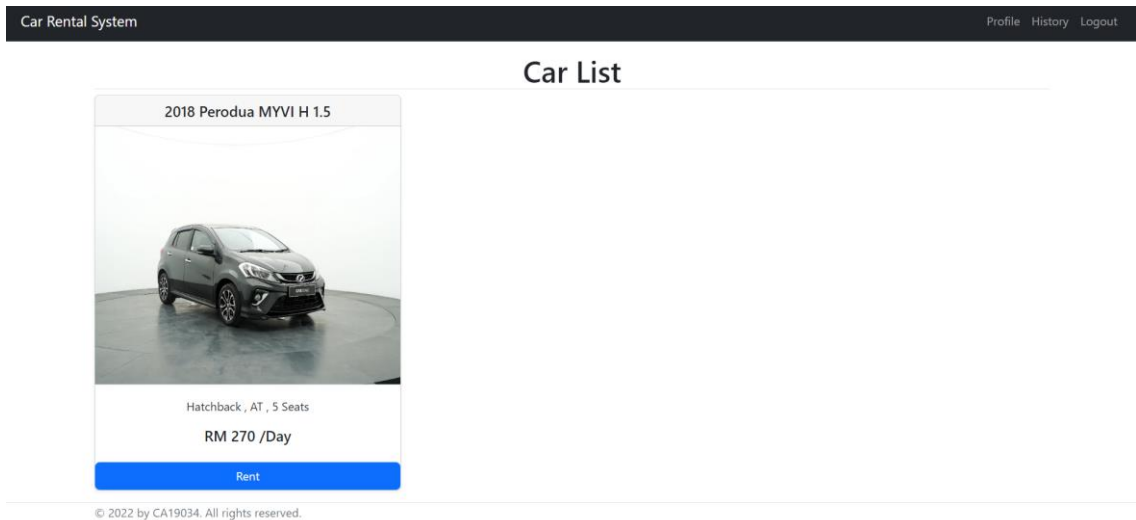


Figure 3.10 Customer Car List Page

In the customer car list page, car list will be shown after the customer select their idea parameter. The parameter will send to the rule-based function to search for the scheduled car listing. The result of the car listing will send to the car list page and display the scheduled car list for the customer. The car list will be show with the name of the car, image of car, car detail and the prices. Each car with the detail will show in each box provided in the page from left to right and top to bottom. When the customer found their ideal car, the user will need to press the “Rent” button which will show in the box of each car show in the car list to proceed for next page.

### 3.5.5 Add-On Services Page

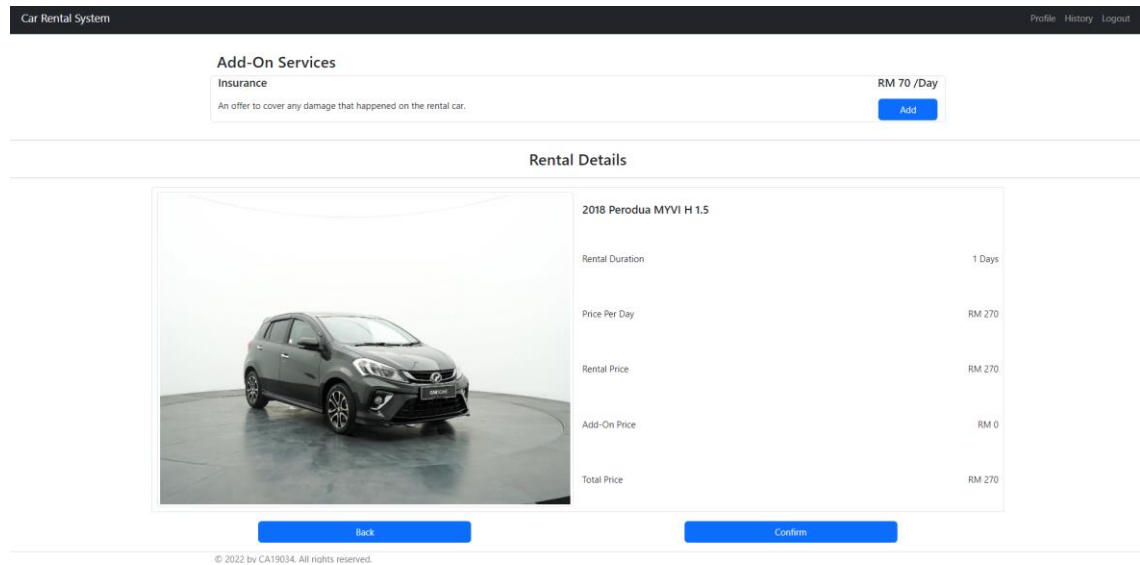


Figure 3.11 Add-On Services Page

In the add-on services page, the top will show with the add-on services that provided by the company while bottom of the page displays the rental detail such as car image, Car Name, Rental Duration, Price Per Day, Rental Price, Add-On Price and Total Price. In the add-on services menu, each add-on service is show with the name, description, price and a “Add” button. When the customer presses the “Add” button, the Add-On Price below the Rental Detail will increase the value. Customer able to remove the add-on service that they have been added with the “Cancel” button. The “Cancel” button only display for the customer after they add the add-on service. If the customer has thought about to change the car that they want to rent, there a “Back” button provided at bottom left of the page which will lead the customer back to the car list page. If the customer has confirmed all his rental detail and the add-on services, then the customer able to proceed with the next page by pressing the “Confirm” button.



### 3.5.6 Checkout Page

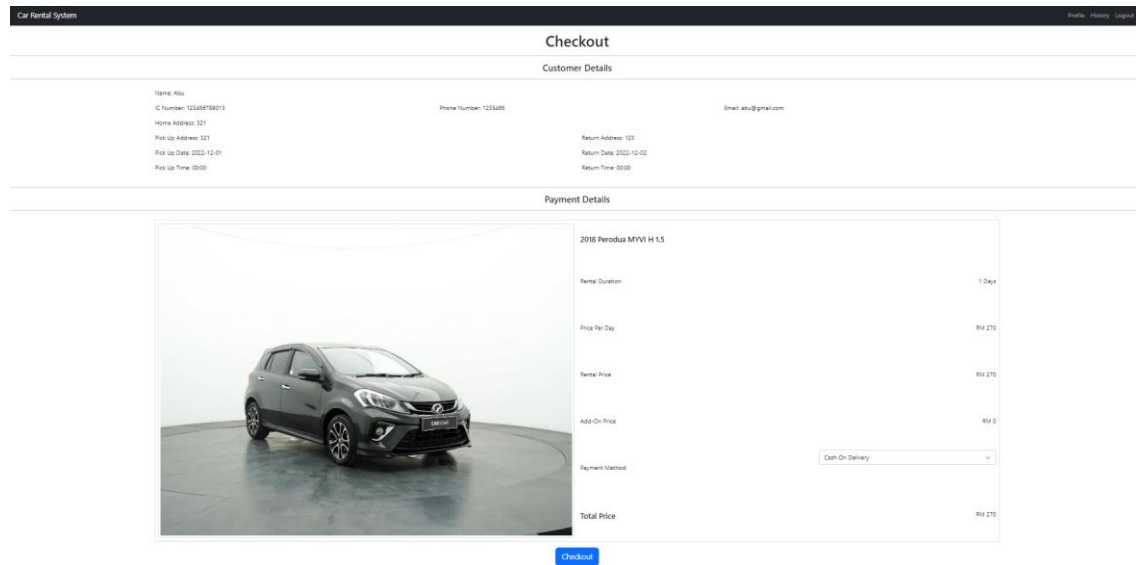


Figure 3.12 Checkout Page

In the checkout page, the customer's personal detail such as Name, IC Number, Phone Number, Email and Home Address will displayed with the rental detail such as Pickup Address, Pickup Date, Pickup Time, Return Address, Return Date and Return Time in the customer detail. Below the customer detail will display the payment detail which also include the several rental detail such as Car Name, Rental Duration, Price Per Day, Rental Price, Add-On Price and Total Price as the previous page with the addition payment detail which is the Payment Method. The customer able to choose two payment method which is Cash On Delivery or Online Banking. The Cash On Delivery means the customer able to pay their payment when they receive the car while Online Banking means the customer pay the payment through the bank and they only need to receive the car when the pickup date come. Once the customer confirms their personal detail and the payment detail, there provide a "Checkout" button to confirm the rental and company will receive the rental request.

### 3.5.7 Profile Page

Car Rental System Profile History Logout

### User Profile

Full Name  
abc

Identity Card Number 123456789012 Date Of Birth 27/07/1999

Email Address abc@gmail.com Phone Number 0123456789

Home Address pekan,pahang

Username abc

Password

Register

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Figure 3.13 Profile Page

In the profile page, there will show all the personal detail such as name, identity card number, date of birth, email address, phone number, home address, username of the customer except the password. The customer able to edit their personal detail include the password. The customer will receive the error message if the customer changes their personal detail is match with other used detail in the car rental system.

### 3.5.8 History Page

Car Rental System Profile History Logout

### Rental List

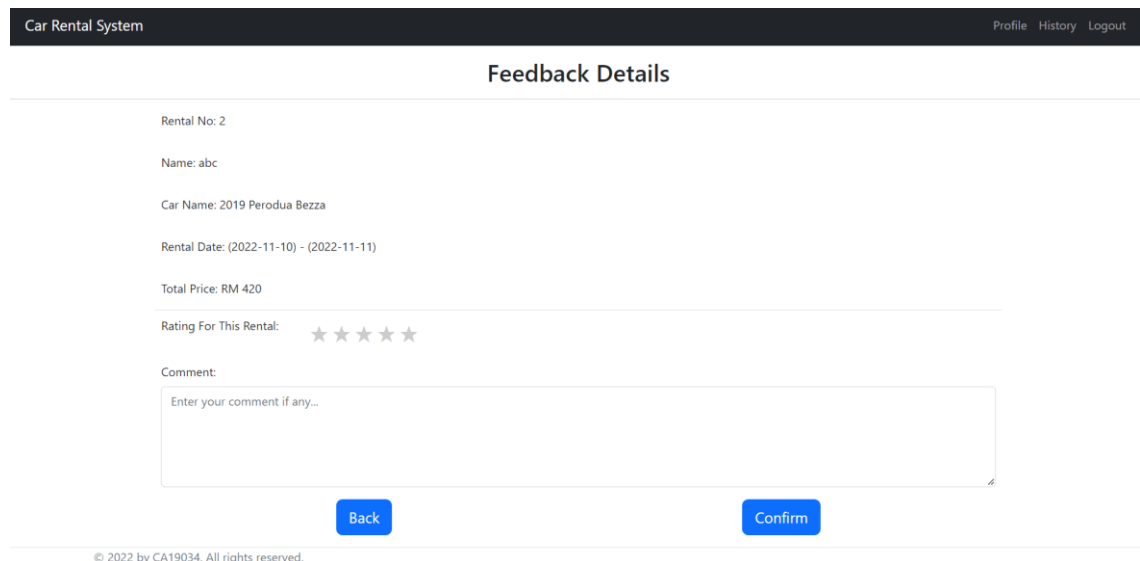
Rental ID	Pickup Address	Pickup Date	Pickup Time	Return Address	Return Date	Return Time	Duration	Status	Option
1	pekan, pahang	2022-11-11	16:00	gambang, pahang	2022-11-12	17:25	1	Complete	
2	abc	2022-11-10	00:00	cba	2022-11-11	00:00	1	Complete	Rate And Comment
3	tq	2022-12-01	00:00	qt	2022-12-03	00:00	2	Rented	
4	888	2022-11-17	00:00	099	2022-11-18	00:00	1	Cancel	

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Figure 3.14 History Page

In the history page, the customer able to view all their rental history in the page and provide with the “Rate And Comment” button after the rental has completed. The “Rate And Comment” button will lead the customer to the feedback page for the selected rental id. Once the customer finishes the feedback process, the “Rate And Comment” button will disappear from the Option column for the associated rental.

### 3.5.9 Feedback Page



Car Rental System Profile History Logout

#### Feedback Details

---

Rental No: 2  
Name: abc  
Car Name: 2019 Perodua Bezza  
Rental Date: (2022-11-10) - (2022-11-11)  
Total Price: RM 420

Rating For This Rental: ★★★★★

Comment:  
Enter your comment if any...

[Back](#) [Confirm](#)

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Figure 3.15 Feedback Page

Once the customer has returned their car, the car rental system will display the feedback page for the latest rental to collect the customer opinion about their rental experience. In the feedback page, the feedback detail such as rental number, customer name, car name, rental date and total price is show at the top. While the bottom, there a selection for the customer to choose their rating from 1 to 5 about their rental experience and the comment about the problem if they meet and need the company to improve also been provide with a text field. Once all the comment detail has input by the customer, the customer will able to press the “Confirm” button to submit their feedback.

### 3.5.10 Admin Home Page

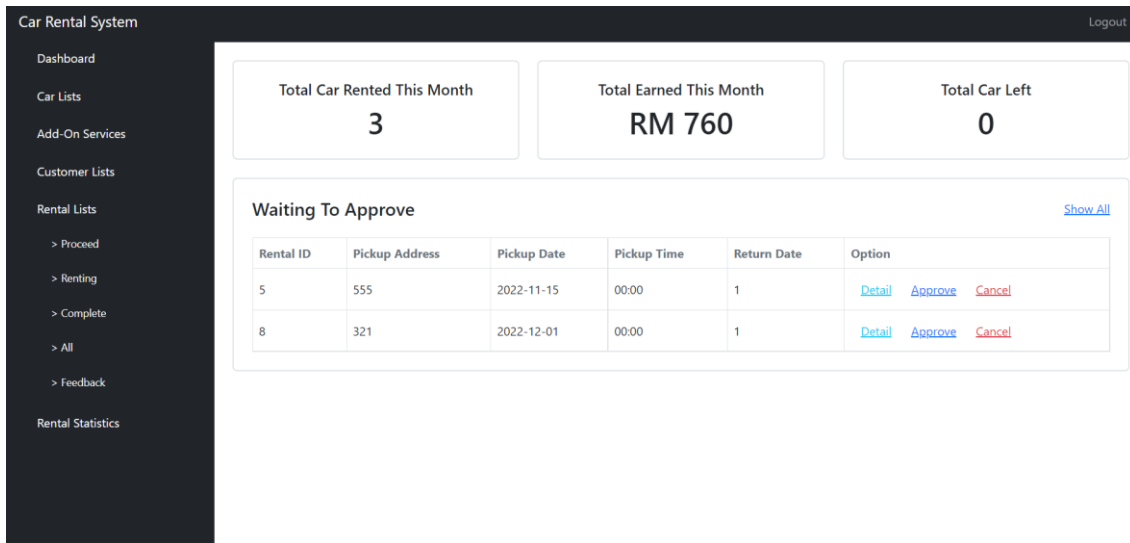


Figure 3.16 Admin Home Page

Once the admin successfully login, they will firstly locate to the dashboard which also known as admin home page. In this page, there show some numeric statistics for several information such as Total Car Rent This Month, Total Revenue This Month and Total Car Left For Rent. Admin also provided with the 5 oldest rental list that are waiting the admin to manage below the statistic. The admin able to click the “Show All” link to proceed to the rental list page or the admin able to manage the rental detail in this page where the “Detail” link show the detail of the rental, “Approve” link to approve the rental and the “Cancel” link to cancel the rental. The statistic able to give an easier understand report of the car rental system for the admin while the rental list shown able to assist the admin quickly approve the oldest rental requeuse. If the admin requires the detail report for the car rental system, the system will require to go the “Rental Statistics” link provide at sidebar to go the associated page for getting the detail report of the car rental system. There also provide other pages link such as “Dashboard”, “Car List”, “Add-On Services”, “Customer List” and “Rental List” where each link will proceed to their associated page.

### 3.5.11 Admin Car List Page

Name	Type	Brand	Transmission	Year	Color	Number Of Seats	Price	Status	Option
2020 Perodua Aruz	SUV	Local	AT	2020	1500	7	600	Unavailable	<a href="#">Edit</a> <a href="#">Remove</a>
2018 Perodua MYVI H 1.5	Hatchback	Local	AT	2018	1500	5	270	Unavailable	<a href="#">Edit</a> <a href="#">Remove</a>
2019 Perodua Bezza	Sedan	Local	AT	2019	1300	5	350	Unavailable	<a href="#">Edit</a> <a href="#">Remove</a>

Figure 3.17 Admin Car List Page

In the admin car list page, the admin will be able to check all the car that has been add into the system. All the cars will show in the table with their detail and status. The admin will be able to edit the car detail with the “Edit” link provided in Option column while the “Remove” link provided for admin to remove the car from the car rental system. The admin also provided with “Add Car” button at top right to add the car into the car rental system server.

### 3.5.12 Admin Add-On Services Page

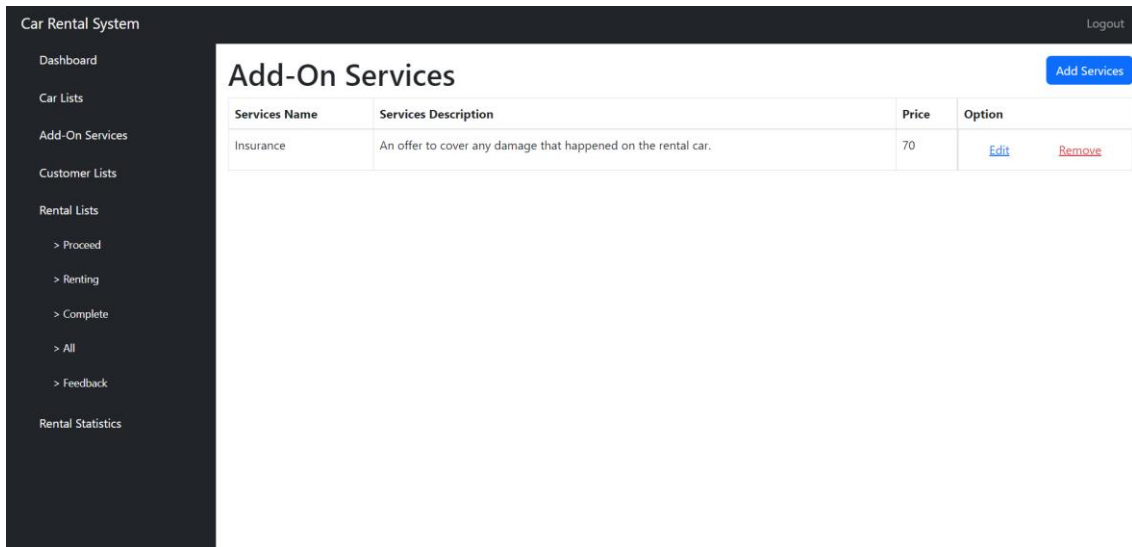


Figure 3.18 Admin Add-On Services Page

In the add-on services page, there provide the similar function as the admin car list page. The admin able to add any services for the customer by pressing the “Add Services” button and then the admin will proceed to insert the services detail such as service name, service description and service price. In the add-on services list, there provide the “Edit” link for the admin to change the service detail such as service name, service description or service price. If the admin require to remove the service from the car rental system, there provide a “Remove” link for the admin to remove the service from the add-on services list.

### 3.5.13 Customer List Page

Name	Identity Number	Birth	Email Address	Phone Number	Home Address
abc	123456789012	1999-07-27	abc@gmail.com	0123456789	pekan,pahang
ali	123456789876	2000-01-01	ali@gmail.com	013456	gambang,pahang
Abu	123456789013	1999-01-01	abu@gmail.com	1235465	321

Figure 3.19 Customer List Page

In the customer list page, the admin will be able to know their customer detail. All the necessary customer detail such as Name, Identity Card Number, Birth Of Date, Email Address, Phone Number and Home Address will be shown in the table. Admin will not be able to edit the customer detail but only able to view the customer detail. This able to assist the Admin to contact the customer if there any happen on their rental.

### 3.5.14 Rental List Page

Rental ID	Pickup Address	Pickup Date	Pickup Time	Return Address	Return Date	Return Time	Duration	Status	Option
1	pekan, pahang	2022-11-11	16:00	gambang, pahang	2022-11-12	17:25	1	Complete	<a href="#">Detail</a>
2	abc	2022-11-10	00:00	cba	2022-11-11	00:00	1	Complete	<a href="#">Detail</a>
3	tq	2022-12-01	00:00	qt	2022-12-03	00:00	2	Rented	<a href="#">Detail</a> <a href="#">Complete</a>
4	888	2022-11-17	00:00	099	2022-11-18	00:00	1	Cancel	<a href="#">Detail</a>
5	555	2022-11-15	00:00	666	2022-11-16	00:00	1	Proceed	<a href="#">Detail</a> <a href="#">Approve</a> <a href="#">Cancel</a>
8	321	2022-12-01	00:00	123	2022-12-02	00:00	1	Proceed	<a href="#">Detail</a> <a href="#">Approve</a> <a href="#">Cancel</a>

Figure 3.20 Rental List Page

In the rental list page, admin is provided with the necessary rental detail in the table and the admin is allowed to press the “Detail” link for each rental to get the more rental detail such as car detail and customer detail for the associated rental. Once the admin has checked all the detail of the rental, they will be able to approve the rental by pressing the “Approve” link or cancel the rental by pressing the “Cancel” link. After the customer has return their rented car, they a “Complete” link provide for the admin to press for mention the rental has complete. The admin able to choose to the related rental list page from the sidebar such as “Proceed” which only show the rental that waiting to approve or cancel, “Renting” which show the rental list that in renting status, “Complete” which show the completed rental list, “All” which show all the rental list in any status and “Feedback” which show the feedback of each rental.



