MALAYSIA CAR PLATE RECOGNITION

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DECLARATION

I hereby declare that this thesis, submitted to University Malaysia Sabah as partial fulfillment of the requirements for the degree of Bachelor of Computer Science (Software Engineering), has not been submitted to any other university for any degree. I also certify that the work described herein is entirely my own, except for quotations and summaries sources of which have been duly acknowledged.

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10th July 2015 _____

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ABSTRACT

Automatic Number Plate Recognition (ANPR) has gained much popularity over the years. ANPR are used for automatic toll collection and management for parking areas. However, there is no international common standard for car plates which makes the task of automatic car plate's recognition very challenging. In Malaysia, the Malaysian Road Transport Department (JPJ) is the government body in charge of issuing car plate licenses. Malaysian license plates consists of English alphabets and numbers and so designing ANPR for Malaysia license plates is straightforward and easy. However, there are a number of memorial plates, or plates with distinctive prefixes that are made available by the JPJ. These types of license plates are sold at a higher cost. These special plates are used to denote the manufacturer of the car such as Proton Malaysia introduced "Proton Waja" cars, a special event car plate BAMbee was issued in 2000 for Thomas and Uber Cup which was held in Kuala Lumpur in that particular year. Hence, designing an accurate ANPR system for such license plates is challenging. This research project involves autonomously localizes and recognizes non-standardized Malaysian's car plates using conventional Backpropagation algorithm in combination with Feed-Forward Neural Network (BPNN). The experimental result is compared with the results obtained using simple Radial Basis Function Network (RBF). This research aims to solve four main issues; (1) localization of car plates that has the same colour with the vehicle colour, (2) detection and recognition of car plates with varying sizes, (3) detection and recognition of car plates with different font types, and (4) detection and recognition of non-standardized car plates. The proposed method involves two tasks, pre-processing and recognition. The captured car images are first binarized in order to remove unwanted small objects. Then, filtering is applied in order to remove larger objects. Next, a deblurring technique is proposed to create an area for bounding box. The bounding technique could segment the characters correctly. Lastly, BPNN as well RBF are used to train the segmented and extracted characters. The experimental results show that the combination of BPNN and RBF can be effectively used to solve these four issues. In BPNN, letters 'J' and 'M' and digit '7' and '8' achieved 90.91%, 85.71%, 97.22% and 97.14%, respectively. In RBF, letters 'B', 'S' and digit '0' accuracy rates are 97.22%, 96.97% and 86.67%, respectively. Hence, it shows RBF performed better than BPNN.

ABSTRAK

Nombor Plat automatik Pengiktirafan (ANPR) dapat popularity banyak selama ini. ANPR digunakan untuk kutipan tol automatik dan pengurusan bagi kawasan letak kereta. Tugas pengiktirafan plat kereta automatik yang sangat mencabar sebab tidak ada ukuran antarabangsa untuk plat kereta. Di Malaysia, Jabatan Pengangkutan Jalan Malaysia (JPJ) merupakan badan kerajaan yang bertanggungjawab mengeluarkan lesen plat kereta. Plat lesen Malaysia terdiri daripada huruf Bahasa Inggeris dan nombor jadi menbentuk ANPR untuk plat lesen Malaysia adalah mudah. Terdapat beberapa plat peringatan, atau awalan plat tersendiri yang disediakan oleh JPJ. Jenis-jenis plat lesen dijual pada kos tinggi. Plat khas menunjukkan pengeluar kereta seperti Proton Malaysia telah memperkenalkan "Proton Waja" kereta, plat kereta khas seperti BAMbee telah dikeluarkan pada tahun 2000 untuk Thomas dan Piala Uber yang diadakan di Kuala Lumpur pada tahun berkenaan. Oleh itu, menbentuk sistem ANPR tepat untuk plat lesen adalah mencabar. Projek penyelidikan ini melibatkan cara autonomi untuk menempatkan dan mengiktiraf plat kereta tidak standard yang menggunakan algoritma Backpropagation konvensional dalam kombinasi dengan Rangkaian Neural Feed-Forward (BPNN). Hasil eksperimen dibandingkan dengan keputusan yang diperolehi menggunakan Radial Rangkaian Fungsi Asas (RBF) mudah. Kajian ini bertujuan untuk menyelesaikan empat isu utama; (1) penempatan plat kereta yang mempunyai warna yang sama dengan warna kenderaan itu, (2) pengesanan dan pengiktirafan plat kereta dengan pelbagai saiz, (3) pengesanan dan pengiktirafan plat kereta dengan jenis font yang berbeza, dan (4) pengesanan dan pengiktirafan plat kereta tidak standard. Kaedah yang dicadangkan melibatkan dua tugas, pra-pemprosesan dan pengiktirafan. Imej-imej kereta yang ditangkap adalah binarized untuk membuang benda kecil yang tidak diingini. Kemudian, penapisan digunakan untuk memadam objek yang lebih besar. Seterusnya, teknik deblurring adalah dicadangkan untuk mewujudkan kawasan yang diingini. Teknik bounding boleh segmen watak-watak dengan betul. Akhir sekali, BPNN serta RBF digunakan untuk melatih watak bersegmen dan diekstrak. Keputusan eksperimen menunjukkan bahawa gabungan BPNN dan RBF boleh digunakan secara berkesan untuk menyelesaikan empat isu. Dalam BPNN, huruf 'J' dan 'M' dan angka '7' dan '8' mencapai 90,91%, 85,71%, 97,22% dan 97,14%, masing-masing. Dalam RBF, huruf 'B', 'S' dan kadar ketepatan angka '0' adalah 97,22%, 96,97% dan 86,67%, masing-masing. Oleh itu, ia menunjukkan RBF prestasi yang lebih baik daripada BPNN.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Car plate recognition system is a system which aided human in reading car plate number in an efficient way which save energy and time. Before emerge of the computer-based car plate recognition, human recorded car plate number manually by using pen and paper until the introduction of the great technology in photo-enforcement industry, which is after the cold war. In 1993, it made a successful transition from the research bench to the commercial marketplace. And recently, there is an increasing number of vendor from every corner of the world are finding its way into progressively more solutions-oriented systems.

