UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF CAR PLATE NUMBER RECOGNITION SYSTEM: AN IMPLEMENTATION OF MVTECH IMAGE PROCESSING LIBRARY

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Engineering Technology (Automation and Robotics) (Hons.)

By

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FACULTY OF ENGINEERING TECHNOLOGY
2015

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SESI PENGAJIAN: **2014/15 Semester 2**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Application & Robotics) with Honours. The member of the supervisory committee is as follow:

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ABSTRAK

Sistem pengenalpastian plat kereta adalah berkenaan penempatan dan pengenal pastian nombor plat kereta. Terdapat banyak aplikasi yang boleh digunakan dengan menggunakan sistem ini seperti akses parkir kereta, kawalan lalu lintas dan pemantauan keselamatan. Sistem ini telah dijayakan dengan menggunakan teknik pemprosesan imej dan disimulasikan dengan menggunakan perisian Halcon. Projek ini terbahagi kepada dua kaedah yang terdiri daripada fungsi luar talian dan fungsi dalam talian. Projek ini pada asasnya melibatkan pembangunan algoritma yang boleh mengenal pasti karakter iaitu huruf dan nombor pada plat kereta. Antara proses pembangunan algoritma yang dibangunkan terdiri daripada proses pengekstrakan plat, proses segmentasi plat, dan proses pengenal pastian plat. Optical Character Recognition (OCR) telah digunakan untuk mengenal pasti setiap karakter pada imej yang mengandungi nombor plat. Bagi fungsi luar talian , sistem ini telah diuji dengan menggunakan *80 sampel imej* kereta yang berada di sekitar Kampus Teknologi, UTeM Sampel tersebut bertujuan bagi menganalisa ketepatan algoritma yang dibangunkan, manakala bagi fungsi dalam talian, kamera USB telah digunakan untuk menangkap imej dalam masa nyata dan imej tersebut akan diproses dengan *menggunakan perisian Halcon. Data yang terhasil boleh digunakan bagi tujuan* analisis di masa hadapan.

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ABSTRACT

A car plate recognition system is about localizing and recognizing the license plate number of car. Many type of application can be applied by using this system such as parking access, traffic control and security monitoring. This system was accomplish by using Image Processing technique and simulate by using HALCON software. This project is developing and designing with two mode which is in offline and online mode. This project is basically involves the development of the algorithm that can recognize the character on the license plates by implementing the MVtech image processing library. The algorithm designed consists of Plate extraction process, Plate segmentation process, and Plate recognition process. The implementation of Optical Character Recognition (OCR) is used to recognize each character on the license plate number images. In offline mode, this system was tested on 80 samples of car still images around Campus of Technology for the accuracy of algorithm developed while for online mode, the USB camera was used to capture the image in real time and the image will be process by using HALCON software. The data executed will be used for further analysis.

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DEDICATION

Specially dedicated to my family

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LIST OF SYMBOLS AND ABBREVIATIONS

JPJ	=	Jabatan Pengangkutan Jalan
OCR	=	Optical Character Recognition
GUI	=	Graphical User Interface
UTeM	=	Universiti Teknikal Malaysia Melaka
HALCON	=	Machine Vision Software
UN	=	United Nation
MLP	=	Multilayer Perceptron
UELA	=	Unwanted Lines Elimination Algorithm
RGB	=	Red Green Blue
VEDA	=	Vertical edges based detection
USB	=	Universal Serial Bus
IDE	=	integrated development environment
3D	=	Three dimensional
ROI	=	Region of Interest

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CHAPTER 1

INTRODUCTION

This chapter will introduce the overview of the car plate number recognition system. It will consist of the problem statement of this system and background of this research. Other than that, the scope and objective that will be cover for this project will be discussed.

1.1 Overview

License plate is act as a personal identification for a various vehicles. Therefore, it has been use for various security and traffic application involving the vehicles such as controlling access of parking system, entrance admission, security monitoring and crime prevention operations.

License plate number act as a personal identification for a various vehicles. Therefore, it has been use for various security and traffic application involved by vehicles such as controlling access of parking system, entrance admission, security monitoring and crime prevention operations.

