



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**NUMBER PLATE RECOGNITION SYSTEM BASED ON SOBEL  
EDGE DETECTION, BOUNDING BOX AND TEMPLATE  
MATCHING**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

By

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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: NUMBER PLATE RECOGNITION SYSTEM BASED ON SOBEL EDGE DETECTION, BOUNDING BOX AND TEMPLATE MATCHING

Sesi Pengajian: 2019

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## **APPROVAL**

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

.....  
(TS DR. ROSTAM AFFENDI BIN HAMZAH)

## ABSTRAK

Pengiktirafan plat nombor menjadi sangat penting dalam kehidupan seharian kita kerana peningkatan kereta dan sistem pengangkutan yang tidak terhad menjadikannya mustahil untuk diurus sepenuhnya dan dipantau oleh manusia, contohnya sangat banyak pemantauan lalu lintas, mengesan kereta yang dicuri, menguruskan tol tempat letak kereta, penguatkuasaan pelanggaran merah terang, tempat pemeriksaan sempadan dan kastam. Namun ia adalah masalah yang sangat mencabar, kerana kepelbagaian itu format plat, skala yang berbeza, putaran dan keadaan pencahayaan yang tidak seragam semasa pengambilalihan imej. Sistem ini adalah pendekatan berdasarkan kaedah pengesanan pinggir Sobel yang mudah tetapi cekap untuk penyetempatan plat. Pendekatan ini dipermudahkan untuk membahagikan semua huruf dan nombor yang digunakan dalam plat nombor dengan menggunakan pembahagian aksara kaedah pengikat kotak dan kemudian menggunakan Matching Template untuk pengiktirafan nombor dan aksara. Pekat diberikan untuk mencari kawasan plat nombor dengan betul untuk menyatukan semua nombor dan huruf untuk mengenal pasti setiap nombor secara berasingan.

## **ABSTRACT**

Number Plate Recognition became a very important in our daily life because of the unlimited increase of cars and transportation systems which make it impossible to be fully managed and monitored by humans, examples are so many like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border and customs checkpoints. Yet it's a very challenging problem, due to the diversity of plate formats, different scales, rotations and non-uniform illumination conditions during image acquisition. This system is approach based on simple but efficient Sobel edge detection method for plate localization. This approach is simplified to segmented all the letters and numbers used in the number plate by using bounding box method character segmentation and then to use Template Matching to recognition of numbers and characters. The concentrate is given to locate the number plate region properly to segment all the number and letters to identify each number separately.

## **DEDICATION**

To my lovely mum and dad,

Nasir Bin Omar and Midah Binti Md Yunus,

With loving sacrifices and their unconditional support in my life,

To my siblings and friends,

Who always who always help me prepared and completed this report.

And

For those I love very much

For the lectures, my supervisors, assistant engineers who are given  
much guidance to me without expecting any reward.

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## LIST OF ABBREVIATIONS

<b>%</b>	Percentage
<b>NPR</b>	Number Plate Recognition
<b>ITS</b>	Intelligent Transport System
<b>GUI</b>	Graphical User Interface
<b>NPL</b>	Number Plate Localization
<b>CS</b>	Character Segmentation
<b>OCR</b>	Optical Character Recognition
<b>CCA</b>	Connected Component Analysis
<b>NN</b>	Neural Network
<b>ANN</b>	Artificial Neural Network
<b>KNN</b>	K-Nearest Neighbors
<b>ROI</b>	Region of Interest
<b>HoG</b>	Histogram of Oriented Gradient
<b>RGB</b>	Red, Green, Blue
<b>HSV</b>	Hue Saturation Value

# CHAPTER 1

## INTRODUCTION

### 1.1 Project Background

The Number Plate Recognition (NPR) was invented in 1976 at the Police Scientific Development Branch in the UK. Number plate is used for identification of vehicle in all over the world. Vehicles are identifying either manually or automatically. Number Plate Recognition (NPR) is an image processing technology used to identify vehicles by their number plates registration. Vehicle identification plays important role in intelligent infrastructure systems and intelligent transportation system (ITS). Vehicle identification system used for the purpose applications such as unattended parking lots, security control of restricted areas, traffic law enforcement, congestion pricing, and automatic toll collection. Consequently, numerous unused algorithm has been created, particularly to identify the car number plate naturally. There are numerous challenges involved in number plates recognition. In spite of these numerous algorithm, contrasts in rules, shape, content textual style, color and format for the number plate in a certain nation lead to miss recognition for a few algorithms. Additionally, the natural factors, for example, light, brightness, dirt influences the outcome. For instance, in Malaysia, the number plate can be in two distinct composes, white numbers and letters with dark background or the other way around.

