Faculty of Computer Science and Information Technology

PARKED CAR TRACKER IN SHOPPING MALL VIA QR CODE

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Bachelor of Computer Science with Honours

(Network Computing)

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Date: **5 AUGUST 2020**   Date: 12 August 2020

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PARKED CAR TRACKER IN SHOPPING MALL VIA QR CODE

KUAN ZHEN YANG

This project is submitted in partial fulfillment of

the requirement for the degree of

Bachelor of Computer Science with Honours (Networking Computing)

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UNIVERSITY MALAYSIA SARAWAK

2020

PENJEJAK TEMPAT KERETA YANG DILETAKKAN DALAM

PUSAT MEMBELI-BELAH MELALUI KOD QR

KUAN ZHEN YANG

Projek ini merupakan salah satu keperluan untuk

Ijazah Sarjana Muda Sains Komputer dengan Kepujian

(Pengkomputeran Rangkaian)
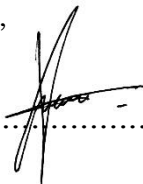
Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

2020

DECLARATION

I hereby declare that this thesis entitled *"Parked Car Tracker in Shopping Mall via QR Code"* is my original work. I have not copied from any other student's work or from any other sources except where due to reference or acknowledgment is not made explicit in the test, nor has any part has been written for me by another person.

Signed,

Date Submitted

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5 August 2020

(KUAN ZHEN YANG)

Matric No: 56338

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ABSTRACT

Parked Car tracker is a kind of car tracking system that helps the user to locate their car parked in the car park. This tracking system is demanded in a shopping mall. Users tend to have a problem tracking their parked cars due to unfamiliar with the building structure of the shopping mall car park or have a bad memory. The presence of a car tracking system can solve the problem and thereby improve the shopping experiences of users in that shopping mall. Nowadays, the Internet of Things (IoT) grows rapidly. This leads the IoT platform to more robust that allow the implementation of IoT platform in a more complicated application such as image processing. In this proposed system, the car tracking system is an IoT based platform. This proposed system used a single-board computer, Raspberry Pi to recognize and track the parked car through cameras installed within the car park area. Related departments such as security staff can locate a car in the car park with a proposed system after login car park website with their staff account. QR Code is implemented in this proposed system to ease the user to locate a parked car. They can scan the QR Code printed on the parking ticket to retrieve the result of the parked car location. This method is easier and faster than the user manually launch the car park website in a web browser.

ABSTRAK

Penjejak tempat kereta yang diletakkan adalah sejenis sistem penjejakan yang membolehkan pengguna menjejak lokasi kereta mereka. Pusat membeli-belah memerlukan sistem penjejakan kereta kerana pengguna selalu menghadapi masalah untuk mengesankan tempat kereta letak. Hal ini demikian kerana tabiat lupa atau tidak biasa dengan struktur bangunan pusat membeli-belah terutamany tempat letak kereta. Kewujudan sistem penjejakan kereta pada suatu pusat membeli-belah tersebut dapat menyelesaikan masalah ini dan meningkatkan pengalaman pengguna membeli-belah di pusat tersebut. Pada masa sekarang, Internet Thing (IoT) berkembang cepat. Hal ini membolehkan platform IoT menjadi lebih mantap dan dapat dilaksanakan dalam aplikasi yang rumit seperti pemprosesan imej digital. Sistem penjejakan kereta baharu yang dicadangkan berasaskan platform IoT dengan menggunakan Raspberry Pi untuk mengesankan lokasi kereta melalui kamera-kamera yang dipasang di sekeliling kawasan tempat letak kereta. Jabatan seperti jabatan keselamatan boleh mengesankan lokasi kereta dengan menggunakan sistem tersebut selepas log masuk sistem dengen akaun yang disediakan. Kod QR dilaksanakan dalam sistem ini dengan cara dicetakkan pada tiket letak kereta bagi tujuan memudahkan penguna menggunakan sistem. Kaedah ini lebih mudah dan cepat kerana pengguna boleh terus dapatkan keputusan lokasi kereta selepas mengimbaskan kod QR tersebut

