UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTOMATIC VEHICLE RECOGNITION USING MORPHOLOGICAL AND TEMPLATE MATCHING TECHNIQUE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Computer Engineering Technology (Computer Systems) with Honours.

by

KHAIRUL IKHWAN BIN SAMSUDIN
B071410514
950909-04-5091

FACULTY OF ENGINEERING TECHNOLOGY

2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **AUTOMATIC VEHICLE RECOGNITION USING MORPHOLOGICAL AND TEMPLATE MATCHING TECHNIQUE**

SESI PENGAJIAN: **2017/18 Semester 2**

Saya **KHAIRUL IKHWAN BIN SAMSUDIN**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✔)

☐ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

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

☐ TIDAK TERHAD

Disahkan oleh:

_____   _____

Alamat Tetap: Cop Rasmi:

_____

_____

_____

Tarikh: _____   Tarikh: _____

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

DECLARATION

I hereby, declared this report entitled "Automatic Vehicle Recognition Using Morphological and Template Matching Technique" is the results of my own research except as cited in references.

Signature   :   …………………………………….

Author's Name   :   …………………………………

Date   :   …………………………………

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Computer Engineering Technology (Computer Systems) with Honours. The member of the supervisory is as follow:

…………………………………

(Project Supervisor)

ABSTRAK

Dokumen ini adalah berkenaan automatik pengenalan kenderaan menggunakan kaedah morfologi dan teknik padanan templat. Projek ini akan mencipta satu sistem menggunakan perisian MATLAB. Projek ini mempunyai 3 objektif utama iaitu untuk meningkatkan pengenalan nombor pendaftaran kenderaan dengan menggunakan morfologi dan teknik padanan templat, untuk menggunakan pengetahuan pengaturcaraan dengan menggunakan perisian MATLAB dan Simulink untuk menyiapkan projek ini dan akhir sekali adalah untuk menganalisa adakah prestasi dan ketepatan teknik yang digunakan dapat menghasilkan pengenalan nombor kenderaan yang efisien. Proses morfologi digunakan untuk membuatkan gambar yang dimasukkan lebih terang dan proses yang terlibat adalah proses pengembangan dan proses hakisan dan proses ini adalah berdasarkan bentuk. Proses ini dilakukan menggunakan struktur elemen ke dalam imej yang dimasukkan and proses ini akan membezakan setiap nilai piksel dengan nilai piksel jiran untuk mendapatkan gambar keluaran. Gambar yang dimasukkan mestilah dalam keadaan yang baik untuk memastikan mudah diproses untuk proses-proses yang akan datang iaitu proses segmentasi dan proses pengenalan setiap karakter.Dokumen ini menggunakan teknik padanan templat di mana ia akan membezakan karakter yang telah disegmentasi dengan karakter yang sudah ada dalam pangkalan data dan karakter yang mempunyai level persamaan yang paling tinggi akan dipilih sebagai keluaran karakter. Hasilnya, daripada 30 sampel nombor pendaftaran kenderaan yang dicuba menggunakan sistem ini, 18 daripadanya memberikan respon dengan jayanya and memberikan sebanyak 60% untuk ketepatan sistem ini. Konklusinya, sistem ini berjaya dimajukan walaupun terdapat sedikit masalah yan menyebabkan kepada sistem tidak dapat mengenali nombor pendaftaran kenderaan dengan efisien.

ABSTRACT

This document is about an automatic vehicle recognition using morphological process and template matching technique. This project will design a system from a MATLAB software on automatic number plate recognition. This project have 3 main objectives which is to develop a vehicle plate number recognition by using morphological and template matching technique, to apply the programming knowledge by using the MATLAB software and Simulink in order to compute the project and lastly is to analyze whether the performance and the accuracy of the technique used can efficiently recognize the vehicle plate number. In order to enhance the image quality for future process, the morphological process was used to make the input image clearer and sharper and the process that are involved are dilation and erosion and the process are based on the shapes. The process are done by applying the structuring elements into an input image and the process will compare each pixel value with its neighbour in order to produce output image. Dilation will adds the pixels to the boundaries of objects in an image while erosion will removes the pixels on object boundaries. The input image must be in good condition in order to being processed in the future process which is segmentation and recognition of the character process. To recognize the plate number, this document will use the template matching technique where it will compare the segmented characters with the character in the database and character that have the most similarity level will be choose as an output. As a result from this research, from a 30 samples that have been tested, 18 plate number responded successfully and give the percentage of 60% of accuracy for the system. To be conclude, the system was being successful developed in this project despite some problems that lead to inefficiency of the system to recongnize some kinds of plate number.

DEDICATION

To my beloved parents, Samsudin Bin Kassim and Norizan Binti Md Sin who always support and inspiring me during process of completing this project.