### 3.5.15 Admin Feedback Page

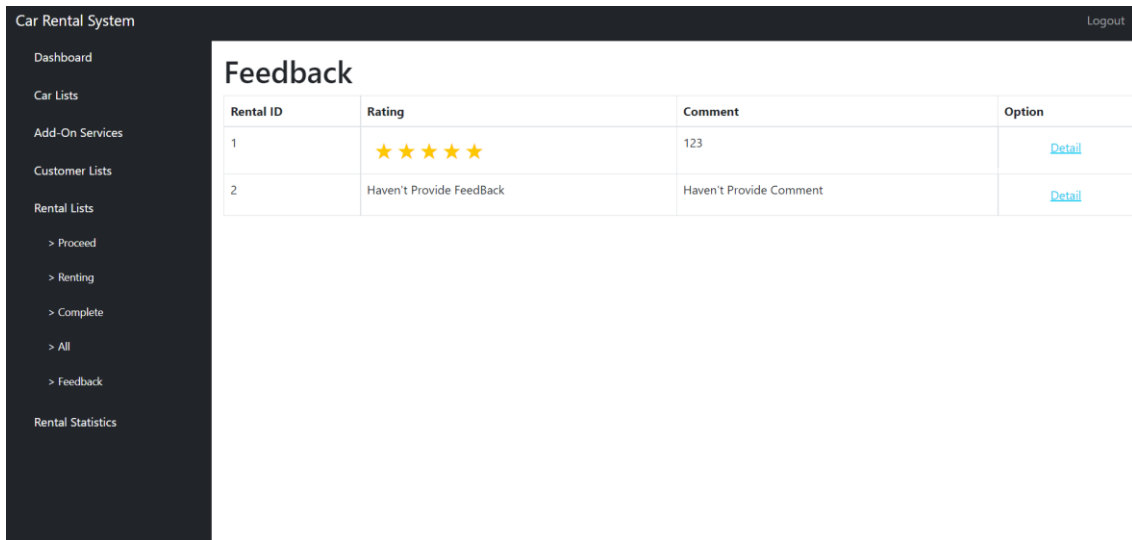


Figure 3.21 Admin Feedback Page

In the admin feedback page, there show the rating and comment from the customer experience for each completed rental. There provides a “Detail” link for the admin to know the rental detail such as car detail to assist them on improving their services when receive a lower rating.

### 3.5.16 Rental Statistics Page

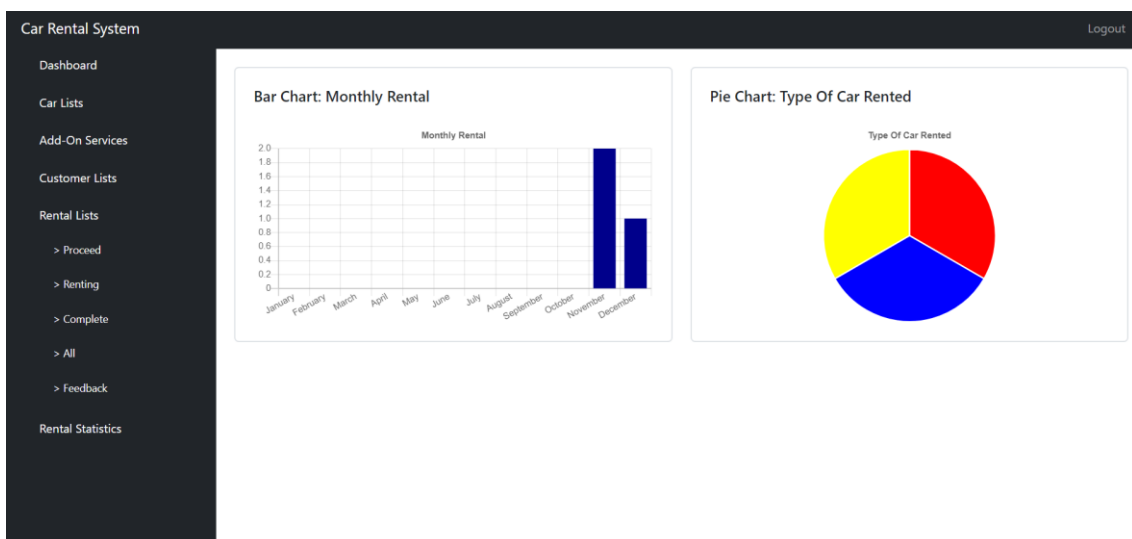


Figure 3.22 Rental Statistics Page

In the rental statistics page, there are provide more detail statistics such as the Monthly Rental and Type Of Car Rented in the car rental system for the admin. The

statistic are provided in form of chart such as the Monthly Rental in bar chart and Type Of Car Rented in pie chart where this assist the admin to get a clearer image of the statistics report of the car rental system.

### **3.6 Testing Plan**

Testing plan is important to identify the existing problem of the car rental system once the car rental system finishes the development before open for the public. The researcher has decided to use the User Acceptance Test (UAT) as the testing plan to test the function of the car rental system. The User Acceptance Test will choose a minimum number of 15 users to test for the functionality of the website.

The users who join in the User Acceptance Test will be given the User Acceptance Test (UAT) form to fill their feedback while they are using the car rental system. The User Acceptance Test (UAT) form will contain all the module involve in the car rental system. Each module has their specific activities that other module might not contain, so the user will need to state the status of the activities and also the user might be able to leave a comment for each activity if there any problem or any improvement that need to be done on the specific activities.

Once the users have done the testing, the research able to look for the User Acceptance Test (UAT) form that collect from those users who join the User Acceptance Test to improve and modify the car rental system to ensure the problem able be control to the minimum.

### **3.7 Potential Use Of Proposed Solution**

The car rental system with the rule-based technique gives much impact for the existing car rental system and the user. The existing car rental system has the limited technique on providing the car rental list but with the rule-based technique, the existing car rental system might be able to improve the efficiency of the car rental system on providing a better car rental list for their customer. The rule-based technique assists the customer find their ideal car without wasting their time on searching the ideal car in the

messy car rental listing. The rule-based technique implemented in the car rental system assists customer on processing the decision making to find out the suitable car for the customer based on the rental detail that had been insert by the customer.

In the term of company, the company able to improve their productivity on providing the car rental for the customer because all the rental process will do by the system and the company will receive and confirm the rental detail to proceed with sending the car to the customer based on the rental detail. When the customer has returned their car, the customer might send feedback about their rental experiences to the company and the company can look at the feedback get from the customer to improve their services. The car rental system also assists the company on providing the sales report which the company will use the sales report to plan for their organization.

### 3.8 Gantt Chart

Figure below display the Gantt Chart that created for this project to show the activities that happen from the beginning until the end of this project. All the tasks are complete between the time that show in the Gantt Chart.

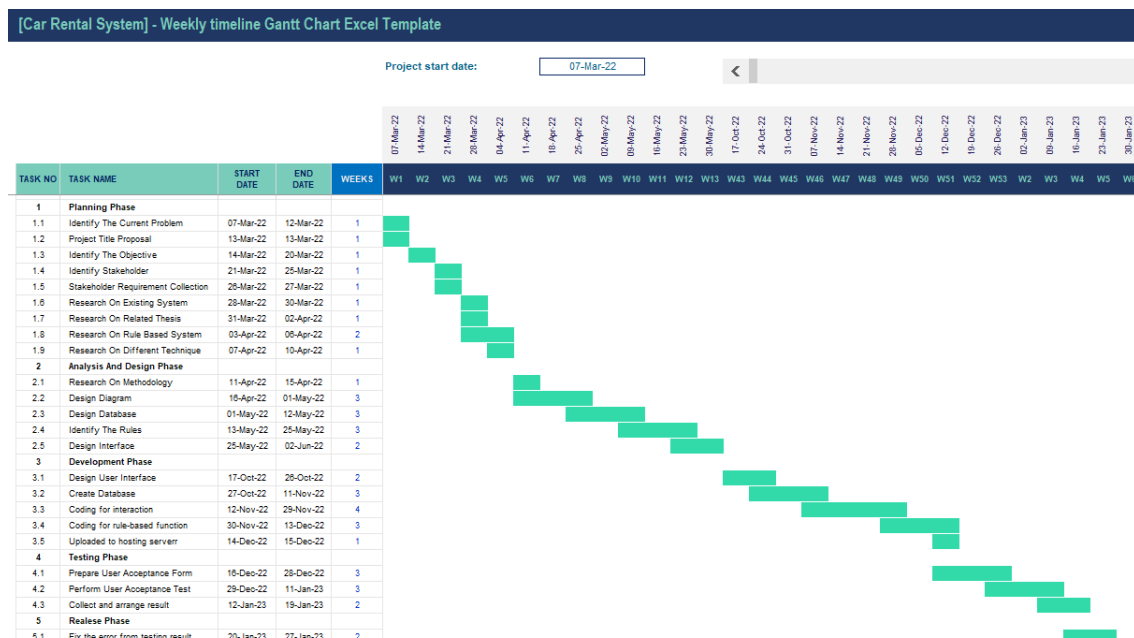


Figure 3.23 Gantt Chart

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

The result and discussion provide the view of the completed car rental system. This contains the implementation, result and discussion of the car rental system. The car rental system is developed as web application which operate on the web browser. The result of development of the car rental system will be tested through User Acceptance Test (UAT) where the car rental system will test by public user for collecting the improvement information for the development. Researcher will base on the result provided in User Acceptance Test (UAT) to improve the car rental system in order to provide the efficiency services.

#### **4.2 Implementation**

This section will contain the tool used on the development process for design and create the car rental system.

##### **4.2.1 Develop Environment**

The car rental system is a web application which develop using HTML, CSS and JavaScript on designing the user interface of car rental system while PHP is used on develop the interaction function for car rental system with database server. The car rental system will require a database server to store the data of each rental, car and customer in order to provide a trading process for the car rental system. So, phpMyAdmin has been selected to used on storing the database of the car rental system while PHP will used on connecting with phpMyAdmin in order to store and retrieve the database of the car rental system.

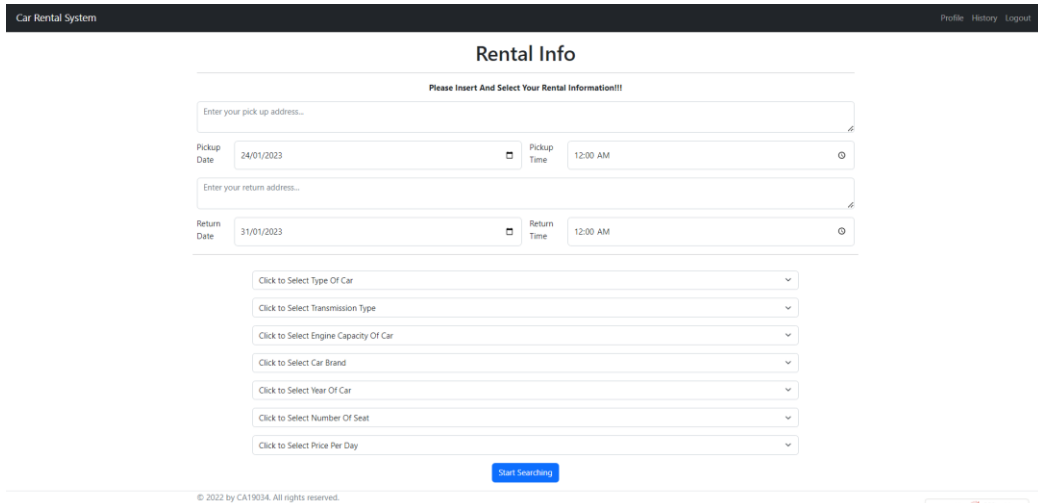


Figure 4.1 User Interface

Figure 4.1 show one of the user interfaces of the car rental system which involve the user on filling a form of the rental detail. The element involves in the rental detail form require the user on texting their address and select the time, data and car detail they wish to rent from the system. All elements involve in the user interface are develop using HTML elements while CSS and JavaScript has been used on arranging the elements until the user interface able to view easily by the user to enjoy.

```

<form class="rental-form" action="insertdetail.php" method="post">
<input type="hidden" id="rentid" name="rentid" value="<?php echo $rentinfo['rentid']; ?>" />
<div class="row g-3 justify-content-center">
  <div class="col-12">
    <textarea class="form-control" id="pickupadd" placeholder="Enter your pick up address..." name="pickupadd"><?php if(isset($rentinfo['pickupadd'])) echo $rentinfo['pickupadd'];>
  </div>
  <div class="col-lg-6 d-flex">
    <label class="form-label" for="pickupdate">Pickup Date</label>
    <input class="form-control" type="date" id="pickupdate" name="pickupdate" <?php if(isset($rentinfo['pickupdate'])) echo $rentinfo['pickupdate'];>
  </div>
  <div class="col-lg-6 d-flex">
    <label class="form-label" for="pickuptime">Pickup Time</label>
    <input class="form-control" type="time" id="pickuptime" name="pickuptime" <?php if(isset($rentinfo['pickuptime'])) echo $rentinfo['pickuptime'];>
  </div>
  <div class="col-12">
    <textarea class="form-control" id="returnadd" placeholder="Enter your return address..." name="returnadd"><?php if(isset($rentinfo['returnadd'])) echo $rentinfo['returnadd'];>
  </div>
  <div class="col-lg-6 d-flex">
    <label class="form-label" for="returndate">Return Date</label>
    <input class="form-control" type="date" id="returndate" name="returndate" <?php if(isset($rentinfo['returndate'])) echo $rentinfo['returndate'];>
  </div>
  <div class="col-lg-6 d-flex">
    <label class="form-label" for="returntime">Return Time</label>
    <input class="form-control" type="time" id="returntime" name="returntime" <?php if(isset($rentinfo['returntime'])) echo $rentinfo['returntime'];>
  </div>
  <hr>
  <div class="col-10">
    <select class="form-select" id="toc" name="toc">
      <option value="" selected="selected">Click to Select Type Of Car</option>
      <option value="Sedan">Sedan</option>
      <option value="SUV">SUV</option>
      <option value="Hatchback">Hatchback</option>
    </select>
  </div>
</div>
</form>

```

Figure 4.2 HTML Element In Coding

From figure 4.2, this shows the coding on creating the rental detail form for the car rental system. In the coding, there multiple of HTML elements involve in on creating one module. Example in a rental detail module might involves title element, paragraph element, form element, input element, select element and button element. Each element

has there own function to be assigned in the user interface such as <h1> will assigned as the title element for making the word into a title format, <input> will assigned as the input element which require for the user to input their detail based on the type of input and there also much HTML elements will be assigned in the coding to show the word, paragraph or just require the input from the user.

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Rental Details</title>

  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-Zenh87qX5JnK2J1jvW88"
  <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/js/bootstrap.bundle.min.js" integrity="sha384-OERcA2EjJCMA+/3y+gx10QMEjwX3Y

</head>
<body>
  <?php
    include("navibar.php");
  >
  <div class="container w-75">
    <div class="form-title text-center">
```

Figure 4.3 Bootstrap In Coding

In the coding, Bootstrap has been used for designing the framework of the car rental system. Bootstrap is an open-source CSS framework and it contains the CSS and JavaScript template for everyone to easily design there application. So, the researcher will just only need to include the Bootstrap by using <link> and <script> for connecting the coding with the Bootstrap template. Once it has been success connected through the <link> and <script>, then the research will able to access the css and js file in Bootstrap where the HTML elements will need to through the class attribute for calling the class name from Bootstrap. Example, <div class="container"> where <div> is HTML element while the "container" is the class attribute used for calling the class name in the css and js file in Bootstrap.

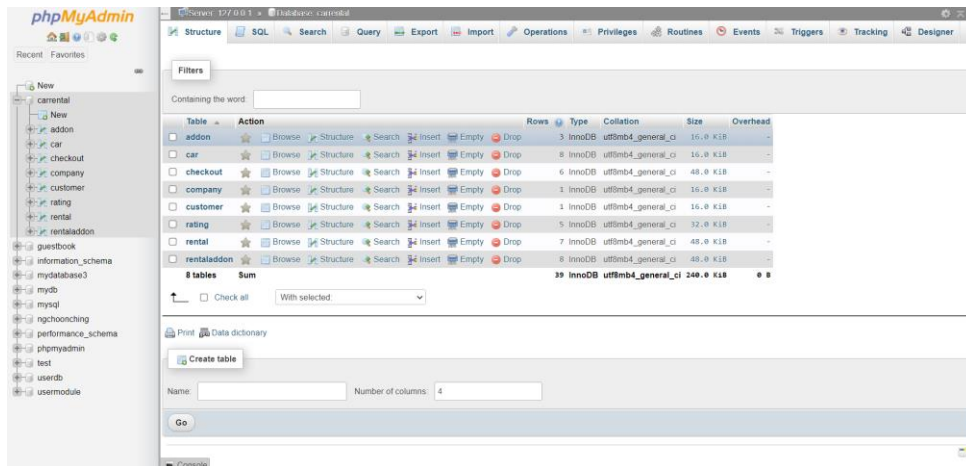


Figure 4.4 Database

Other than designing the user interface of the car rental system, database of the car rental system also needed to create and the database will be created in phpMyAdmin as shown in figure 4.4. The database is created to store the necessary data that can be retrieved from the user, such as car details, customer details, rental details, and others. The database will contain multiple tables, and each table will be used to store the associated data. Users are not only able to store their data but also able to retrieve the data to view.

```
<?php
define("DATABASE_HOST", "localhost");
define("DATABASE_USER", "root");
define("DATABASE_PASSWORD", "");
define("DATABASE_NAME", "carrental");

$connect = mysqli_connect(DATABASE_HOST, DATABASE_USER, DATABASE_PASSWORD, DATABASE_NAME);

if (mysqli_connect_errno())
{
    echo "Failed to connect to MySQL: " . mysqli_connect_error();
}
?>
```

Figure 4.5 Connect To Database

After the design of the user interface and also the successful creation of the database, there will be a need for a bridge to allow interaction between the system and the database. PHP has been chosen for this purpose. Before storing and retrieving data from the database, PHP must be used to connect the car rental system to the database server. In figure 4.5, the function `mysqli_connect()` is used for connecting to the database. This function requires the database domain, database username, database password, and the name of the database to access the specific database.

```

<?php
session_start();
$custid = $_SESSION['custid'];
$rentid = $_SESSION['rentid'];
$carid = $_SESSION['carid'];

$payment = $_POST['payment'];
$totalprice = $_POST['totalprice'];
$checkout = $_POST['checkout'];

include("connectdb.php");

//echo $payment;

$updatecar = "UPDATE car SET carstatus='Unavailable' WHERE carid='$carid'";
//echo $updatedetail;
mysqli_query($connect, $updatecar);

$updateedetail = "UPDATE rental SET rentstatus='$checkout' WHERE rentid='$rentid'";
//echo $updatedetail;
mysqli_query($connect, $updateedetail);

$insertcheckout = "INSERT INTO checkout(custid, rentid, totalprice, paymethod) VALUES('$custid', '$rentid', $totalprice, '$payment')";
//echo $insertcheckout;
mysqli_query($connect, $insertcheckout);

header('location: rentaldetail.php');
>>

```

Figure 4.6 MySQL Function In Coding

After the database has successful connected, there also need some SQL function such as insert, update, delete and select to manage the database with using PHP which shown in figure 4.6. The insert function will used to store the data from the car rental system to the selected table in database, update function will used to alter the data from the selected table in database, delete function will used to remove the unneeded data from the database and the select function will used on retrieve the data from the database.

