

**VEHICLE PARKING SYSTEM USING OPTICAL CHARACTER
RECOGNITION**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: VEHICLE PARKING SYSTEM USING OPTICAL CHARACTER RECOGNITION

SESI PENGAJIAN: 2017/2018

Saya KONG MING HAN

Mengaku membenarkan tesis PSM ini disimpan di Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dengan syarat-syarat kegunaan seperti berikut:

1. Tesis dan projek adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan Fakulti Teknologi dan Komunikasi dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ** Sila tandakan (/)

 SULIT
 TERHAD

(Mengandungi maklumat yang berdarjah Keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan)

 TIDAK TERHAD





(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat tetap: 29, Laluan Kledang Timur 4, Bandar Baru Menglembu, 31450 Ipoh, Perak.

Mohd Hariz bin Naim

Nama Penyelia

Tarikh: 6/8/2017

Tarikh: 21/8/2017

CATATAN: * Tesis dimaksudkan sebagai Laporan Akhir Projek Sarjana Muda (PSM)

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa.

VEHICLE PARKING SYSTEM USING OPTICAL CHARACTER RECOGNITION



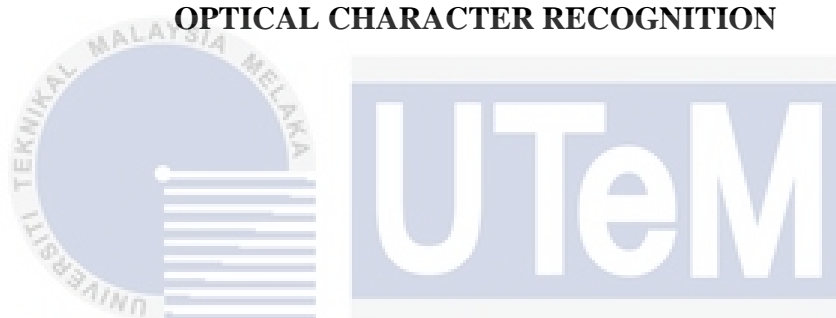
This report is submitted in partial fulfilment of the requirements for the Bachelor of
Computer Science (Software Development)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I hereby declare that this project report entitled
**VEHICLE PARKING SYSTEM WITH
OPTICAL CHARACTER RECOGNITION**



is written by me and is my own effort and that no part has been plagiarized
without citations.

STUDENT :  _____ Date: 21/8/2017

(KONG MING HAN)

SUPERVISOR  _____ Date: 21/8/2017

(Mohd Hariz Naim @ Mohayat)

DEDICATION

I would like to dedicate this project to parents for their endless support, without their supports, it would not be possible. I also want to dedicate this project to every single one of them who offered endless support and encouragement.



ACKNOWLEDGEMENTS

This project was supported and assisted by my supervisor Mr. Mohd Hariz Naim @ Mohayat who always give me help and full support throughout the development of this project. His advices, ideas, wisdoms and comments had lead me to make this project to a success. I appreciated for his patience for spending his valuable time with me especially during project discussion and brainstorming session.

Besides, I would like to express my appreciation to Faculty of Information Communication and Technology for giving us such a good platform to sharpen and implement our skills by developing the final year project.

Lastly, I wanted to express my profound gratitude and sincere to my parents for providing me continuous and unfailing encouragement throughout the years of my study. This project would not be possible accomplished without them. Thank you.

ABSTRACT

Paying parking payment has been the most ordinary task for those who get used to park at shopping mall parking lots. That person need to go through the process from taking parking ticket at the parking entrance until paying parking fees at the AutoPay machine. However, there's a time-wasting and inconvenient for customer who is disabled and pregnant women. They are having difficulties to queue and look for the AutoPay machine to pay their parking fees. Firstly, car owners don't know how long they have parked in which they might get shocked due to hefty parking fees sometimes. Next, car owners such as pregnant women and disabled may find hard to make their parking payment due to inconvenience to use AutoPay machine. Then, current system is causing a lot of paper wastage due to printing parking ticket at the entrance which is not environmental friendly and loss of ticket might happen to some careless customer. Therefore, this project is to develop a system that acts as an alternative way of paying parking fees in shopping malls. In this project, it includes three systems, which is desktop, mobile and web application. The mobile application will be used by user to check parking duration and also paying parking fees. The parking fees will be paid through payment gateway such as PayPal, Stripe and In-App Wallet instead of using cash. For the desktop application, it will be used with camera to capture car image, perform image processing and apply optical character recognition to identify and recognise car registration number. Next, the web application will be used by admin to see the car records. At the end of the project, it can reduce the hassle that brings to pregnant women and disabled. Besides, it creates greener, safer and easier ways of making parking payment.