Image-processing technology which is a technique involve to treat the image as a two-dimensional signal and applying standard signal-processing to it. This technique is a crucial technique in car plate recognition system to read the car plate number from the car image. There are many ways of phrases to design a car plate recognition system by different vendors. The car plate recognition technology is also known as automatic number plate recognition, automatic vehicle identification, car plate recognition, car plate reader or optical character recognition for cars.

Car plate recognition system has a wide range of applications since the license plate of vehicles is the most primary, widely accepted, human readable, mandatory identifier of motor vehicles. This system has played a significant rules in traffic law enforcement and it is widely applied over the world to identify stolen cars based on the up-to date blacklist. There are other useful applications such as vehicle access control, automatic toll collection, real-time monitoring and parking area security and management.

This chapter is divided into seven sections. Section 1 provides a description of the problem background while section 2 provides a description of the problem statement. Section 3 defines the objectives of the project and section 4 defines the hypothesis of the project. Next, section 5 discussed the research question. In section 6, the scope of project is discussed. Finally, section 7 will outline how this report is organized.

1.1 Problem Background

Character recognition has played an important role in many system included car plate recognition system. This car plate recognition system is used in recognising car plate at the car park entrance. By employing this technology in car park entrance and exit management, conventional car park ticket system can be replaced. In the car plate recognition system, it identifies unique plate number of each car. Plate number can be read by computer using proper step of image processing which start from car plate localization, car plate extraction, character segmentation and recognition of characters.

Recognition happened quite frequently in real world but in artificial intelligence world, recognition is done through machine that is called pattern recognition. There are many important application areas of pattern recognition including finger print identification, voice recognition, face recognition, character recognition and signature recognition. Pattern recognition in research area has a close connection with the neural network since they are adaptive-learning, self-organizing and has capability of fault tolerance. That is why neural network is suitable in pattern recognition.

Although there has been many commercialized software that can be used for identification of car plate in automated car plate recognition system, they are not readily be used in certain countries where their car plate is not standardized like Malaysia. Character on car plate is differ in term of size, styles and format. Thus,

research and development of license plate recognition in Malaysia is still on going to overcome the existing issues.

Artificial neural network has played an important role in machine learning and cognitive science. Back-propagation Neural Network and Radial Basis Function Network are artificial neural networks that will be used in car plate recognition. There are less research have been done in comparison of back propagation neural network and radial basis function network in recognising characters. This has created an initiative to carry out the comparison of accuracy rate between the two artificial neural networks.

1.2 Problem Statement

Car plate in developed country such as United Kingdom and United States is standardized in term of types of fonts, letter size and plate size. This standardized car plates are easy to be localised and recognized by the existing car plate recognition system. Malaysia uses standardized car plate too, but special car plates are introduced from time to time to commemorate certain events or occasions. For example, when Proton (which is the main automobile manufacturer), produces a new model such as Perdana, Bambee, Satria and Waja, it is authorized to customize the license plates for their first one thousand customers.

This special privilege allows the car owners to have their car plates to be different from the standardized car plate. There are many non-standard car plate that cannot be recognized by current car plate recognition system. Character which appeared on standard car plate is individually separated and they have constant fonts type, letter size and plate size whereas character on non-standard car plate consists of cursive connected words and has inconsistent fonts type, letter size and plate size. Figure 1.1 shows the example of non-standard car plate which the character "PERODUA" is a cursive connected words.

Figure 1.1: PERODUA car plate

Localization of car plate is an important step in order to extract car plate and read the characters on the plate. When a car image is taken using camera, non-car-plate objects which around the car environment will be included into the image such as trees. This makes car plate localization becomes more challenging since localization of car plate may extract non-car-plate objects. Thus, character detection is done on objects found in car image before removing non-car-plate objects. Somehow, some of the car owners paste stickers which contained characters on their car. Stickers on their cars are advertisement sticker and information sticker which contained phone number, examples are shown in Figure 1.2 and Figure 1.3. Besides that, there are some logos appeared on the car which this logo is car manufacture's logo. Example of the car logo is "FORD" and "ISUZU" which can be seen in Figure 1.4 and Figure 1.5.