```

<?php
function searchRule($carType, $carTransmission, $carEngineCC, $carBrand, $carYear, $noOfSeat, $carPrice){
    if($carType=="Sedan" and $carTransmission=="AT" and $carEngineCC=="1300" and $carBrand=="Local" and $carYear=="2018" and $noOfSeat=="5" and
    $searchCar = 'SELECT * FROM car WHERE cartye="Sedan" AND transmission="AT" AND enginecap="1300" AND carbrand="Local" AND caryear="2018"
    return $searchCar;
    }
    if($carType=="Sedan" and $carTransmission=="MT" and $carEngineCC=="1300" and $carBrand=="Local" and $carYear=="2018" and $noOfSeat=="5" and
    $searchCar = 'SELECT * FROM car WHERE cartye="Sedan" AND transmission="MT" AND enginecap="1300" AND carbrand="Local" AND caryear="2018"
    return $searchCar;
    }
    if($carType=="Sedan" and $carTransmission=="AT" and $carEngineCC=="1500" and $carBrand=="Overseas" and $carYear=="2018" and $noOfSeat=="5" a
    $searchCar = 'SELECT * FROM car WHERE cartye="Sedan" AND transmission="AT" AND enginecap="1500" AND carbrand="Overseas" AND caryear="20
    return $searchCar;
    }
    if($carType=="Sedan" and $carTransmission=="MT" and $carEngineCC=="1500" and $carBrand=="Overseas" and $carYear=="2018" and $noOfSeat=="5" a
    $searchCar = 'SELECT * FROM car WHERE cartye="Sedan" AND transmission="MT" AND enginecap="1500" AND carbrand="Overseas" AND caryear="20
    return $searchCar;
    }
}

```

Figure 4.7 Rule-Based Function

PHP in the development is not only used for creating the connection and interaction for car rental system and database server but PHP also used for creating the rule-based function of the car rental system. The function is implemented with using the IF statement and each statement will only execute while the input value is match to the condition of the statement. Example, when the input of car type is match to the sedan in the IF statement, then the result of the statement will be return which contain the car list with the sedan car type.



### 4.3 Result And Discussion

This section will show the testing method which used for testing the car rental system. The result testing is based on the experience from the user who has use the car rental system.

#### 4.3.1 User Acceptance Test (UAT)

There contain multiple modules involve in the car rental system and there are 30 persons have involved in the testing process to provide the satisfaction of the car rental system based on their experience. Each result of the user acceptance testing for each module will be recorded dedicatedly based on the given user acceptance form while there also contain the overall result of the user experience on the car rental system. There are multiple question will ask on each module in the user acceptance form. The questions of the user acceptance form have been attach in Appendix A

Table 4.1 User Position

<b>User Position</b>	<b>Number Of Responder</b>
Lecturer	1
Student	18
Others	12

Table 4.1 shows the number of each position of the user who involve in the user acceptance test. In the user acceptance test, there involve 1 lecturer, 18 student and 12 other positions on testing the car rental system and provide the feedback based on their experiences.

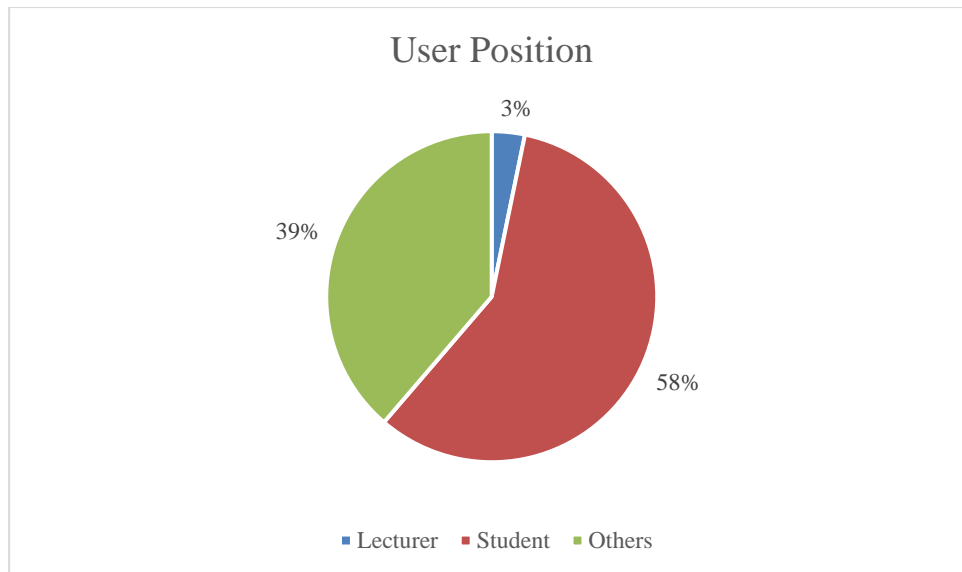


Figure 4.8 User Position

Figure 4.8 shows the position of the user who has been involved in the user acceptance test in a pie chart format. Based on figure 4.8, there are 3% of the total user who have join the user acceptance test is lecturer, 58% from the total user who join the user acceptance test is student and the left of 39% from the total user has their position on another sector.

#### 4.3.1.1 Registration Module

The user will require to register an account before they able to use the feature of car rental system. Four items will be collected from the user experience which is the understanding of the user to the registration module, time spent by user in registration module, satisfaction of user in registration module and the last is the user able continue to login module.

Table 4.2 Understanding Level For Registration Module

Understanding Level	Number Of Responder
Extremely Easy	4
Very Easy	11
Somewhat Easy	9
Not So Easy	7
Not At All Easy	0

Table 4.2 shows the number of the responder with the understanding level of the detail shown in the registration module. The registration module is important role to make sure user detail is only able to use by themselves. So, it important to ensure user to understand what the detail is needed while creating the account. In Table 4.2, the detail shown in the registration module is extremely easy understand by the user only contain 4 persons, very easy to understand by the user contain 11 persons, somewhat easy understand by user contain 9 persons, not so easy understand by user contain 7 persons and there no one is not at all understand the detail present in registration module.

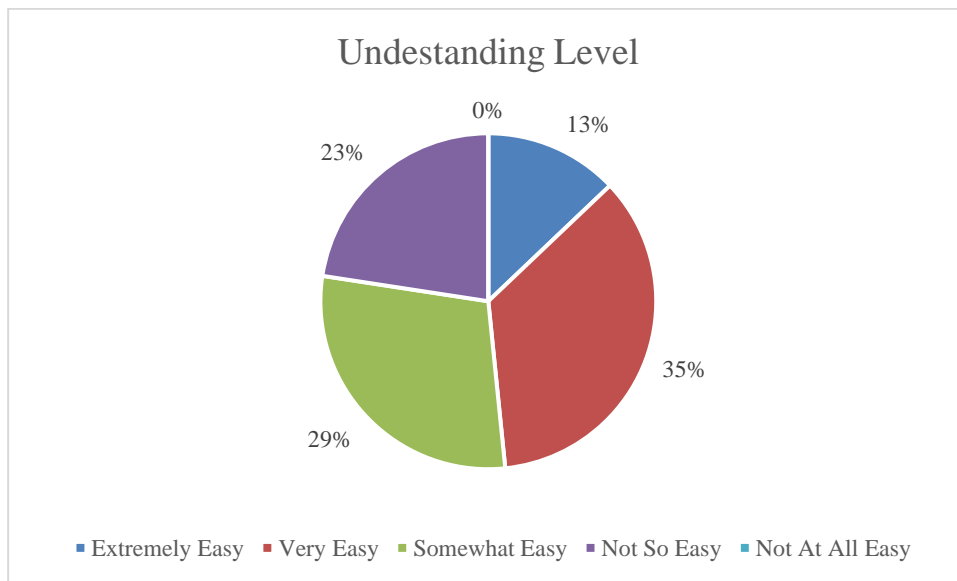


Figure 4.9 Understanding Level For Registration Module

Figure 4.9 shows the percentage for number of responders in each understanding level. Based on figure 4.9, the registration module is very easy understand by the user with the highest percentage which is 35% while the lowest percentage is not at all easy understand by the user which recorded with 0%. This show there are no one is not understanding the detail needed in the registration module and most of the user are quick enough understand what the detail needed from the user. Even there are no one is not understanding the detail needed by registration module but there still contain 23% of people who are not easy to understand the detail needed in the registration module. This problem might be due to too much detail that needed from user but the detail needed able to ensure each user only available an account in car rental system.

Table 4.3 Time Spent In Registration Module

<b>Time Spent</b>	<b>Number Of Responder</b>
A Lot Less Time	1

A Little Less Time	9
About What I Expected	12
A Little More Time	7
A Lot More Time	2

Table 4.3 shows time spent by the user in the registration module for creating their account. From the result collect from the user experience, there contain 1 person who take a lot less time in creating the account, 9 persons take a little less time in creating the account, 12 persons take the time that similar with their expectation on creating the account, 7 persons take a little more time in creating the account and 2 persons take a lot more time on creating the account. This shows mostly of the user take the time that they expected on creating the account.

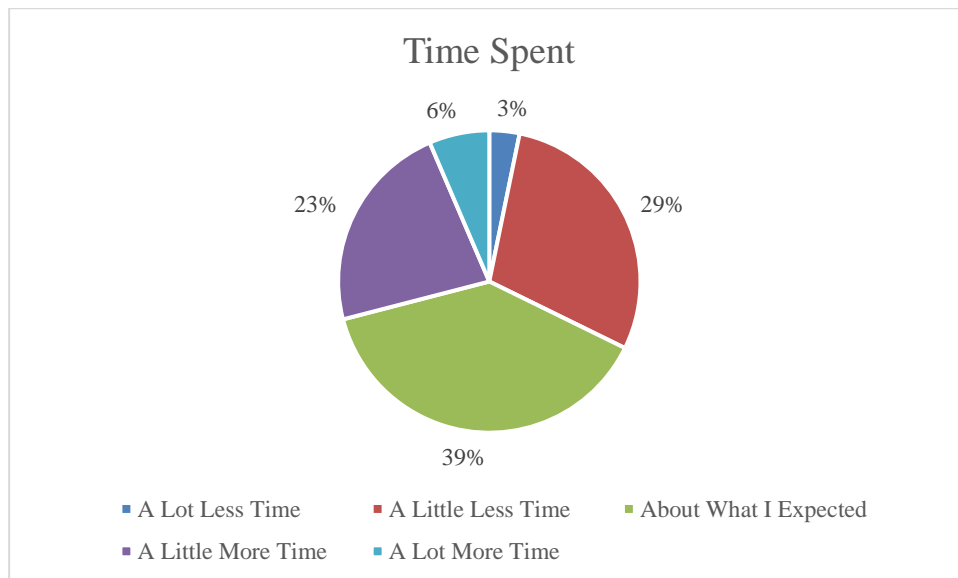


Figure 4.10 Time Spent In Registration Module

Figure 4.10 shows the percentage of user amount in each time spent for creating the account in registration module. The highest percentage of time spent by the user is recorded as 39% which is the time spent that same as their expectation and the lowest percentage of time spent by the user is 3% where the user takes a lot less time on creating the account. This result shows there not much user who take too long time on creating the account even there are many details that require the user to input.

Table 4.4 Satisfaction With Registration Module

<b>Satisfied</b>	<b>Number Of Responder</b>
Extremely Satisfied	2
Very Satisfied	13
Somewhat Satisfied	11
Not So Satisfied	5
Not At All Satisfied	0

Table 4.4 shows the satisfaction of the user to the registration module. There contains 5 level of satisfied of the user with the registration module which are extremely satisfied, very satisfied, somewhat satisfied, not so satisfied and not at all satisfied. Each level of satisfied recorded different amount of user based on their experience. The user who extremely satisfied with the registration module are only contain 2 persons, the user who very satisfied with the registration module contain 13 persons, the user who somewhat satisfied with the registration module contain 11 person and the user who not so satisfied with the registration module contain 5 persons while there no one are not at all satisfied with the registration module.

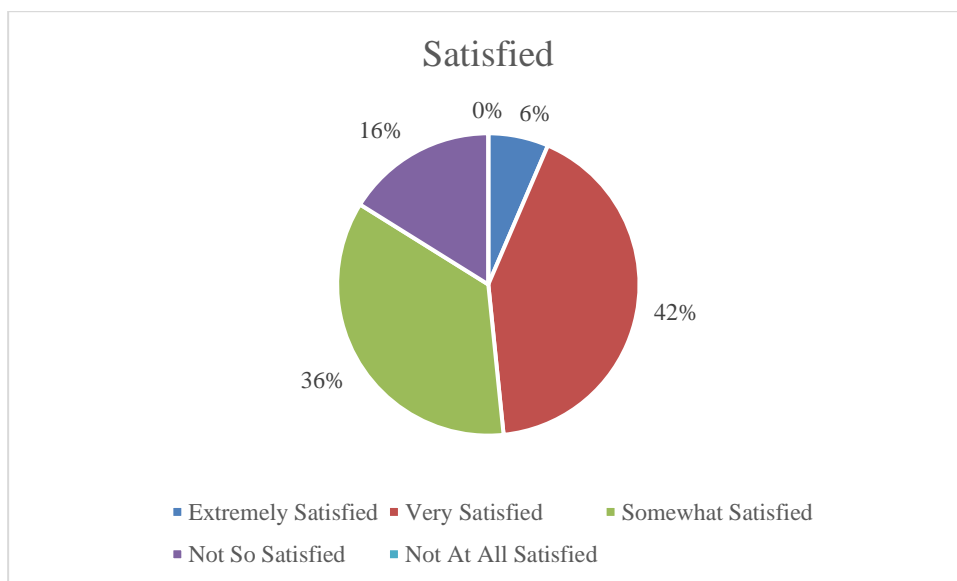


Figure 4.11 Satisfaction With Registration Module

Figure 4.11 shows the percentage of user amount with their satisfaction on registration module. From the figure 4.11, the highest percentage is the user very satisfied with the registration module which recorded with 42% while the lowest percentage is 0% on satisfaction level with not at all satisfied. This show there is not any user are not at all satisfied to the registration module. However, there still recorded the 16% of amount of

user who are not so satisfied to the registration module. This result might due to the detail that require from the user is too much but those detail able to ensure only a person having an account in the car rental system.

Table 4.5 Continue To Login Module

Continue Login Module	Number Of Responder
Yes	29
No	2

Table 4.5 shows the amount user who able to continue to login module after they register their account. From table 4.5, there are 29 persons has successfully proceed to the login module after their registration while 2 persons is fail to proceed to the login module after their registration.

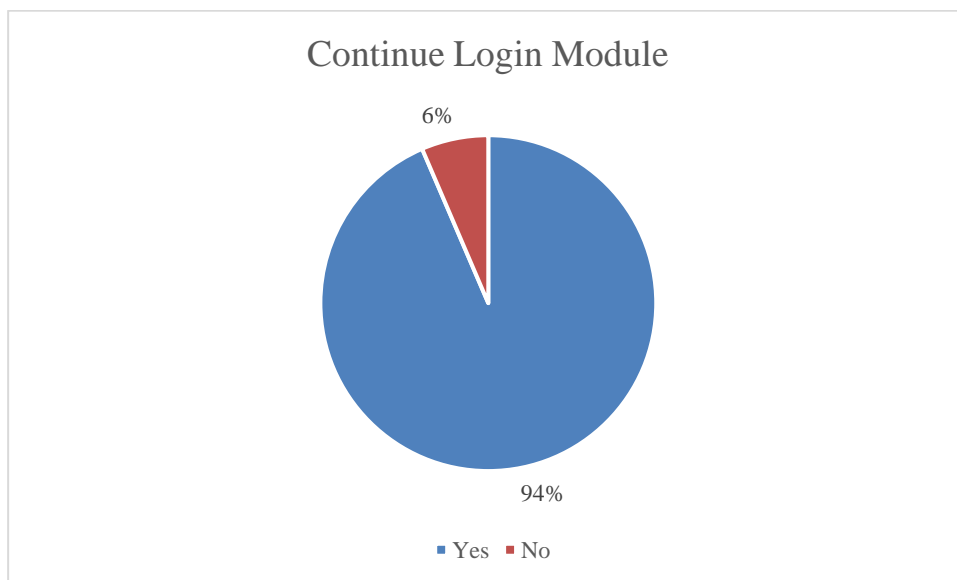


Figure 4.12 Continue To Login Module

Figure 4.12 shows the percentage amount of user who able to continue to login module after their registration process. From figure 4.12, there are 94% amount of user who are successfully continue their process in login module after their registration while 6% amount of user have failed to proceed to the login module after their registration. The problem of the user failed to proceed to login module might be due to the limited function provided by the hosting server.

### 4.3.1.2 Login Module

Once the user successfully creates their account, then they will automatically proceed to login module to proceed for login. In the login module, the user understanding level to the login module, comfortable with the design of login module, satisfaction of user to the login module and either the user successfully proceed to rental detail module after the login process will be recorded based on their experiences.

Table 4.6 Understanding Level For Login Module

<b>Understanding Level</b>	<b>Number Of Responder</b>
Extremely Easy	10
Very Easy	12
Somewhat Easy	6
Not So Easy	1
Not At All Easy	0

Table 4.6 shows the result of amount user on each understanding level with the login module. From table 4.6, there are 10 persons who are extremely easy to understand the login module, 12 persons are very easy to understand the login module, 6 persons are somewhat easy to understand the login module, 1 person is not so easy to understand the login module and there no one are not at all easy to understand the login module.

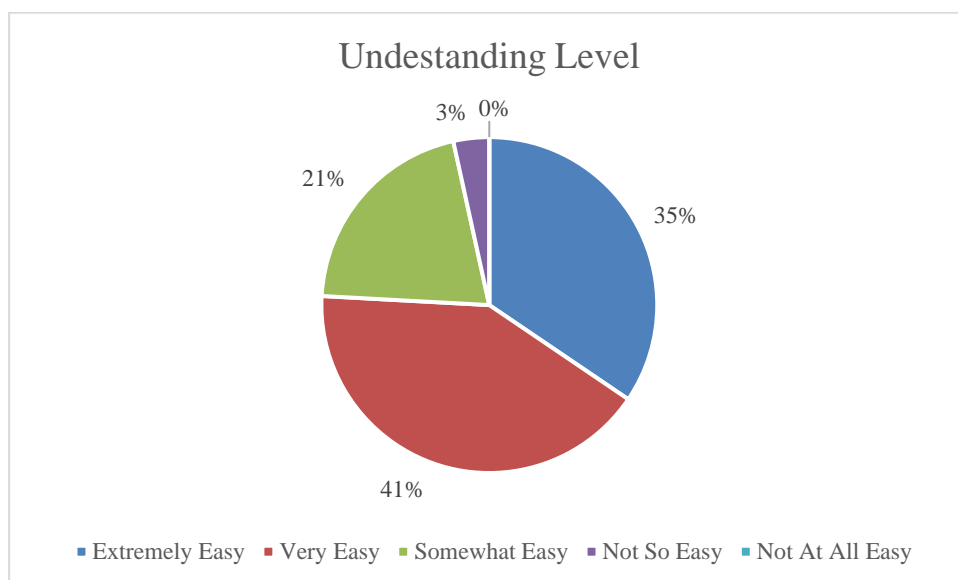


Figure 4.13 Understanding Level For Login Module

Figure 4.13 shows the percentage amount of user on each understanding level with the login module. The highest percentage recorded in figure 4.13 is about 41% where

the 41% amount of user are thinking the login module is very easy to understand while the lowest is 0% with understanding level of not at all easy which means there no one are not at all understanding what login module present for the user. Even most of the user are understand about the login module but there still contain 3% of user who are thinking the login module are not easy to understand. This problem might be due to the user will need to select the user type before the login. Most of the car rental system not contain this function but in order to easy for admin and customer, the login module applied for admin and customer is in the similar module while there only need the user to choose their own user type.

Table 4.7 Comfortable With Login Module Design

<b>Comfortable With Design</b>	<b>Number Of Responder</b>
Extremely Comfortable	9
Very Comfortable	13
Somewhat Comfortable	6
Not So Comfortable	1
Not At All Comfortable	0

Table 4.7 shows the amount of user comfortable with the design of login module. Based on table 4.7, there are 9 persons who are extremely comfortable with the design of login module, 13 persons are very comfortable with the design of login module, 6 persons are somewhat comfortable with the design of login module, 1 person are not so comfortable with the design of login module and there no one are not at all comfortable with the design of login module.



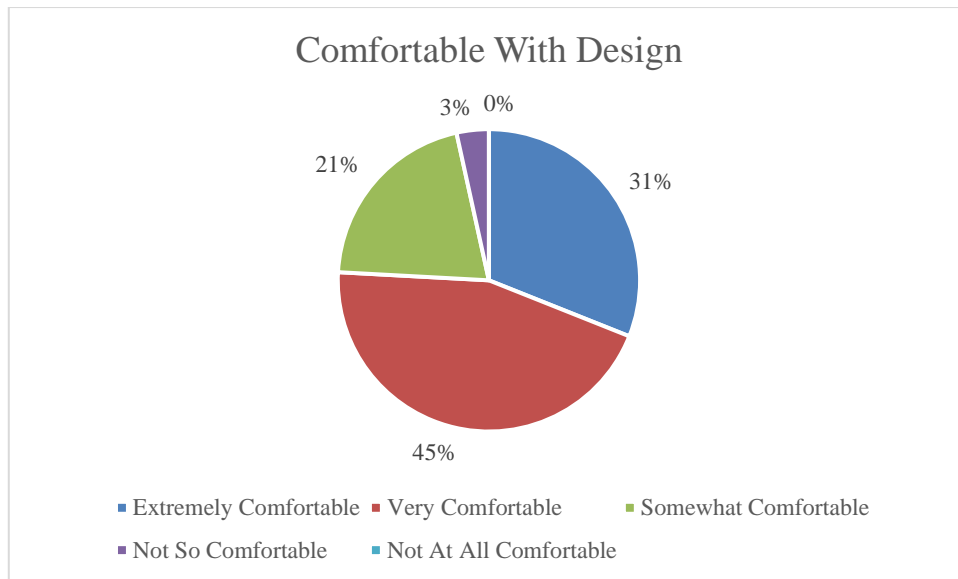


Figure 4.14 Comfortable With Login Module Design

Figure 4.14 shows the percentage amount of user comfortable with the design of login module. Based on figure 4.14, the highest percentage is recorded as 45% where the user is very comfortable with the design of the login module while the lowest is 0% for the not at all comfortable and which means there no one are not at all comfortable with the design of login module. The second lowest percentage is 3% which show there are 3% of the user are not so comfortable with the login module. This problem might be due to the user type selection because the user type selection are not normally implement in any system. So, this causes the user to confuse on the user type selection function in the login module.

Table 4.8 Satisfaction With Login Module

Satisfied	Number Of Responder
Extremely Satisfied	11
Very Satisfied	12
Somewhat Satisfied	6
Not So Satisfied	0
Not At All Satisfied	0

Table 4.8 shows the satisfaction of the user to the login module. The amount of user who are extremely satisfied with the login module contain 11 persons, the amount of user who are very satisfied with the login module is 12 persons, the amount of user

who are somewhat satisfied with the login module is 6 persons while the amount of user who are not so satisfied and not at all satisfied recorded with 0 person.

