DESIGN OF A RECOGNITION SYSTEM FOR SPECIAL MALAYSIAN CAR PLATES USING STROKE ANALYSIS

ANOOP SEHGAL A/L PARAS RAM

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A humble offering at the Lotus Feet of Dearest SAI,
whose divine grace made this possible.

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ABSTRACT

Car-plate recognition systems are used commercially, both in the overseas and locally. In Malaysia, however, the usage of car-plate recognition systems is restricted to the ordinary car-plates. This means that the system is unable to detect car-plates assigned for taxis, as well as special types of car-plates. These special types of car-plates use special words to designate special occasions such as *SUKOM*, *Putrajaya*, *Tiara*, etc., instead of using the normal alphabets. Therefore, this system is aimed for implementation of a recognition system for Special Malaysian car plates using the recognition technique of Stroke Analysis. The system consists of several modules. The system is an offline system where the images gathered are first preprocessed using image processing techniques. Next, the image is converted into a binary image. After that, the boundary of the car plate characters is extracted. Then the image is passed through a stroke analysis system, i.e. the main module of the system. Here, the strokes for the characters are extracted and matched to a listed sequence. Finally, the system displays the output in ASCII format.

ABSTRAK

Sistem mengecam plat kereta digunakan di secara komersial di luar negara dan juga secara domestik. Walaubagaimanapun, di Malaysia, penggunaan sistem ini terhad kepada pengecaman plat kereta biasa. Ini bermakna, system tersebut tidak dapat mengecam plat kereta yang digunakan untuk teksi dan juga plat kereta jenis khas. Plat kereta jenis khas ini menggunakan perkataan khas seperti *SUKOM*, *Putrajaya*, *Tiara* dan sebagainya. Oleh yang demikian, sistem ini ditujukan bagi mengenali plat kereta khas di Malaysia dengan menggunakan kaedah penggenalian analisis strok. Sistem ini terdiri daripada beberapa modul. Sistem ini merupakan sistem offline di mana imej plat kereta yang dikumpul akan pada mulanya diproses menggunakan kaedah pemprosesan imej. Selepas itu, imej tersebut akan ditukar ke imej binary. Seterusnya, rangka bagi huruf di dalam plat kereta diperoleh. Setelah itu, imej akan diproses oleh modul utama system, iaitu modul analisis strok. Di sini, susunan strok bagi setiap huruf diperoleh dan dibandingkan dengan susunan yang telah disenaraikan dalam program. Akhirnya, huruf yang dicam dipamerkan oleh sistem dalam format ASCII.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

1.1.1 Car Plate Recognition Systems

Until recently, all wet film and digital images of car plates were interpreted by humans. However, much technology that was developed in the cold war has now found its way into the photo-enforcement industry. Computer-based car plate recognition emerged in the 1980's. In 1993, it made a successful transition from the research bench to the commercial marketplace. And recently, it has started to become available from a greater number of vendors. Now, the technology is finding its way into progressively more solutions-oriented systems.

A car plate recognition system is an image-processing technology used to identify vehicles by reading their car license plates. Different vendors tend to use slightly different phrases to designate their car plate recognition system. 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.

Dramatically increasing traffic density is evident in long waits on obstructed motorways. Motorists lose time and money, and safety and security are compromised. Into this scenario comes one form of relief: the image-based car plate recognition technology, which captures, interprets, records, and processes the image of a car license plate for use in a variety of applications.

1.1.2 Overall System

A typical car plate recognition system comprises a video image-acquisition subsystem, a central processing unit for image processing and control, a hardware-based or software-based character recognition engine, and storage or transmission subsystem for electronically recording plate contents and data such as date, time, and location that are pertinent to the end application.

As a vehicle enters a system's field of view, it triggers a complex processing cascade. Vehicle presence can be detected by an external trigger, such as a trip wire, in-ground loop, or cross-traffic light beam, or an internal trigger, wherein the signal change from the video subsystem alerts the processor that an object of interest may be present. The video camera, with its synchronized shutter and illuminator, then captures an image or series of images of the passing vehicle.

Once the image is digitized, the next job is to determine if and where a license plate is located. The system must search for a plate among a sea of similar objects such as bumper stickers, fleet identification numbers, manufacturers' labels, dealer logos, and parking permits. Usually, several tests isolate and confirm that a plate is present and submit it for character recognition.

Once the characters are recognized, their font, or particular style of lettering, and syntax can aid in refining the determination. Syntax refers to the number and placement of characters on the plate, their sequence, and whether each can be a letter, number, or other character. The interpreted data and imagery can then be retained locally for query against an established database or transmitted to a remote file server for further processing or storage. If the system is being used for enforcement, the original images may be archived and used as evidence later.

Early car plate recognition systems suffered from a low recognition rate, lower than required by practical systems. The external effects (sun and headlights, bad plates, wide number of plate types) and the limited level of the recognition software and vision hardware yielded low quality systems. However, recent improvements in the software and hardware have made the car plate recognition systems much more reliable and wide spread. They can now be found in numerous installations and the number of systems is growing exponentially, efficiently automating more and more tasks in different market segments. In many cases the car plate recognition unit is added as retrofit in addition to existing solutions, such as a magnetic card reader or ticket dispenser/reader, in order to add more functionality to the existing facility. Even if the recognition is not absolute, the application that depends on the recognition results can compensate the errors and produce a virtually flawless system. For example, when comparing the recognition of the entry time of a car to the exit time in order to establish the parking time, the match (of entry verses exit) can allow some small degree of error without making a mistake. This intelligent integration can overcome some of the car plate recognition flaws and yield dependable and fully automatic systems.

