



**Faculty of Electrical and Electronic Engineering Technology**



**DEVELOPMENT OF SMART PARKING LOT WITH REAL-TIME  
SPACE MONITORING BASED ON COMPUTER VISION**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**NUR FILZAH BINTI MOHD AFFANDI**

**Bachelor of Electronics Engineering Technology (Industrial Electronics) with  
Honours**

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**DEVELOPMENT OF SMART PARKING LOT WITH REAL-TIME SPACE  
MONITORING BASED ON COMPUTER VISION**

**NUR FILZAH BINTI MOHD AFFANDI**

**A project report submitted  
in partial fulfillment of the requirements for the degree of  
Bachelor of Electronics Engineering Technology (Industrial Electronics) with  
Honours**



اونيورسيتي تیکنیکل ملیسيا ملاک  
**Faculty of Electrical and Electronic Engineering Technology**  
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Alamat Tetap: NO 6696, TAMAN  
FIKRI 2, FASA 2, 24000  
KEMAMAN, TERENGGANU



(COP DAN TANDATANGAN PENYELIA)

**DR. SUHAILA BINTI MOHD NAJIB**

Pensyarah Kanan  
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer  
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik  
Universiti Teknikal Malaysia Melaka

Tarikh: 11/1/2022

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I declare that this project report entitled “Development Of Smart Parking Lot With Real-Time Space Monitoring Based On Computer Vision” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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: 

Student Name

: NUR FILZAH BINTI MOHD AFFANDI

Date

: 11/1/2022

اونيورسيتي تيكنيكل مليسيا ملاك

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

Signature :



Supervisor Name :

DR SUHAILA BINTI MOHD NAJIB

Date :

11/1/2022

Signature :



Co-Supervisor :

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Name (if any)

Date :

.....  
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## DEDICATION

First of all, I am dedicated this project to ALLAH S.W.T, thank you for His mercy, guidance, power of mind and giving me a healthy life during completing this project. This bachelor degree project is dedicated to my beloved mother, Nor Muhayani Binti Mustafa and father, Mohd Affandi Bin Jusoh, who always keep supporting me, gave me a strength and inspired me emotionally and physically.

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## ABSTRACT

Currently, our technology development keeps enhancing and it is lead to one of our Malaysia Framework in which Malaysia can become one of the Smart City Country. Smart Parking facilities are the most important considerations to create Smart City concept since parking problem become an annoying issue. Besides, the number of vehicles on the road keep increasing as vehicles become one of necessity in our life and currently, the market value of the cars is low. Due to this matter, user need to consume more energy and time to find free parking space manually that end up lead to traffic congestion and excess consumption of fuel. This system comprises Raspberry pi as a main controller, ESP32 as a second controller to monitor parking availability, Raspberry pi camera for capturing vehicle plate number, MySQL database, Android Studio as an IDE for the development mobile application and OpenCV software for license plate number recognition process. Raspberry pi cameras were installed in certain locations which were entrance gate barrier and exit gate barrier to capture license plate number for the user authorization. The proposed system used some of recognition software such as Optical Character Recognition to segment and recognize the characters in the captured images. There are several process of image processing have been done by using algorithm in the OpenCV which read input image, preprocessing image such as convert to grayscale and binary images, character segmentation. The license plate number will be converted into text to compare with the data in the database. Once license plate number matched, the user will be authorised and the gate barrier will be opened or closed. Infrared sensor were installed in each parking slot to detect the presence of vehicle. Mobile application is significant to ease the user to check the parking availability. As conclusion, the implementation of this system will solve all of the problem occurs such as traffic congestion, time and fuel consuming and also ease user to park their vehicle without competing with other users.