ABSTRAK

Pembayaran tiket letak kereta merupakan tugas yang biasa bagi orang yang sentiasa meletakkan kereta mereka di pusat membeli-belah. Pelanggan perlu melalui proses yang panjang dan membazirkan masa iaitu mendapatkan tiket dari mesin di pintu masuk tempat letak kereta sehingga proses membayar tiket di mesin *AutoPay*. Proses ini agak merumitkan bagi pengguna seperti ibu mengandung dan orang kurang upaya. Mereka menghadapi masalah seperti susah beratur dan mencari mesin. Selain itu, pengguna menghadapi masalah tidak mengetahui bayaran yang perlu dibayarkan. Jadi, mereka mungkin terkejut dengan bayaran yang perlu diayarkan semasa mereka menjelaskan bayaran mereka. Seterusnya, sistem semasa ini tidak mesra alam kerana telah mengakibatkan pembaziran kertas semasa mencetak tiket di pintu tapak penletakan kereta. Selain itu, pengguna yang cuai akan menghilangkan tiket tersebut. Oleh itu, sistem ini adalah dibangunkan sebagai cara alternatif untuk menyelesaikan masalah yang dikemukakan. Sistem yang akan dibangunkan mengandungi tiga sub-sistem iaitu aplikasi desktop, aplikasi mudah alih dan aplikasi web. Aplikasi mudah alih akan memudahkan pengguna dengan membekalkan fungsi semakan bayaran dan menjelaskan bayaran mereka melalui *Stripe*, *PayPal* atau *In-App Wallet*. Aplikasi web membolehkan admin menguruskan rekod-rekod kereta dan mengemaskinikan kadar bayaran. Manakala aplikasi desktop adalah untuk memproseskan gambar kereta untuk mendapatkan nombor kenderaan. Kesimpulannya, system ini adalah untuk mewujudkan persekitaraan yang hijau, pembayaran yang selamat dan senang.

TABLE OF CONTENTS

	SUBJECT	PAGE
	DECLARATION	I
	DEDICATION	II
	ACKNOWLEDGEMENTS	III
	ABSTRACT	IV
	ABSTRAK	V
	TABLE OF CONTENTS	VI
	LIST OF FIGURES	XII
	LIST OF TABLES	XV
	LIST OF ABBREVIATIONS	XVI
CHAPTER I	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Problem Statements	2
	1.3 Objective	3
	1.4 Scope	3
	1.4.1 User Group	4
	1.4.2 Desktop Application	5

1.4.3 Mobile Application	5
1.4.4 Web Application	5
1.4.5 Optical Character Recognition (OCR)	5
1.5 Project Significance	6
1.6 Expected Output	6
1.7 Conclusion	7

CHAPTER II LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction	2
2.2 Facts and findings	9
2.2.1 Domains	9
2.2.1.1 Internet of Things (IoT)	10
2.2.1.1.1 Major Components of Internet of Things	12
2.2.1.1.2 Arduino Microcontroller	12
2.2.1.1.3 Raspberry Pi	13
2.2.1.1.4 Google Firebase	14
2.2.1.2 Artificial Intelligence	15
2.2.1.2.1 Computer Vision	17
2.2.1.2.2 Google Vision API as Visual Processing	21
2.2.1.3 Multi-platform Application Development	23
2.2.1.3.1 Desktop Application	24
2.2.1.3.2 Web Application	25
2.2.1.3.3. Mobile Application	26
2.2.2 Existing System	28

2.2.2.1 Automated Payment System for Car Parks based on Near Field Communication Technology (APS)	28
2.2.2.2 Parking Meter Payment by Cell Phone Link (PMP)	30
2.2.3 Technique	32
2.2.3.1 Optical Character Recognition	33
2.2.3.2 Motion Detection on Static Background	33
2.2.3.3 EmguCV	34
2.3 Project Methodology	35
2.3.1 Requirement and Analysis	36
2.3.2 System Design	36
2.3.3 Implementation	37
2.3.4 Testing	37
2.3.5 Deployment	38
2.3.6 Maintenance	38
2.4 Project Requirements	38
2.4.1 Software Requirement	39
2.4.2 Hardware Requirement	41
2.5 Project Schedule and Milestones	42
2.6 Conclusion	45
CHAPTER III ANALYSIS	9
3.1 Introduction	9
3.2 Problem Analysis	47
3.3 Requirement Analysis	48

