Faculty of Electrical and Electronic Engineering Technology

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

MUHAMMAD AMIRUL FAIZ BIN MOHD REDWAN

Bachelor of Computer Engineering Technology (Computer Systems) with Honours

2022

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

MUHAMMAD AMIRUL FAIZ BIN MOHD REDWAN

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Computer Engineering Technology (Computer Systems) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek :

Sesi Pengajian :

Saya **Muhammad Amirul Faiz Bin Mohd Redwan**.. mengaku membenarkan laporan Projek Sarjana

Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☒	**TIDAK TERHAD**	

Disahkan oleh:

Faiz

(TANDATANGAN PENULIS)

(COP DAN TANDATANGAN PENYELIA)

Ts. DR. ROSTAM AFFENDI BIN HAMZAH
Dean
Faculty of Electrical & Electronic Engineering Technology
Universiti Teknikal Malaysia Melaka

Alamat Tetap:

No 65 Jalan Impian Setia, Saujana Impian, 43000 Kajang Selangor.

Tarikh: 11/1/2022

Tarikh: 11/1/2022

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled "NUMBER PLATE RECOGNITION SYSTEM BASED ON SOBEL EDGE DETECTION, BOUNDING BOX AND TEMPLATE MATCHING" 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.

Signature : Faiz

Student Name : MUHAMMAD AMIRUL FAIZ BIN MOHD REDWAN

Date : 11/1/2022

APPROVAL

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 Computer

Engineering Technology (Computer Systems) with Honours.

Signature :

Supervisor Name : TS Dr. Rostam Affendi bin Hamzah

Date : 11/1/2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

To my lovely mum and dad,

Mohd Redwan Bin Abd Rahman and Nor Aidah Binti Deraman,

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

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 like traffic monitoring, tracking stolen cars, managing parking toll, red-light traffic violation enforcement, border, and customs checkpoints. Yet it is 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 segment all the letters and numbers used in the number plate by using bounding box method character segmentation and then to use Template Matching to recognize of numbers and characters. The concentrate is given to locate the number plate region properly to segment all the numbers and letters to identify each number separately.

ABSTRAK

Pengecaman 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. Focus ini diberikan untuk mencari kawasan plat nombor dengan betul untuk menyatukan semua nombor dan huruf untuk mengenal pasti setiap nombor secara berasingan.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to all those who provided me the possibility to complete this report. A special gratitude I give to our final year project supervisor, TS Dr. Rostam Affendi bin Hamzah, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my project especially in writing this report. Not to forget both of my dearest father and mother who has contributed in many forms in order to help me with this project regardless in energy, time and money. A special thanks goes to my friends especially my group mates and those who are under the same supervisor of mine who help me to assemble the parts and gave suggestion about the task. I have to appreciate the guidance gave by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills thanks to their comment and advices.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

NPL	-	Number Plate Localization
NPR	-	Number Plate Recognition
OCR	-	Optical Character Recognition
RGB	-	Red, Green, Blue
%	-	Percentage
GHZ	-	Gigahertz

LIST OF ABBREVIATIONS

GUI	-	Graphical User Interface
ITS	-	Intelligent transportation systems
UteM	-	Universiti Teknikal Malaysia Melaka
CCA	-	Connected Component Analysis
NN	-	Neural Network

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 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 systems (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 algorithms have been created, particularly to identify the car number plate naturally. The identification of number plates is fraught with difficulties. Despite the numerous algorithms, differences in rules, shape, content textual style, colour, and format for the number plate in a specific country cause a few algorithms to fail to recognize the number plate. Furthermore, natural variables such as light, brightness, and dirt influence the result. In Malaysia, for example, the number plate may have two different designs: white numbers and letters on a dark background, or the other way around.