To my respected supervisor, Mr Rosman Bin Abd Rahim who taught me from the start of this project, from I have zero knowledge for this project until I can finish this project on time.

Sincerely, from my deepest heart, thank you for all the support and guidance that help me to complete this project.

v

ACKNOWLEDGEMENT

Firstly, I would like to thank God because finally after 5-6 months. I am able to finish this project. Special thanks to my father, Samsudin Bin Kassim and my mother, Norizan Binti Md Sin for always keep supporting me throughout my ups and downs during finishing this project. I would like express my gratitude to my dedicated supervisor, Mr. Rosman Bin Abd Rahim. Not to forget to all Fakulti Teknologi Kejuruteraan (FTK) lecturers that provides many resourceful information that related to this project. Lastly, a big thanks to all my friends in Universiti Teknikal Malaysia Melaka (UTeM) especially to my housemates that keep helping me in many things in order to make this project happened.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ALPR	-	Automatic License Plate Recognition
ANN	-	Artificial Neural Network
ANPR	-	Automatic Number Plate Recognition
FFNN	-	Feed Forward Neural Network
GUI	-	Graphical User Interface
GUIDE	-	Graphical User Interface Development Environment
MATLAB	-	Matrix Laboratory
OCR	-	Optical Character Recognition
UTeM	-	Universiti Teknikal Malaysia Melaka
GUI	-	Graphical User Interface

CHAPTER 1
INTRODUCTION

1.0   Introduction

This chapter presents the overview for overall description for this project. Hence, this chapter also provides the brief information of the background of project, problem statement, objectives and scope.

1.1   Background

Nowadays, so much criminal takes place everywhere by using a vehicle. This is because it is easy for them to run away right after doing the crime. Usually, it is difficult for people around the crime scene area to recognize the vehicle plate number.

Plate number is vehicle registration plate and it will vary for every vehicle. Plate number is a unique official identification number for every vehicles and must be registered with the official agency. Plate number is unique because it is combination of some letters and numbers. There is no vehicle with same plate number. Every vehicle will have different plate number and each country have different format to assign the plate number. For example, in Malaysia, the most-right letter will represent where the vehicle being registered. If the vehicle register in Selangor and Melaka, the plate number will start from letter 'B' and 'M' respectively. The vehicle plate number usually placed in a front and rear of a vehicle

1

so it is easy to detect or see the plate number especially when there is a crime involving a vehicle or hit-and-run by a vehicle.

The only way and maybe the best way to recognize the plate number are by installing the security camera around the high possibility crime scene area. Other than it can help monitoring the area, it also can help in detecting the plate number or the criminal body gesture. Hence, this program is made to identifying the plate number after it being captured by the security camera. There is some importance of this system and one of it is can reduces the crime rate in the using area because when it captured the image and after system have done, the output result will give the right plate number. So, it will not take time to identify the car that involves in the crime. Next, the system can be used in a high school or university where the student is prohibited to use a car. So, the systems will detect all cars that passing through the main gate and it will detect if any students break the rule.

In this project, the software we want to use is MATLAB software. This is because the software will fulfill all the requirement needed including the pre-processing part. The program also can run the mathematical operation, correlation function which is used in this project to detect the possibility of the plate number. Correlation function will be used in order to correlate between the input image and the template image.

By the end of this project, the system will recognize the vehicle plate number that being tested and will give about 70% of accuracy rate.

1.2   Problem Statement

The problems are for an automatic recognition of vehicle plate number without human supervision for solving many problems such as:

a. Any vehicle is involved in some crime such as accident, burglary, theft, violation of any traffic rules.

b. A crime happened in a quiet place.

c. Smuggling of cars.

d. Usage of cars in terrorist attacks or illegal activities.

e. In speed trap.

f. Parking entrance.

1.3   Objectives

The objectives of this project are:

a. To develop a vehicle plate recognition by using morphological and template matching technique.

b. To apply the programming knowledge by using the MATLAB software and Simulink in order to compute the project.

c. To analyze whether the performance and the accuracy of the technique used in the system can efficiently recognize the vehicle plate number.

1.4   Scope

The scope of this project will involve the use of MATLAB software to compute the algorithm. The work scope also involves the image processing discipline where the input image will be processing digitally in order to solve the recognition problems. MATLAB can help in segmentation of vehicle plate number by using it is bounding box property. After the input image is taken, pre-processing process will be carried out including from RGB image to grayscale and then to binary. Next, process to brighten the image and remove noise was done which is erosion, dilation and median filter process. Then, the project used the mathematical operation which is correlation function and it can easily be done in MATLAB where correlation function is done in template matching process. Lastly, the input images