In Malaysia, generally the plate numbers begin with alphabet and followed by number. A legal plate number design usually in single or double row. There are 3 type of specification of number plate that allowed by Department of Road Transport (JPJ). Since the specification are white alphabets and number that embossed or glue on the black plate, it is different with some country such as Czech (Petr Cika, 2011), Iran (Mahmood Ashoori-Lalimi, 2011) and India (Sourav Roy, 2013).

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This paper is focusing on localizing and recognizing the license plate number on the still image by using image processing technology in different condition such as environment, type of car and the major different condition are the quality of the images captured. Image processing are method to convert an image into digital form and perform some operation in order to get an enhanced image or to extract some useful information from it (Mohd Firdaus Zakaria, 2010. In this project, Optical Character Recognition (OCR) library has been used to recognize each character extracted from the plate number.

In UTeM, each of vehicles own by students and staffs must be registered with Jabatan Keselamatan. For this system, it will distinguish the staff's vehicles and student's vehicles. Next, by using database application and Graphical User Interface (GUI), this system will display the details of the vehicle such as the driver name and attendance time at Campus Technology UTeM.

1.2 Background of Research

This research is basically about one of the machine vision application which is to recognize the plate number of car by using image processing technique. To develop an algorithm, there are 7 basic frameworks that will be applied in image processing. Firstly is the Image Acquisition or Image Representation. In this process, the image file such as BMP, JPEG, TIFF and etc. will be acquired with some header which is the image information such as resolution and format.

Second process are image pre-processing that used for magnify, reduce the scale of image and to rotate the image that have been combining two or more image in a single large image. This process is for preparing the image for the next process. Next, the image enhancement process which is consists of edge enhancement, noise filtering, sharpening, and contrast. It is useful for feature extraction and image analysis. For this project, this process can be used for localizing the region of interest (ROI) and for plate number extraction.

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Image analysis is for making quantitative measurement from an image. The segmentation technique is for isolate the ROI from the background so that the measurement will be more accurate and efficient. Image Segmentation is the process that subdivides an image into its constituent part. For this project, the plate number will be segment into each character individually.

After segmentation process, the image will be label based on the gray value. For this project, the segmented image will be label based on the shape and colour. Each character indicated by different colour.

1.3 Problem Statement

This project was developed to apply the license plate number recognition in UTeM by using image processing technology. Every day, the security will check every vehicle at the entrance to make sure all vehicles are registered with Jabatan Keselamatan UTeM. This will cause the congestion especially during peak time especially in the morning where all staffs is rushed for punch card their attendance while student are rushed for their class.

The security is not able to fully monitor and check for every vehicle at the time. This situation can be a problem such as when there is a robbery occurred at that place. The security cannot trace the vehicles enter and out during that time. This is because they still use the conventional method which is using a log book that possible to be misplaced and lost. This system can be an input analysis to trace the vehicles that have possibility involve in that situation. The analysis will give information about the vehicles that pass the entrance such as vehicles details, driver's detail and time.

1.4 Objectives

The objective of this project is aim to:

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1) Design and develop algorithm for detecting the car plate number supported by Mvtech Image Processing library

2) Implementation of image processing using two major step (offline and online mode)

3) Analyze the accuracy of the algorithm.

4) Integrate the algorithm designed with Graphical User Interface (GUI)

1.5 Scope

The scope of this project is developing the algorithm by using HALCON 7.0 software. This project is only focusing on the staff's and student's car in Technology Campus,UTeM. It is not applicable for van, motorcycle, lorry and public transportation such as taxi and bus. The image of car is captured randomly at the entrance of Technology Campus, UTeM. The system will be executed in control environment such as on a sunny and cloudy day. The images are not captured on the night vision because of most of the activity at this campus in a day.

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CHAPTER 2

LITERATURE REVIEW

This chapter will discuss about researches and the image processing technique that had been done before in developing a Malaysian car license plate number recognition system.

2.1 Type of License Plate Number

A license plate number is a small metal or plastic plate attached to vehicles for identification purposes. On each vehicle, it must attach in pair which is at the front and rear. In Malaysia, there are 3 specification of license plate number allowed by Department of Road Transport (JPJ) as shown in figure 2.0. There are:

a) White alphabets and numbers embossed or glued on a black plate.
b) White alphabets and numbers embossed or glued on a red plate for vehicles belonging to embassies, the UN and the International Natural Rubber Association.
c) Black alphabets and numbers embossed or glued on a white plate for taxicabs and hired cars.