1.2 Problem Statement

Vehicles are now an important part of transportation, especially in Malaysia. As the number of vehicles on the road rises, traffic congestion will increase in certain areas, necessitating the development of a plate recognition system to address the issue. Since the parking lot at

UTEM are extremely restricted, parking management is a major issue for students at the Faculty of Engineering and Technology campus. The university can be the only car that third- and fourth-year students will use to access the school, but according to university records, the dilemma occurs from unregistered cars entering the campus due to some students attempting to duplicate a university sticker. For university, the program must verify whether the vehicle seeking entry has been registered with the university, which would necessitate the use of the database that stores vehicle details. This plate recognition system has been used in many countries, but it employs a few algorithms, resulting in variations in algorithm accuracy depending on the process employed. Since the algorithm has already shown its inability to identify the number plate and has not performed exceptionally well in comparison to traditional benchmark systems, it will be limited to only making Malaysian car plate numbers.

1.3 Project Objective

The objectives of this project are as follows:

a) To develop an algorithm for the Number Plate Recognition System (NPRS) based on the Sobel Edge Detection, Bounding Box, and Template Matching techniques.
b) To create a Graphical User Interface (GUI) that uses MATLAB tools to show information about cars in detail.

c) To assess the algorithm's output accuracy using a traditional benchmarking method for number plate recognition.

1.4 Scope of Project

The aim of this project is to create a framework that uses image recognition to identify vehicles based on their number plate registration and country-approved number plate specifications. Following that, this machine can read each of the characters on the number plate and identify them using a MATLAB software-based algorithm. However, the aim of this project is to detect the number plate from the input images and then observe the results. Furthermore, this project will build an algorithm and GUI on MATLAB to show the output character of the plates to analyses the accuracy of results. There are some limitations in this project, such as the algorithm's inability to detect number plates when the picture taken is of the whole car, but only recognizes the number when the image is only of the number plate images. The algorithm is also restricted to Malaysian license plate numbers. Only the sample format of 24x42 pixels is used in the recognition process.

a)

1.5 Summary

By the conclusion of this chapter, I have a better understanding of the project's issue as the number of cars on the road increases, traffic congestion will increase in some areas, forcing the construction of a plate recognition system to handle the problem. As a result, we decided to use the Sobel Edge Detection, Bounding Box, and Template Matching methods to create an algorithm for the Number Plate Recognition System (NPRS). develop a graphical user interface (GUI) that shows detailed information about vehicles using MATLAB tools. As a result, the goal of this project is to develop a framework that uses image recognition to identify cars based on their registration numbers and country-approved number plate standards. Following that, using a MATLAB software-based algorithm, this computer can scan each of the characters on the number plate and identify them.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This part will talk about the research 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 completing this project will be explained each part in detail.

2.2 Related Work

2.2.1 Automatics Number Plate Recognition on FGPA

Xiaojun Zhai, 2013[1] 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.

