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Image Recognition Technique of Road Tax sticker in Malaysia

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***Abstract* — Plate Recognition became significant in daily life because of the unlimited increase of transportation systems which make it impossible to be fully managed and monitored by humans, examples are so many like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border, toll gates and customs check points. This paper will propose a new image recognition technique for inspecting the validity of car Road Tax information in Malaysia based on Neural Network. The development of vehicle Road Tax Recognition (RTR) System will result in greater efficiency for vehicle monitoring system at Toll Gates in Malaysia. In Malaysia, the usage of recognition system is limited to the vehicle plates. It means that the system is unable to detect Road Tax stickers. Therefore, The Implementing of the Image Recognition of The Road Tax and Monitoring the License Plate Number Identification system helps to automatically detect the Road Tax sticker information and plate number. Previously, the police used to observe the expiry date of the Road Tax sticker and matched it with the car plate number manually. So this paper aimed to propose a technique to monitor the vehicle by automatically capturing and extracting the Road Tax sticker image.**

Keywords*; *image recognition, neural network, road tax sticker, license plate recognition, Image processing.

I. INTRODUCTION

The License Plate Recognition system (LPR) was first used in Britain in 1979 with trial units placed on the A1 road and the Dartford tunnel. The system is use for monitoring of traffic, collect tolls and enforce traffic rules and regulations. Nowadays LPR becomes a key technique to many automated systems such as road traffic monitoring, toll gates, security access, and parking lots access control [1]. The image recognition technology can help enhance security in areas where it is important to verify the identity of vehicles based on Road Tax images. Examples of such applications include fraud control of Road Tax Stickers issuance, video surveillance and traffic control.

The image recognition has a wide range of applications since the license number is the primary, most widely accepted, human readable, mandatory identifier of motor vehicles [2] such as automatic number plate recognition and traffic sign recognition. It is use to extract the plate number and Road Tax to create automated solutions for various problems. For example, the plate number is used to produce a violation fine on speed or red-light systems [1]. Moreover, it used to check the validity of car Road Tax information (whether is active, expired or not matched with the car plate number) based on Neural Network (NN). Road Tax sticker location is an essential and important stage in this technique, and it has received considerable attention [3]. Rodolfo and Stefano (2000) devised a method based on vector quantization (VQ). VQ image representation is a quad tree representation by the specific coding mechanism, and it can gives a system some hints about the contents of image regions, and such information boosts location performance[4].

The RTR is an image processing technology used new technique to identify the Road Tax sticker, license plate of the vehicles in Malaysia and to compare the accuracy of the matched information. This technique is to give wide benefits for the security and traffic installations. This work seems to be the attempt towards the recognition of Malaysia Road Tax stickers.

Image processing is an essential process in RTR system, and the quality of processing directly affects the location. The image processing in this research includes edge detection, image filtering and binarization [5].

Neural Networks (NN) are widely used as a classifier in pattern recognition applications. NN can be viewed as a set of interconnected components that aid a decision making process. In its simplest form a NN consists of three layers: input layer, one or more hidden layers and an output layer [6].

The Toll Gates require the vehicle to stop to pay the tariff. In an automatic system the vehicle would no longer need to stop. As it passes the toll gate, it would be automatically classified in order to calculate the correct tariff. This gates can be used to monitor the Road Tax validation and license plate.

II. ROAD TAX RECOGNITION CONCEPTS

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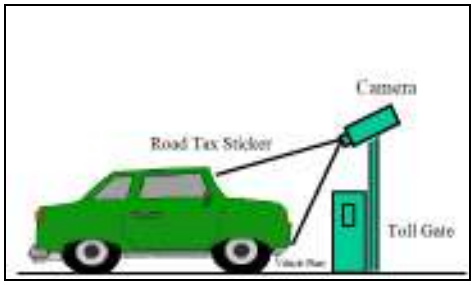
LPR is an development over the past two decades has given rise to highly accurate systems. Whole systems can now be purchased for specific applications ranging from private parking access to traffic light violation detection. All Road Tax Recognition (RTR) systems follow a basic high level process. The process starts when a sensor detects the presence of a vehicle and signals the system camera to record an image of the passing vehicle. The image is passed on to a computer where software running on the computer extracts the license plate number and Road Tax sticker from the image. License plate and Road Tax sticker numbers can then be recorded in a database with other information such as time vehicle past and expiry date of sticker. it can also be further processed and be used to control other systems such as raising a gate. As shown in figure 1 the license plate recognition systems are generally composed of four main components; a light source to illuminate the license plate, a video camera to capture images of passing vehicles, a computer with image processing software, and a trigger that signals when a vehicle is passing [7].