3.3.1 Data Requirement	48
3.3.2 Functional Requirement	49
3.3.3 Non-Functional Requirement	59
3.4 Conclusion	60
CHAPTER IV DESIGN	47
4.1 Introduction	47
4.2 High-Level Design	62
4.2.1 System Architecture	62
4.2.2 User Interface Design	66
4.2.3 Database Design	75
4.2.3.1 Conceptual and Logical Database Design	75
4.3 Detailed Design	81
4.3.1 Software Design	81
4.3.1.1 Data Flow Diagram (DFD)	83
4.3.2 Physical Database Design	85
4.3.3 Proposed Architecture Design	87
4.3.3.1 Detailed Proposed Architecture Design	88
4.4 Conclusion	90
CHAPTER V IMPLEMENTATION	91
5.1 Introduction	91
5.2 Software Development Environment Setup	92
5.2.1 Java JDK	92

5.2.2 Android Studio	93
5.2.3 Google Sign-in API	93
5.2.4 Google Firebase	93
5.2.5 Angular 2	97
5.2.6 Visual Studio Community 2017	97
5.2.7 EmguCV	98
5.2.8 Git & GitHub	98
5.3 Software Configuration Management	99
5.3.1 Configuration Environment Setup	100
5.3.2 Version Control Procedure	101
5.4 Implementation Status	103
5.5 Conclusion	105
CHAPTER VI TESTING	106
6.1 Introduction	106
6.2 Test Plan	107
6.2.1 Test Organisation	107
6.2.2 Test Environment	107
6.2.3 Test Schedule	108
6.3 Test Strategy	109
6.3.1 Classes of Tests	109
6.4 Test Design	110
6.4.1 Test Description	110
6.4.2 Test Data	133
6.5 Test Result and Analysis	133

6.5.1 White-box Testing Result	133
6.5.2 Black-box Testing Result	138
6.6 Conclusion	141
CHAPTER VII CONCLUSION	142
7.1 Introduction	142
7.2 Observation on Weakness and Strengths	143
7.3 Propositions for Improvement	145
7.4 Project Contribution	146
7.4 Conclusion	147
REFERENCES	148
APPENDICES	149



LIST OF FIGURES

Figure 2.1: Characteristics of Internet of Things.....	11
Figure 2.2: Optical Character Recognition.....	19
Figure 2.3: 3D modelling	19
Figure 2.4: Morphing.....	19
Figure 2.5: Automotive Safety	20
Figure 2.6: Google Vision API's Text Detection Feature	22
Figure 2.7: Process of Google Vision API	22
Figure 2.8: The Kiosk Interface.....	29
Figure 2.9: The flow of parking meter payment process.....	31
Figure 2.10: Illustration of Waterfall Model Process.....	35
Figure 3.1: Use case diagram	51
Figure 3.2: Sequence diagram for user authentication	52
Figure 3.3: Sequence diagram for manage car record	53
Figure 3.4: Sequence diagram for checking parking duration	54
Figure 3.5: Sequence diagram for making payment using PayPal	55
Figure 3.6: Sequence diagram for making payment using credit card	55
Figure 3.7: Sequence diagram for making payment using In-App Wallet (Fingerprint).....	56
Figure 3.8: Sequence diagram for making payment using In-App Wallet (PIN).....	56
Figure 3.9: Sequence diagram for checking history	57
Figure 3.10 Sequence diagram of detecting car plate.....	58
Figure 4.1: Three-tier architecture diagram.....	64
Figure 4.2: Home page of the mobile application	66
Figure 4.3: The dialog box that allows user to enter their car plate number.....	66
Figure 4.4: Parking duration screen.....	67
Figure 4.5: The bottom modal sheet for payment method.	67