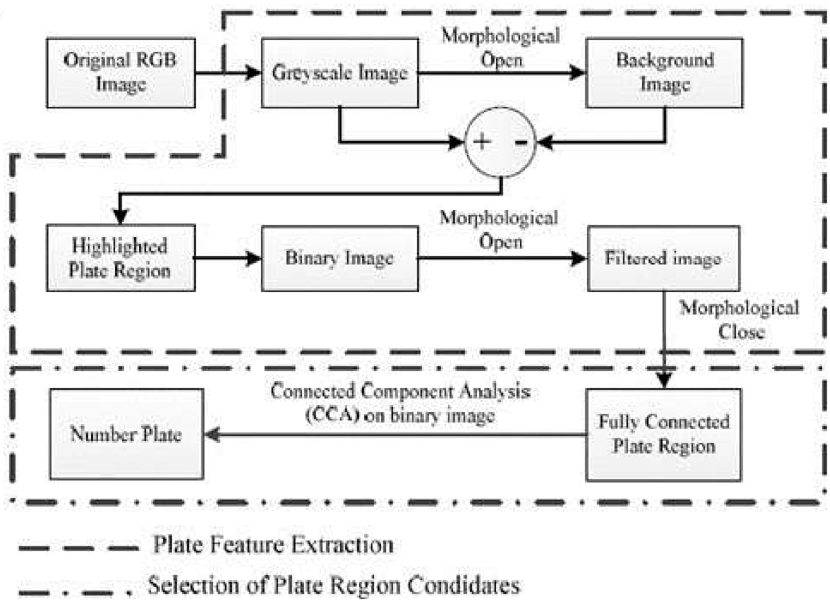

Figure 2.1: Block Diagram of NPL system

Based on the figure 2.1, 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. Surajit Das, 2017 stated CCA scans and labels the pixels of a binarized image component, and every pixel is assigned with a value depending on the components. 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.

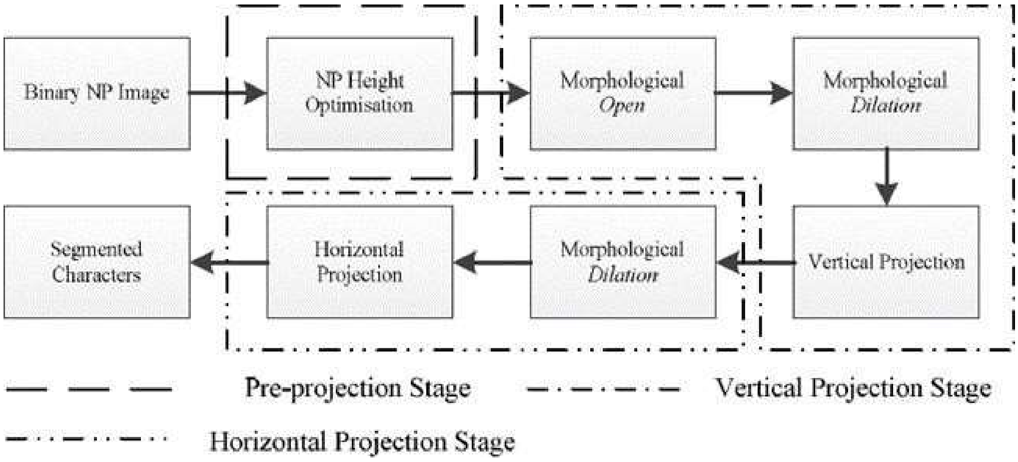

Figure 2.2Block Diagram of CS system

According to the image above, a number plate height optimization was used to eliminate the unneeded section of the number plate, and then morphological and dilation methods were used to reduce the noise effect. The horizontal projection was then used to locate the letters' horizontal placements. After then, the author employed the OCR approach. To translate character pictures into machine code text, this approach employed a multi-layer feed forward Neural Network (NN). According to H. E. Khodke, a neural network is a data-processing facility that is impacted in the same manner as the biological nervous system, such as the brain, is. The architecture of a two-layer feed forward Neural Network is depicted in the diagram below (NN).

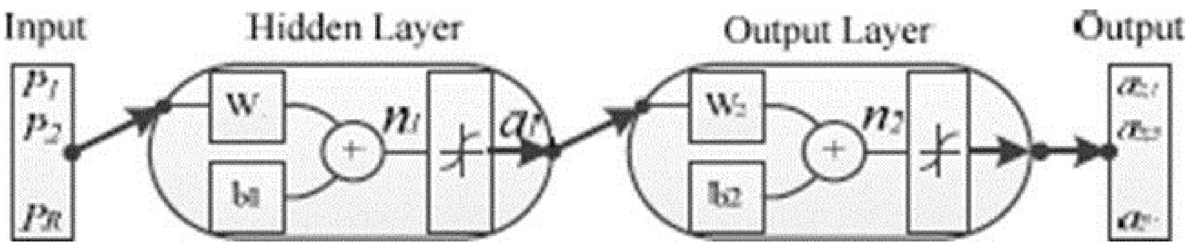

Figure 2.3Architecture of Neural Network

Consequently, the ANPR systems used 80 percent of the Virtex-4 on-chip FPGA slices, while the remaining 20% was used to run the communication and display units. This