## ***ABSTRAK***

Pada masa kini, perkembangan teknologi di negara ini semakin membangun dan ianya sejajar dengan Kerangka Malaysia Framework dimana Malaysia akan menjadi sebuah Negara *Smart City*. Kemudahan *Smart Parking* amat penting dalam membentuk konsep *Smart City* kerana masalah tempat letak kenderaan merupakan masalah yang menjengkelkan. Selain itu, bilangan kenderaan juga semakin bertambah diatas jalan raya kerana kenderaan merupakan salah satu keperluan dan kini, nilai pasaran kenderaan seperti kereta juga murah. Disebabkan itu, pengguna perlu menggunakan lebih tenaga dan masa untuk mencari tempat letak kenderaan kosong secara manual dan ini akan membawa kepada kesesakan lalu lintas dan penggunaan bahan bakar yang berlebihan. Sistem ini merangkumi Raspberry pi sebagai pengawal utama, ESP32 sebagai pengawal kedua untuk mengawasi kekosongan tempat letak kenderaan, kamera Raspberry pi untuk menangkap nombor plat kenderaan, MySQL sebagai pangkalan data, Android Studio sebagai IDE untuk pembangunan aplikasi telefon pintar dan perisian OpenCV untuk proses pengiktirafan nombor plat kenderaan. Kamera Raspberry pi dipasangkan di tempat tertentu seperti di penghalang pintu masuk dan penghalang pintu keluar bagi menangkap nombor plat kenderaan untuk proses mengenalpasti pengguna. Sistem yang dicadangkan menggunakan Optical Character Recognition untuk segmen dan mengiktiraf karakter yang terdapat di dalam gambar yang dimasukkan. Terdapat beberapa proses untuk memproses gambar yang telah dilakukan menggunakan algoritma di dalam OpenCV yang boleh membaca gambar yang dimasukkan, prapemprosesan seperti menukar gambar asal kepada skala kelabu dan binari, segmen karakter. Nombor plat kenderaan akan ditukarkan kepada teks untuk dibandingkan dengan nombor plat kenderaan di dalam pangkalan data. Setelah Nombor Plat Kenderaan dipadankan, pengguna akan dikenalpasti dan penghalang pintu akan terbuka atau tertutup. Sensor infrared dipasang di setiap tempat letak kenderaan untuk mengesan kehadiran kereta. Aplikasi telefon pintar adalah penting kerana ianya memudahkan pengguna untuk memeriksa kekosongan tempat letak kenderaan. Kesimpulannya, pelaksanaan sistem ini dapat menyelesaikan semua masalah yang timbul seperti kesesakan lalu lintas, pembaziran masa dan tenaga minyak, dan memudahkan pengguna untuk meletakkan kenderaan tanpa bersaing dengan pengguna lain.



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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of study

For the time being, the number of vehicles on the road keep increasing as vehicles become one of necessity in our life. And currently, the market value of the cars is low. Hence, not only rich people can buy a car, even poor or average people are affordable to buy vehicles. Due to these scenarios, an unexpected issue occurs and one of them is limited parking space especially in open parking space. Limited parking space give a serious impact to the consumer such as traffic congestion, high fuel and time consuming. Some of the parking space or crowded places such as hospital are not efficient since our system do not have the real time data that allows drivers to check the availability of parking slot before arriving there. In addition, some of parking system using Radio Frequency Identification (RFID) but sometimes, it fails to work due to damage RFID tags or RFID read more than one time [1].

Since this issue keep growing, the development of smart parking lot with real-time space monitoring based on computer vision shall become one of our best solution for this matter. Our smart parking system has been designed to solve this parking issue by using the Internet of Things and technology. The network is connected with sensors, software and others technologies are called Internet of Things. Data are exchangeable among devices and systems over the internet.

By using all of this technology, users are able to shorten the time consuming. User have to register all details required to check the availability of parking slot in crowded area

before arriving there. The mobile application is able on Android phone only. The license plate number was captured by Raspberry Pi camera once the driver reach the parking entrance for user authorization. Input image will be processed to convert it into text before send to database to match with the registered license plate number that have been registered in the database. The database used will keep all data receive from mobile application or main controller. Once user have been authorised, the gate barrier will be opened. Only registered user can enter the parking area because the gate barrier will be not opened if there is no data for that license plate number registered. Some processes need to done same as entry gate when the user wants to get out and reach exit gate barrier.