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LIST OF ABBREVIATIONS

API	- Application Programming Interface
CCTV	- Closed-circuit Television
CSI	- Camera Serial Interface
ERD	- Entity Relationship Diagram
GPIO	- General Purpose Input-Output
IDE	- Integrated Development Environment
IoT	- Internet of Thing
IP	- Internet Protocol
LPR	- License Plate Recognition
MVC	- Model-View-Controller
OpenALPR	- Open Source Automatic License Plate Recognition
OpenCV	- Open Computer Vision
OS	- Operating System
PGS	- Parking Guidance System
QR Code	- Quick Response Code
RAD	- Rapid Application Development
RPi	- Raspberry Pi
URL	- Uniform Resource Locator
VPGS	- Video-based Parking Guidance System

Chapter 1 INTRODUCTION

1.1 Parked Car Tracker

Generally, shopping malls often have their car park area and it might be on several levels. The building layout design for each level is similar and commonly differentiated by labeling. The purpose of this labeling is for the user to remind the location of their car parked. Some modern architecture buildings might have a wide and complex car park area. Visitors keep in mind the label of parking slots after they park their car. They trace back to the parked car based on the label after they are done shopping. This label also being used by the visitor to ask help from the related department in a shopping mall to them find their car parked.

A shopping mall often has some security guards to patrol randomly in the car park area for security purposes. Their scopes of work might include help visitor searching their car and guide them to the car parked location. This is the traditional method of car tracking in the car park. Apart from this, major shopping malls have *Closed-circuit Television* (CCTV) cameras installed in the car park area. These cameras are set in specific positions to avoid blind angles and able to capture the complete view of the car park area. Some security departments might needless security guards to patrol as they can observe the condition of the car park through CCTV cameras. These cameras also being used to track the location of the visitor's car parked.

However, these parked car tracking methods have limitations. If visitors forget the label of the parking slot, time consumption is high for the tracking process. The security guard needs to patrol around the car park area or through the CCTV cameras search the parked car in the car park one by one. More time spent to track the car if the car park side size is wide and levels of layout. The situation becomes inconvenient if visitors forget both label of slot park and the license plate. The car tracking process can only refer to the verbal description from the visitor.

The proposed system aims to improve the current car tracking system with the implementation of the *Internet of Thing* (IoT) system. IoT is a simple network of interconnected devices that embedded with sensors network connectivity and software to enable data resource process and management (McClelland, 2019). The proposed system will implement the *Quick Response Code* (QR Code) feature in tracking the car. QR Code has been widely used in automatic identification fields (Liu, Yang, & Liu, 2008, July). Rather than manually input the license plate, the user can scan the QR Code and track the location of the parked car. Each QR Code that printed on the parking ticket is unique and linked to a specific license plate. This ensures the availability and reliability of the car tracking system.

1.2 Problem Statement

The building with a modern architecture design is easier to confuse visitors when using the car park. If the visitor visits an unfamiliar shopping mall, they can easily get lost especially tracks the location of the parked car. It is quite common as human negligence to forget the location of the parked car due to the reason building structure has several and similar building layout.

For the traditional method, visitors proceed to related departments such as a security department to ask help for car tracking. They will either use CCTV cameras or patrol of security guard patrol to find the parked car. These methods are to consume time. The whole process would be prolonged as visitors fail to recall the car details or descript the information detail.

Moreover, visitors might take time to proceed to the correct departments for help. The tracking process might not smoothly if the department lack workers at the moment to operate the tracking process. If other visitors are tracking their car, a visitor needs to queue and wait for turns to locate a parked car. Thus, it is inefficient as high time consumption.

1.3 Objective

The main objective of this project is to implement an IoT system within the car park area inside a building to track the location of the parked car.

Other objectives include:

- To recognize the license plate of the car through the cameras that installed within the car park area.

- To create a database that associates with parked car tracker to store or record the detail of the cars that used the car park.

- To track the location of parked car via QR Code.