(Figure 1: The RTR system setup for a toll gates)

The Road Tax sticker are usually different in shape and location. Therefore, the RTR system designed to decide the right location of the Road Tax sticker and the stop cars at toll gates is selected for designing the Road Tax sticker recognition model. Next to check the validation of Road Tax such as expiry date and plate number. The basic diagram of a Road Tax sticker is as shown in Figure 2 below. Thus each Road Tax sticker has following details: Registration plate Number and Road Tax expiry date.

(Figure 2: Malaysian Road Tax sticker)

III. Elements of Road Tax Recognition System

The system will consist the following elements [6]:

Camera - It used to takes images of a Road Tax sticker and vehicle license plate from front of the vehicle.

Computer - a PC runs operating system. It runs the application that will use to control the system, reads the images, analyzes and identifies the road tax, plate, and interface with other applications and systems.

Tools - The application and recognition system which is MATLAB toolbox.

Clarification - A controlled light at toll gates that can bright up the road tax, and allows day and night operation.

Database - To record the results on an internal database or transmitted via network. The data includes the recognition results and might be the vehicle or driver-face image file. It stores Plate and Road Tax Recognition events date, time, plate number.

Windows Application The application controls the recognition sequence, interfaces the hardware elements, runs the recognition process, and outputs the results.

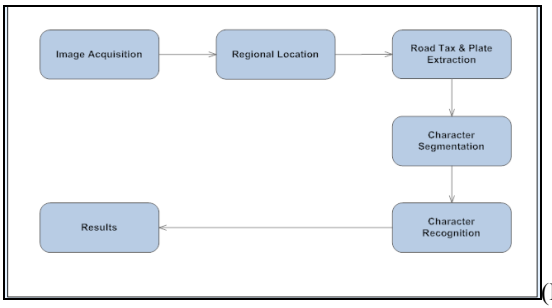
Input/Output Card – it receives inputs signals, and sends outputs.

Terminal Block - This a mechanical interface between the Input/Output card and the external connections. It has leds to indicate on the Input/Output status.

Remote Database The recognition data can be transmitted over the network to a remote database. The data contains recognition results from License Plate and Road Tax Recognition units.

IV. Proposed RTR System Design

The Proposed method for RTR consists of the steps explained in the figure 3 as a flowchart:



(Figure 3 : RTR System proposed method)

V. PROPOSED METHOD AND RECOMMENDATION

The proposed methods in this paper is designed to recognize license plates and Road Tax stickers of vehicles automatically. Input of the system is the image of a vehicle captured by a camera at toll gates. The captured image taken from 2-3 meters away is processed through the Road Tax sticker extractor with giving its output to segmentation part. Segmentation part separates the characters individually. finally recognition part recognizes the characters giving the result as the plate number and expiry

date that wrote in the Road Tax stickers and matched with license plate.

The original image captured by camera is scanned into the computer and saved as an image.

There are some new technique recommended to be implement in the system that will help to automatically detect the Road Tax sticker information and plate number and manage and monitor the cars automatically which are as following (Figure 4):

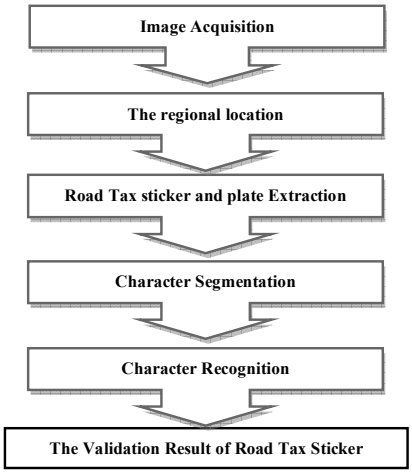


Figure 4 : The Proposed methods of RTR system

In This paper carried out the techniques employed in developing an RTR System of the following six stages image acquisition, Regional location, Road Tax extraction, Road Tax segmentation, Information recognition and Recognition Results phases (shown in figure 3). The following steps clarify how does the proposed image recognition system work:

1) Image Acquisition:

It is the first step in an RTR system and there are a number of ways to acquire images. It is an hardware, which is to extract the foreground image of the vehicle, to convert the camera's video signal to digital image signals to be sent to the computer for processing [10]. In the proposed system, it used a high resolution digital camera to acquire the road tax sticker image. The input image is 1200 x 1600 pixels.

(Figure 5: Acquisition of Road Tax sticker image)

2) The regional location or Localization of the Road Tax sticker:

The localization of the Road Tax sticker is to extract the coordinates of the vehicle Road Tax sticker area from the vehicle image, and then identify the sticker characters. It also needs to consider the distortion of the captured image, and transmission impact. If the the Road Tax area is not clear, the extraction will be greatly difficult [13].

The proposed algorithm for the localization will be as follows (as shown in figure 6 below)

1.Turn the image into black-and-white for easier differentiation between dark and light spots.

2.Filter the image to remove noise (single-pixel white spots).

