VOL. 10, NO. 22, DECEMBER 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

DEVELOPMENT OF VISION-BASED HANDICAPPED LOGO REGONITION SYSTEM FOR DISABLED PARKING

Mohd Sahdan Bin Abd Ghani, Chee Kiang Lam and Kenneth Sundaraj
School of Mechatronic Engineering, Universiti Malaysia Perlis, Kampus Pauh Putra, Pauh, Perlis, Malaysia
E-Mail: sahdanghani@gmail.com

ABSTRACT

This paper describes the development of a handicapped logo recognition system for disabled parking access control. The system is proposed to solve the current community issue which irresponsible able-bodied drivers abuse disabled parking space at area such as hospitals, hotels, shopping centres, public transport stations and residences. The idea of this development is to provide a vision-based automatic recognition system to identify handicapped motorists who displays handicap sticker on the front windscreen of their vehicle. The proposed logo recognition system has been developed by applying template matching method in machine vision to identify handicapped logo. The results of this study show that the developed system can detect the handicapped logo accurately and it can be implemented into the automatic parking access system in helping the handicapped motorists to preserve their special privilege in parking facility.

Keywords: handicapped motorists, logo recognition, machine vision, and parking.

INTRODUCTION

Most of the parking facilities in the business centres, hotels, shopping centres, and public transport stations do provide priority parking space for handicapped vehicles, but some able-bodied drivers will errantly park at these specially designated handicapped areas. Although some parking facilities set barrier on the accessible parking to prevent unethical parking, but it causes trouble for the handicapped drivers. The disabled motorists, who are driving alone, will have difficulty to move away the barrier when nobody is around the area to provide assistance. In order to overcome this problem, a vision-based handicapped logo recognition system is proposed in this paper. A digital camera is used to capture the image of the vehicle's front windscreen, where the distance between the camera and windscreen is about 1.5 meters. The information on the captured image will be extracted by the logo recognition system and if the system recognizes the handicap sticker on the windscreen, it will automatically open the gate.

RELATED WORK

Alharaki *et al.* [1] used neural network to recognize the validity of car road tax information. This application uses new technique to identify the road tax sticker and the license plate of the vehicle using image processing and also neural network. The security and traffic installation is widely benefited using this technique. This system uses edge detection, image filtering and binarization for image processing. The classifier in pattern recognition uses neural network as decision making. Neural network consists of three layers; there are input layer, hidden layer and output layer.

Norzali *et al.* [2] used logo recognition method for the development of halal logo detection and recognition system. This paper aims to help Muslim user to identify whether the halal logo is original or imitation. This system is able to help Muslim user in buying the halal product legally in the Islamic law. This project consists of two modules; they are detection module and recognition module. The input classification is by using the neural network method and as a result, the output will show whether the logo is actually original or imitation. The success rate of this system is 91.67%, where most of the logos were correctly detected.

Farajzadeh's research is related to handicapped parking system, which applied image processing for vehicle logo recognition by using image and textural features. Based on histogram manipulation and automatic real time logo recognition system for moving car is introduced. This research contains image matching technique and textural features. The result of 96% and 90% on average for image matching and textural features were successfully recorded [3].

The other related research work on logo recognition is from Zhu *et al.* [4]. The key factor in document classification domain is receiving a great interest of logo recognition. The document classification is to be identified by using logo recognition. The algorithm consists of four steps; they are image segmentation, image representation, feature extraction and pattern classification. Based on pattern recognized using KNN classification, there are five tests for this method and every test consists 40 samples, the accuracy for original logo is 100%, strip corrupted logo is 92.5% and partially occluded is 95%.

The research conducted by Hassanzadeh *et al.* [5, 6] is about the logo recognition to improve the major problem in logo detection and recognition for separated part logo in documents. The authors used novel logo detection and also recognition framework based on spatial and structural feature which consist a new tessellation of logo images based on histogram that object occur for features method. KNN is used to recognize the detected logo.

Psyllos and his research team tackled the problem of vehicle security for vehicle manufacturer and model recognition using SIFT method. Parts that are needed to be

segmented is the front view of the vehicle such as headlights, grill and logo area. For feature recognition using this method in image processing is obtained with high performance. The vehicle recognition identification shows the accuracy result of 87% and the time to finish the process is less than a second, which is suitable to be used as real time application [7, 8].

Other method in image processing for logo recognition is developed by Kang *et al.* [8] in recognizing vehicle logo using Modest Adaboost and radial Tchebichef moment. The first solution is machine learning algorithm based on Modest Adaboost for input image detection and then radial Tchebichef is take place to recognize the vehicle logo. Based on experiment, the result shows with the total sample of 200 images, 184 images were successfully recognized.