1.4 Project Scope

This project is to provide a car tracking system on a car parked inside the shopping mall via QR Code. The thesis focuses on developing a prototype system using a single-board computer to recognize the license plate of the car and the slot it parked within the car park area. CCTV cameras that installed at barriers and within the car park area will be used to recognize the car through the license plate by image processing method. Proposed system the generated QR Code and use it to retrieve the data of license plate from the car park database. Each QR Code generated on parking ticket must be unique and assigned with a specific license plate once the car enters the car park through access barriers. The data in the car park database will be represented through web-based applications to a user after scan the QR Code. Car details in the car park database will be updated when the car exit the car park or parked in another parking slot.

1.5 Methodology

The proposed project used *Rapid Application Development* (RAD) as the project development methodology. RAD model is a method of software development that heavily emphasizes rapid prototyping and iterative delivery. Due to the reason of time constraint, this model is chosen to produce a working product quickly and obtain constant feedback on it. RAD model included four phases which are analysis and Quick Design, Prototype Cycle, Testing, and Deployment.
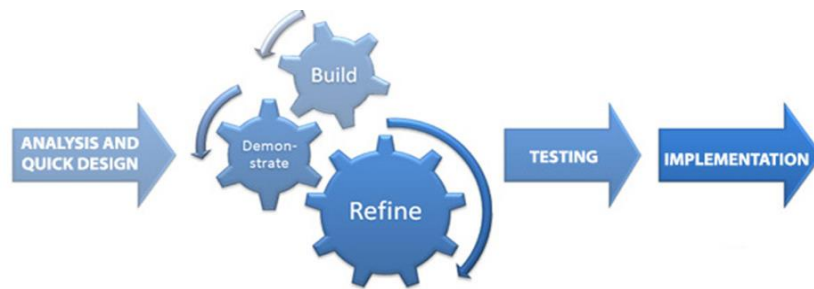
Figure 1.1: Rapid Application Development (RAD) Model

1.5.1 Phase 1 - Analysis and Design

This is the initial phase of the RAD model. In the analysis phase, the information will be collected from the study regarding the car tracking system in a shopping mall. The data is then gathered and analyzed to determine the problem, requirement, and objective to develop the proposed system. A detailed proposal or plan created to describe the solution for the car tracking system in a shopping mall. Further research is done based on the requirement and the problem that needs to be solved, then underlined the estimated timeline of the project.

After the analysis phase completed, the quick design phase began with the designing system architecture of the proposed system. A use case is used to show the interaction between the user and the system to archive the project goal. The sequence diagram is used to illustrate the behavior of objects and messages passing based on the use cases designed. The layout of the web application is designed and sketched. These elements will be discussed in Chapter 3.

1.5.2 Phase 2 - Prototyping Cycle

   i.   *Build*

As the requirement and timeline of the project have been figured out in the previous phase, the development of the prototype can be started instantly. In this project, the camera will connect to a single board system to implement image processing for recognition of the license plate. Once the license plate recognized, the system will generate a QR code that linked to a specific URL address. The database will be prepared to store those identified license plates and use web-based applications to retrieve the data from it to represent a result of scanning QR code.

   ii.   *Demonstrate*

When the prototype is developed and completed, the proposed system will be demonstrated to the user. The demonstrated will be evaluated whether it meets the project requirement and satisfied the system expectation.

   iii.   *Refine*

In this phase, the prototype will be refined and improve based on the feedback gathered from the previous demonstration phase. Certain features might remove or added to the prototype as revised on the feedback gained.

1.5.3 Phase 3 - Testing

This phase aims to test on a prototype to ensure it achieves the objectives of the proposed system and solved the problem statements. Two types tested will be applied to the prototype which is unit testing and usability testing. Unit testing used to verify the outcomes of the prototype meet the expectation of the project, while usability testing used to test on ease of prototype. Bugs and errors will be fixed and solved upon detected in this phase. This phase will be further explained in Chapter 4.

1.5.4 Phase 4 - Implementation

After the testing phase completed, the system is ready to be released for development. Before releasing the system, the system will be optimized to improve the stability and maintainability of the system as no further change will be made after released. The product of the project will be introduced to the public at the end of this phase and further description included in Chapter 5.