Figure 4.6: The credit card payment method screen.	68
Figure 4.7: The error message for credit card payment.....	68
Figure 4.8: Fingerprint authentication screen.....	69
Figure 4.9: PayPal payment screen	69
Figure 4.10: Receipt screen	70
Figure 4.11: The main page.....	70
Figure 4.12: History screen	71
Figure 4.13: In-App Wallet screen	71
Figure 4.14: Add money screen for In-App Wallet.....	72
Figure 4.15: The car plate record screen	72
Figure 4.16: The error message at the exit screen	73
Figure 4.17: The success message at the exit screen.....	73
Figure 4.18: Admin dashboard for the web application.....	74
Figure 4.19: Parking statistics page.....	74
Figure 4.20: Conceptual Entity Relationship Diagram	75
Figure 4.21: Entity Relationship diagram	76
Figure 4.22: Code snippet to generate and store messaging token.....	81
Figure 4.23: Code snippet to verify string pattern.....	82
Figure 4.24: Code snippet to generate real time graph.....	82
Figure 4.25: Context diagram of desktop application	83
Figure 4.26: Context diagram of web application	84
Figure 4.27: Context diagram of mobile application.....	84
Figure 4.28 Proposed architecture design diagram	88
Figure 4.29: Detailed Proposed Architecture Design.....	89
Figure 5.1: Firebase’s architecture	94
Figure 5.2: Data Structure in Firebase Database	95
Figure 5.3: build.gradle’s root level	96
Figure 5.4: app level build.gradle.....	96
Figure 5.5: Firebase Database dependency	96
Figure 5.6: Branching in Git.....	99
Figure 5.7: Git Version Control Log	101

Figure 6.7: Chart of white-box testing result..... 137
Figure 6.8: Chart of black-box 140



LIST OF TABLES

Table 2.1: Comparison among APS, PMP and VPS	31
Table 2.2: Description of software requirements	39
Table 2.3: Description of Hardware Requirement	41
Table 2.4: Project Milestone and schedule	42
Table 3.1: Functional Requirement of the system	49
Table 3.2: Non-functional requirements of the system	59
Table 4.1 Data Dictionary	78
Table 5.1: System Version Control	101
Table 5.2: Implementation Status	104
Table 6.1: Table of Test Schedule	108
Table 6.2: Table of classes of tests	109
Table 6.3: Test cases of white-box testing	112
Table 6.4: Test cases of black-box testing	120
Table 6.5: White-box testing result for each version of the system	134
Table 6.6: Test result from white-box testing	136
Table 6.6: Test result from black-box testing	138

LIST OF ABBREVIATIONS

VPS – Vehicle Parking System

LPR – License Plate Recognition



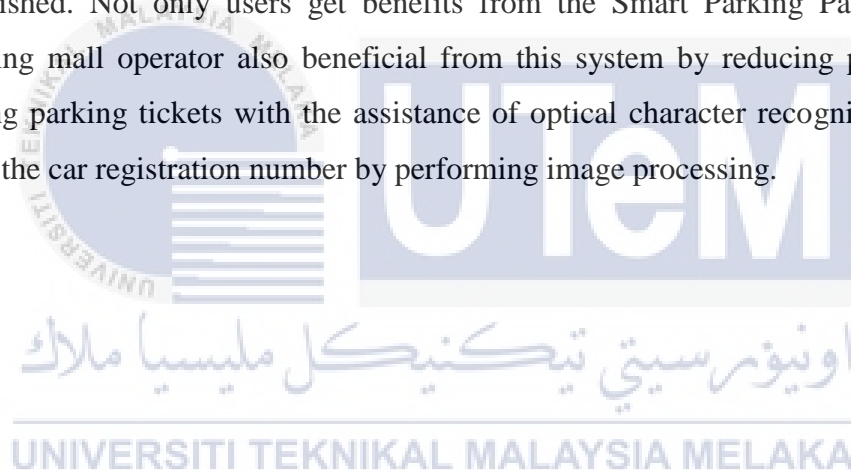
CHAPTER I



1.1 Introduction

Paying parking payment with parking ticket has been the most ordinary task for those who are get used to park at shopping mall parking lots. That person need to go through the process from taking parking ticket at the parking entrance until paying parking fees at the autopay machine. However, there's a time-wasting process where user need to queue at the entrance and at the autopay machine. Most of the time, there are many users spending time to look for autopay machine and queueing to wait for their turn. Especially during peak hour or weekends, users may have to wait longer than usual. This has brought inconvenience for disabled, pregnant women and those who are not willing to walk far away to look for autopay machine just to pay their parking fees and spending most of the time on queuing at the entrance and making payment. With the advance of