3

will be compare to the template image in order to get the output. The figure below shows the framework for the system that will be develop in this project from the captured of image until the output that will be stored in the text file.
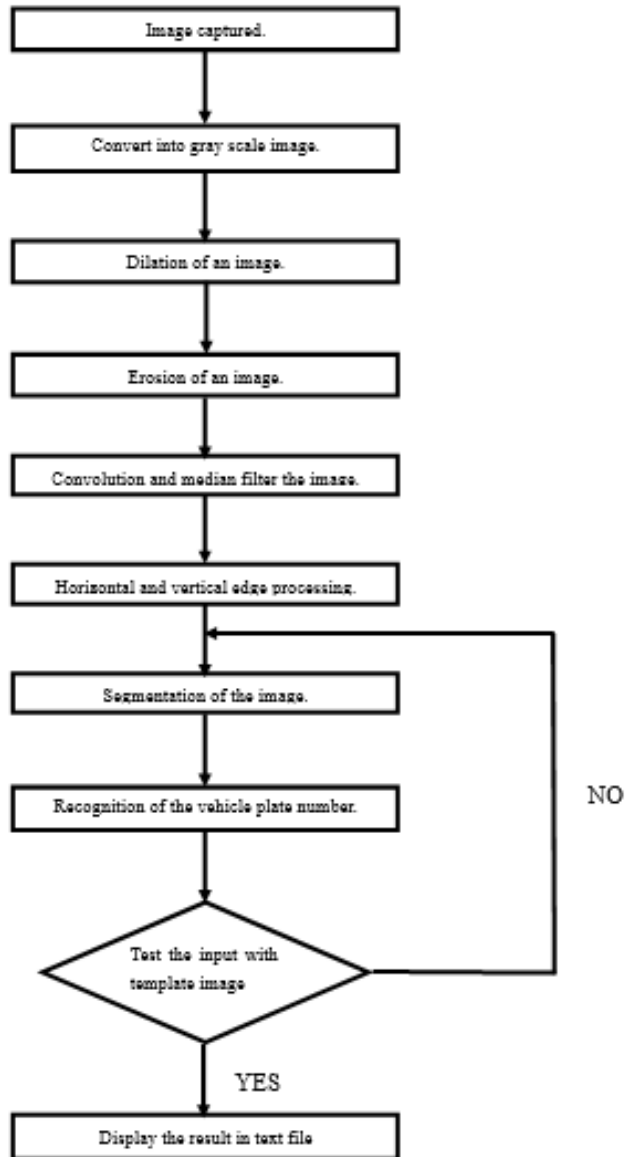

Figure 1.1: Flow chart of the project

1.5   Chapter Summary

This report is basically the discussion of the how the project will be done which is includes the morphological process and template matching technique. The morphological process and the technique will be combine in order to gain the right output. In chapter one (1), the introduction of the project was explained which includes the background, objectives, problem statement and scope of the work. The second chapter will discuss on the literature review and the related review. This will include the discussion about the accuracy when another technique and process used. Besides, it will also discuss on how to overcome the problem from other technique. Chapter three will discuss about the methodology used to complete the project. So, the software used and the features in the software will be discuss precisely. Next, in chapter four, we will focus on the result obtain and if the result cannot be obtained and will discussing the problem on why it cannot produce the right output. In last chapter, the recommendations and conclusions of the project will take place.

CHAPTER 2
LITERATURE REVIEW

2.1   Overview

This chapter will cover about the past research about the automatic vehicle plate recognition and will discussed about the methods used and the result that obtained from past researches. From the articles that have been go through, there are many different methods used and it is more about recognition of the number plate. For the morphological part, mostly research used the same technique which is pre-processing process from conversion of the image, enlighten the image by using erosion and dilation process and using median filter to remove noise in the input image.

2.2   Introduction

Nowadays, in order to minimize the human activity there are many technology or systems being invented and one of them is automatic vehicle plate recognition and in the last few years, it has become an important subject of study. Not only, it can prevent a crime like smuggling of cars, it also can improve the security of a parking lots where it will alert to violations of permitted, time limited or scofflaw vehicles. By using this system, the management mainly can detect if any wrongdoings by any vehicle driver and this will help to reduce the crime activity in that area. Not just that, this system also used by police forces to check whether the vehicle is registered or not and whether it is involved in any crime or wrongdoings

such as clone cars and stolen cars. Even though it can capture the image and reduce the crime, it also fears the citizens if the image taken is misidentification. It also used by police forces as a method of electronic toll collection on pay-per-use roads and monitoring traffic activity, such as red light adherence in an intersection (Badr *et al.*, 2011).

Automatic vehicle plate recognition will recognize the correct plate number if and only if the pre-processing process had done successfully because if the input image still in RGB, it cannot undergo enlighten process like erosion. Then, the segmentation also the important part because if the area of interest taken is not what it should be, the output result will not produce the correct answer because the technique used need to match the input image with the template image.