1.6 Significance of Project

The significance of the project must be considered in the proposed system to ensure the project is meaningful. This proposed project will attain efficient for the car park monitoring system and offer convenience to the user using the car park in the shopping mall. The proposed system is the ease of use in which the location of a parked car can be known by scan the QR Code on the parking ticket instead of manual typing to load to a website. As compared to the traditional method in which users need to proceed to customer service or security department to track their car, this proposed system is simple and easier which only require to scan on QR Code to get the tracking result. Moreover, application download on a mobile device is needless. Hence, the facilitation of the proposed system simplified the tracking process and convenient for the user which application download is needless. This system is reliable for the user especially to those who rented cars as it is needless to remember the car detail such as license plate. To those unfamiliar with the structure building of the shopping mall, they can show the result from the QR Code to the security guard to ask help for guiding the location of the parked car. Thus, implemented this IoT system could improve user experience to shop in that shopping mall.

1.7 Project Schedule

The project schedule is shown in a full detailed Gantt chart as in Figure 1.2.

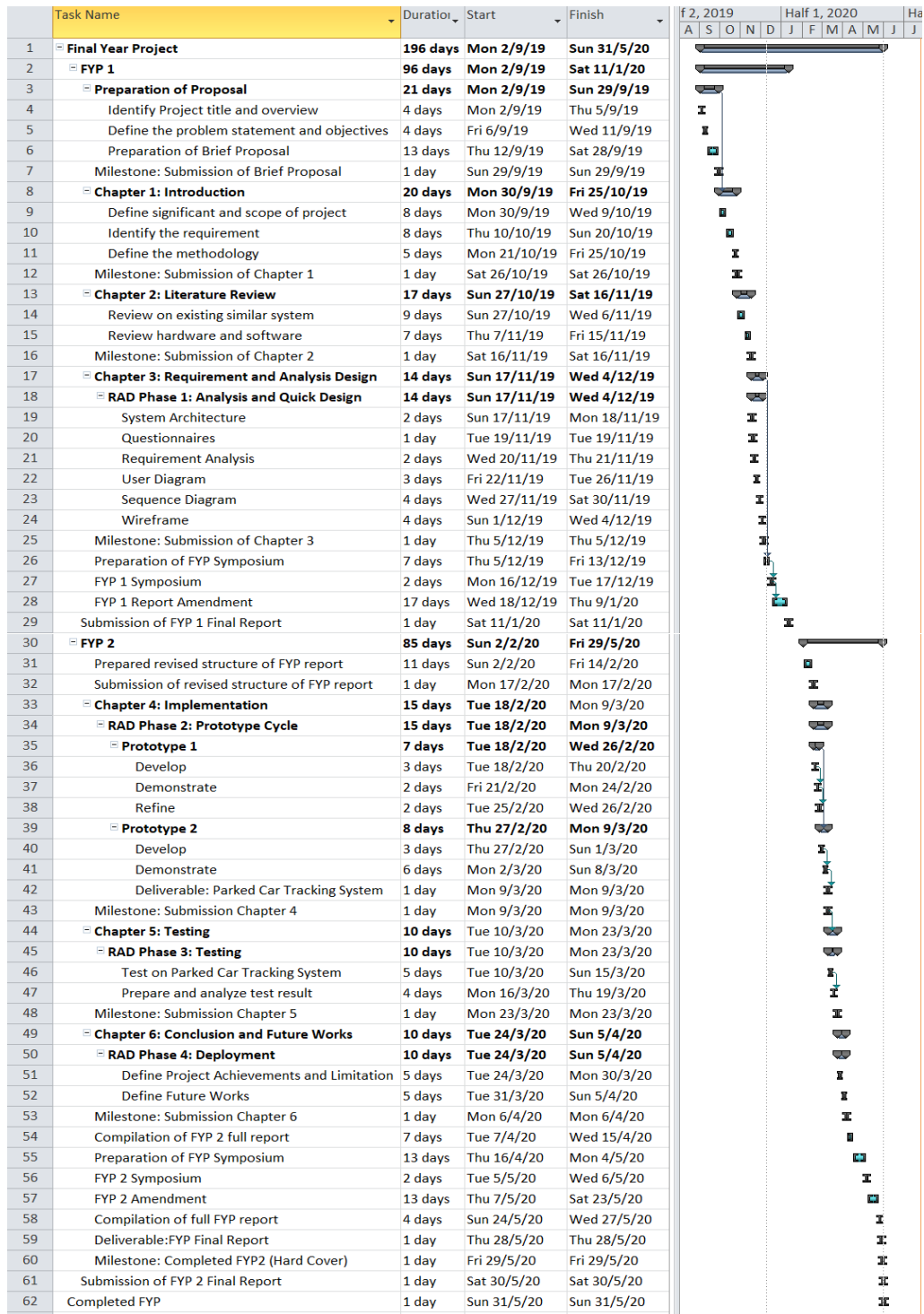|	Task Name	Duration	Start	Finish
1	⊟ **Final Year Project**	**196 days**	**Mon 2/9/19**	**Sun 31/5/20**
2	⊟ **FYP 1**	**96 days**	**Mon 2/9/19**	**Sat 11/1/20**
3	⊟ **Preparation of Proposal**	**21 days**	**Mon 2/9/19**	**Sun 29/9/19**
4	Identify Project title and overview	4 days	Mon 2/9/19	Thu 5/9/19
5	Define the problem statement and objectives	4 days	Fri 6/9/19	Wed 11/9/19
6	Preparation of Brief Proposal	13 days	Thu 12/9/19	Sat 28/9/19
7	Milestone: Submission of Brief Proposal	1 day	Sun 29/9/19	Sun 29/9/19
8	⊟ **Chapter 1: Introduction**	**20 days**	**Mon 30/9/19**	**Fri 25/10/19**
9	Define significant and scope of project	8 days	Mon 30/9/19	Wed 9/10/19
10	Identify the requirement	8 days	Thu 10/10/19	Sun 20/10/19
11	Define the methodology	5 days	Mon 21/10/19	Fri 25/10/19
12	Milestone: Submission of Chapter 1	1 day	Sat 26/10/19	Sat 26/10/19