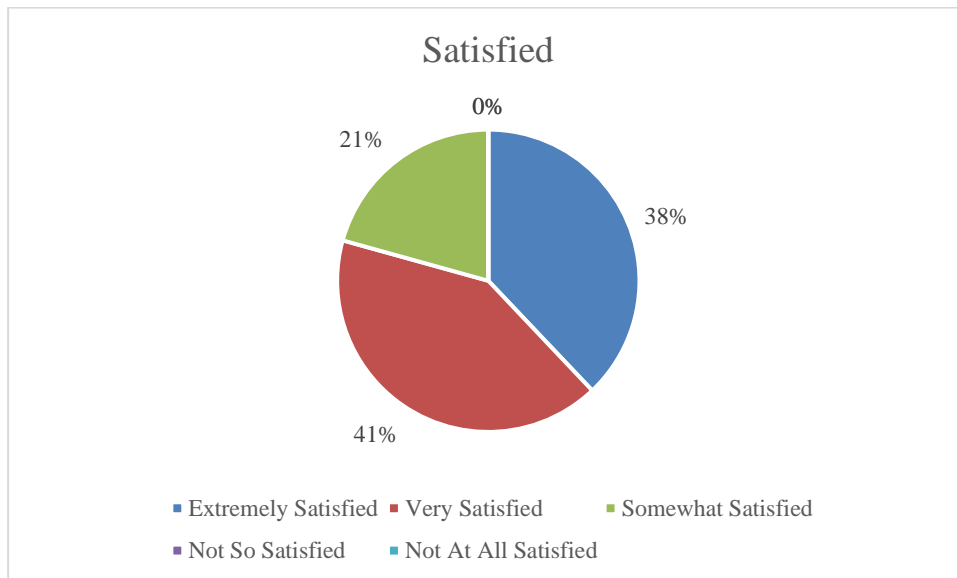


Figure 4.15 Satisfaction With Login Module

Figure 4.15 shows the percentage amount of user satisfied with the login module. From figure 4.15, the amount of user who are very satisfied with the login module record the highest module which is 41% and while the lowest percentage is the user not so satisfied and not at all satisfied with the login module. This show there no one are not satisfied with the login module but most of the person are satisfied with the login module. This is because there only a user type selection in the normal login module, so this might not make any big problem for user experience.

Table 4.9 Continue To Rental Detail Module

Continue Rental Detail Module	Number Of Responder
Yes	29
No	0

Table 4.9 shows the amount of user who are able to continue to the rental detail module after they login from the login module. There recorded with 29 person who have successfully login to the rental detail module and there no one are fail to login to the rental detail module.

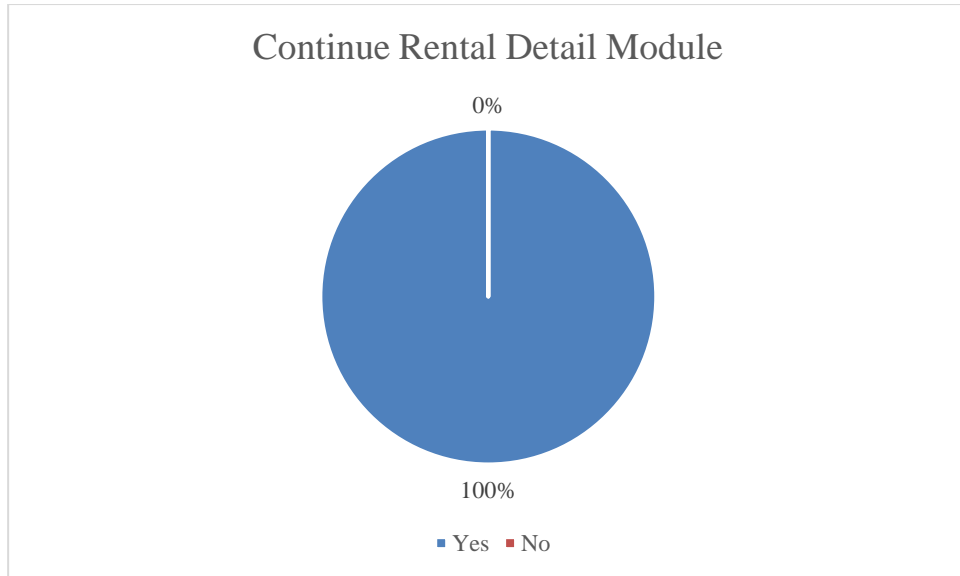


Figure 4.16 Continue To Rental Detail Module

Figure 4.16 shows the percentage amount of user who are able to login to the rental detail module after the login process. Based on figure 4.16, there recorded 100% of the amount user are able to login to the rental detail module and 0% amount of user are fail to login to the rental detail module after the login process. This shows there are no problem on the user to input and other error on the login process.

#### 4.3.1.3 Rental Detail Module

After the user login to the rental detail module, the user will required to fill some necessary detail in order to collect the user rental detail and assist the user to schedule the suitable car list for them easily to find their ideal car on the next module. In this module, the user will recorded the usage level of the rental detail module, effective of the selection in the rental detail module, time spent in rental detail module and user able to continue to the car list module after they filled the rental detail.

Table 4.10 Usage Level Of Rental Detail Module

<b>Usage Level</b>	<b>Number Of Responder</b>
Extremely Easy	3
Very Easy	11
Somewhat Easy	7
Not So Easy	8
Not At All Easy	0

Table 4.10 shows the amount of user who based on their experience to provide the usage level of the rental detail module. In table 4.10, the amount of user who think the rental detail module is extremely easy to be used contain 3 persons, amount of user who think the rental detail module is very easy to be used contain 11 persons, amount of user who think the rental detail module is somewhat easy to be used contain 7 persons, amount of user who think the rental detail module is not so easily to be used contain 8 persons and there are no user think the rental detail module is not at all easy to be used.

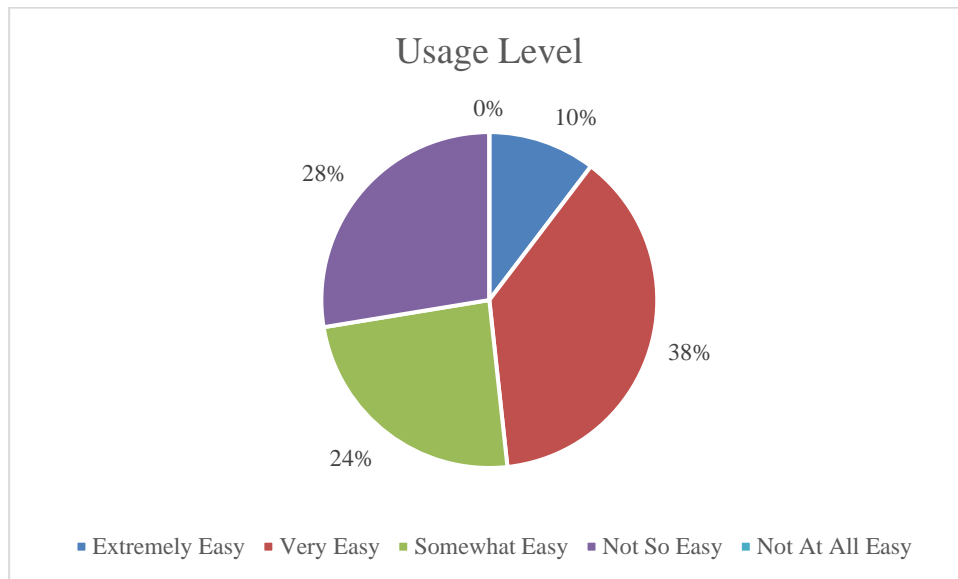


Figure 4.17 Usage Level Of Rental Detail Module

Figure 4.17 shows the percentage amount of user think about the usage level of the rental detail module. Based on figure 4.17, the highest percentage of the usage level think by the user is 38% where the 38% amount of user think the rental detail module are very easy to be used. The lowest percentage is 0% for the not at all easy which means there no one are think the rental detail module is not at all easy to be used. However, the second highest percentage show there still are 28% amount of user think the rental detail module are not so easy to be used. This problem might be due to the user are require to select the necessary detail from the given selection. However, the selection will also require the user have some basic knowledge of the car in order to ask the car rental system to schedule the car list which contain their ideal car.

Table 4.11 Effective Of The Selection In Rental Detail Module

<b>Effective Of The Selection</b>	<b>Number Of Responder</b>
Extremely Effective	2
Very Effective	8

Somewhat Effective	13
Not So Effective	6
Not At All Effective	0

Table 4.11 shows the amount of user think how effective does the selection in the rental detail module. From table 4.11, there are 2 persons think the selection in the rental detail module are extremely effective, 8 persons think the selection in the rental detail module are very effective, 13 persons think the selection in the rental detail module are somewhat effective, 6 persons think the selection in the rental detail module are not so effective and there no one are thinking the selection in rental detail module are not at all effective.

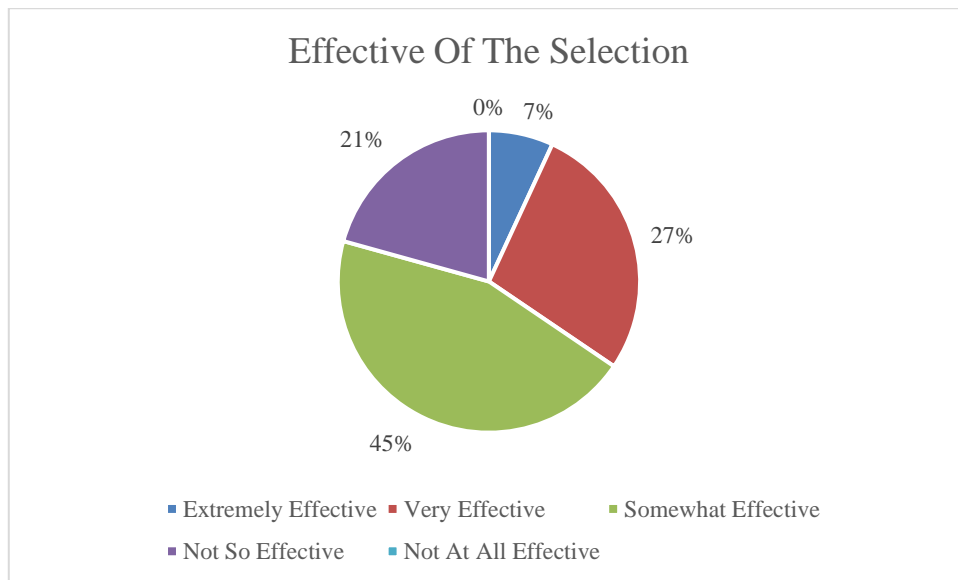


Figure 4.18 Effective Of The Selection In Rental Detail Module

Figure 4.18 shows the percentage amount of user think how effective of the selection in the rental detail module. Based on figure 4.18, the highest percentage is 45% for somewhat effective which means there are 45% amount of user think the selection in the rental detail module are somewhat effective. The lowest percentage is 0% for not at all effective and this shows there no one think the selection in the rental detail module is not at all effective. Even there are nobody think the selection in rental detail is not at all effective but there still contain 21% amount of user think the selection in the rental detail module is not so effective. This show the car rental system still needs to be improved on the rule-based function in order to make a more effective function for the user.

Table 4.12 Time Spent In Rental Detail Module

<b>Time Spent</b>	<b>Number Of Responder</b>
A Lot Less Time	1
A Little Less Time	6
About What I Expected	12
A Little More Time	10
A Lot More Time	0

Table 4.12 shows the time spent by the user in the rental detail module. There are multiple user spent different amount of time on the rental detail module and this also might be the problem affect the effective of the car rental system. The amount of user take a lot less time in the rental detail module are only contain 1 person, amount of user who spent a little less time in the rental detail module contain 6 persons, amount of user who spent the time as they expected contain 12 persons, amount of user who spent a little more time in the rental detail module contain 10 persons and there no one take a lot more time in the rental detail module.

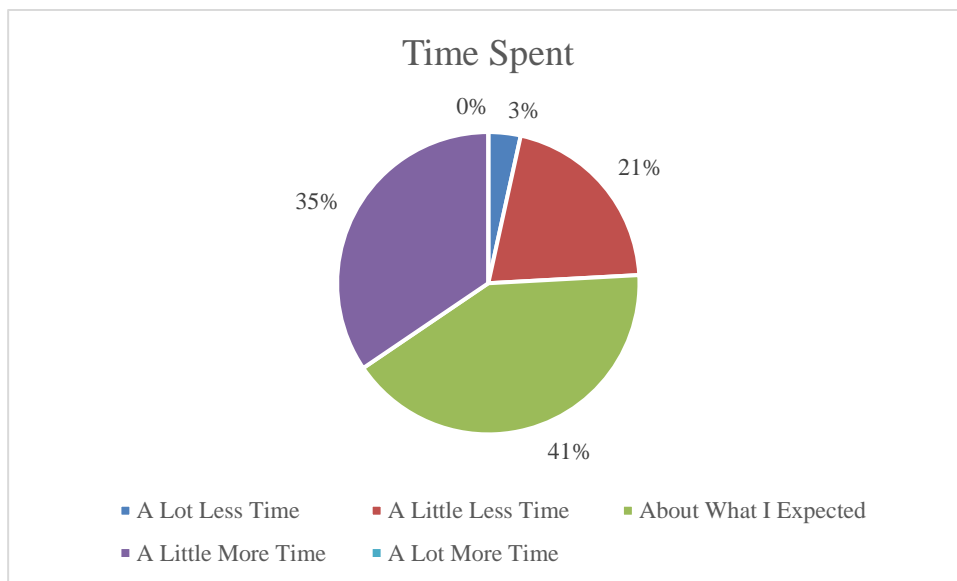


Figure 4.19 Time Spent In Rental Detail Module

Figure 4.19 shows the percentage amount of user who spent the time in the rental detail module. Based on figure 4.19, the highest percentage of the time spent by the user is the time that same as the user expected which is 41% while the lowest percentage is 0% for the a lot more time spent by the user which mean there no user spent lot more time in the rental detail. Even there nobody spent lot more time in the rental detail module but there still contain 35% of the user who spent little more time in the rental detail. This

is because the rental detail is requiring the user not only fill the necessary rental detail but also request the user to select the car specification in order to let the car rental system schedule suitable car list for the user.

Table 4.13 Continue To Car List Module

Continue Car List Module	Number Of Responder
Yes	27
No	2

Table 4.13 shows the amount of user who are able to continue to the car list module after they fill the rental detail. Based on table 4.13, there are 27 persons are able to proceed to the car list module after they fill the rental detail and 2 persons are not able to proceed to the car list module.

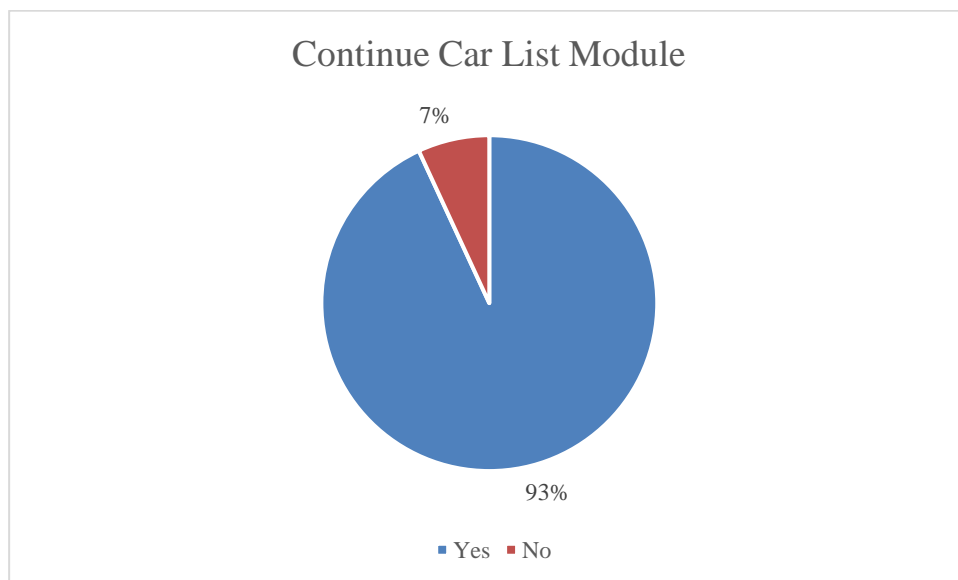


Figure 4.20 Continue To Car List Module

Figure 4.20 shows the percentage amount of user who are able to continue to the car list module after they fill their rental detail. Based on figure 4.20, there are 93% amount of user who are able to proceed to the car list module after they fill the rental detail but there also contain 7% amount of user who are not able to proceed to car list module. This problem might be due to the user not understanding what detail are needed in the rental detail and cause them to lose their interest to continue for the next module.

#### 4.3.1.4 Car List Module

After the user fill their rental detail, the car rental system will be based on their selection to schedule a suitable car list for the user to assist user easily to find their ideal car to rent. In this section, the user experience will be recorded based on the understanding level of user to the car list module, helpful of the rating in car list module, time spent in the car list module and user able to continue to add on module.

Table 4.14 Understanding Level For Car List Module

<b>Understanding Level</b>	<b>Number Of Responder</b>
Extremely Easy	5
Very Easy	14
Somewhat Easy	8
Not So Easy	0
Not At All Easy	0

Table 4.14 shows the amount of user in each understanding level for the car list module. Based on table 4.14, the amount of user who think the detail present in car list module are extremely easy to understand contain 5 persons, 14 persons think the detail present in the car list module are very easy to understand, 8 persons think the detail present in the car list module are somewhat easy to understand and there are no one think the detail present in the car list module are not so easy and not at all easy to understand.

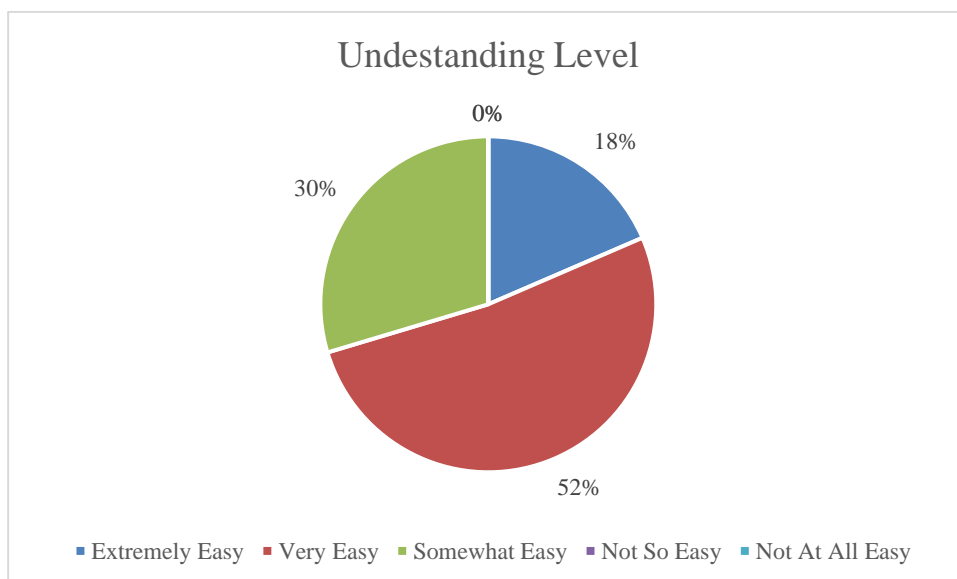


Figure 4.21 Understanding Level For Car List Module



Figure 4.21 shows the percentage amount of user with the understanding level for car list module. Based on figure 4.21, the highest percentage amount of user is 52% on thinking the detail present in car list module are very easy to understand while there contain two lowest percentage amount of user in 0% of user who think the detail present in car list module is not so easy and not at all easy to understand. This shows most of the person can easily understand what the detail present in the car list module.

Table 4.15 Helpful Of Rating In Car List Module

<b>Helpful Of Rating</b>	<b>Number Of Responder</b>
Extremely Helpful	3
Very Helpful	14
Somewhat Helpful	10
Not So Helpful	0
Not At All Helpful	0

Table 4.15 shows amount of user think how helpful does the rating in car list module. From table 4.15, there contain 3 persons think the rating in car list module are extremely helpful, 14 persons think the rating in car list module are very helpful, 10 persons think the rating in car list module are somewhat helpful and no persons think the rating in car list module are not so helpful and not at all helpful.

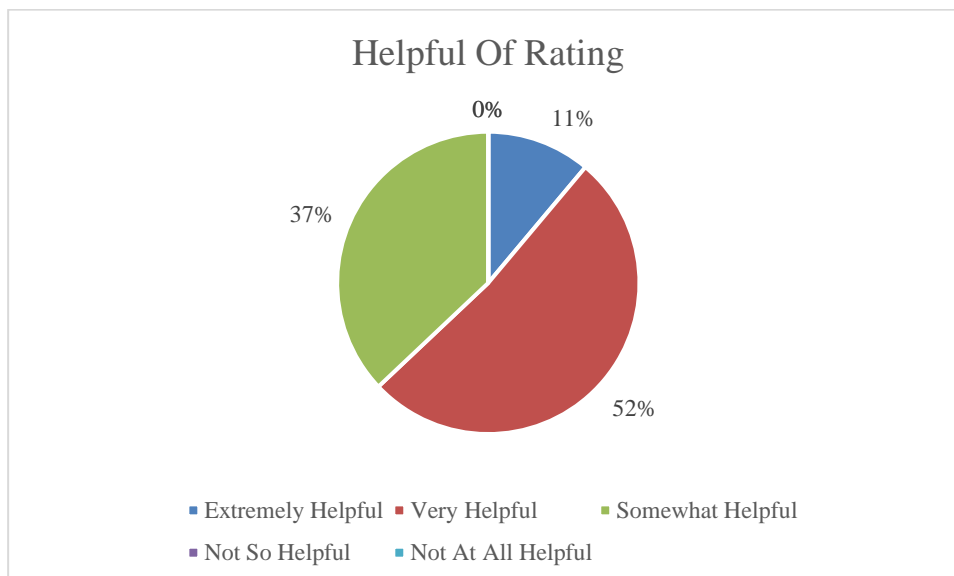


Figure 4.22 Helpful Of Rating In Car List Module

Figure 4.22 show the percentage amount of user on thinking how helpful the rating in car list module is. Based on figure 4.22, the highest person amount of user is 52% on thinking that the rating in car list module are very helpful while the lowest

percentage amount of user are 0% on thinking that the rating in car list module are not so helpful and not at all helpful for the user. This shows the rating in car rental system able to help the user on selecting the suitable car for them to rent.

Table 4.16 Time Spent In Car List Module

Time Spent	Number Of Responder
A Lot Less Time	2
A Little Less Time	15
About What I Expected	8
A Little More Time	2
A Lot More Time	0

Table 4.16 shows the amount of user who spent the different time in car list module. Based on table 4.16, there are 2 persons who spent a lot less time in the car list module to find their ideal car, 15 persons who spent a little less time in the car list module to find their ideal car, 8 persons who spent the time as they expect in the car list module to find their ideal car, 2 persons who spent a little more time in the car list module to find their ideal car and nobody spent lot more time in the car list module to find their ideal car.

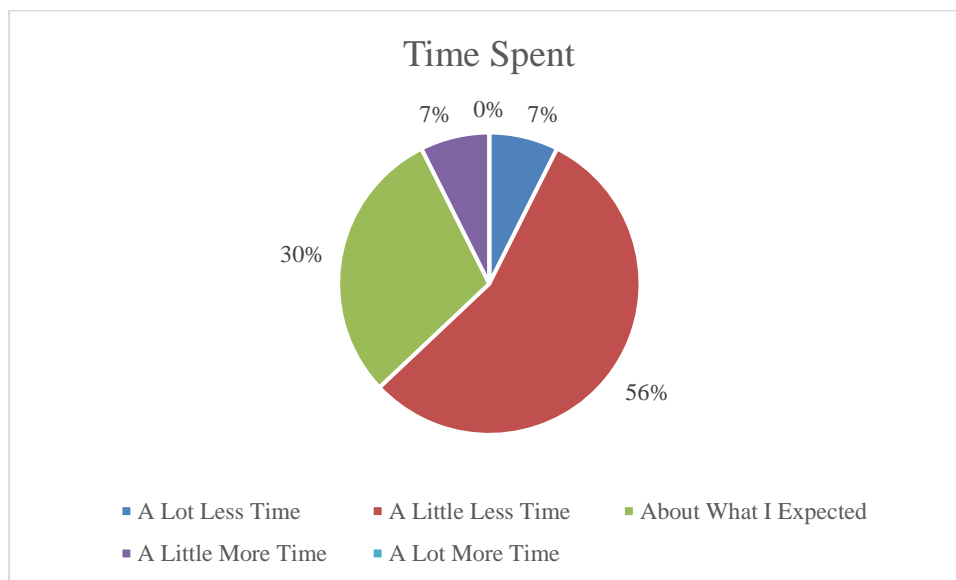


Figure 4.23 Time Spent In Car List Module

Figure 4.23 shows the percentage amount of user who spent different time in the car list module. Based on figure 4.23, the highest percentage amount of user is 56% on spending a little less time on finding their ideal car and the lowest percentage amount of user is 0% on spending lot more time on finding their ideal car but there still contain 7%

amount of user who spent little more time on searching their ideal car. This might because of the detail present in the car list module is not much and cause the user to confuse which car suitable for them to rent.

Table 4.17 Continue To Add-On Module

Continue Add-On Module	Number Of Responder
Yes	27
No	0

Table 4.17 shows the amount of user who are able to continue to the add-on module after the user found their ideal car to rent. Based on table 4.17, there are 27 persons who are able to continue to add-on module after select the car that they wish to rent and there are nobody are fail to proceed to add-on module after select the car to rent.

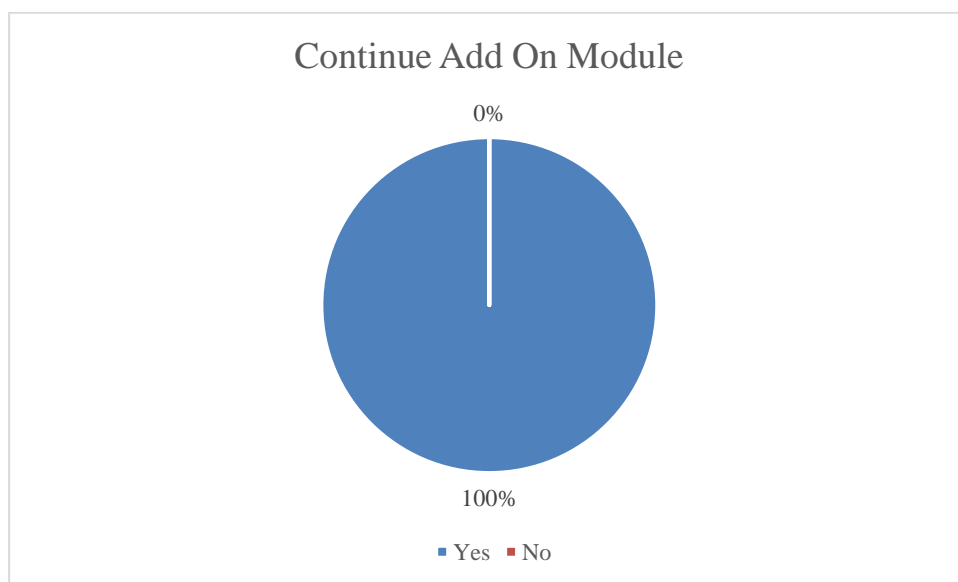


Figure 4.24 Continue To Add On Module

Figure 4.24 shows the percentage amount of user who are able to continue their process in the add-on module. Based on figure 4.24, the percentage amount of user who are able to proceed to add-on module is 100% which means all user successfully proceed to the add-on module without any error.

### 4.3.1.5 Add-On Services Module

After the user found their ideal car to rent, then the user will proceed to the add-on services module for getting addition services from the company. The result of usage level of add-on module, understanding level of detail present in the add-on module, how well does add-on module meet customer needs and user able to proceed to the checkout module will be collected.