## 1.2 Problem Statement

Currently, most of parking area having a serious issue in which the driver needs to spend a lot of time to find the free parking space especially in crowded area. In addition, the current system used in each parking slot are inefficient because driver cannot check the availability of parking slot before arriving there since a real-time data is not available. This problem will lead to illegally parked.

Some of parking system using Radio Frequency Identification (RFID) which used to read the vehicle RFID tag in the parking entrance to match the vehicle's unique RFID tag with the value in the database but sometimes, the system fails to work accurately due to damage of RFID tags or RFID read more than one tags at one time [1].

Due to this matter, smart parking lot with real-time space monitoring based on computer vision using Raspberry Pi and ESP32 will be develop. With this new parking system, we are able learn and understand the process of license plate number recognition using Raspberry Pi camera and OpenCV software, and monitor the effectiveness of smart parking lot with real-time space.

### 1.3 Project Objective

The objectives of this project are:

- a) To develop a smart parking lot with real-time space monitoring based on computer vision using Raspberry Pi and ESP32.
- b) To learn and understand the process of license plate number recognition using Raspberry Pi camera and OpenCV software.
- c) To monitor the effectiveness of smart parking lot with real-time space monitoring.

### 1.4 Project Significant

This system has been designed to give a real-time data of parking availability to user. In addition, it is also ease customer to park their vehicle with minimum waiting time without competing with others. Apart from that, user do not have to use touch n go card or RFID tags since to enter the parking area since this system use license plate recognition for user authorization.

### 1.5 Scope of study

The scope is to develop this system which is development of smart parking lot with real-time space monitoring based on computer vision. This proposed system was designed and suitable to be applied for open area parking only. Raspberry Pi has been chosen as the main controller to receive or send data from Raspberry Pi camera and database. ESP32 was used with infrared (IR) sensor to detect the presence of vehicle in the parking slot for parking slot real-time data and display the available parking slot to the user. Servomotor was used as a gate barrier and have been control by using Raspberry pi. 5 megapixels with a fixed focus lens on board will be used to capture the license plate number of vehicles. OpenCV software

was used for license plate number recognition process to convert the characters on the image into text using certain algorithm or command. Besides, MySQL database used in this system to keep all of the data including the text of license plate number. Moreover, XAMPP used as server for database retrieve and send data to mobile application. Lastly, Android Studio was used to create a mobile application for user registration in terms of fullname, username, password, email and plate number.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Nowadays, our technology development keeps rising not only in the industrial sector, but also in our lifestyle. Due to this technology enhancement, lots of advantage happen in our lifestyle such as save our time and cost, reduce traffic congestion issue and improve our working environment. In this chapter, we are summarizing some resources on our topic and analyze all collected resources in order to get the best hardware used for our project.

#### 2.2 Comparison on the previous parking system

[1] developed an Internet of Things (IoT) based smart parking reservation system using Raspberry-pi where drivers can make a reservation for parking in shopping mall or urban areas. The system has been designed to transmit data from real objects, internet, sensors and controllers to database. The Figure 2.1 shows the design of this system.

