LICENSE PLATE RECOGNITION SYSTEM USING VIDEO AND IMAGES

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ABSTRACT

The purpose of this project was to build a real time application which recognizes license plates from cars at gate, for example at entrance of a parking area. The system, based on regular PC with video camera, catches video frames which include a visible car license plate and processes them. Once a license plate is detected, its digits are recognized, displayed on the User Interface or checked against database. The focus is on the design of algorithms used for extracting the license plate from a single image, isolating the characters of the plate and identifying the individual character. Image sample of vehicle's license plate is acquisited by video camera, then, it is converted into Black and White (BW). Artificial Neural Network (ANN) is applied to recognize the character's plate. Learning method of the ANN is back propagation and all process is handled by Matlab version R2006a 7.1.

ABSTRAK

Projek ini dijalankan adalah bertujuan untuk mengaplikasikan kepada suasana ataupun kepada keadaan yang sebenar iaitu mengenai pengenalpastian nombor pendaftaran kenderaan, contohnya seperti pada pintu masuk di kawasan tempat letak kereta. Sistem ini menggunakan aplikasi komputer dan juga kamera video yang mana akan menangkap gambar, iaitu gambar nombor pendaftaran kenderaan dan akan memproseskannya. Apabila nombor pendaftaran kenderaan telah dikesan, digit-digit yang ada pada nombor pendaftaran kenderaan tersebut akan dikenalpasti, dan dipaparkan pada User Interface ataupun membuat pemeriksaan pada database. Focus projek ini adalah untuk mereka algoritme untuk "extracting" nombor pendaftaran kenderaan kepada imej yang lebih mudah untuk dikenalpasti, memisahkan semua ciri-ciri pada nombor pendaftaran dan mengenalpasti setiap abjad dan nombor. Nombor pendaftaran kenderaan ini akan ditangkap dengan kamera video, dan selepas itu, akan ditukarkan kepada warna hitam dan putih. Jaringan Neural digunakan untuk mengenalpasti semua cirri-ciri yang ada pada nombor pendaftaran kenderaan. Kaedah pembelajaran di dalam Jaringan Neural adalah "back propagation" dan semua proses akan menggunakan Matlab versi R2006a 7.1.

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LIST OF ABBREVIATION

1. NN = Neural Network
2. ANN = Artificial Neural Network
3. GUI = Graphical User Interface
4. LPR = License Plate Recognition System
5. MLP = Multilayer Perceptron

CHAPTER I

INTRODUCTION

1.0 Introduction

The number of vehicle in metropolitan cities is always growth. The growth has a positive implication to provide a professional and sufficient parking system. This fact requires a plate number recognition system to support a parking arrangement.

The aim of this final project is to develop Simulink Model of License Plate Recognition system using Simulink, Video and Image Processing Block set R2006a (software).

License Pate Recognition system (LPR) is an image-processing technology used to identify vehicles by their license plates number. LPR project is to present a real time car park control system. A video-based car park model will be built by using Simulink of Video and Image Processing Block set to capture the license plate number.

The proposed of this License Plate Recognition system (LPR) works, whenever the vehicle approached the secured area (Entrance). The sensor senses the car and its presence signaled to the LPR unit. After that, the LPR unit activates the illumination (Infrared) and takes pictures of the front plates from the LPR camera. The images of the vehicle include the plate and the pixel information is read by the LPR unit's image processing hardware. Then, the LPR unit checks if the vehicle appears on a predefined list of authorized cars compare with the database, and if found, it gives signals to open the gate. Next, the authorized vehicle enters into the secured area. After passing the gate, its detector closes the gate. Now the system waits for the next vehicle to approach the secured area. The same process will be repeated when the car goes out of the parking lot.

1.1 Project Objectives

The objective of the project proposal:

1. To develop Simulink Model of License Plate Recognition System using Video and Image Processing Block set (software).
2. Capturing images (license plate number)
3. Training character of the license plate number
4. Recognized the character of the license plate number.

1.2 Problem Statements

Nowadays parking lots are becoming organic part of our everyday life. We use the entrance, day by day when going to work, shop, a hotel, a restaurant, an airport, a hospital etc. But, for people who are living in private area like in condominium, they have to wait for guard to open the gate before cars can enter the entrance. Parking our car, leaving it in safe, finding it there again, fast, comfortably and easily, that's the goal. To reduce time, increase efficiency and security, that's an important issue. License plate recognition system using video and images offers flexible, low maintenance, yet effective and intelligent technology for car park operation: ticketing, security, location services, etc.

With integration of license plate recognition system using video and images into parking management systems in private area, 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. The usage of license plate recognition with specially designed camera set, equipped and synchronized with a Infra Red flash - provides quick and accurate identification of vehicles 24 hours a day, 7 days a week, without human assistance or any driver co-operation. It is a significant added value for comprehensive parking management systems.