Malaysian plate number are in the form of single row or two rows that have been standardized by JPJ as shown in figure 2.1. It is different with other country license plate number such as Czech and India. According to Sourav Roy, Amitava Choudhury and Joydeep Mukherjee, Indian plate number are containing white or

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yellow background with black foreground and start with two digit letter followed by two digit numeral followed by single letter after those four consecutive digits (Sourav Roy, 2013).

For this project, it will focus on common cars for both form of plate number which is single and double row. According to the project by Othman Khalifa, Sheroz Khan, Rafiqul Islam, Ahmad Suleiman (Othman Khalifa, 2007) and by C.N Anagnostopoulos, I. Anagnostopoulos, V Loumos and E.Kayafas (C.N Anagnostopoulos, 1994), they were focused on both license plate form which is vertical and horizontal. The project by Petr Cika, Maartin Zukal, and Miroslav Sebela (Petr Cika, 2011) are focused on horizontal license plate form. All of them are focused on car license plate only. So that, this project will also focus on car license plate for both license plate form.

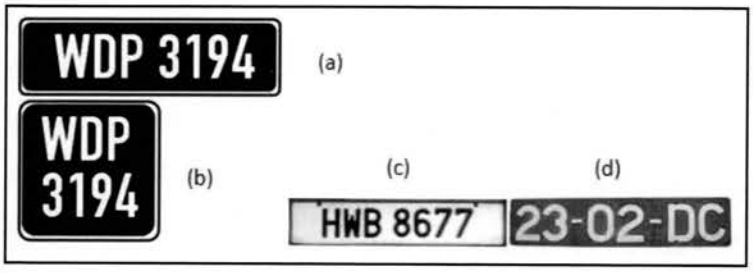

Figure 2.1: (a) One row license plate form (b) Two row license plate form (c) Samples of taxi license plate (d) Sample of embassy license plate

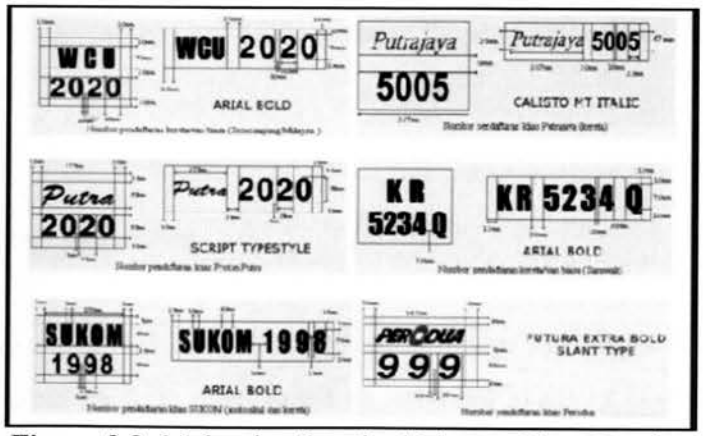

Figure 2.2: Malaysian Standard License Plate Number

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2.2 Application of Plate Recognition System

According to Nima Asadi in "A study of Automatic License Plate Recognition Algorithms and Technique" license plate recognition consist of three main processes which is localization of the license plate location, segmentation of the character and identification of the license plate number character (Asadi). In first process, by localizing the location of the license plate it may help to minimizing the processing time taken for the next process. To get the exact location of the license plate is a crucial process in license plate recognition (Norazhar Abu Bakar, 2012). This is challenging due to the nature of light. License plate recognition is a new tool for automatic vehicle and traffic monitoring.

License plate recognition two major application are for security and automation(S.Kranthi). There is another application that can be use by using plate recognition system:

a) Highway toll collection
b) Traffic analysis
c) Vehicles thief prevention
d) Enforcement of traffic rules
e) Border control system
f) Security monitoring
g) Car park entrance

For this project, its application is based on security monitoring and admission entrance. It also can be used for monitoring the attendance of the staff and students respectively.