Table 4.18 Usage Level Of Add On Module

Usage Level	Number Of Responder
Extremely Easy	3
Very Easy	17
Somewhat Easy	7
Not So Easy	0
Not At All Easy	0

Table 4.18 shows the amount of user who think how easy the add-on module able to be used. Based on 4.18, there are 3 person who think the add-on module are extremely easy to be used, 17 persons think the add-on module are very easy to be used, 7 persons think the add-on module are somewhat easy to be used and nobody think the add-on module are not so easy and not at all easy to be used.

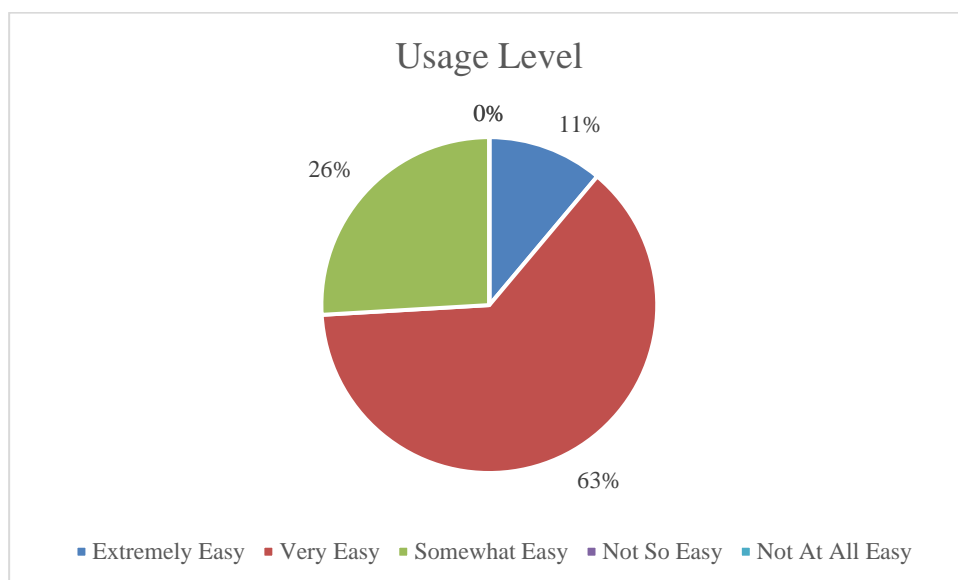


Figure 4.25 Usage Level Of Add On Module

Figure 4.25 shows the percentage amount of user think how easy the add-on module able to be used. Based on figure 4.25, the highest percentage amount of user are

63% which think the add-on module are very easy to be used while the lowest percentage amount of user are 0% on thinking not so easy and not at all easy to use the add-on module. This result shows most of the user think the add-on module is easy enough to be used.

Table 4.19 Understanding Level For Add On Module

<b>Understanding Level</b>	<b>Number Of Responder</b>
Extremely Easy	2
Very Easy	13
Somewhat Easy	10
Not So Easy	2
Not At All Easy	0

Table 4.19 shows the amount of user think how easy to understand the detail present in add-on module. Based on table 4.19, there are 2 persons think the detail present in the add-on module are extremely easy to understand, 13 persons think the detail present in the add-on module are very easy to understand, 10 persons think the detail present in the add-on module are somewhat easy to understand, 2 persons think the detail present in the add-on module are not so easy to understand and nobody think the detail present in add-on module are not at all easy to understand.

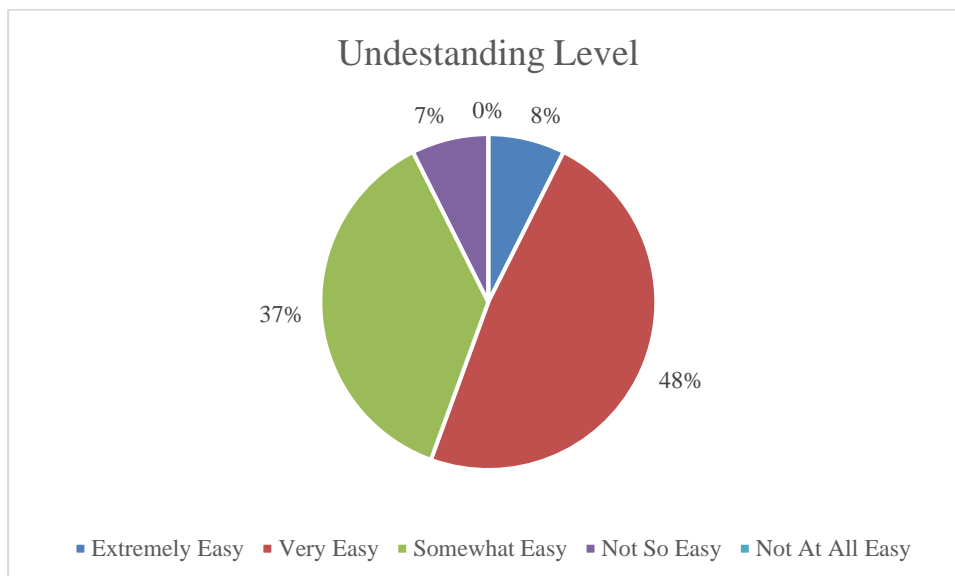


Figure 4.26 Understanding Level For Add On Module

Figure 4.26 shows the percentage amount of user who think how the detail present in add-on module are easy to understand. Based on figure 4.26, the highest percentage amount of user is 48% which think the detail present in the add-on module are very easy

to understand while the lowest percentage is 0% where there are nobody think the detail present in add-on module are not at all easy to understand. Even there nobody are not at all easy to understand the detail present in add-on module but there still contain 7% amount of user still think the detail present in add-on module are not so easy to understand. This might because of the description in each add-on services are not present in a clear form and cause the user to confuse on what the add-on services provide.

Table 4.20 Meet Customer Needs In Add On Module

<b>Meet Customer Needs</b>	<b>Number Of Responder</b>
Extremely Well	3
Very Well	15
Somewhat Well	7
Not So Well	2
Not At All Well	0

Table 4.20 shows the amount of user on thinking how well add-on module meets their needs. Based on table 4.20, there contain 3 persons think the add-on module is extremely well on meeting their needs, 15 persons think the add-on module meet their needs very well, 7 persons think the add-on module meet their needs somewhat well, 2 persons think the add-on module is not so well on meeting their needs and nobody think the add-on module is not at all well on meeting their needs.

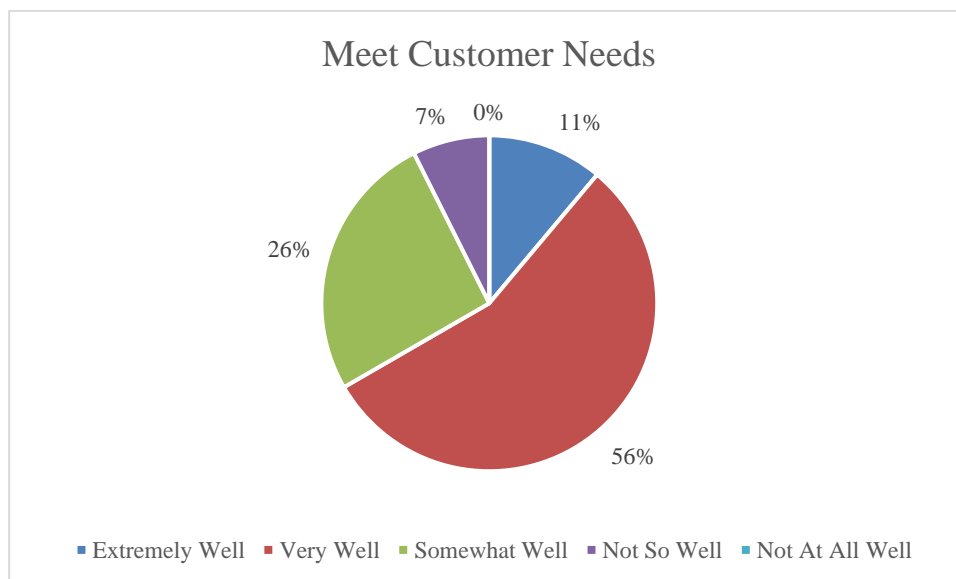


Figure 4.27 Meet Customer Needs In Add On Module

Figure 4.27 shows the percentage amount of user think how well the add-on module meet the user needs. Based on figure 4.27, the highest percentage is 56% of user

think the add-on module meet their need very well while the lowest percentage of 0% show there nobody thinks the add-on module is not at all well on meeting the user needs. However, there still contain 7% of user still think the add-on module not so well on meeting their needs and this might because there not contain the suitable add-on services for the user. So, the car rental system might need to add more add-on services for the user to enjoy the rental.

Table 4.21 Continue To Checkout Module

<b>Continue Checkout Module</b>	<b>Number Of Responder</b>
Yes	27
No	0

Table 4.21 shows the amount of user who are able to continue the process in the checkout module. Based on table 4.21, all 27 persons are able to continue the process in the checkout module and nobody are failed to proceed to checkout module.

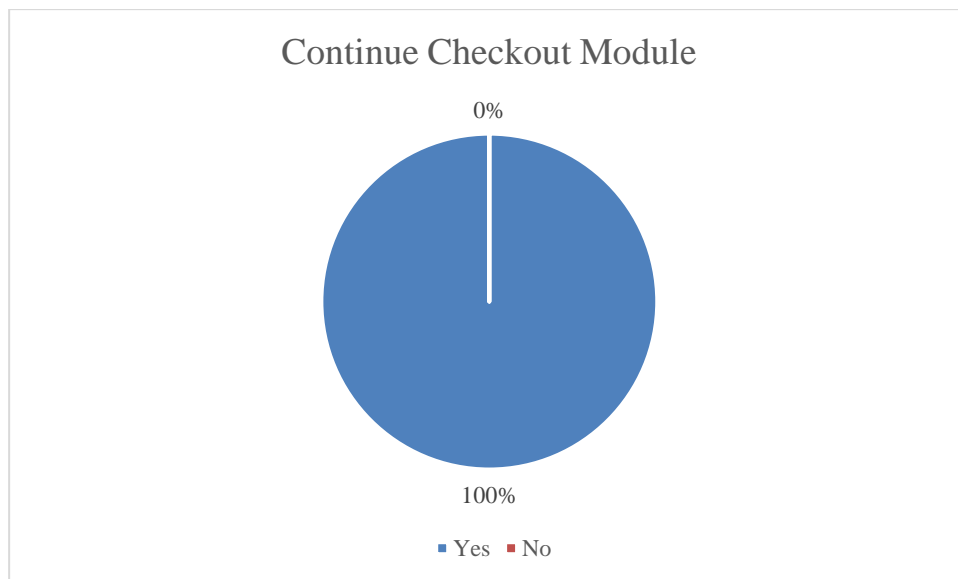


Figure 4.28 Continue To Checkout Module

Figure 4.28 shows the percentage amount of user who able to continue the process in the checkout module. Based on figure 4.28, there are 100% of the amount of user are able to continue to checkout module which means all the user are able to continue their process in the checkout module without any error.

#### 4.3.1.6 Checkout Module

After the user finish the process in the add-on services module, then the user will proceed to checkout module to make the payment and the last confirmation. In this section, the result collected from the user in the checkout module are clearly of detail present in checkout module, helpful of detail in checkout module, satisfaction with the checkout module and user able to return back rental detail module after the checkout.

Table 4.22 Clearly Of Detail Present In Checkout Module

<b>Clearly Of Detail</b>	<b>Number Of Responder</b>
Extremely Clearly	5
Very Clearly	13
Somewhat Clearly	9
Not So Clearly	0
Not At All Clearly	0

Table 4.22 shows the amount of user think how clear does the detail present in the checkout module. Based on table 4.22, the amount of user who think the detail present in the checkout module are extremely clearly contain 5 persons, amount of user who think the detail present in the checkout module are very clearly are 13 persons, amount of user think the detail present in checkout module are somewhat clearly are 9 persons and there nobody think the detail present in the checkout module are not so clearly and not at all clearly.



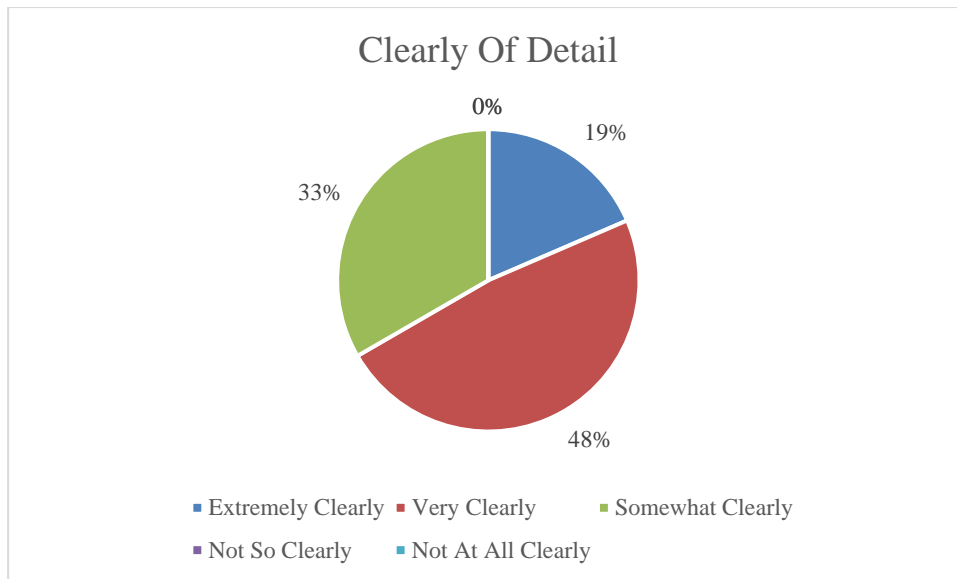


Figure 4.29 Clearly Of Detail Present In Checkout Module

Figure 4.29 shows the percentage amount of user who think how clear does the detail present in checkout module. Based on figure 4.29, the highest percentage amount of user is 48% which show that 48% of the user think the detail present in the checkout module are very clear while the lowest percentage is 0% which shows there nobody think the detail present in the checkout module are not so clearly or not at all clearly. This result shows the detail present for the user is clear enough and able to easily understand by them.

Table 4.23 Helpful Of Detail In Checkout Module

Helpful Of Detail	Number Of Responder
Extremely Helpful	3
Very Helpful	15
Somewhat Helpful	9
Not So Helpful	0
Not At All Helpful	0

Table 4.23 shows the amount of user think how helpful does the detail present in the checkout module. Based on table 4.23, there contain 3 persons think the detail present in the checkout module are extremely helpful, 15 persons think the detail present in checkout module are very helpful, 9 persons think the detail present in the checkout module are somewhat helpful and there nobody think the detail present in the checkout module are not so helpful and not at all helpful.

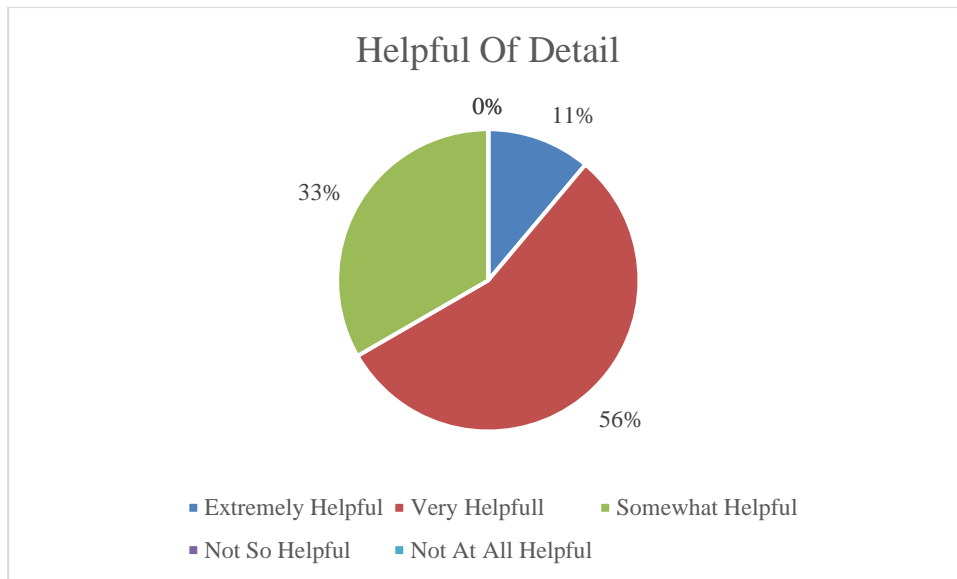


Figure 4.30 Helpful Of Detail In Checkout Module

Figure 4.30 shows the percentage amount of user think how helpful does the detail present in the checkout module. Based on figure 4.30, the highest percentage amount of user is 56% who think the detail present in the checkout module are very helpful while the lowest percentage is 0% which show there nobody think the detail present in checkout module are not so helpful or not at all helpful. This result shows the important of the detail display in checkout module are able to assist the user to confirm all the detail in correct before the confirmation.

Table 4.24 Satisfication With Checkout Module

Satisfied	Number Of Responder
Extremely Satisfied	3
Very Satisfied	14
Somewhat Satisfied	10
Not So Satisfied	0
Not At All Satisfied	0

Table 4.24 shows the satisfaction of the user to the checkout module. Based on table 4.24, there contain 3 persons are extremely satisfied with the checkout module, 14 persons are very satisfied with the checkout module, 10 persons are somewhat satisfied with the checkout module and there nobody are not so satisfied and not at all satisfied with the checkout module.

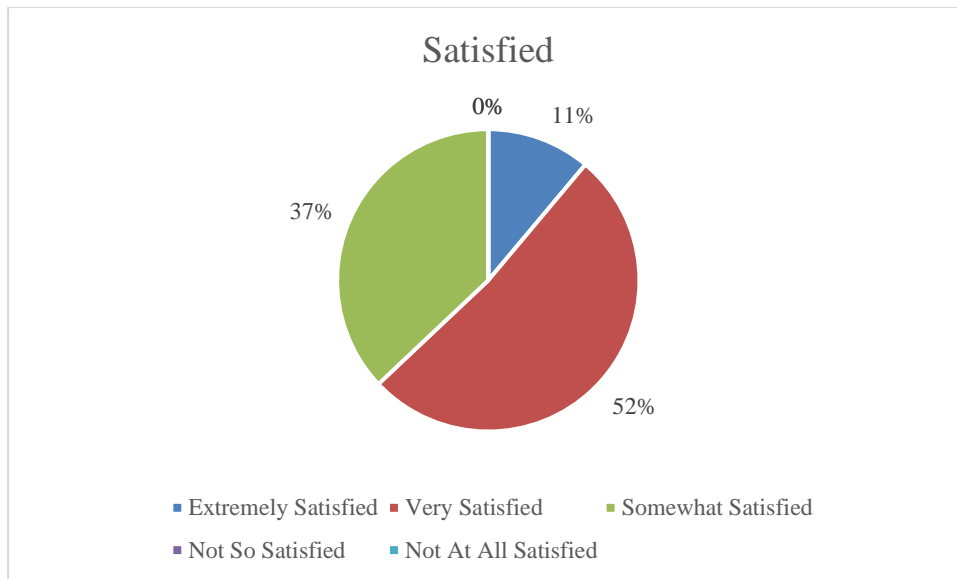


Figure 4.31 Satisfaction With Checkout Module

Figure 4.31 show the percentage amount of user how satisfied with the checkout module. Based on 4.31, the highest percentage is 52% which are very satisfied with the checkout module while the lowest percentage is 0% which shows there are nobody is not so satisfied or not at all satisfied with the checkout module. This result show the checkout module successfully provide the enough information for the user to ensure their rental.

Table 4.25 Back To Rental Detail Module

Back Rental Detail Module	Number Of Responder
Yes	27
No	0

Table 4.25 shows the amount of user who are able to back to the rental detail module after checkout the rental. Based on table 4.25, all the 27 persons are able to back to the rental detail module after they confirm and checkout their rental while nobody are having fail on backing to rental detail module after the checkout process.

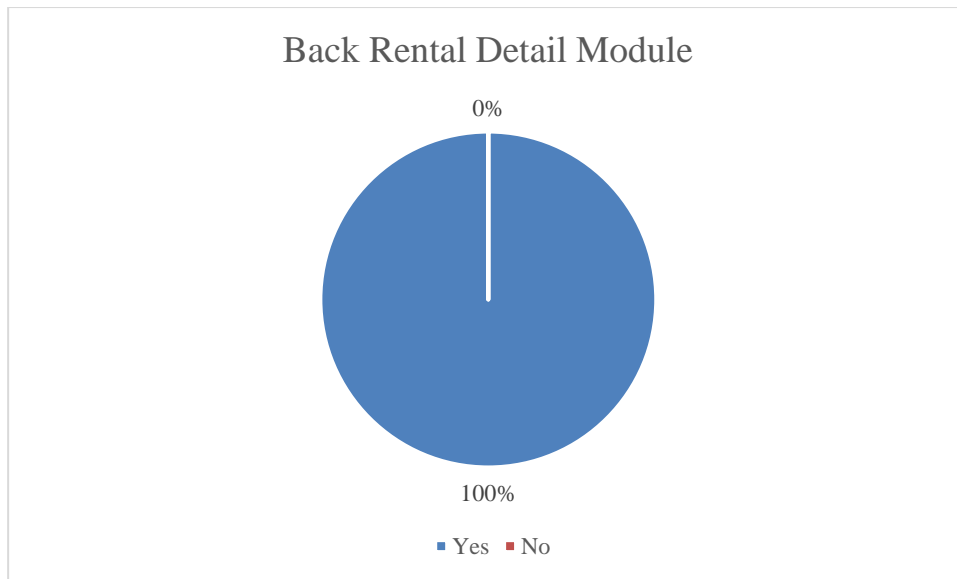


Figure 4.32 Back To Rental Detail Module

Figure 4.32 shows the percentage amount of user who are able to return back to rental detail module. Based on figure 4.32, the answer Yes has get the 100% which means all the user are able to return the rental detail module after the user confirm and checkout their rental.

#### 4.3.1.7 History Module

History module will display all the rental history that made by the user. After the user checkout their rental, then the user able to check the rental detail in the history module. In this section, the result of the understanding level for history module, helpful of detail present in history module and amount of detail present in history module will be collected.

Table 4.26 Understanding Level For History Module

Understanding Level	Number Of Responder
Extremely Easy	6
Very Easy	14
Somewhat Easy	7
Not So Easy	0
Not At All Easy	0

Table 4.26 shows the amount of user who think how the detail present in history module are easily to understand. Based on table 4.26, the amount of user who think the detail present in the history module are extremely easy to understand contain 6 persons, 14 persons think the detail present in the history module are very easy to understand, 7 persons think the detail present in the history module are somewhat easy to understand and nobody think the detail present in the history module are not so easy or not at all easy to understand.

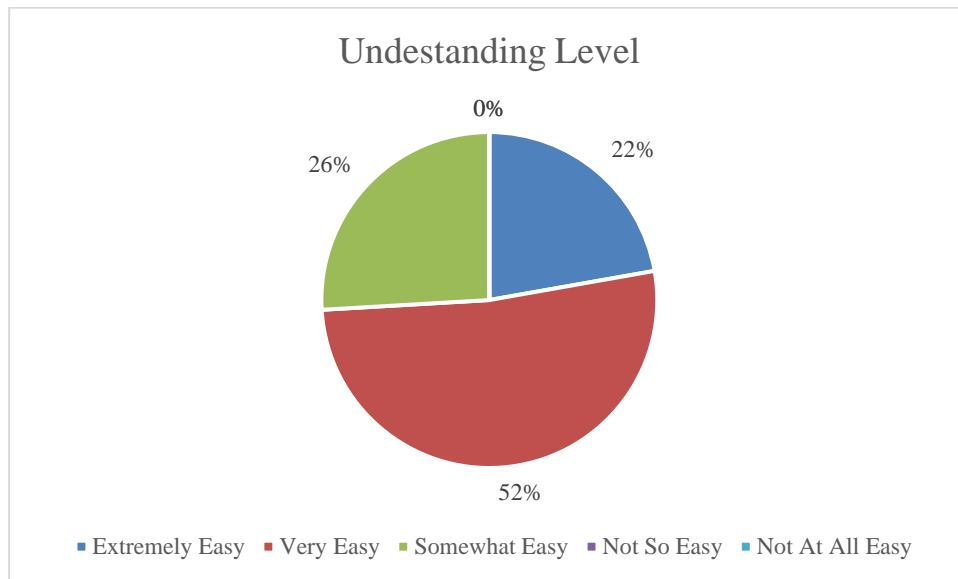


Figure 4.33 Understanding Level For History Module

Figure 4.33 show the percentage amount of user who think the detail present in the history module are easily understand. Based on figure 4.33, the highest percentage amount of user is 52% which think the detail present in the history module are very easy to understand while the lowest percentage is 0% which shows there no user think the detail present in the history module are not so easy or not at all easy to understand. This result shows the detail present in history module able to help the user to quickly find the detail they need from the relevant rental.

Table 4.27 Helpful Of Detail Present In History Module

Helpful Of Detail	Number Of Responder
Extremely Helpful	4
Very Helpful	12
Somewhat Helpful	11
Not So Helpful	0
Not At All Helpful	0

Table 4.27 shows the amount of user who think how helpful does the detail present in the history module. Based on table 4.27, there are 4 persons who think the detail present in the history module are extremely helpful, 12 persons think the detail present in history module are very helpful, 11 persons think the detail present in history module are somewhat helpful and there nobody think the detail present in history module are not so helpful or not at all helpful.

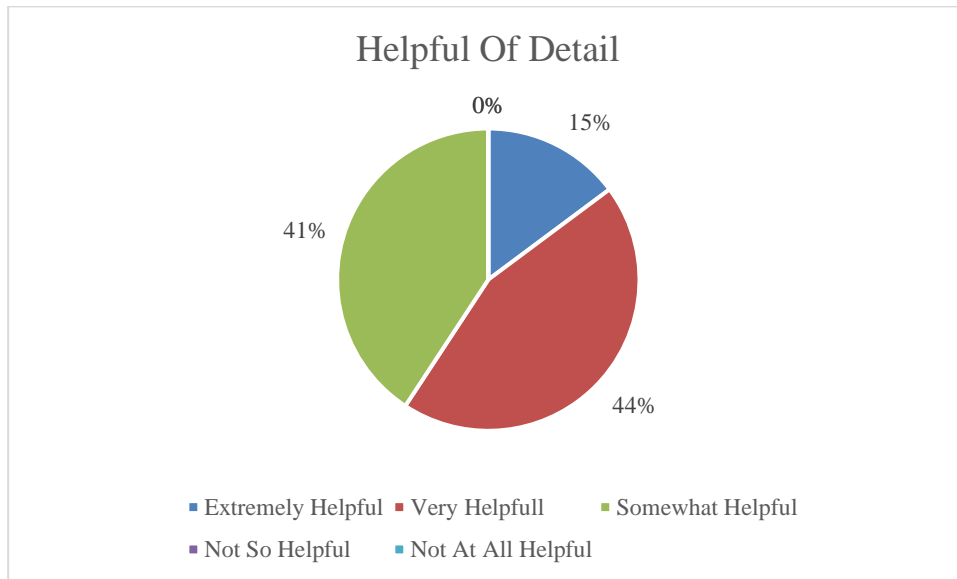


Figure 4.34 Helpful Of Detail Present In History Module

Figure 4.34 shows the percentage amount of user who think the detail present in history module are helpful enough. Based on figure 4.34, the highest percentage amount of user is 44% where the user think the detail present in the history module are very helpful while the lowest percentage is 0% which shows there no user think the detail present in the history module are not so helpful or not at all helpful. This result shows the detail present in the history module is helpful enough on provide any addition information for the user while they require.

Table 4.28 Amount Of Detail Present In History Module

<b>Amount Detail Present</b>	<b>Number Of Responder</b>
A Lot Less Detail	8
A Little Less Detail	14
About What I Expected	5
A Little More Detail	0
A Lot More Detail	0

Table 4.28 shows the amount of user on thinking about the amount of detail present in the history module. In table 4.28, there are 8 persons who think the amount of detail present in the history module are a lot less, 14 persons think the amount of detail present in the history module are little less, 5 persons think the amount of detail present in the history module are same as their expect but there is nobody think the detail present in history module are little more or lot more.

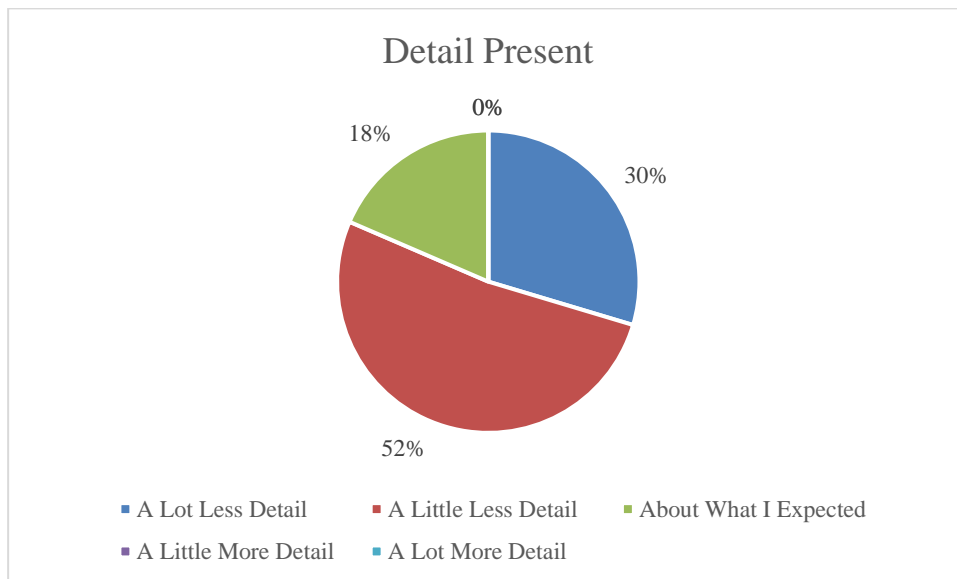


Figure 4.35 Amount Of Detail Present In History Module