Finally, the application developed by Zyga *et al.* is used to recognize the logo and trademark in document analysis. The system consists of two stages, which the first stage is generalizes regression neural network and second stage is to increase the classification accuracy in novel method of tiling. MATLAB software has been used to simulate the system with neural network using GRNN method [10].

METHODOLOGY

This section describes the methodology of the development of handicapped logo recognition system. The 4 main phases that needed to be taken are image acquisition, image pre-processing, detection module and recognition module.

Image acquisition

A digital camera, which is positioned at the height of 1.7 meters above the ground and the distance of 1.5 meter from the vehicle as illustrated in Figure-1, will capture the front windscreen of the vehicle as the input image. After the image was captured, it will be loaded into the system for pre-processing.

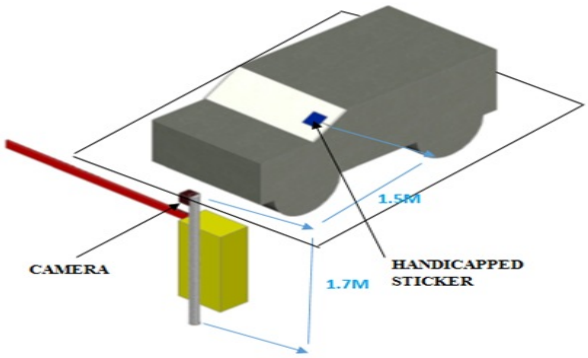

Figure-1. Isometric view of the system setup.

Image pre-processing

Handicap logo could be recognized by the system with some techniques to process the image in the system. By using median filter technique, most of the handicapped logo could be extracted by the proposed system.

Detection module

i. Colour detection

A RGB image is called true colour that stored in MATLAB as an m-n-by-3 data arrays. For each individual pixel it defines the red, green, and blue colour. The pixel locations are determined by red, blue, and green intensities stored in each colour plane [2].

The first step of the system is the extraction of the blue coloured object because the international standard colour for handicap sticker is blue.

ii. Image binarization

Image binarization is a process where an original image is being converted into black and white pixels. Thresholding method is used in the development of this system to create the binary image.

iii. Edge detection

The aim of edge detection is to extract the different region in the image and also divide the image into region there to make up the pixel which something in common.

For this research, sobel mask edge detection is suitable due to low level of noise. The derivation of a two dimension images could be carried over two dimensions as long it is an accurate approximation. The 2D spatial gradient measurement on that image for sobel operator of detection, usually finds the absolute gradient for input greyscale images. The convolution mask is 3x3 firstly x-direction and second estimate gradient y-direction.

Edge image is processed by extracting the region, which is not required, before the template matching process. The result of edge image will be inserted into the database for neural network process in order to recognize the image. If the edge image does not match with the input pixel then the system will not recognize the logo.

Recognition module

i. Neural network

One of the suitable methods to solve the complex problem is by using neural network. When the neural network had natural potential to solving nonlinear problem and input-output easily achieve mapping, it is a good method to be used for solving the prediction problem. The neural network is an effective tool theory to predict a situation when the architecture and input data were available. The type of neural network used is back propagation network; this algorithm can be used to solve the problem of the proposed system. Back propagation is composed of three parts; there are input layer, single or multi-hidden layer and output layer [1].

ii. Training data set for neural network

A set of handicap logo were collected to be used as training set for the neural network, all having the matrix of 3 by 58 inputs. Neural network training may be made for competent when pre-processing is performed on that network input and target.

The three values of feature extraction will be loaded into the neural network. The size of the input layer is corresponded to an input image.

iii. Define and create network

A network was to be designed and trained to recognise the two different situations, day and night with fixed length and height between the camera and the vehicle. The network contains 58 samples and there are 50 samples used for training and 8 samples are used for testing in neural network.

This method consists of three types of learning algorithm, Levenberg-Marquardt back propagation, resilient backpropagation and Bayesian regularization backpropagation. Every learning algorithm consists of 10 sets for training and testing, finally the most accurate method from the three algorithms will be chosen. The results will be shown in the results and discussion section. The flow chart of the proposed handicapped logo recognition system is shown in Figure-2.