1.1.3 Application of a Car Plate Recognition System

A car plate recognition system has a wide variety of applications. Normally, casual observers tend to relate it with police applications, police equipment, especially for crime detection and crime prevention. However, the actual application of a car plate recognition system covers a much higher range of fields, and its role in aiding the police is just a small segment of them.

Despite the existence of all the latest chips and other electronic identification technologies, as of today, the car plate numbers of the vehicles are the main and primary identifiers of the vehicles. It is widely believed, that number plates will keep this privilege for a long time in the future. This is because car plate numbers are visible and human readable. This is very important. Everybody can read them - thus everybody can identify a vehicle by them. Secondly, the usage of plate numbers is already, for quite some years, a world-wide international standard. Now, imagine, how long would it take to standardize a chip solution. There are several other aspects too, but these two are the most important ones. As a consequence, practically everywhere, where a vehicle has to be identified (uniquely identified) the recognition of the plate number is an essential issue. Amongst the various application of the car plate recognition system include:

a. Car Parking Systems

The car plate recognition system is probably most widely used in parking systems. The plate number is used to automatically enter pre-paid members and calculate parking fee for non-members (by comparing the exit and entry times). The optional driver face image can be used to prevent car hijacking. A parking lot equipped with a car plate recognition system software can provide:

(i) Flexible and automatic vehicle entry to and exit from a car park or secure area.

(ii) Possibility to analyze car park usage (for management

purposes).

(iii) Improved security for both car park operators and car park users.

(iv) Improved traffic flow during peak periods, therefore preventing rush hour queuing.

b. Vehicle Access Control

A gate automatically opens for authorized members in a secured area, thus replacing or assisting the security guard. The events are logged on a database and could be used to search the history of events. With integration car plate recognition system software into parking management systems, it becomes possible to automate vehicle entry to and exit from a car park or a secure zone and to use the recognized registration number for inventory management. It is a significant added value for comprehensive parking management systems.

c. State Border Control

The car plate number is registered in the entry or exits to the country, and used to monitor the border crossings. It can short the border crossing turnaround time and cut short the typical long lines. A border control system aims to automate the process of vehicle and personal identification by offering a simple and reliable solution for personal document (passports, ID cards) authenticity check and license plate recognition. Its benefits include reduced operational costs, spare of time and resources, reduced error-prone human operation and improved service.

d. Traffic Surveillance

The car plate recognition system is used to produce a violation fine on speed or red-light systems. The manual process of preparing a violation fine is replaced by an automated process which reduces the overhead and turnaround time. The fines can be viewed and paid on-line.

e. Vehicle Traffic Monitoring

The vehicles which have number plates can be identified while they continuously cross the monitoring point by the traffic monitoring system. The identifying of the vehicles is in progress without stopping them, make it possible to identify the perpetrator of the motoring offence and crime and it is possible to make traffic measurement. A traffic monitoring system can help to detect and identify the delinquent of a crime.

f. Law Enforcement

A list of stolen cars or unpaid fines is used to alert on the passing of the particular car. The 'black list' can be updated in real time and provide immediate alarm to the police force. The car plate recognition system is deployed on the roadside, and performs a real-time match between the passing cars and the list. When a match is found a siren or display is activated and the police officer is notified with the detected car and the reasons for stopping the car.

g. Intelligent Traffic Management

A number of car plate recognition system units are installed in different locations in city routes and the passing vehicle plate numbers are matched between the points. The average speed and travel time between these points can be calculated and presented in order to monitor municipal traffic loads. Additionally, the average speed may be used to issue a speeding ticket. Using these monitoring units, many kind of statistics can be made too, for example traffic counting, route overloading.

1.2 Problem Statement

With the rapid growth in the number of vehicles in Malaysia, there is a need to improve existing systems for the identification of vehicles. There has been a number of commercialized software that can be used for identification of license plates. However, they cannot be readily used in Malaysia because Malaysian vehicles license plates differ in style and format. This means that the system is unable to detect car-plates assigned for taxis, as well as special types of car-plates. These special types of car-plates use special words to designate special occasions such as SUKOM, PUTRAJAYA, TIARA, etc.., instead of using the normal alphabets.

1.3 Project Objectives

The main objective of this project is to design a recognition system for the special types of car plates used in Malaysia such as Sukom, Putrajaya, etc. Besides, the project also aims to apply stroke analysis as a means of character recognition in the proposed car plate recognition system.

1.4 Scope of Project

The scope of the project is to develop an offline system for car plate recognition application. The project is focused on developing a Windows-based software using the Microsoft Visual C++ 6.0 that will perform the image processing and decoding. The image processing techniques to be applied include techniques for gray level image processing and stroke analysis for character recognition.

1.5 Thesis Layout

The layout of the thesis is as follows:

Chapter 1: Introduction

This chapter discusses the objectives and scope of the project and gives a general introduction to car plate recognition systems.

Chapter 2: Literature Review

This chapter reviews the relevant literature and previous work regarding car plate recognition systems.

Chapter 3: Theoretical Background

This chapter discusses the necessary principles in image processing in detail that were considered or studied and are relevant academically to the work that has been done.

Chapter 4: Stroke Analysis

Chapter 4 discusses the main module of the system, which is the module concerning stroke analysis. The two main topics covered by this chapter are the Stroke Extraction and Stroke Matching. Prior to that, a general description of this technique is also provided.

Chapter 5: Development of Algorithms

Chapter 5 describes and discusses the various algorithms applied in this project for implementing the software of the car plate recognition system.

Chapter 6: Results

The final results of this project are shown and discussed in this chapter.

Chapter 7: Conclusion

Chapter 7 consists of conclusion and suggestions for future work.