UNIVERSITI PUTRA MALAYSIA

CHARACTER CLASSIFICATION FOR LICENSE PLATE RECOGNITION SYSTEM BASED ON IMAGE PROCESSING USING MATLAB

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By

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To My Family

ABSTRACT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

CHARACTER CLASSIFICATION FOR LICENSE PLATE RECOGNITION SYSTEM BASED ON IMAGE PROCESSING USING MATLAB

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January 2016

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A License Plate Recognition System (LPRS) is one of the most important systems used for monitoring and controlling transportation and traffic in many countries. The LPRS is used for many purposes such as toll collection, traffic monitoring and control, smart parking, speed limiting Because of its importance, LPRS should be continually studied and improved by doing a lot of studies to solve each problem that can reduce the performance of LPRS. One of the problems is the noise in the captured images, caused by rain and haze, which lead the system to incorrectly recognize the characters. To address this problem, multiple filters to reduce the noise inside the images, especially the noises which is caused by haze and rain, have been investigated. Studies attempt to enhance the effectiveness of the system that is used to detect and recognize car plate characters and numbers and to find

the accurate algorithm most suitable for specific countries, depending on the country's standard car plate specifications. Because of our study done in Malaysia, and for Malaysian car plates we should know more about Malaysian car plate design. Malaysia has specific car plates designed with black background and white font at a fixed size. Several applications have been developed in Malaysia to identify these plates and recognize the characters and numbers. This research is mainly focused on comparing two such applications. Each application uses a different algorithm and each algorithm will be tested with the same proposed filters and dataset, which is taken under bad weather and illumination conditions to test each algorithm's performance in the most challenging cases.

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First and above all, I praise God, the almighty for providing me this opportunity and granting me the capability to proceed successfully.

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Special thanks to my dearest friends who are always willing to help and to share ideas and knowledge at times when they are busy with their own project themselves. I will treasure their friendship.

I certify that a Thesis Examination Committee has met on 18 January 2016 to conduct the final examination of **Mustafa Adil Hashim** on his thesis entitled "**Character Classification for License Plate Recognition System Based on Image Processing Using Matlab"** in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the master degree.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

MUSTAFA ADIL HASHIM

Date:

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LIST OF ABBREVIATIONS

LPRS	License Plate Recognition System
OCR	Optical Character Recognition
ASCII	American Standard Code for Information Interchange
GUI	Graphical User Interfaces
HDR	High Dynamic Range
HDRI	High Dynamic Range Imaging
EV	Exposure Value
RGB	Red, Green and Blue

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, it's not that easy to manually enforce law and control traffic due to increasing numbers of cars around the globe [Jusoh, N. A., and Zain, J. M., 2011]. Highway tolls and parking fees are also problematic, as they require the drivers to stop. This can cause a traffic jam, waste the time of the drivers, and necessitates a human monitor at all times. A traffic speed controller system on free high ways is also needed to automatically and continuously monitor the roads. For all these applications, we can see the importance of having an automatic system to make these processes more effective [Kate, R., 2012]. This requires automatic identification of each car, not by color, model, or mark, but by its unique number.

Each country has different license plate designs. To get the number from the plate we have coding some programs to let the system recognize the plate design itself and how to extract the number. Only then can it be compared with a database to access the full records on the vehicle's owner and legal information.

In recent years, a lot of research has worked on extending the License Plate Recognition System's (LPRS) [Toral, S. L., Torres, M. M., Barrero, F. J., Arahal, and M. R., 2010]. The LPRS is dependent on computer vision and text mining, first using image-processing technology to extract high level information from a digital image or video, and then

classifying each character and number from this plate by recognizing the cars and their plate numbers. As mentioned above, LPRS has become an important research topic because of increasing traffic. So a lot of cars now a day using the road and needed a lot of techniques and effort to monitoring, control and manage those roads in order to avoid traffic jam and road crimes. In this study we will focus on LPRS, beginning from the detection and photo capture of a vehicle using a high quality camera. After that, the software uses filters to delete unwanted pixels and objects from this picture and detects the location of the car's plate. By using optical character recognition (OCR) [Peng, H., Long, F., Chi and Z., 2003], we can identify and classify the numbers and letters, converting them from image to written and editable characters. By comparing these numbers to the vehicle database, users can learn more about this vehicle and its legality status.

The dataset used in this study is for Malaysia's normal license plates numbers, so we must know more information about the plates such as its design and shape. There are three standard types of Malaysian number plates: white characters embossed or glued on a black plate; white characters embossed or glued on a red plate for vehicles belonging to embassies, the UN, and the International Natural Rubber Association; and finally black characters embossed or glued on a white plate for taxicabs and hired cars. The plate itself comes in two sizes. The horizontal plate is 48cm*10cm, with the characters aligned horizontally. The vertical design is 34cm*17cm, with the characters distributed in two lines, the first for alphabetic and the second for numeric characters. In this design, the distance between each line is 10mm. In all cases, plates usually contain three letters to indicate the different states of Malaysia. Tables 1 to 4 show some of these indications.