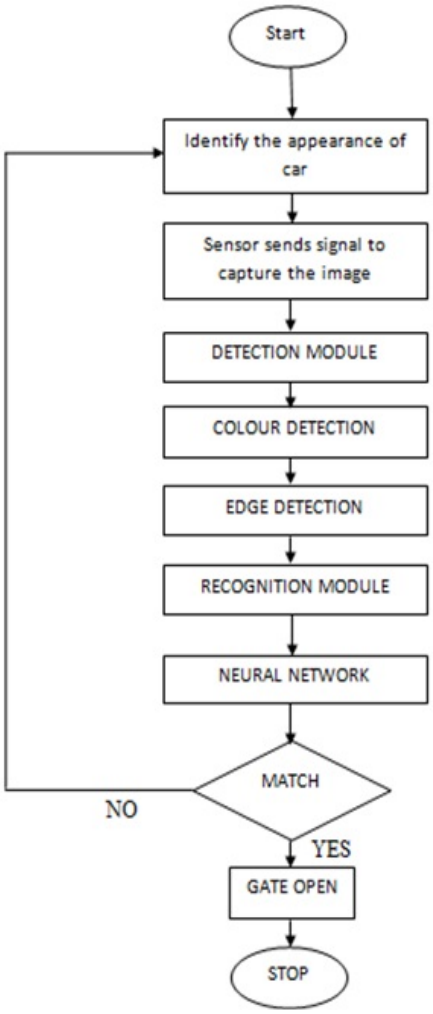

Figure-2. Flow chart of the proposed system.

RESULTS & DISCUSSION

Image acquisition

The camera captures the input image by several setting in length and angle between the vehicle and the camera. After the image of the front windscreen is captured, it will be loaded into the proposed system. Figure-3 shows the sample of the input image.

Figure-3. Sample input image.

After input image was captured, the next process is to crop the image with a fixed location. The location will be used for every sample input image. Figure-4 shows the cropped images.

Figure-4. Cropped images. (a) Day and (b) night.

Pre-processing

The background condition around the handicap logo is the main factor that will interrupt the detection system. If any error occurs when cropping out the right handicapped logo, the detection process will become more complex.

For this part the image filtering is required to be applied on the greyscale image in order to reduce the noise. There are several methods for image filtering, median filter, Gaussian filter, linear filter. The filters are needed to be tested manually until the best output image is obtained.

Image detection

Detecting the presence of specified pattern such as edge and colour are required to be determined as the characteristics of every sample. All the detections are

required using several methods such as colour detection and edge detection. Finally, the feature will extract the edge image using perimeter command code and show the value of perimeter in white pixel.

i. Colour detection

After cropped the desired image, the next process is to determine whether the image is blue or not. The logo recognition system is designed to recognize blue colour only. The next process is conversion to greyscale and followed by image extraction method. After that, the system filters out the noise by using median filter and the final step is to convert the image into binary image, where the object is displayed in white pixels. Figure-5 shows the binary images after the pre-processing.

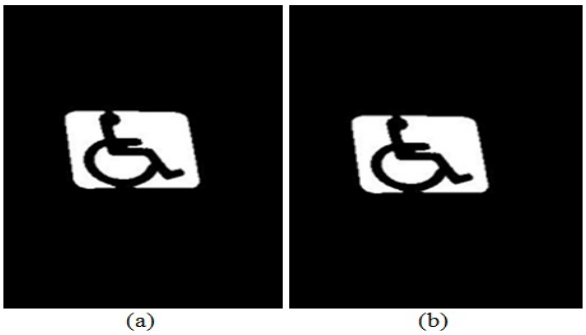

Figure-5. Binary images. (a) Day and (b) night.

ii. Edge detection

Edge detection is implemented in this system to identify the edges of the handicap sticker in order to extract the information for neural network to recognize the characteristics. Figure-6 shows the edges of the handicap logo after the filtering process.

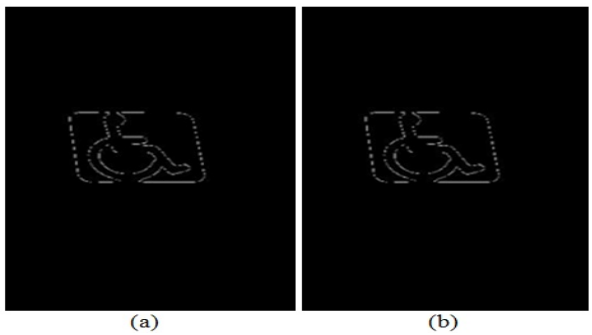

Figure-6. Filtered images. (a) Day and (b) night.

iii. Perimeter count

Perimeter count is to count the value of white pixel perimeter after applied the edge detection by the system. The system will count the value of the feature that was extracted from the white pixels. After that, the system will process and show the value contained in the image.

iv. Data feature extraction and normalize

Every sample will be processed and from that will produce the feature extraction. The value of feature extraction will be recorded on the table of feature extraction for day and night.

The next process before the neural network starts is all data are needed to be normalized. The data will be saved in the system afterwards.