13	⊟ **Chapter 2: Literature Review**	**17 days**	**Sun 27/10/19**	**Sat 16/11/19**
14	Review on existing similar system	9 days	Sun 27/10/19	Wed 6/11/19
15	Review hardware and software	7 days	Thu 7/11/19	Fri 15/11/19
16	Milestone: Submission of Chapter 2	1 day	Sat 16/11/19	Sat 16/11/19
17	⊟ **Chapter 3: Requirement and Analysis Design**	**14 days**	**Sun 17/11/19**	**Wed 4/12/19**
18	⊟ **RAD Phase 1: Analysis and Quick Design**	**14 days**	**Sun 17/11/19**	**Wed 4/12/19**
19	System Architecture	2 days	Sun 17/11/19	Mon 18/11/19
20	Questionnaires	1 day	Tue 19/11/19	Tue 19/11/19
21	Requirement Analysis	2 days	Wed 20/11/19	Thu 21/11/19
22	User Diagram	3 days	Fri 22/11/19	Tue 26/11/19
23	Sequence Diagram	4 days	Wed 27/11/19	Sat 30/11/19
24	Wireframe	4 days	Sun 1/12/19	Wed 4/12/19
25	Milestone: Submission of Chapter 3	1 day	Thu 5/12/19	Thu 5/12/19
26	Preparation of FYP Symposium	7 days	Thu 5/12/19	Fri 13/12/19
27	FYP 1 Symposium	2 days	Mon 16/12/19	Tue 17/12/19
28	FYP 1 Report Amendment	17 days	Wed 18/12/19	Thu 9/1/20
29	Submission of FYP 1 Final Report	1 day	Sat 11/1/20	Sat 11/1/20
30	⊟ **FYP 2**	**85 days**	**Sun 2/2/20**	**Fri 29/5/20**
31	Prepared revised structure of FYP report	11 days	Sun 2/2/20	Fri 14/2/20
32	Submission of revised structure of FYP report	1 day	Mon 17/2/20	Mon 17/2/20
33	⊟ **Chapter 4: Implementation**	**15 days**	**Tue 18/2/20**	**Mon 9/3/20**
34	⊟ **RAD Phase 2: Prototype Cycle**	**15 days**	**Tue 18/2/20**	**Mon 9/3/20**
35	⊟ **Prototype 1**	**7 days**	**Tue 18/2/20**	**Wed 26/2/20**
36	Develop	3 days	Tue 18/2/20	Thu 20/2/20
37	Demonstrate	2 days	Fri 21/2/20	Mon 24/2/20
38	Refine	2 days	Tue 25/2/20	Wed 26/2/20
39	⊟ **Prototype 2**	**8 days**	**Thu 27/2/20**	**Mon 9/3/20**
40	Develop	3 days	Thu 27/2/20	Sun 1/3/20
41	Demonstrate	6 days	Mon 2/3/20	Sun 8/3/20
42	Deliverable: Parked Car Tracking System	1 day	Mon 9/3/20	Mon 9/3/20
43	Milestone: Submission Chapter 4	1 day	Mon 9/3/20	Mon 9/3/20
44	⊟ **Chapter 5: Testing**	**10 days**	**Tue 10/3/20**	**Mon 23/3/20**
45	⊟ **RAD Phase 3: Testing**	**10 days**	**Tue 10/3/20**	**Mon 23/3/20**
46	Test on Parked Car Tracking System	5 days	Tue 10/3/20	Sun 15/3/20
47	Prepare and analyze test result	4 days	Mon 16/3/20	Thu 19/3/20
48	Milestone: Submission Chapter 5	1 day	Mon 23/3/20	Mon 23/3/20