Table 1: Registration plates of Peninsular Malaysia

Registration plates of Peninsular Malaysia			
Prefix	State	Prefix	State
A	Perak	M	Malacca
B	Selangor	N	Negeri Sembilan
C	Pahang	P	Penang
D	Kelantan	R	Perlis
J	Johor	T	Terengganu
K	Kedah	W	Kuala Lumpur

Table 2: Registration plates of Sarawak

Registration plates of Sarawak					
Prefix	Division	Prefix	Division	Prefix	Division
QA/QK	Kuching	QL	Limbang	QR	Sarikei
QB	Sri Aman and Betong	QM	Miri	QS	Sibu and Mukah
QC	Samarahan	QP	Kapit	QT	Bintulu

Table 3: Registration plates of Sabah

Registration plates of Sabah					
Prefix	Division	Prefix	Division	Prefix	Division
SA, SAA-SAC	West Coast	SG	Sabah Government	SS	Sandakan
SB	Beaufort	SK	Kudat	ST	Tawau
SD	Lahad Datu	SL	Labuan (replaced)	SU	Keningau

Table 4: Registration plates of Malaysian Taxi

Registration plates of Malaysian taxis (post-1980s)			
Prefix	State	Prefix	State
HA	Perak	HM	Malacca
HB	Selangor	HN	Negeri Sembilan
HC	Pahang	HP	Penang
HD	Kelantan	HQ	Sarawak
HE	Sabah (replaced)	HR	Perlis
HJ	Johor	HS	Sabah
HK	Kedah	HT	Terengganu
HL	Labuan	HW	Kuala Lumpur

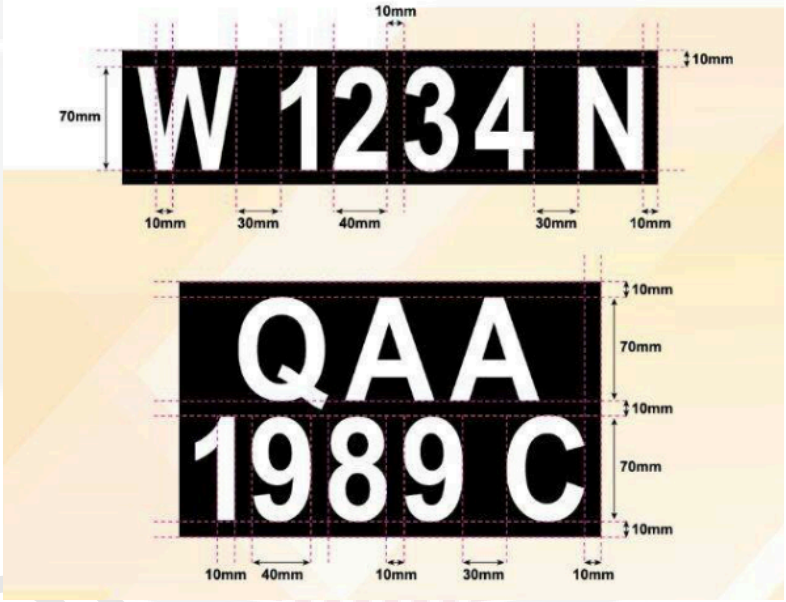

Figure 1: Malaysian plate number designs and size.

As we can see in figure 1, the distance between letters or numbers it self is approximately 10mm, and the distance between the letters and numbers is 30mm. The width of the numbers is around 40mm and the width of the letters is around 60mm, depending on the letter itself because the width of letter (W) is more than the width of letter (J) and so on for the other letters [Chang, S. L., Chen, L. S., Chung, Y. C., Chen, and S. W., 2004].

1.2 Problem Statement

The noise in the captured images due to haze and rain hinders the effectiveness of the system, leading the system to an incorrect plate localization then wrong character recognition.

1.3 Objectives of Research

1. To investigate different filters that can reduce the noise inside images, especially the noise caused by haze and rain, so as to enhance the effectiveness of the system.
2. To investigate the best approaches and algorithms using Matlab to extract and recognize the license plate's characters from cars images, then convert them to ASCII editable text as output.

1.4 Scope of Research

This research was done using Matlab R2015a. The input consisted of 150 images taken with a high quality camera (Canon 7D), which was installed on a moving car to take pictures of several moving cars. Pictures were taken from different angles and at different distances from the target [Emiris, D. M., Koulouriotis, and D. E., 2001, Davies, P., Emmott, N., Ayland, and N., 1990, Adorni, G., Bergenti, F., Cagnoni, and S., 1998, Naito, T., Tsukada, T., Yamada, K., Kozuka, K., Yamamoto, and S., 2000, Abdullah, S. N. H. S., Khalid, M., Yusof, R., Omar, and K., 2006]. This was done to create the most challenging cases to test the performance of the system.

The dataset used in this study is for Malaysia's normal license plate numbers.

1.5 Thesis Structure

This thesis is divided into five chapters:

Chapter 1: introduces and the background of the license plate recognition system and explains the problem statement, objectives of the research, and project scope.

Chapter 2: focuses on literature review and other related work on license plate recognition system techniques and algorithms.

Chapter 3: details the methods used in this research and the processes of different algorithms.

Chapter 4: discusses all results obtained from the system and the limitations of this research.

Chapter 5: discusses the conclusion of this research with some recommendations for future work and development.

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