1.3 Scope Project

The scope of this project using Simulink, Video and Image Processing Block set R2006a (software) are:

1. Used the system for private area only, such as in condominium
2. Capture the license plate recognition.
3. Takes picture of the front plate
4. Train the alphabet (A to Z) and number (0 to 9) using neural network.
5. Recognized the alphabet (A to Z) and number (0 to 9)

CHAPTER II

LITERATURE REVIEW

This chapter reviews existing project created to get an idea about the project design, conception, specification and any information that related to improve the project. In this chapter, some review about an Artificial Neural Network system that proposed to fulfill this project will also be reported.

2.1 Purpose statement for Neural Network approach

Tim Klassen [1] as mentioned in the introduction, this research will show on-line average Arabic character recognition rates above 80% and training recognition rates above 90% using Neural Networks for feature extraction and classification with multiple unconstrained 19 writers. Linear networks will be emphasized, where this represents the lowest computational overhead during both training and recall, hence suitable for the target application device.

2.2 Artificial Neural Network

Haris Al-Qodri Maarif, and Sar Sardy [2] mentioned that Artificial Neural Network (ANN) is a network which imitate to human neural network with some simple processors (units). Each unit has some local memory and connected unidirectional to flow the numerical data. Those units are operated only at local data and input. ANN has some components [3]:

1. Neuron is a unit consists of input, weight, bias, adder and transfer function.
2. Weight defines the position of hyper plane in input space.
3. Bias is used to change the position of hyper plane in order not to across the zero hyperspace.
4. Transfer function gives a threshold value to activate neuron. Some of transfer functions are illustrated on Fig.2.1.

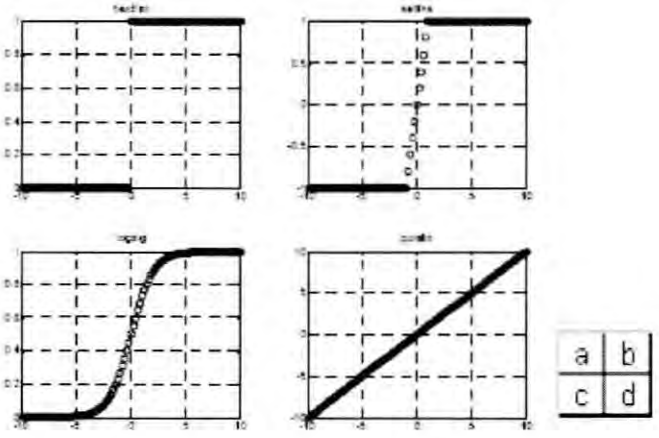

Figure 2.1: Some graphics of transfer function

2.3 Recognition

To recognize the plate, Artificial Neural Network (ANN) is used. ANN is designed to recognize 26 characters of letter and 10 characters of number. Two ANN topology are designed to recognize letter and number. The designed ANN is a back prop network (supervised learning), which is able to recognize input matrix in size 1326 x n. Designing of ANN is conducted by applying function newff. ANN has three layers consisting of input layer, hidden layer and output layer. For ANN's number, there will be 10 neurons for hidden layer and output layer. For ANN's letter, there will be 20 and 26 neurons for hidden layer and output layer respectively.

Target for the ANN are 26 elements for ANN's letter and 10 elements for ANN's number. The value of element of each targets are all zero except one element on specific position which represent the number or letter. For example, the first element is 1 in letter's target, represent A. Learning process applied in this network, is using function traingdx with epoch = 3000, MSE = 1 x 10-5, and learning rate = 0.05.

Output from the network will be two dimensional matrixes with size 26x n and 10 x n for ANN's letter and ANN's number, respectively. The value of output will be in range 0 and 1. To be recognize, output should be processed first by converted the highest value to be 1 and other will be 0. Then, the location of element which has value 1 will be founded and the result will represent number or letter. For example, output from ANN's letter which has value 1 at first element will represent the letter A, [2].

2.4 Preprocessing/Image Extraction

During this process we scan the handwritten or printed character from a sheet of paper with the help of a scanning device into graphic/image file format (BMP). As Mr.Danish Nadeem and Miss Salena Rizvi [4], mentioned, the computer images are made up of pixels, which have a specific color associated with each of them. This is identified by the pixel's value. These pixels are arranged in the form of a matrix of horizontal rows and columns. Once the image file is scanned, the information about the number of rows and columns in the image, pixel offset, and size of image are contained there in collectively called as the image header. When we are dealing with a 24-bit bitmap the header is stored in the first 54 bytes as explained in the header file (bmp.h).

Each image format stores the pixels and their positions in a specific manner. The 24-bit bitmap uses 3 bytes to store the color (pixel value) associated with each pixel. In BMP files the preprocessing starts from bottom to the top, hence, the color of each pixel is stored starting from the bottom and moving right hand upwards. Once we extract the pixel values associated with each pixel of the image, their

decimal equivalent values are stored in a matrix at the corresponding row column position. The size of this matrix is equal to the (number of rows * no. of columns (of the image)).