Figure 4.35 shows the percentage amount of user who thinking about detail present in history module. Based on figure 4.35, the highest percentage amount of user is 52% where the amount of the detail present in the history module are little less while the lowest percentage is 0% which means the detail present in history module is not little more or lot more. There also contain 30% amount of user think the detail present in history module are a lot less. The result shows the detail present in the history module is not enough for the user to check their rental detail and this might cause the problem like the rental company change car that the user request to rent without their acknowledged.

#### 4.3.1.8 Profile Module

After user creating an account, all their detail will store in the database to ensure the account only own by the user. However, sometime user might make change, so the profile module provide user on changing any personal detail. In this section, the result

will be collected based on the clearly of detail present in profile module, easily on updating the detail in profile module and the satisfaction with the profile module.

Table 4.29 Clearly Of Detail Present In Profile Module

Clearly Of Detail	Number Of Responder
Extremely Clearly	5
Very Clearly	17
Somewhat Clearly	5
Not So Clearly	0
Not At All Clearly	0

Table 4.29 shows the amount of user on thinking how clear does the detail present in the profile module. Based on table 4.29, the amount of user who think the detail present in the profile module are extremely clearly contain 5 persons, 17 persons think the detail present in the profile module are very clearly, 5 persons also think the detail present in profile module area somewhat clearly while there is no user think the detail present in the profile module are not so clearly and not at all clearly.

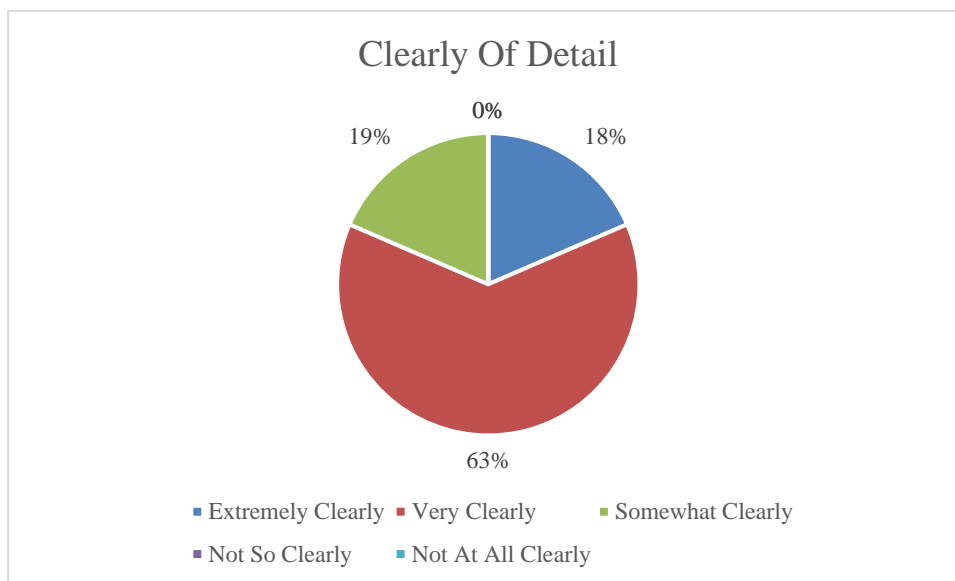


Figure 4.36 Clearly Of Detail Present In Profile Module

Figure 4.36 shows the percentage amount of user think how clearly does the detail present in the profile module. Based on figure 4.36, the highest percentage amount of user is 63% where the user thinks the detail present in the profile module are very clearly while the lowest percentage are 0% which shows there not either one user thinks the detail present in profile module are not so clearly and no at all clearly. The result shows most



of the user think the detail present in the profile module are clear enough and a clear detail display for the user able to assist the user to find out which detail they wish to update.

Table 4.30 Easily On Updating Detail In Profile Module

<b>Easily On Updating</b>	<b>Number Of Responder</b>
Extremely Easy	4
Very Easy	15
Somewhat Easy	8
Not So Easy	0
Not At All Easy	0

Table 4.30 shows the amount of user experience on how easy the profile module assists the user on updating their detail. Based on table 4.30, there are 4 persons who think the profile module is extremely easy on updating the detail, 15 persons think the profile module is very easy on updating the detail, 8 persons think the profile module is somewhat easy on updating the detail while there no user think the profile module is not so easy or not at all easy to update their detail.

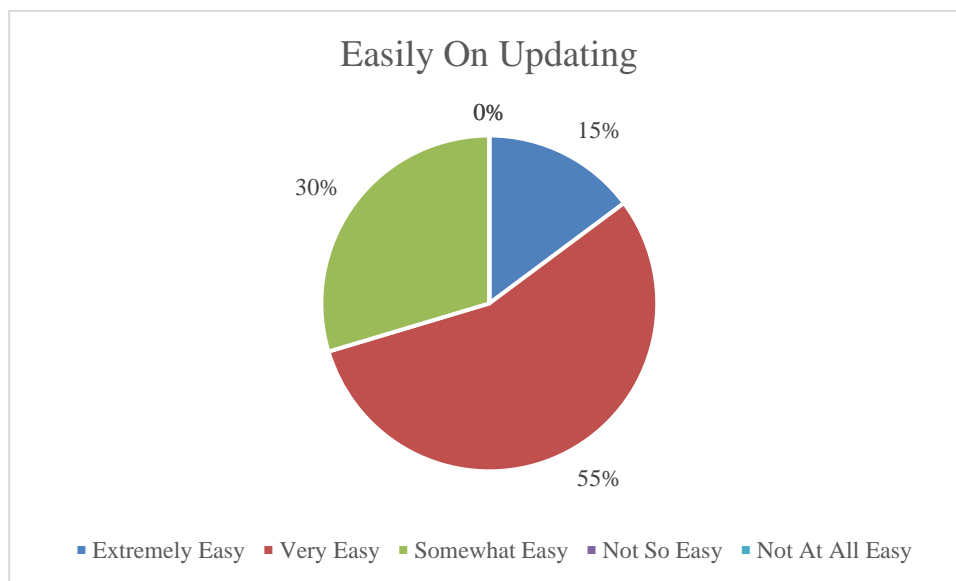


Figure 4.37 Easily On Updating Detail In Profile Module

Figure 4.37 shows the percentage amount of user on thinking how easy profile module updates the user detail. Based on figure 4.37, the highest percentage amount of user is 55% where the detail are very easy to update in the profile module based on the user experience while the lowest percentage is 0% which shows there no user think the detail in profile module are not so easy or not at all easy to update. This result shows most

of the person can easy to update their detail because the user will only require to alter their detail and then press the update button to update their detail.

Table 4.31 Satisfaction With Profile Module

<b>Satisfied</b>	<b>Number Of Responder</b>
Extremely Satisfied	3
Very Satisfied	17
Somewhat Satisfied	5
Not So Satisfied	2
Not At All Satisfied	0

Table 4.31 shows the satisfaction of the user with profile module based on their experience. From table 4.31, there contain 3 persons are extremely satisfied with the profile module, 17 persons are very satisfied with the profile module, 5 persons are somewhat satisfied with the profile module, 2 persons are not so satisfied with the profile module but there no one are not at all satisfied with the profile module.

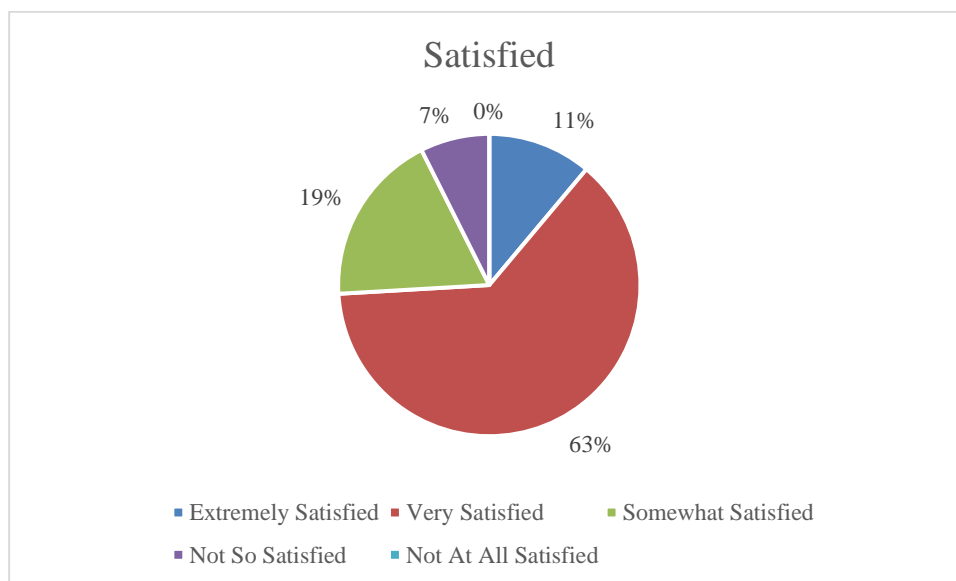


Figure 4.38 Satisfaction With Profile Module

Figure 4.38 shows the percentage amount of user with their satisfaction to the profile module. Based on figure 4.38, the highest percentage amount of user is 63% who are very satisfied with the profile module while the lowest percentage is 0% which shows there no one are not at all satisfied with the profile module. However, the result still contain 7% amount of user are not so satisfied with the profile module. This problem might be due to the detail of user display too much on the profile module and make them scare on their detail easy to expose in the public.

#### 4.3.1.9 Overall Result

After the user enjoy the feature provided in the car rental system, then the user will be based on their overall experience on using the car rental system to provide an overall result. The overall result such as how likely does the user willing to recommend the car rental system to others, how easy does the detail present in car rental system for the user to understand, how well the car rental system meet the customer needs, how comfortable does the design of car rental system and how the user satisfaction with the car rental system will be collected to provide more information for the researcher to improve the car rental system.

Table 4.32 Recommend To Others

<b>Recommend For Other</b>	<b>Number Of Responder</b>
Extremely Likely	2
Very Likely	11
Somewhat Likely	14
Not So Likely	4
Not At All Likely	0

Table 4.32 shows the amount of user how likely does them recommend the car rental system to the others. Based on table 4.32, there contain 2 persons who are extremely likely to recommend the car rental system to the other, 11 persons are very likely to recommend the car rental system to the other, 14 persons are somewhat likely to recommend the car rental system to the other, 4 persons are not so likely to recommend the car rental system to the other but there no one are not at all likely to recommend the car rental system to the other.

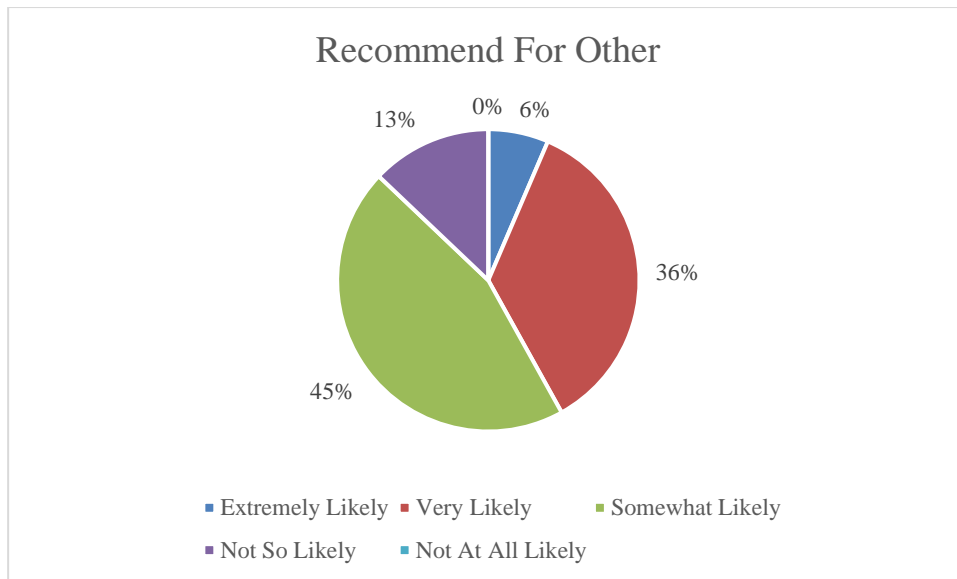


Figure 4.39 Recommend To Others

Figure 4.39 shows the percentage amount of user who think they are likely to recommend the car rental system to the other. Based on figure 4.39, the highest percentage amount of user is 45% on somewhat likely to recommend the car rental system to the other while the lowest percentage is 0% which shows there are no users thinking not at all likely to recommend the car rental system to the other. This is a good result even though there still contain 13% amount of users thinking to not so likely to recommend the car rental system to the other because this is still the testing version of car rental system and there might contain some unexpected error. So, these results are able to keep the research to improve the car rental system in order to make more people to recommend it for others.

Table 4.33 Understanding Level For Car Rental System

<b>Understanding Level</b>	<b>Number Of Responder</b>
Extremely Easy	5
Very Easy	12
Somewhat Easy	10
Not So Easy	3
Not At All Easy	1

Table 4.33 shows the amount of users on thinking how easy the details present in the car rental system are understood by the user. Based on table 4.33, there are 5 persons who think the details present in the car rental system are extremely easy to understand, 12 persons think the details present in the car rental system are very easy to understand, 10

persons think the detail present in the car rental system are somewhat easy to understand, 3 persons are thinking the detail present in car rental system are not so easy to understand and a person think the detail present in car rental system is not at all easy to understand.

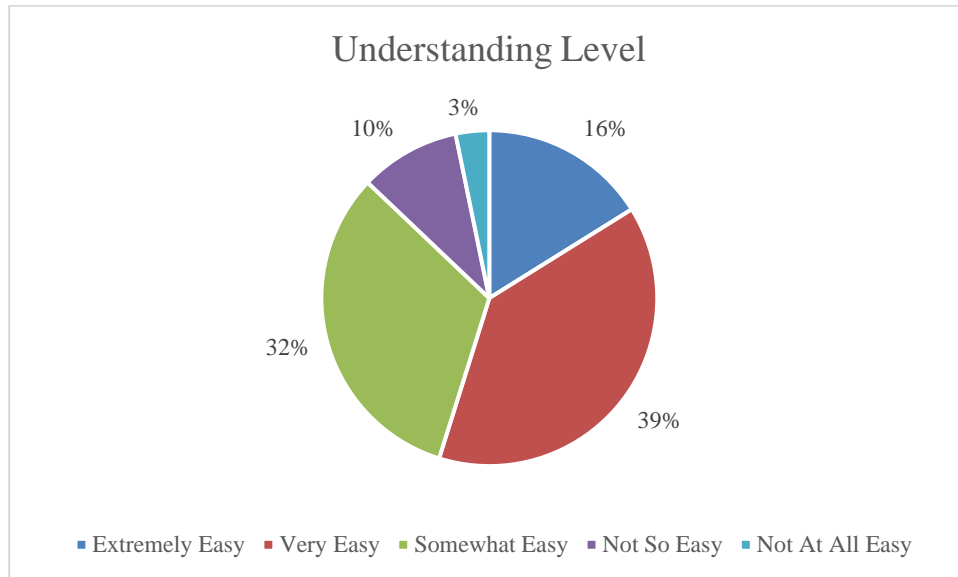


Figure 4.40 Userstanding Level For Car Rental System

Figure 4.40 show the percentage amount of user think about how easy to understand the detail present in car rental system. Based on figure 4.40, the highest percentage amount of user is 39% on thinking the detail present in car rental system are very easy to understand while the lowest percentage is 3% on thinking the detail present in the car rental system is not at all easy to understand. There also contain 10% of user who think the detail present in the car rental system is not so easy to understand. This might be because the registration module and the rental detail module contain too much input field and this cause the user confuse with the detail present by the car rental system.

Table 4.34 Meet Customer Needs With Car Rental System

Meet Customer Needs	Number Of Responder
Extremely Well	4
Very Well	16
Somewhat Well	11
Not So Well	0
Not At All Well	0

Table 4.34 shows the amount of user who think the car rental system meet their needs. In table 4.34, the amount of user who think the car rental system is extremely well meet to the customer needs contain 4 persons, 16 persons think the car rental system is

very well to meet the customer needs, 11 person think the car rental system is somewhat well to meet the customer needs and there no one think the car rental system is not so well or not at all well to meet the customer needs.

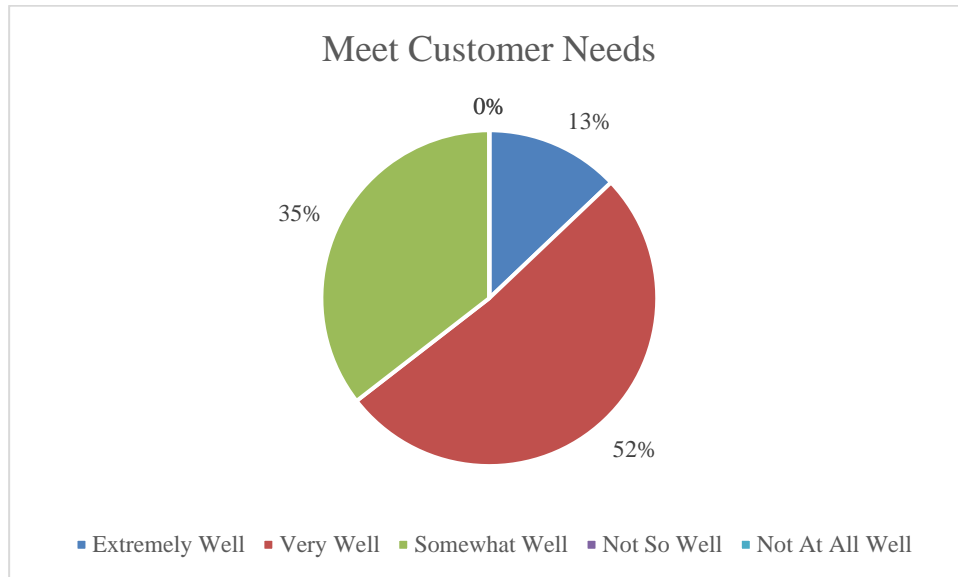


Figure 4.41 Meet Customer Needs With Car Rental System

Figure 4.41 shows percentage amount of user on thinking how car rental system meet the customer needs. Based on figure 4.41, the highest percentage amount of user is 52% on thinking the car rental system is very well to meet the customer meet while the lowest percentage of 0% shows there no user think the car rental system is not so well or not at all well to meet the customer needs. The result shows most of the user think the car rental system is well to meet the customer needs because in current century, many people will require a car even just rent. A car will help people in much on wasting time to walk for a long distance and the also the rule-based function in the car rental system able to quickly help the user to find their ideal car within the time.

Table 4.35 Comfortable With Design Of Car Rental System

<b>Comfortable With Design</b>	<b>Number Of Responder</b>
Extremely Comfortable	5
Very Comfortable	15
Somewhat Comfortable	11
Not So Comfortable	0
Not At All Comfortable	0

Table 4.35 shows the amount of user fell the comfortable with the design of car rental system. In table 4.35, the amount of user who are extremely comfortable with

design of car rental system is 5 persons, 15 persons are very comfortable with the design of car rental system, 11 persons are somewhat comfortable with the design of car rental system and there no one is not so comfortable or not at all comfortable with the design of car rental system.

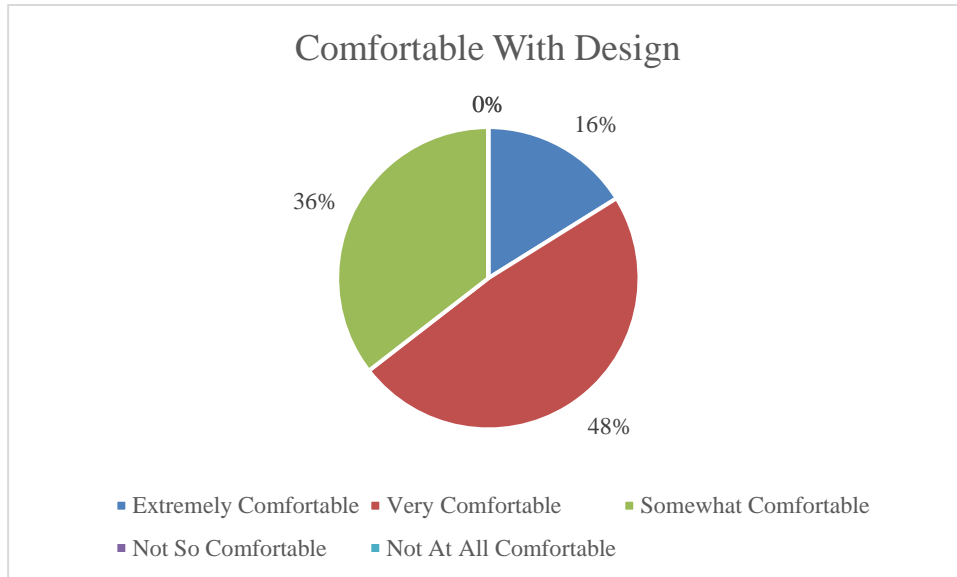


Figure 4.42 Comfortable With Design Of Car Rental System

Figure 4.42 show the percentage amount of user on how the design of car rental system is comfortable for them. Based on figure 4.42, the highest percentage amount of user is 48% on thinking the design of car rental system is very comfortable while the lowest percentage is 0% which shows there no user think the design of the car rental system is not so comfortable or not at all comfortable. This result shows the design of the car rental system is accepted by the user and this might because the design use in the car rental system simply with 3 main color such as black, blue and white. So, this let the user dazzled with the design of car rental system.

Table 4.36 Satisfication With Car Rental System

<b>Satisfied</b>	<b>Number Of Responder</b>
Extremely Satisfied	5
Very Satisfied	15
Somewhat Satisfied	11
Not So Satisfied	0
Not At All Satisfied	0

Table 4.36 shows the amount of user with their satisfaction to the car rental system. In table 4.36, the amount of user who are extremely satisfied with the car rental

system contain 5 persons, 15 persons are very satisfied with the car rental system, 11 persons are satisfied with the car rental system and no one are not so satisfied or not at all satisfied with the car rental system.

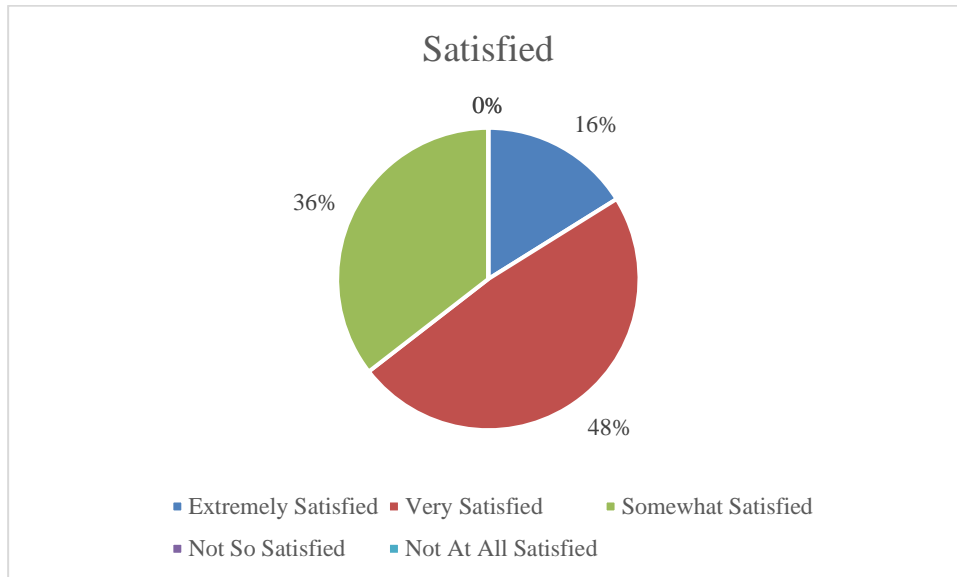


Figure 4.43 Satisfaction With Car Rental System

Figure 4.43 shows the percentage amount of user satisfaction with the car rental system. Based on figure 4.43, the highest percentage amount of user is 48% who is very satisfied with the car rental system while the lowest percentage is 0% which shows there no one are not so satisfied or not at all satisfied with the car rental system. This result shows most of the user are satisfied with the car rental system even there still contain some problem. However, the problem will able be solve and the main function of the car rental system is the rule-based function which able to assist the customer to find the ideal car for them rent within the time.

#### 4.4 User Manual

User manual is a document which able to provide the assistance for the user on using the system. Car rental system also contain a user manual in order to provide any assistance for the user to enjoy the feature of the car rental system. User manual will provide the step of using the car rental system and attached in Appendix B.