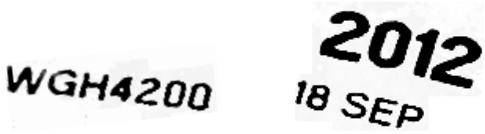
3.Locate the Road Tax Sticker position by scanning the image vertically. The expectation that the row running through the Road Tax Sticker row to have a maximum number of individual dark spots, or clusters.

4.To find the horizontal location of the sticker, scan the image horizontally by moving a square window from left to right and counting the number of clusters inside. The final position of the Road Tax Sticker is square that contains the greatest number of clusters. If any two squares contain the same number of clusters.

(Figure 6: border removed of the Road Tax sticker)

3) Road Tax sticker Extraction

The extraction of Road Tax Sticker will be process after the previous step is completed. This process is used for extracting the Road Tax sticker image, to convert the camera's video signal to digital image signals to be sent to the computer for processing. The image extraction will be trivial noise components or characters to be identified. A border removal mechanism followed by the approximation of Road Tax Sticker height is performed to extract the characters. The border removal process will concentrate to the unwanted region around the number and the letter in the sticker portion as shown in Figure 7.



(Figure 7: Road Tax sticker Extraction)

4) Road Tax Character Segmentation:

Now the image will be left out with the number of Road Tax Sticker characters along with any foreground design to consider as a noise component (as shown in Figure 7). The next step involves the estimation of the character height by finding out one essential component among the set of related components in the Road Tax Sticker. After that the character components can be exposed out of the sticker keeping the height of this essential component as its base condition. Only those components within a narrow range of this base condition are considered as the number sticker characters. All other components are disposed.

(Figure 8: Segmentation result of the character)

But character breakage due to improper illumination can thwart the above mentioned procedure of character extraction. So in order to surmount this problem a character mending procedure is adopted as illustrated in Figure 7. This process strengthens the white pixels in the border removed number sticker by turning its adjacent left and top black pixels to white. This again is done by scanning through the image for a white pixel. Proceeding with character stripping after this mending process proved to provide better results as the extraction of this kind of mended character is quite easier when compared to the extraction and recognition of a distorted character.

5) Road Tax Character Recognition:

This step is the main part of the system and is called as Character Recognition step, where segmented characters are recognized. It is also called as Optical Character Recognition (OCR). Road Tax Sticker Character Recognition is used for number plate and expiry date recognition were Optical Character Recognition and Formula Based Recognition. It used to ensure best accuracy rate along with enhanced recognition speed by Neural Network which is an intelligence engine. One of the Neural Network techniques are used for character recognition Neural Network with Back Propagation Artificial (BP) and NN with Learning Vector Quantization (LVQ), after finding out characters of the sticker by these two methods, voting can be performed to find the best method based upon the time taken and accuracy in the output of the BP and LVQ [12] [4].

BP is a multilayer feed-forward networks according to the training of error reversion propagation algorithm and it can learn and store a large number of input and output models mapping relation without having to expose the mathematical equation which describes the mapping relation in advance. Its learning rule is to use the steepest descent method to constantly adjust the network weights and thresholds, through the back propagation, so that error sum squares of the network is minimum [6].

BP is composed of three parts- input layer, single or multi-hidden layer (middle layer) and output layer.

LVQ is a hybrid network. It uses for supervised learning to form classification. In LVQ each neuron in the first layer is assigned to a class, each class is assigned to one neuron in the second layer. There are three basic steps in LVQ algorithm (1) Initialization, (2) Competition and (3) Learning.

LVQ combines competitive learning with supervision. Target vector is in log sigmoid form (identity matrix). Learning rate is 0.01 for training the network.

6) Road Tax Validation Results:

The expected result of this research is a system that is able to recognize license and Road Tax numbers accurately at toll gates. The results will clarify the plate number and expiry date that wrote in the road tax stickers and matched with license plate. To evaluate effectiveness of the method proposed in this paper a few tests will perform:

1. Efficiency Test of Road Tax localization process.
2. Efficiency Test of character segmentation process.
3. Efficiency Test of character recognition process.

All test were performed on the same data set which consist of 150 pictures. This data set contains pictures took at the Toll gates lighting. The data set also contains pictures of various Road Tax types. The average quality of all pictures may be described by tree elements: resolution 640x480 points, 24-bit or 8-bit color space, images after JPEG compression.

Results of the performed tests are in Table 1. Values in this table show the percent of outcome gained in these trials.

1	2	3
70%	67%	64%

VI. CONCLUSION

In this paper, The method proposed in this paper seems to be very universal in case of localization and recognition of different Road Tax sticker images under various environmental and lighting conditions based on Neural Network techniques and feature extraction approaches were proposed. It is observed that, as fan beam feature extraction method has more features for training the Neural Network thus its simulation accuracy is higher. The paper focused on exploring extraction and recognition methods which can be used for the Neural Network. Also more number of fonts can be used for the network for improving the accuracy of the character recognition

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