## 1.2 Problem Statements

Nowadays, the vehicles play a very big role in transportation especially in Malaysia. The increasing of vehicle will be causing the busy traffic at certain area and therefore plate recognition system was built to solve this problem. In UTEM, the parking management is a big problem for student in Faculty Engineering Technology campus because the parking lot is very limited. The University should be the only vehicle student third and fourth year can be entering the campus but a reports from the university state that the problem arises from unregistered vehicles entering the university because some students who try to copy a sticker made by a university. For university, the system must check if the vehicle requesting access have been registered with university and checking it will require the database that uses to store about information about the vehicle. This plate recognition system has been used in several countries but uses a variety of algorithm and generates differences of accuracy of algorithm based on method was used. The algorithm will be creating only the Malaysia car plate number because the already algorithm indicate isn't proficiency to recognize the number plate and not performing extremely well agreeing standard benchmark frameworks and still can't achieve 100% exactness.

### **1.3 Objectives**

The objectives of this project are as follows:

- a) To develop Number Plate Recognition System (NPRS) algorithm based on Sobel Edge Detection, Bounding Box and Template Matching technique.
- b) To develop a Graphical User Interface (GUI) based on the MATLAB software to display the detail about the cars.
- c) To analyze the performance accuracy of algorithm based on the standard benchmarking system for number plates recognition.

### **1.4 Scope of Projects**

The goal of this project is to build a system using image processing to recognize vehicles utilizing their number plate registration based on number plate specification approved by their country. After that, this system will be read the each of the character lying on the number plate and will recognize them by using algorithm based on MATLAB software. Although, this project focus to detect the number plate from input images then observe the output. Moreover, this project is developing to analyse the accuracy of performance the algorithm and GUI will be developed on MATLAB to display the output character of the plates. In this project, there have some limitation such as algorithm cannot detect number plate when the image taken is the images of a whole vehicle but only recognized the number when the image is only the number plate images. The algorithm also limited to Malaysian plate number only. The recognition process is only working on the template size of 24x42 pixels.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This part will talk about the researches of the related project. It will cover about the study and idea based on the previous project as well as the hypothesis accomplish of this project. The methods used for complete this project will be explained each part in details.

#### 2.2 Related Work

##### 2.2.1 Automatics Number Plate Recognition on FPGA

The author proposed a FPGA implementation to solving the ANPR algorithm included 3 methods of Number Plate Localization (NPL), Character Segmentation (CS) and Optical Character Recognition (OCR). The figure below shows a block diagram of the proposed system (Xiaojun Zhai, 2013).

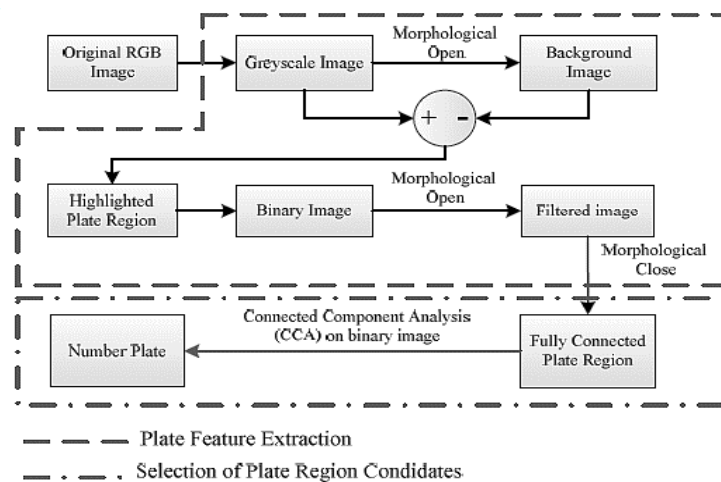
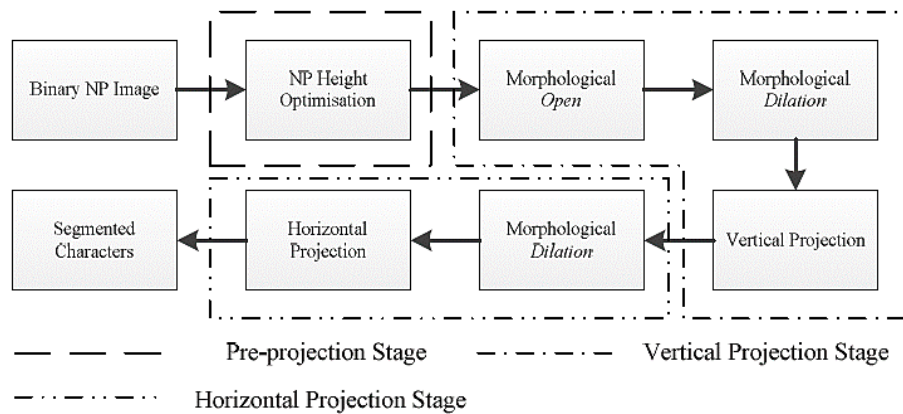


Figure 2.2: Block Diagram of NPL system

Based on the figure 2.2, the begin with open morphological task is capacity to separate the component of number plate and second open process is to expel the clamor. Although, the author also uses Connected Component Analysis (CCA) to mark the connected pixels from previous stage to binary images. The CCA scans and labels the pixels of a binarized image component and every pixel is assigned with a value depending on the components (Surajit Das, 2017). After that, the CS algorithm is used related on pixels and morphology process and also was divided by 3 stage it is pre-projection, vertical and horizontal projection. The diagram below appears the block diagram of CS system.