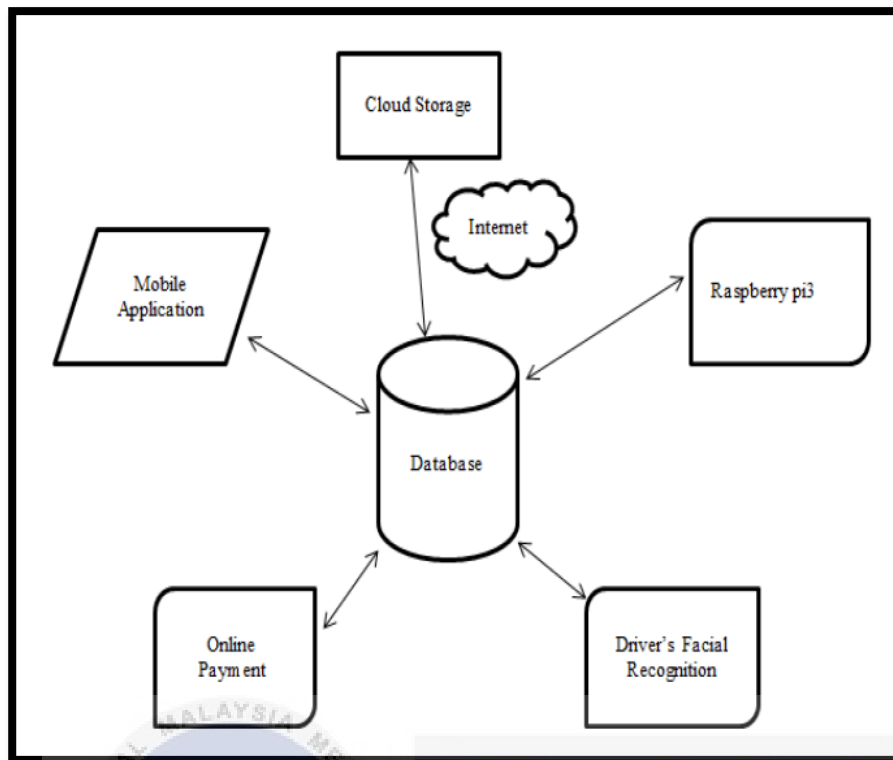


Figure 2.1: The Design of Smart Parking System [1]

The flowchart of the system has been shown in Figure 2.2. First, the user must download the Android or iOS application. Then, the details will be stored in the server once the registration is done. Next, the user can freely make a reservation for parking slot and users need to rush to parking slot within 15 minutes. The vehicle's license plate number and face will be snapped by using raspberry pi camera once the user reached the parking slot. This done to avoid security issues occurred. The user was able to enter their parking slot when the process is done. The parking time will starts counting once the vehicle's user successfully parked. The parking time will be stopped once the driver exits the parking slot. The user will receive their receipt and they can make an online payment through their mobile application. The user is allowed to the parking lot once driver's face match with the previous image using facial recognition. Mobile application has been created for users to store their details, made reservation and do online payments. There was one platform in mobile application have been used which were Android. Raspberry pi 3 was used in this system as

a controller to receive a signal from Raspberry pi 3 camera to recognize the user's vehicle's number plate.