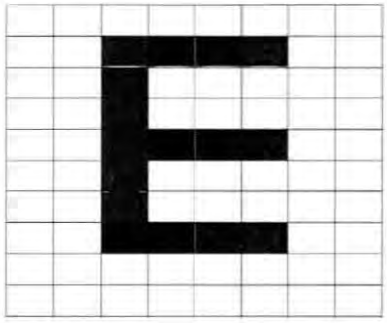

Figure 2.2: Extraction of a character in a matrix

The extraction of the image "E" into a corresponding matrix is shown above. Here w= Numerical value corresponding to white and b= Numerical value corresponding to black. From this matrix we find the element which occur the most. This will correspond to the most prominent color, and hence the background in our case. This is very obvious as the character will be less prominent than the background of the paper on which it has been written or printed. Therefore the number of pixels constituting the background will be less than the number of pixels that make up the character. Hence our assumption is that the numerical values other than the background constitute the character

W	W	W	W	W	W	W	W
W	W	B	B	B	B	W	W
W	W	B	W	W	W	W	W
W	W	B	W	W	W	W	W
W	W	B	B	B	B	W	W
W	W	B	W	W	W	W	W
W	W	B	W	W	W	W	W
W	W	B	B	B	B	W	W
W	W	W	W	W	W	W	W
W	W	W	W	W	W	W	W

Figure 2.3: Identification of background and character.

CHAPTER III

THEORY & BACKGROUND

3.1 Chapter Overview

Some of the fundamental are reviewed in this project. First is the Malaysia vehicle license plate and basic design of license plate. Then, the information of software R2006a including its advantage will be discussed. Lastly, it's all about Neural Network Artificial, including multilayer perceptron (MLP), Neural Network element and Neural Network architecture.

3.2 Malaysian Vehicle License Plate

Malaysian vehicle license plates are the license plates displayed on all motorized road vehicles in Malaysia, as required by law. The issue of license plates is regulated and administered by the department. In standard regulation, all vehicle license plates in Malaysia, other than those issued to diplomats, dealers and taxis , have white characters on a black background, regardless of the vehicle type. All vehicles must also display two of the same license plates numbers of the same colors at the front and rear of the vehicles.

3.3 Basic design of license plate

The most common form of Malaysian license plates, in use since the introduction of motorized vehicles in the country's British colonial era, typically begin with one or more letters (the first letter(s) serving as a vehicle or location prefix) followed by up to four numerical digits with no leading zeros. Thus, the configuration of a common Malaysian number plate may be in the form of *ABC 1234*, as depicted with two examples on the right. The sequence of licensed numbers issued begins with *x 1* ("x" being the prefixes of the vehicle's registered location and vehicle type) to *x 9999*, followed by *xA 1* to *xY 9999*, *xAA 1* to *xAY 9999*, *xBA 1* to *xBY 9999*, and so on (letters I, O and Z are not used to avoid ambiguity with numbers or other forms of local license plates).The format is used in virtually all classes of vehicles with engines, including, unless stated later:

- Private vehicles (cars, motorcycles, vans, trucks and other vehicles of similar design).
- Commercial and industrial vehicles (vans, trucks - light or heavy, buses, road-legal vehicles for construction and excavation and other vehicles of similar design).
- Service vehicles (police cars, ambulances, fire engines, public utility vehicles and other vehicles of similar design).

While motorcycles' rear number plates are normally displayed in standard fashion, there is little restriction to the manner in which their license numbers are displayed at the front, allowing them to be place on the front fender or fairing of the vehicle, or on another license plate.

3.4 Software R2006a

Control software used for this project is MATLAB R2006a by The Mathworks Inc. this software is chosen mainly because of its known capability of modeling and simulation using Simulink and capability Image Acquisition Blockset along with Video and Image Processing Blockset to perform visionary task for this project.

MATLAB, is used and very well known for performing mathematical calculations, analyzing and visualizing data, and writing new software programs, and Simulink, is used for modeling and simulating complex dynamic systems, such as vehicle's automatic transmission system, advance the mapping of the human genome by developing algorithms for DNA sequencing instruments, advance the diagnosis and treatment of gastrointestinal tract disorders by improving visual imaging of the small intestine and many more.

This project is run on Simulink platform with numerous user defined MATLAB functions embedded to perform the desired tasks for this project. Blockset such as Video Viewer and Image Acquisition help to capture the image from USB cameras and stored acquired images into arrays that MATLAB functions can understand.

3.5 Definition of Image Processing

The image processing is a process that takes an image as input and produces another (modified) image as output. It focuses on image manipulation to enhance image quality to restore an image or to compress/decompress an image. Most algorithms on computer vision usually assume a significant amount of image processing has taken place to improve the quality of image processing studies image to image transformation. The input and output of image processing are both images. Typical image processing operations include:

- Image compression
- Image restoration
- Image enhancement