## 4.5 Conclusion

The car rental system with rule-based technique provides a lot of advantage to the community. Rule-based technique is not a new technique that implement in a system but rule-based technique assists a lot of system to step in their first step into artificial intelligent field. Rule-based technique is simple to implement into a system with the argue statement such as IF-THEN statement. The IF-THEN statement is the common statement used in the artificial intelligent code for assist the user on making the decision. Example, IF X happened THEN Y will output to the user. The X in the IF-THEN statement will be the rules that have been created by the engineer while the Y is the suggested solution that provided to the user for the rule X.

In this research, rule-based technique assists the customer on making the decision to find their possible ideal car in a listing. The customer will be required to input the parameter and then the system will be based on the parameter provide by the customer to find the matched rules from the rules structure. Once the matched rule is found by the system, the car listing provided by the rule will send to the customer.

The created rules in the system are required the knowledge of the specific field before the developer develop for the rules. This problem is able to fix with interview or collecting the information from an expert in the field. In this research, the researcher also has used his previous work experience to create the rules but the knowledge base from researcher is limited. However, researcher has success to retrieve more knowledge about the field by collecting the information from the expert.

After the development of the car rental system, the user acceptance test has been implemented by allowing some amount of user to join the testing of the car rental system. The result of collect from the user experience provide much information of the car rental system. The result of user acceptance will be used as the reference to improve the car rental system based on the unsatisfied user experience in order to provide the function of car rental system that able to allow the user very satisfied with the car rental system but not only somewhat satisfied.

## CHAPTER 5

### CONCLUSION

#### 5.1 Introduction

The project on developing the car rental system is successfully but there still some improvement that should be done by the researcher in order to create an effective car rental system to assist the user on easily using the feature to rent their ideal car. As said in the project, the development of the car rental system is to provide a more efficient car rental system with schedule a suitable car list for the user in order to assist the user not wasting too much time to find their ideal car to rent.

Researcher has implemented the artificial intelligent to the car rental system. Rule-based technique has been selected in the project to provide the efficient function for schedule the suitable car list for the user. Rule-based technique is an artificial intelligent technique that use the knowledge base of the researcher to provide the function to the car rental system. Nowadays, artificial intelligent are normally implement in every system to provide more efficient services for their user but the rule-based technique that implement in the car rental system is not much. This creates an opportunity for researcher to develop a car rental system which implement the rule-based technique with the goal to provide more efficient services for the user while renting the car on car rental system.

The process to implement the rule-based technique will require some knowledge base on the car in order to schedule the suitable car list for the user. The researcher has collected the user requirement from the public and also the knowledge of car from the expert to provide the preparation before starting to develop the car rental system. The methodology also has been selected in order to ensure the development process of car rental system is suitable. After a long duration of decision, PHP has been the main programming language to design and develop the car rental system and data dictionary of the car rental system also been design before the development process.

Development process of the car rental system has been started after the preparation complete. The car rental system is uploaded in the hosting server name 000WebHost. Before uploaded the functional car rental system, the development of the coding is implemented in the localhost where the coding is developed in Visual Studio Code. There also a database created to store the information collect from the car rental system and also to display the information of the car rental system to the user. The database server has been selected with phpMyAdmin because this easily import the database from localhost to the hosting server without any different server issue.

Development process has been taken few months to complete and functional in the hosting server. In order to ensure the car rental system able to provide the efficient services for the customer, the researcher decide to apply the user acceptance testing to test the performance of the car rental system. There will be an amount of user join the user acceptance testing and provide their feedback based on their experience in the user acceptance form. The researcher will collect the user acceptance form to make the improvement of the car rental system in order to make the car rental system is much efficient on providing the services at the future.

## **5.2 Development Constraint**

There are contain some constraints during the development of the car rental system. Those constraints might be the problem on affecting the function of the car rental system where those constraints are:

1. **Combination Of Frontend And Backend**

The frontend and backend of the car rental system is not completely separate and this will cause the problem where the personal detail of the user can easily exposed to the public and also cause the unauthorized people to access the user account.

## 2. Limited Feature Of Hosting Server

The hosting server that used to implement the car rental system has the limited feature due to researcher didn't have the ability to subscribe the paid version. So, this limited feature of hosting server will cause the problem such as taking long duration on loading a page, unexpected error or disconnect from server and others problem.

## 3. Not Mobile Friendly

The car rental system is a web application which implement in the web browser. However, there also some limitation for the mobile user due to the design of the car rental system. This cause the problem for the mobile user is hard on using the car rental system but they are only able to choose the desktop version in the browser to view the comfortable design of car rental system.

### **5.3 Future Work**

The car rental system is not enough efficient on provide the services for the user. So, there will need some improvement on the car rental system in order to provide much efficient services for the user in the future. The improvement of the car rental system may start from the constraint that found from the development process. So, the improvement that able to be applied at the future are:

#### 1. Separate The Frontend And Backend

The car rental system will require to separate the frontend and the backend coding in order to protect the personal detail of the user exposed to the public and avoid the unauthorized people to access the user account.

## 2. Upgrade Or Change The Hosting Server

The hosting server will require to upgrade to a paid version in order to getting more feature or the other option to change the other hosting server that able to provide more feature. This able to ensure the unexpected problem or connection problem able to be solved.

## 3. Create In Mobile Application

The car rental system will need to create one as a mobile application in order to provide the mobile user to use the car rental system without any uncomfortable issue in the design. This also able to easily access by the user in anywhere by just using their phone.

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## APPENDIX A

### QUESTIONS IN USER ACCEPTANCE TEST (UAT)

# Survey About Performance Of Car Rental System

Good day, I am a final year student from Universiti Malaysia Pahang, conducting a survey study for my final year project related to Car Rental System. I would like to request for your cooperation to use the Car Rental System website below and fill up the questionnaire at the following link based on your experience.

Car Rental System Link: <https://umpproject.000webhostapp.com/>

Survey Form Link: <https://forms.gle/AYqDXbgeU6zSiWtt7>

This questionnaire consists of up to 10 sections. Each section will represent each module of the Car Rental System. **The Car Rental System will not request any actual payment.** This survey would take around 10 to 15 minutes of your time. Please answer ALL the questions based on your honest opinion and knowledge.

The result of this questionnaire will only be disclosed in aggregate format and be used solely for me to enhance the Car Rental System website.

Thank you very much for your kind assistance.

 vuvyar@gmail.com (未分享) [切换帐户](#)



\*必填

## Participant Detail

Which of the following describes your current position? \*

- Lecturer
- Student
- Others



## Registration Module

You are able to input a fake personal detail during the registration.

1) How easy was it to understand the needed detail on Registration Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) Did it take more or less time than you expected to register an account on Registration Module? \*

- A Lot Less Time
- A Little Less Time
- About What I Expected
- A Little More Time
- A Lot More Time

3) How satisfied are you with the account setup experience on Registration Module? \*

- Extremely Satisfied
- Very Satisfied
- Somewhat Satisfied
- Not So Satisfied
- Not At All Satisfied

4) Are you able to proceed to Login Module after the registration? \*

- Yes
- No

## Login Module

You may input the registered username and password. The 'Customer' will be the default for user level.

1) How easy was it to understand the needed detail on Login Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How comfortable did you feel about the design on Login Module? \*

- Extremely Comfortable
- Very Comfortable
- Somewhat Comfortable
- Not So Comfortable
- Not At All Comfortable

3) How satisfied are you with the account login experience on Login Module? \*

- Extremely Satisfied
- Very Satisfied
- Somewhat Satisfied
- Not So Satisfied
- Not At All Satisfied

4) Are you able to proceed to Rental Detail Module after login to the Car Rental System? \*

- Yes
- No

### Rental Detail Module

You are able to insert any fake address. The selection below will affect the car searching. A quick example below to get the result of Proton Saga in the car list.

**Type Of Car:** Sedan

**Transmission Type:** Automatic Transmission(AT)

**Engine Capacity Of Car:** 1.3

**Car Brand:** Local

**Year Of Car:** 2018

**Number Of Seat:** 5

**Price Per Day:** Less than RM500

1) How easy was the Rental Detail Module to be used? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How effective was the selection on Rental Detail Module to assist you to find your ideal car? \*

- Extremely Effective
- Very Effective
- Somewhat Effective
- Not So Effective
- Not At All Effective

3) Did it take more or less time than you expected to fill the rental detail on Rental Detail Module? \*

- A Lot Less Time
- A Little Less Time
- About What I Expected
- A Little More Time
- A Lot More Time

4) Are you able to proceed to Car List Module after pressing Searching button? \*

- Yes
- No

### Car List Module

You can choose any car to proceed to the next module.

1) How easy was it to understand the car information on Car List Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How helpful was the rating of each car shown on Car List Module? \*

- Extremely Helpful
- Very Helpful
- Somewhat Helpful
- Not So Helpful
- Not At All Helpful

3) Did it take more or less time than you expected to find the ideal car that you were looking for on Car List Module? \*

- A Lot Less Time
- A Little Less Time
- About What I Expected
- A Little More Time
- A Lot More Time

4) Are you able to proceed to Add-On Services Module after select which car to rent? \*

- Yes
- No

### Add-On Services Module

You are able to refuse to add any add-on services.

1) How easy was the Add-On Services Module to be used? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How easy was it to understand the rental detail shown on Add-On Services Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

3) How well does the Add-On Services Module meet your needs? \*

- Extremely Well
- Very Well
- Somewhat Well
- Not So Well
- Not At All Well

4) Are you able to proceed to Checkout Module after pressing Confirm button? \*

- Yes
- No

## Checkout Module

The default Payment Method will be Cash On Delivery. There will not require any actual payment.

1) How clearly did the detail shown on Checkout Module? \*

- Extremely Clearly
- Very Clearly
- Somewhat Clearly
- Not So Clearly
- Not At All Clearly

2) How helpful was the detail presented on Checkout Module? \*

- Extremely Helpful
- Very Helpfull
- Somewhat Helpful
- Not So Helpful
- Not At All Helpful

3) How satisfied are you with the detail shown on Checkout Module? \*

- Extremely Satisfied
- Very Satisfied
- Somewhat Satisfied
- Not So Satisfied
- Not At All Satisfied

4) Are you back to the Rental Detail Module after pressing the checkout button? \*

- Yes
- No

## History Module

Please press the History link at top right to proceed the History Module. History Module will display the rental you just made in the table.

1) How easy was it to understand the rental detail on History Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How helpful was the rental detail presented on History Module? \*