There are many techniques that can produce the correct output but all the techniques need the clearly image that already enlighten and already remove the noise in the image.

2.3   Pre-Processing Method

Pre-processing is the main and important step before move to the next steps. To recognize the input image using template matching technique, the image need to convert first or else it will not recognize the image. Same goes to erosion and dilation process it will process the only if the image is grayscale or binary image and will undergo the process if the image is still in RGB.

Pre-processing process for an image will go through many procedures like grey-scaling, dilation, erosion and edge enhancement. After converting RGB images or the input image to the Grayscale image by using mathematical morphology and the Sobel operator will be used to calculate the value of the threshold of the image. Basically, pre-processing process are the preparation for the input images (Khodke, Nagargoje and Patil, 2016) and it is essential to enhance the input image (Badr *et al.*, 2011) for the next stages of the system. Not just that, this process will removes noise,

7

highlight edges in order to improve the quality of the image (Munuo, 2014). To fill the holes in the binary images, use the imfill function.

2.4   Morphological Process

Based on Vandini (2014) in their research about automatic license plate recognition, the input image must have a background of yellow and they have to find the regions where contains the intensity of R(Red), G(Green) and B(Blue) that corresponding to the yellow colour. The nearest value of the arena is calculated and considering arena as black and then depends on the RGB index, the plate number is binarized. Comparing to research from Mitra (2014), after the input image has converted into a binary image, the erosion and dilation process carried out. This process is often used to remove irrelevant details from binary images and dilation is used to fill the gaps or hole (Mitra, 2014). Not just that, the research also make image opening and image closing. Opening generally smooth the contour of an object, breaks narrow isthmuses, and eliminates thin protrusions (Mitra, 2014) while image closing tends to smooth sections of contours but as opposed to opening, it fuses narrow breaks and fills gaps in the contour (Mitra, 2014). Following are the example for erosion, dilation, image opening and image closing:
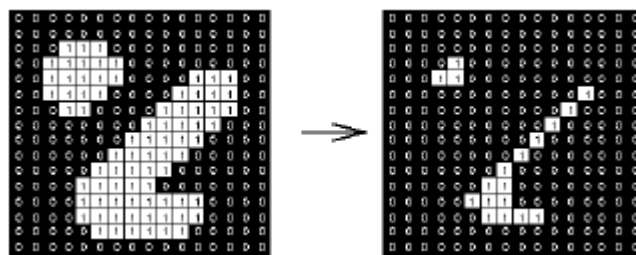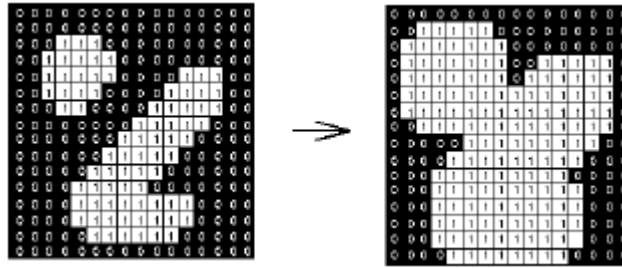

Figure 2.1: Example of erosion process

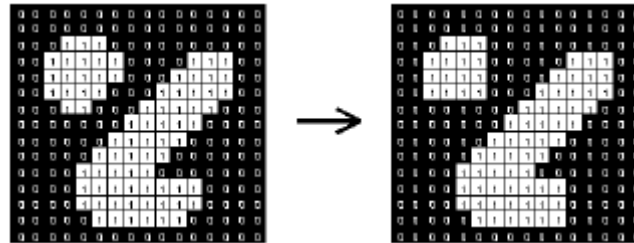Figure 2.2: Example of dilation process

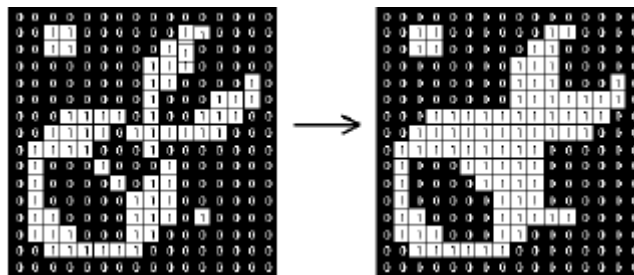Figure 2.3: Example of image opening

Figure 2.4: Example of image closing

2.5   Methods used for Character Recognition

There are many methods for recognize the plate number after the plate number being pre-processed and segmented. According to Munuo (2014), the technique or methods used are improved algorithm. The algorithm was developed by using a MATLAB R2012b software by first creating the database template for each letter and numbers that contained A-Z letters and 0 to 9 numbers as it is used in Tanzanian numbering system. The developing of the database template is based on the letters and numbers used in the country where the system developed. The example of database template is as follows:

9