Differentiation has to be carried out between stickers, logos and car plate so that stickers and logo will be removed while car plate will be remained in the car image for further image processing. Besides that, car plate localisation becomes more difficult when there is no car plate border found on car in black colour. Standard car plate consists of a border around the edge of the car plate and the colour of the border usually is in white in colour. This issue causes the edge of the car plate cannot be detected since the background colour of the car plate is in black which same colour as the car. Figure 1.6 and Figure 1.7 show the example of car plate without border and the car is in black colour.

Figure 1.2: Advertisement sticker

Figure 1.3: Information sticker

Figure 1.4: Ford logo

Figure 1.5: Isuzu logo

Figure 1.6: Car plate without border

Figure 1.7: Car plate without border

1.3 Objectives

Here are the lists for objective of the project.

1) Design and implement a pre-processing framework for localising car plate number at car park entrance.

2) Design and implement a car plate recognition algorithm to recognise car plate number.

3) Compare results found using Feed-forward Back-Propagation Neural network and Radial Basis Function (RBF) Network.

1.4 Hypothesis

The hypotheses of this research are:

a. To generate rule-based algorithm to perform the car plate detection and localization tasks correctly.
b. To propose a new pre-processing technique to recognise the non-standard car plate which consists of connected cursive character.
c. Test and compare Feed-forward Back-Propagation Neural network and Radial Basis Function (RBF) Network in the recognition phase to recognise car plate character.

1.5 Research Questions

a. How to autonomously detect and localize car plate from a captured image?
b. Is that possible to have an algorithm that capable to recognise non-standard car plate which consists of connected cursive words.
c. Which of the artificial neural network will perform well in the recognition phases?

1.6 Research Motivation

Large number of papers within last three decades for car plate recognition have been demonstrated which shows the importance and the worth of this subject in literature. These corresponding implementations mainly fall into two categories which are the vehicle plate localization and the plate character recognition. Literatures of this two categories are particularly devoted to one of them and some considers both parts. By taking a look beyond the published papers and completed works in license plate identification over the years, it shows a particular motivation and enthusiastic. These motivations might address the essence of the subject and corresponding algorithms.

In regard to the essence of problem, one can classify three factors as main reasons and goals. First is the accuracy which itself is divided in to two subclass including accuracy on localization of vehicle license plate and accuracy on recognizing the license plate characters. In this field, especially more complex and robust works have been done in recent years. This is the attribute of advances in technologies which are proportional with increasing accuracy for intelligent agents.

The second factor is algorithm time complexity which is significant when the science purpose is implementation. For the car plate recognition system, some robust algorithm is presented but due to the high time complexity they are not applicable in real time systems. However, it is believed that those approaches could provide a proper pattern for novel hybrid or more simple algorithms.

Third factor is adaptability as expected the intelligent agent, the algorithm or the model has the ability to adapt itself with environment to cope with dynamic outdoor

conditions therefore without human being intervention the expected tasks has been done. In the case of license plate identification such conditions address the various lighting, weather, crashed etc.

To achieve adaptability, more efforts must be performed. Algorithms with enough generality and high accuracy can perform such tasks that need high adaptive capabilities. Such algorithms by supporting simple and complex conditions in their structural model bring confidence out for human beings. Increasing of confidence to machines is a direct relation with reliability of intelligent agents.

1.7 Project Scopes

In carrying out the project, here are the scope of the project. Car plate recognition system is recognising car plate number of static car which means that the car is not moving. Picture of static car is taken and kept as data and will be evaluated in the system. Besides that, the data is acquired at parking lots under bright environment which is on daytime. Camera will be used as a tool to capture car image at the parking lots. Next, there is no occlusion and broken characters on car plate when the car image is taken. Besides that, there is only one direction when the car picture is taken, which is 0 degree from the camera to the car. Last but not least, the distance when the car picture is taken is about four feet from the car.

1.8 Report Organization

The report outline contains the undergoing chapter of the final year project report.

Chapter 1 presents a general overview of this project, including the problem background, objectives, hypothesis, research question, project scope and the organization of this report. This chapter also gives explanation on the statement of problem.

Chapter 2 is the literature review where it summarizes the recent research and scholarly sources relevant on the particular issue and theory in this project. This chapter also summarizes the particular of theory on simulation approach that connected with this project.

Chapter 3 is methodology which summarize about the method that will be used in this project to obtain the result. In this project the method that will be used in recognizing the license plate character is image processing approach and neural network simulation using MATLAB.

Chapter 4 explains preliminary experiment and experimental setting. The result represent in form of performance table, the network simulation result from the network training and the discussion on recognition result.

Chapter 5 discussed result of car plate localisation rate and car plate character recognition. Experiment is conducted to the data and result of the accuracy rate is recorded. Analysis of the results will be carried out to check how well the accuracy rate is.

Chapter 6 concludes the report summary of the finding obtained from the whole FYP project. The conclusion on work experience and work effort done to meet the requirement on this project development is discussed. The future work on improve this project and recommendation on new title research that similar with the project also been suggest here.

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