- Extremely Helpful
- Very Helpfull
- Somewhat Helpful
- Not So Helpful
- Not At All Helpful

3) Did the rental detail presented more or less detail than you expected on History Module? \*

- A Lot Less Detail
- A Little Less Detail
- About What I Expected
- A Little More Detail
- A Lot More Detail

## Profile Module

Please click the Profile link at top right to proceed the Profile Module. All your registered detail except password will display in Profile Module.

1) How clearly was it to show the account detail on Profile Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

2) How easy was it to update your account detail on Profile Module? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

3) How satisfied are you with the account update experience on Profile Module? \*

- Extremely Satisfied
- Very Satisfied
- Somewhat Satisfied
- Not So Satisfied
- Not At All Satisfied



## Overall Feedback

1) Overall, how likely is that you would recommend the Car Rental System to friends? \*

- Extremely Likely
- Very Likely
- Somewhat Likely
- Not So Likely
- Not At All Likely

2) Overall, how easy was it to understand the information presented on Car Rental System? \*

- Extremely Easy
- Very Easy
- Somewhat Easy
- Not So Easy
- Not At All Easy

3) Overall, how well does the Car Rental System meet your needs? \*

- Extremely Well
- Very Well
- Somewhat Well
- Not So Well
- Not At All Well

4) Overall, how comfortable did you feel about the design of Car Rental System? \*

- Extremely Comfortable
- Very Comfortable
- Somewhat Comfortable
- Not So Comfortable
- Not At All Comfortable

5) Overall, how satisfied are you with the user experience on the Car Rental System? \*

- Extremely Satisfied
- Very Satisfied
- Somewhat Satisfied
- Not So Satisfied
- Not At All Satisfied

6) Do you have any other comments about how the Car Rental System able to be improved?

您的回答

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## **APPENDIX B**

### **USER MANUAL**

#### **TABLE OF CONTENT**

#### **1.0 GENERAL INFORMATION**

1.1 System Overview

#### **2.0 SYSTEM SUMMARY**

2.1 System Configuration

#### **3.0 GETTING STARTED**

3.1 Customer Menu

3.2 Admin Menu

## **1.0 GENERAL INFORMATION**

### **1.1 System Overview**

Car rental system is a web application which able to provide the user to rent the car from the company with just online process. The car rental system implement the rule-based technique on assisting the user to schedule the suitable car list for them to find their ideal car to rent without wasting much time.

## **2.0 SYSTEM SUMMARY**

### **2.1 System Configuration**

Car rental system is a web application which only operate in the web browser. So, the user will require to having a web browser in their device and also the internet connection in order to enjoy the car rental system.

## **3.0 GETTING STARTED**

User of the car rental system will start from the index page before they able to login or register. Figure 1 shows the index page where the user will start from when they successfully access with the car rental system website.

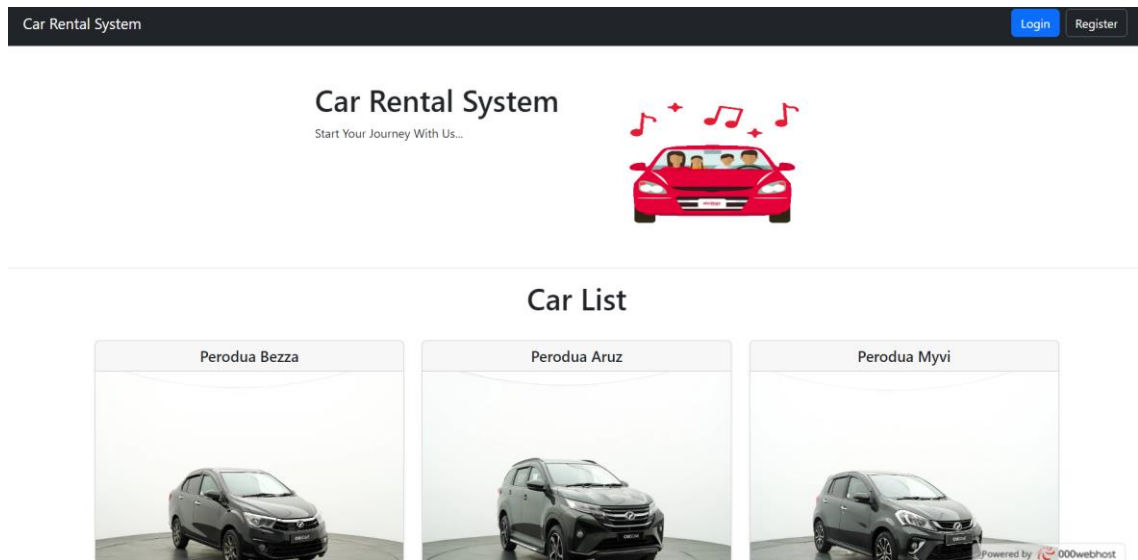


Figure 1 Car Rental System Webpage

### 3.1 Customer Menu

Customer will start with creating the account before they able to access into the car rental system for getting the services. The customer is required to press the “Register” button at top right in index page which shown in figure 1 to continue the process in the registration module.

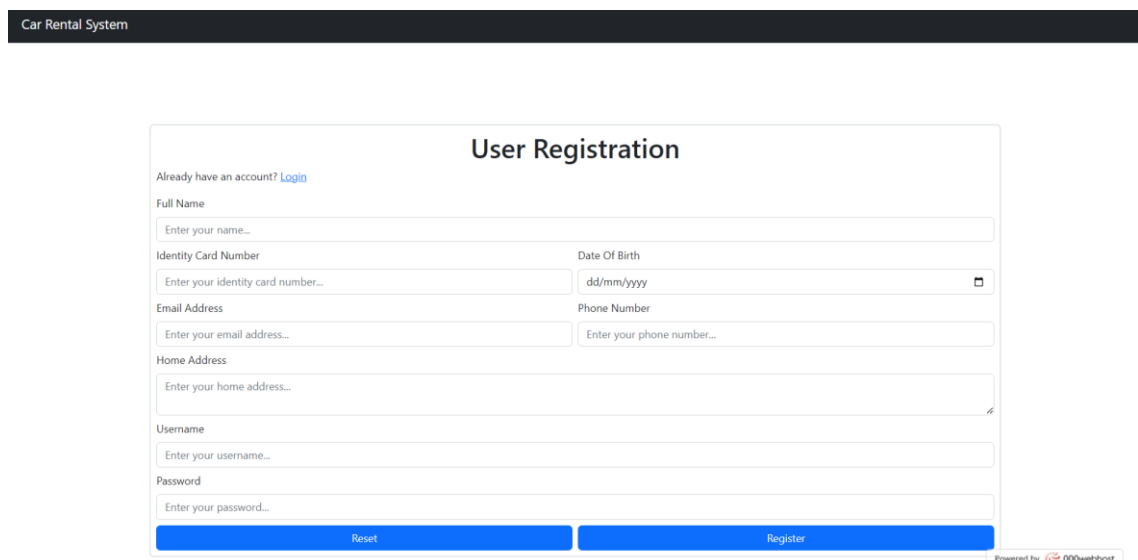


Figure 2 Registration Module

After the user successfully direct to the registration module that shown in figure 2, then the user will required to insert their personal detail such as name, identity card number, date of birth, email address, phone number, home address, username and

password. Once the user inserts their detail, there a “Register” button located at bottom right to create their account.

Figure 3 Login Module

After the user register their account, the user will proceed to the login module as shown in figure 3. The user is requiring inputting their registered username and password. The user type selection will show “Customer” as default, so there nothing customer need to do with the selection and the customer can just press the “Login” button after input the username and password. Then the user will proceed to the rental detail module.

Figure 4 Rental Detail Module

After the user login to the rental detail module as shown in figure 4, then the user will require to input the detail such as pick up address and return address. The date and time for pick up and return is allow the user to select based on the time the wish. The 7 selections below are required the user to choose the specification of their ideal car in order to let the car rental system schedule the suitable car list for them in the car list

module. Once all detail have been input and select, the user will require to press “Start Searching” button to proceed to car list module.

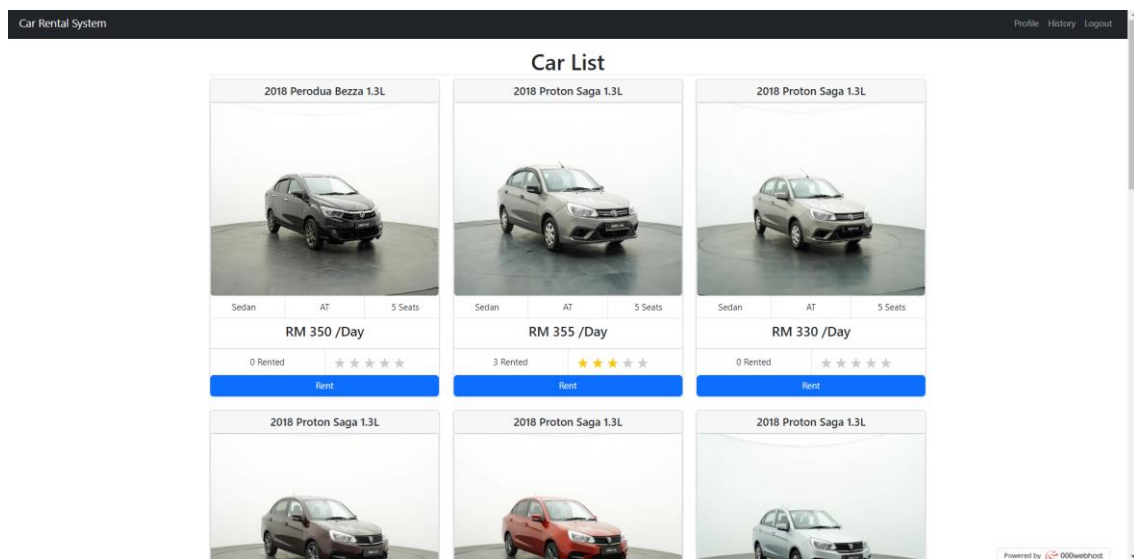


Figure 5 Car List Module

Once the user has access car list module, then there will contain the scheduled car list based on the user selection on the previous module and those car list will list on the car list module as shown in figure 5. The car detail for each car will be shown such as car name, car image, price per day, amount sold and rating. Customer can based on the detail shown in each car to choose the car they wish to rent by pressing the “Rent” button.

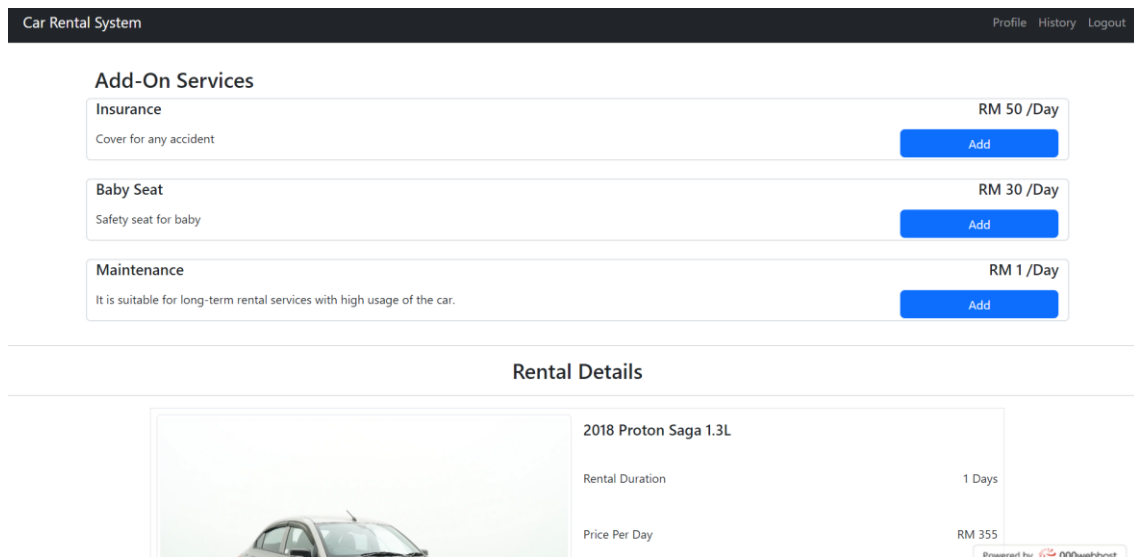


Figure 6 Add-On Services Module

After the customer select the car they wish to rent, then the customer will proceed to add-on services module that shown in figure 6. This will allow customer to add any service provide by the company and the customer just need press the “Add” button. The

user also able to cancel the added server by pressing again the button. Below also display the rental detail such as prices for the customer. The customer will require to press the “Confirm” button to proceed the checkout module.

Figure 7 Checkout Module

Once the customer redirect to the checkout module as shown in figure 7, then the customer will require to make the last confirmation by checking all the detail present is correct and the customer also will need to choose the payment method in the payment details where the “Cash On Delivery” will be the default. After confirming all the detail is correct, then the customer will need to press the “Checkout” button to confirm the rental.

Rental ID	Pickup Address	Pickup Date	Pickup Time	Return Address	Return Date	Return Time	Duration	Status	Option
1	abc	2022-12-09	00:00	cba	2022-12-10	00:00	1	Complete	
2	abc	2022-12-09	00:00	cba	2022-12-10	00:00	1	Cancel	
3	selangor	2022-12-12	00:00	selangor	2022-12-13	00:00	1	Complete	
4	123	2022-12-18	00:00	321	2022-12-31	00:00	13	Complete	
6	selangor	2022-12-31	00:00	selangor	2023-01-06	00:00	6	Complete	
7	pekan	2022-12-31	00:00	selangor	2023-01-01	00:00	1	Complete	
8	123	2023-01-08	00:00	321	2023-02-11	00:00	34	Complete	Rate And Comment
11	111	2023-01-30	00:00	222	2023-01-31	00:00	1	Proceed	

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Figure 8 History Module

Customer able to check their rental history by pressing the “History” word that display on the top right. Then the customer will redirect to the history module that shown as figure 8.



Car Rental System Profile History Logout

### User Profile

Full Name

Identity Card Number  Date Of Birth

Email Address  Phone Number

Home Address

Username

Password

[Update](#)

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**Figure 9** Profile Module

Customer also able to edit their detail in the car rental system by accessing the profile module. The customer will need to press the “Profile” word display on the top right to access the profile module. Once the customer access the profile module, the customer detail will show as figure 9. Customer will just need to edit any detail they want and press the “Update” button to save the latest detail.

### 3.2 Admin Menu

Admin will not require to register the account because the admin account is created during the development process. So, admin will just need to press the “Login” button that display on top right of the index page as figure 1 shown.

**Car Rental System**

### User Login

New to our website? [Create an account](#)

Username

Password

Staff

[Login](#)

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Figure 10 Login Module

In login module, the admin is required to input the username and password provided. The user type selection also needs to change to “Staff” as figure 10 or the system will give the error message.

**Car Rental System** Logout

Dashboard

Car Lists

Add-On Services

Customer Lists

Rental Lists

- > Proceed
- > Renting
- > Complete
- > All
- > Feedback

Rental Statistics

Total Car Rented This Month

**2**

Total Earned This Month

**RM 3261**

Total Car Left

**275**

**Waiting To Approve** [Show All](#)

Rental ID	Pickup Address	Pickup Date	Pickup Time	Duration	Option
11	111	2023-01-30	00:00	1	<a href="#">Detail</a> <a href="#">Approve</a> <a href="#">Cancel</a>

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Figure 11 Admin Dashboard Module

After admin login, admin will first come to the admin dashboard. Admin able to approve, cancel or check detail of the rental made by customer at the waiting list as shown in figure 11.

Name	Type	Brand	Transmission	Year	Engine Capacity	Number Of Seats	Price (RM)	Status	Option
2018 Perodua Bezza 1.3L	Sedan	Local	AT	2018	1.3	5	350	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2018 Proton Saga 1.3L	Sedan	Local	AT	2018	1.3	5	355	Unavailable	<a href="#">Edit</a> <a href="#">Remove</a>
2019 Perodua Myvi 1.5L	Hatchback	Local	AT	2019	1.5	5	360	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2020 Perodua Aruz 1.5L	SUV	Local	AT	2020	1.5	7	514	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2020 Nissan Terra 2.5L	SUV	Overseas	MT	2020	2.5	7	610	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2018 Perodua Axia 1L	Hatchback	Local	AT	2018	1	5	270	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2019 Renault Megane RS 1.8L	Hatchback	Overseas	MT	2019	1.8	5	410	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2019 Honda Civic 1.8L	Sedan	Overseas	MT	2019	1.8	5	410	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2018 Peugeot 208 GTi 1.6L	Hatchback	Overseas	MT	2018	1.6	5	370	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2020 Hyundai i30N 2L	Hatchback	Overseas	MT	2020	2	5	410	Available	<a href="#">Edit</a> <a href="#">Remove</a>
2018 Honda City 1.5L	Sedan	Overseas	AT	2018	1.5	5	380	Available	<a href="#">Edit</a> <a href="#">Remove</a>

Figure 12 Car List Module

Admin able to access the car list module as shown in figure 12 by pressing the “Car Lists” link at the left bar. Car list module allow admin to add, remove or edit the car.

Services Name	Services Description	Price (RM)	Option
Insurance	Cover for any accident.	50	<a href="#">Edit</a> <a href="#">Remove</a>
Baby Seat	Safety seat for baby	30	<a href="#">Edit</a> <a href="#">Remove</a>
Maintenance	It is suitable for long-term rental services with high usage of the car.	1	<a href="#">Edit</a> <a href="#">Remove</a>

Figure 13 Add-On Services Module

Admin able to access the add-on services module as shown in figure 13 by pressing the “Add-On Services” link at the left bar. Add-on services module also same as the car list module where allow the admin to add, remove or edit the services.

Name	Identity Number	Birth	Email Address	Phone Number	Home Address
abc	123456789012	1999-07-27	abc@gmail.com	0123456789	pekan,pahang
ali	123456789876	2000-01-01	ali@gmail.com	013456	gambang,pahang
Abu	123456789013	1999-01-01	abu@gmail.com	1235465	321

Figure 14 Customer List Module

Admin able to access the customer list module as shown in figure 14 by pressing the “Customer Lists” link at the left bar. Admin will able to get the detail of the customer that had been register in the car rental system but admin will not allow to edit or remove the detail of the customer.

Rental ID	Pickup Address	Pickup Date	Pickup Time	Return Address	Return Date	Return Time	Duration	Status	Option
1	abc	2022-12-09	00:00	cba	2022-12-10	00:00	1	Complete	<a href="#">Detail</a>
2	abc	2022-12-09	00:00	cba	2022-12-10	00:00	1	Cancel	<a href="#">Detail</a>
3	selangor	2022-12-12	00:00	selangor	2022-12-13	00:00	1	Complete	<a href="#">Detail</a>
4	123	2022-12-18	00:00	321	2022-12-31	00:00	13	Complete	<a href="#">Detail</a>
6	selangor	2022-12-31	00:00	selangor	2023-01-06	00:00	6	Complete	<a href="#">Detail</a>
7	pekan	2022-12-31	00:00	selangor	2023-01-01	00:00	1	Complete	<a href="#">Detail</a>
8	123	2023-01-08	00:00	321	2023-02-11	00:00	34	Complete	<a href="#">Detail</a>
11	111	2023-01-30	00:00	222	2023-01-31	00:00	1	Proceed	<a href="#">Detail</a> <a href="#">Approve</a> <a href="#">Cancel</a>

Figure 15 Rental List Module

Admin able to access the rental list module as shown in figure 15 by pressing the any link that under the “Rental Lists” link at the left bar. “Proceed” mean only shows the rental request to approve or cancel. “Renting” shows only the rental that is renting the car for the customer. “Complete” shows the rental that had been completed. “All” shows all rental without specific status which include proceed, cancel, renting and complete. “Feedback” shows the rating of the customer to the rental that they made before.

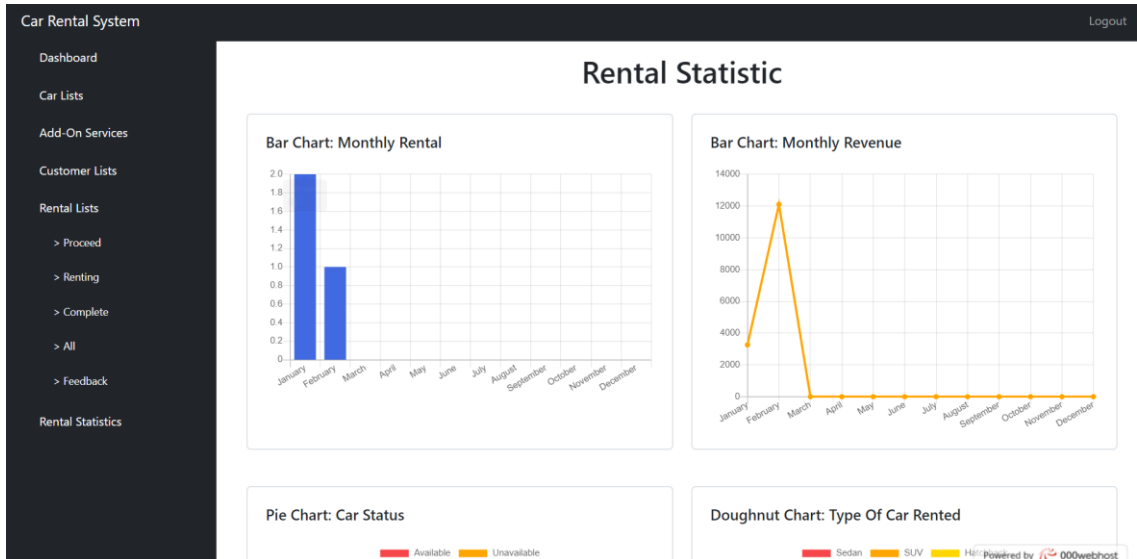


Figure 16 Rental Statistic Module

Admin able to access the rental statistic module as shown in figure 16 by pressing the “Rental Statistic” link at the left bar. There contains multiple chart such as bar, line or pie chart for admin to prepare their report.