**Figure 2.3: Block Diagram of CS system**

Based on figure above, the unnecessary part of number plate was removed by a number plate height optimization and then morphological and dilation method was utilized to release the noise effect. Then, the horizontal projection presented to localize horizontal positions of the characters.

After that, the method OCR was used by author. This method used a multi-layer feed forward Neural Network (NN) to convert character images into machine code text. The neural network is an information-processing capability that is

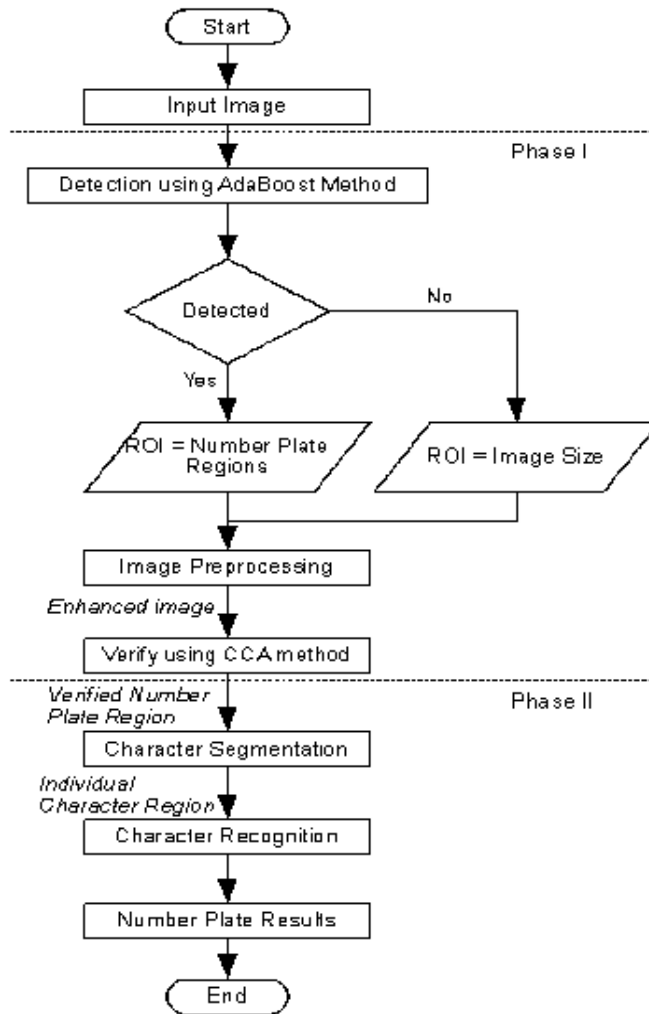
influenced by the same way as the biological nervous system, like brain (H.E. Khodke, 2017). From the result, the ANPR systems required 80 percent of the on-chip FPGA slices of Virtex-4 and the remaining 20% can utilized for executing the communication and show units. This proposed system only run with the maximum frequency of 57.6 MHz and execution time finished this processing of one image is 11ms. Lastly, the successful segmentation rate for NPL, CS and OCR are 97.8%, 97.7% and 97.3% with respectively and overall system accuracy of proposed system is 93.0%.

**Table 2.2: Comparison successful accuracy of proposed system**

ANPR System	Character Set	Hardware Platform	Successful Rate (%)	Speed (ms)
[5]	Australia	TI C64 DSP	85	52.11
[19]	Turkey	FPGA Virtex-4	73	500
[20]	Japan	PC Intel Core 1.8 GHz	93.54	284
[21]	Chinese	PC 3 GHz	93.9	293
Proposed System	UK	FPGA Virtex-4	93.0	11

### 2.2.2 Malaysian Car Number Plate Detection and Recognition System

Author proposed implement of Malaysia car number plate detection and recognition system by using number plate detector depends on combination of AdaBoost and connected component analysis (CCA) algorithms (Choo Kar Soon, 2012). The objective of this project is recognize distinguished number plate are utilizing KNN classifier technique.



**Figure 2.4: Flowchart of proposed system**

In detection stage, the vehicle number plate discovery calculation dependent on AdaBoost needs to perform an offline training to acquire a strong classifier. A huge accumulation of pictures which incorporate positive and negative number plates tests are required during training stage to improve the strong classifier. In the midst of number plate disclosure using AdaBoost calculation, a sub-picture needs to experience all the classifier with the ultimate objective to be recognized as number plate region.