2.2.1 Image Processing

Image processing is a method to convert an image into digital form and perform some operation on it, in order to get an enhanced image or to extract some useful information from it. Image processing has two types of method which is digital and

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analogue. For car plate recognition system, image processing method such as thresholding, edge detection and filtering has been used to localizing and recognizing the plate and the character. There are three general phases as show in figure 2.3 that the data should undergo are pre-processing, enhancement and display, and information extraction.

For this project, it will use digital image processing. This is because digital image processing methods help in manipulation of the digital images by using computers. There are four primary algorithms that the software requires for identifying a license plate according to Othman Khalifa (Othman Khalifa, 2006) as shown in figure 2.4:

1) Plate localization – responsible for finding and isolating the plate on the picture
2) Plate orientation and sizing - compensates for the skew of the plate and adjust the dimensions to the required size.
3) Normalization - adjust the brightness and contrast of images
4) Character segmentation – finds the individual characters on the plates

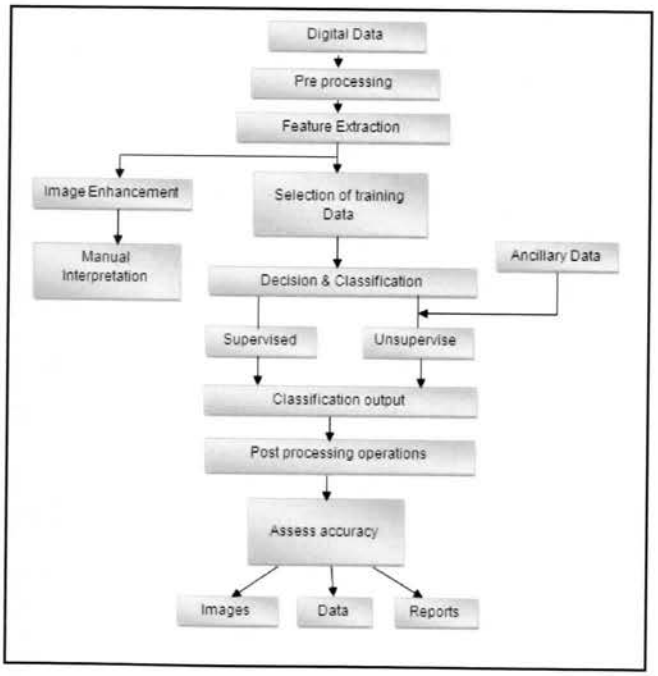

Figure 2.3: Digital Technique Phases

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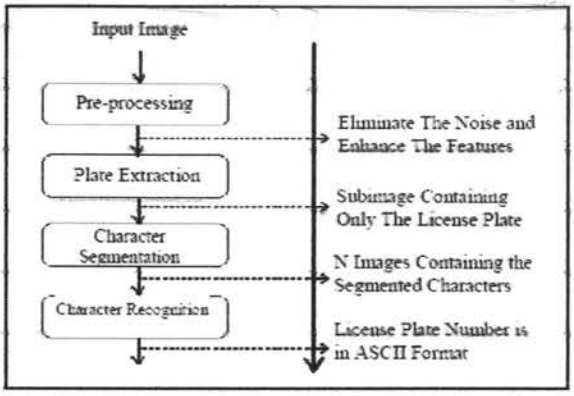

Figure 2.4: License Plate Recognition Model

2.2.2 Image Acquisition

Image acquisition is the process of obtaining an image from the camera. This is the first step of any vision based system. In this project, the image acquired by using a digital camera captured in the Technology Campus, UTeM for frontal image of vehicles and facing outgoing vehicles for back image. The image captured and loaded to the system are in RGB colour. Normally, the images captured are in JPEG file.

The original image is generally in a large pixel. If it is necessary, the image need to be resized or cropped because the upper part does not contain a plate number area as shown in figure 2.5. According to (Norazhar Abu Bakar, 2012) to this process can minimized the processing time during filtering process later.

In research by (Abbas M. Al-Ghaili, 2012) the image was captured by using web camera with 352 x 288 resolution and the plate detection was perform for the whole scene image. It is complex due to the ambient lighting condition, interference character and other problems.

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