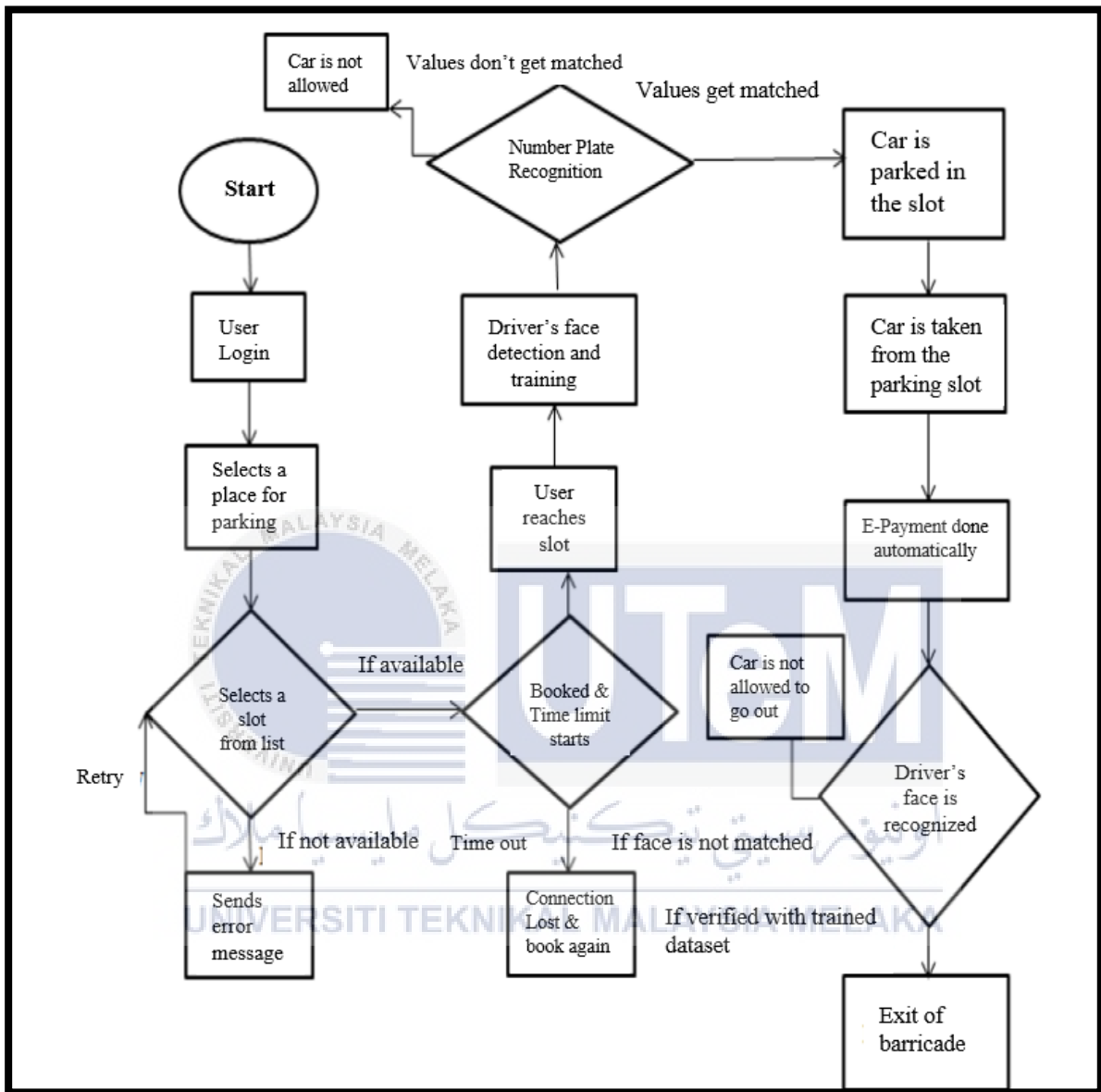


Figure 2.2: Flowchart of the system [1]

### 2.2.1 Smart Parking System Using Image Processing and Artificial Intelligence

[2] developed a smart parking system using image processing and artificial intelligence. For image acquisition, this system used ultrasonic wave to detect the presence of the car in the parking slot. Moreover, this system does not mentioned the platform either Android and iOS application as mobile application has been used for arrangement of parking

places, online payment and parking recommendation. Lastly, this system also uses Raspberry pi as a Wi-Fi router. Some device will be mounted on raspberry pi board which is Raspberry Pi 4G + GPS Shield. The ALPR camera will have an access control to each parking slot. Other device will be attached to the Raspberry pi known as Edimax wireless nano USB adapter through USB port to speed up the network.

### **2.2.2 IoT Parking Application with Car Plate Recognition for Smart City using Node Red**

[3] developed an IoT parking application with car plate recognition for smart city using Node Red and Raspberry pi. The ALPR software was used to recognize plate number through a Cloud Application Programming Interface (Cloud API) to enable the development of applications and services used for the provisioning of cloud hardware, software and platforms. The comparison of the output data with the record of license plates that have been registered in the database were thoroughly checked to open the gate.

Two controllers have been utilized; Arduino Uno R3 and Raspberry Pi 3. There were several components that were connected to Raspberry pi which were raspberry pi camera, PIR motion sensor and LED while, LCD, Servo Motor and Bluetooth Module were connected to Arduino Uno R3. Raspberry pi camera and PIR motion sensor were connected to the Raspberry Pi and identified the presence of car, respectively. Moreover, the Servo Motor functioned as a gate or barrier which will only be opened by the admin through Android application using Bluetooth module, HC-06. LED has been used to indicate the process once license plate number has been verified.