technology, this process can be simplified by applying optical character recognition. Optical character recognition is a technology that can identify character from a given image or video frame by using image processing. In this case, optical recognition technology can be applied at the parking entrance to identify the car registration number. This serves as an alternative way to shorten the time-wasting parking process in which user can just drive through without wasting time to wait for the machine to print out their parking ticket. Hence, by implementing Smart Parking Payment System, users will be making their parking payment via online payments, such as PayPal and Stripe. Besides, users don't have to worry about the long queue at the entrance and autopay machine because this system provides information about the duration of their parking because the notification will be triggered and sent to users when the duration of parking is about to be finished. Not only users get benefits from the Smart Parking Payment System, shopping mall operator also beneficial from this system by reducing paper usage on printing parking tickets with the assistance of optical character recognition which can detect the car registration number by performing image processing.



1.2 Problem Statements

- Car owners don't know how long they have parked. Some of them might get shock due to hefty parking fees when they check at AutoPay machine
- Car owners such as pregnant women and disabled may find hard to pay their parking fees due to inconvenient to use the AutoPay machine.
- Paper wastage due to use of parking tickets. In the current system, parking ticket has to be printed out to distribute to each user. Consequently, usage of paper would be increased.

- Parking ticket can be lost easily. Customer is more likely to lose parking ticket due to careless mistake.

1.3 Objective

This project embarks on the following objectives:

1. To check parking duration with the provided application.
2. To reduce paper usage caused by parking ticket using optical character recognition (OCR) to identify car registration number at the entrance.
3. To reduce the risk of losing parking ticket by where car's records are stored in cloud.
4. To make paying parking fees easy for pregnant women and disabled by using mobile payment gateway.

1.4 Scope

This project will consist of developing an alternative smart parking payment system with the use of optical character recognition technology. In this project, it will involve creation of system on three platforms which are desktop application, mobile application and web application. The system will comprise of two distinct groups of

system user which are system admin and system user (customer). The system admin will be responsible for managing most of the system function including some basic system operations such as view and analyse on system data. On the other hand, system user will be involved in car license plate detection and recognition module and parking payment module.

1.4.1 User Group

- System admin
 - Check parking payment and car parking records through the web application
 - Perform basic operation such as view and analyse on the data.
 - View the statistics of the parking payment and car parking records.
- User (Customer)
 - Make parking payment on mobile application through PayPal, Stripe or In-App Wallet.
 - Check parking duration.

1.4.2 Desktop Application

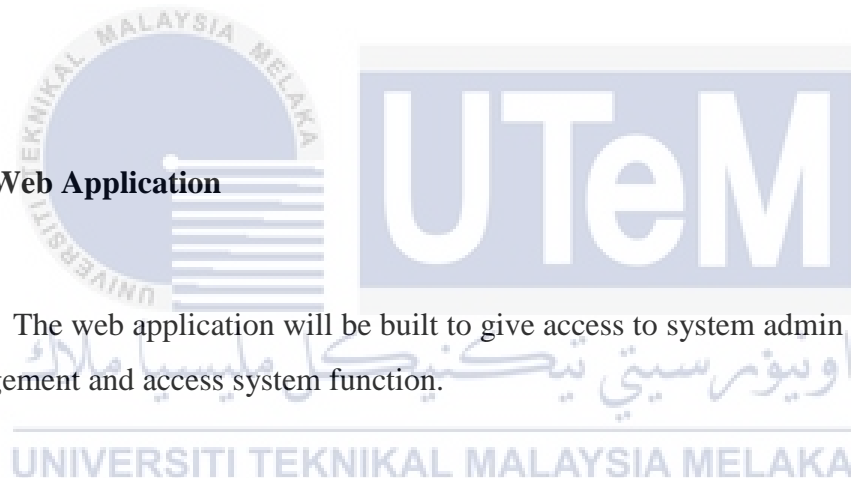
Perform license plate detection and recognition using optical character recognition technique when car comes in.

1.4.3 Mobile Application

The mobile application will be targeted to build on Android platform only since it is the most dominating operating system on smart phone in current market.

1.4.4 Web Application

The web application will be built to give access to system admin to perform data management and access system function.



1.4.5 Optical Character Recognition (OCR)

OCR is a technique used to recognise text from the image or video frame. This technique will be used for license plate detection.