Image recognition

i. Neural network

The classification took place through neural network when the handicap logo was detected. The network consists of three separate section, they are input layer, hidden layer and output layer. Total output squared error was minimized by using backpropagation network, which is gradient descent method. In training the network using back propagation involves three stages; there are input training pattern, error and accuracy [2].

For neural network there are many types of backpropagation and this research only used three types. The first type is Levenberg-Marquardt backpropagation, second type is Bayesian regularization backpropagation and the third type is Resilient backpropagation.

ii. Preparing input to Neural Network

When the logo is cropped, which is in the form of binary image is transformed into matrix numbering. The value comes from the feature extraction in numbering with three edge detection by using 'sobel' edge detection. The matrix will become 3 columns and 58 rows. After obtained the data from feature extraction, the data is required to be normalized for input neural network.

iii. Architecture

Neural network receives 2500 Boolean values as a 2500-element input vector. It is then required to identify the appearance by responding with a 10-elements output vector. The 10-elements of the output vector each represent a sign. To operate correctly, the network should respond with a 1 in the position of the sign being presented to the network [2]. Table-1 shows the comparison of the success rate of the recognition system by applying three different types of neural network. Levenberg-Marquardt backpropagation is most suitable for the proposed system because it acquires highest success rate among the three neural networks.

Table-1. Comparison of success rate for different types of neural network.

Neural Network	Training %	Testing %
Levenberg-Marquardt back propagation	99.64	89.25
Bayesian regularization back propagation	89.36	81.83
Resilient back propagation	82.17	82.07

A graphical user interface is designed in the proposed system to show the result of the handicap logo recognition. Figure-7 and Figure-8 show the results of the recognition when the handicap sticker exist or non-exist on the front windscreen of the vehicle. This shows that the system is working successfully.

Figure-7. Handicapped logo detected.

Figure-8. Handicapped logo not detected.

CONCLUSIONS

The research work to extract the region that is needed for logo recognition is successfully done. The final result for the proposed system is displayed in the GUI, where the handicap logo on the front windscreen of the vehicle can be detected accurately.

After the development of handicap logo recognition system, further improvement will be to produce highest accuracy and better research in all modules. The system can be improved to locate the handicap sticker with different directions, for example if driver parks the car improperly, the system can recognize the handicap logo with several setting in different length and height between the logo and windscreen.

Study on how to implement camera with auto zoom in and zoom out functions is important in order to capture the image of the vehicle's windscreen in different distances. This improvement will aid the logo recognition system to become more efficient in recognizing the handicap logo and will reduce the time required for the pre-processing stage.

REFERENCES

[1] Alharaki O. and Zeki A. 2012. Image Recognition Technique of Road Tax Sticker in Malaysia. Int. Conf. Adv. Comput. Sci. Appl. Technol. pp. 397-401.

[2] Norzali M., Helmy M. and Yaakob A. 2008. Halal Logo Detection and Recognition System. 4th International Conference on Information Technology and Multimedia. pp. 618-625.

[3] Farajzadeh N. 2014. Vehicle Logo Recognition using Image Matching and Textural Features. Scientific Cooperations International Workshops on Electrical and Computer Engineering Subfields. pp. 82-86.

[4] Zhu G. and Doermann D. 2007. Automatic Document Logo Detection. Ninth Int. Conf. Doc. Anal. Recognit. Vol. 2, pp. 864-868.

[5] Hassanzadeh S. and Pourghassem H. 2011. A Fast Logo Recognition Algorithm in Noisy Document Images. Int. Conf. Intell. Comput. Bio-Medical Instrum. pp. 64-67.

[6] S. Hassanzadeh and H. Pourghassem. 2011. A Novel Logo Detection and Recognition Framework for Separated Part Logos in Document Images. Australian Journal of Basic and Applied Sciences. Vol. 5, No. 9, pp. 936-946.

[7] Psyllos A., Anagnostopoulos C. and Kayafas E. 2009. Sift-Based Measurements for Vehicle Model Recognition. Proc. of the XIX IMEKO World Congress on Fundamental and Applied Metrology. pp. 2103-2108.

[8] Psyllos A., Anagnostopoulos C. and Kayafas E. 2012. M-SIFT: A new method for Vehicle Logo Recognition. IEEE Int. Conf. Veh. Electron. Saf. pp. 261-266.

[9] K. Sam and X. Tian. 2012. Vehicle Logo Recognition Using Modest AdaBoost and Radial Tchebichef Moments. International Conference on Machine Learning and Computing. Vol. 5, pp. 91-95.

[10] K. Zyga, R. Price and B. Williams. 2000. A generalized regression neural network for logo recognition. Fourth International Conference on Knowledge-Based Intelligent Engineering Systems and Allied Technologies. Vol. 2, No. 2, pp. 475-478.

.