49	⊟ **Chapter 6: Conclusion and Future Works**	**10 days**	**Tue 24/3/20**	**Sun 5/4/20**
50	⊟ **RAD Phase 4: Deployment**	**10 days**	**Tue 24/3/20**	**Sun 5/4/20**
51	Define Project Achievements and Limitation	5 days	Tue 24/3/20	Mon 30/3/20
52	Define Future Works	5 days	Tue 31/3/20	Sun 5/4/20
53	Milestone: Submission Chapter 6	1 day	Mon 6/4/20	Mon 6/4/20
54	Compilation of FYP 2 full report	7 days	Tue 7/4/20	Wed 15/4/20
55	Preparation of FYP Symposium	13 days	Thu 16/4/20	Mon 4/5/20
56	FYP 2 Symposium	2 days	Tue 5/5/20	Wed 6/5/20
57	FYP 2 Amendment	13 days	Thu 7/5/20	Sat 23/5/20
58	Compilation of full FYP report	4 days	Sun 24/5/20	Wed 27/5/20
59	Deliverable:FYP Final Report	1 day	Thu 28/5/20	Thu 28/5/20
60	Milestone: Completed FYP2 (Hard Cover)	1 day	Fri 29/5/20	Fri 29/5/20
61	Submission of FYP 2 Final Report	1 day	Sat 30/5/20	Sat 30/5/20
62	Completed FYP	1 day	Sun 31/5/20	Sun 31/5/20

Figure 1.2: Gantt Chart

1.8 Expected Outcome

The expected outcome is a working prototype system that scans the QR Code and able to track the location of the parked car. The result will show the level and slots of the car parked in the car park area.

1.9 Project Report Outline

1.9.1 Chapter 2: Literature Review

Chapter 2 discusses the study and review of existing methods and systems based on the articles, journals, and conference papers that are related to the proposed project. In this chapter, it enlightens on the limitation of the project as well and how should it be improved.

1.9.2 Chapter 3: Requirement Analysis and Design

Chapter 3 provides detail on how the requirement will be identified and analyzed. RAD methodology will be used as a guideline to develop the proposed system. This chapter will further describe the methodology used throughout the project development.

1.9.3 Chapter 4: Implementation

This chapter describes the implementation phase done in this project. A system prototype is developed according to the system design to conduct testing.

1.9.4 Chapter 5: Testing

This chapter will discuss the testing phase Several types of testing will be done on the prototype for evaluation will be explained in this chapter.

1.9.4 Chapter 5: Conclusion and Future Works

Chapter 5 will conclude the whole developed project and outlines for future works. This chapter will also describe the lessons learned throughout the whole project.