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'Halal' Logo Detection and Recognition System

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Abstract

Illegal and unapproved 'Halal' logo has been widely used by many unscrupulous producers on their products. Consequently, Muslim consumers become confused in deciding whether a product is carrying a legal 'Halal' logo or otherwise. This paper reports the use of an image detection and recognition system in overcoming the problem. This system is an essential module for the user warning assistance and it contains two main modules; detection and recognition module. The images of 'Halal' logo were capture by using a digital camera. The images were taken from various product surfaces such as metal, plastic and glass. Then 'Halal' logo images were detected in order to load the images manually to the recognition system. After doing preprocessing process on the samples of 'Halal' logo images, it shows that Gaussian Blur effect give a good impression on the detection time. Therefore, it is the most suitable techniques for detection system to detect and crop 'Halal' image properly. From the observation based on the result, Gaussian blur technique state about 85.71% in successfully crop the image compared to normal image, 19.05% and brightness and contrast effect, 47.62%. In the recognition system, Neural Networks methods were used to recognize and classify the images. It is a suitable technique in solving such complex problems. Neural network were fed by 2500 bits of 1's and 0's. In order to increase the recognition system performance, it's depends on how the Neural Network was trained and many sets of binary logo should be used in the system.

1. Introduction

Many irresponsible entrepreneurs use imitation 'Halal' logo on their products. Consequently, Muslim users find it hard to determine the validity of 'Halal' logo used. This project aims to remind and inform Muslim users about the use of illegal imitation 'Halal' logo. It is hoped that, users could use this system to confirm that they are buying 'Halal' products that are registered and legal according to Islamic law.

This project consists of two modules; detection module and recognition module. In the detection module, the edge detection and the symbol extraction are used to create segments to the image. The features or specifications of 'Halal' logo are investigated to detect potential objects. Once the potential objects are found, the objects are clipped from background, normalized to a specified size, and sent to the recognition module, which consists of a classification validation neural network. The inputs of the classification neural network are the intensified images of the potential objects and the outputs show whether the logo is legal or not.

2. Related Work

E-'HALAL' System by JAKIM

In JAKIM E-'HALAL' system, in order to know whether the item is certified 'Halal', the GS1 (Global Standard One) number is entered into the search engine. The program then search for the GS1 number stored in JAKIM's 'Halal' database extracts the information of the item and then displays the information on the screen.[9] There are some drawbacks of this system that have been found, there are:

1. Each SMS sent to e-'HALAL' will charge 15 cent and each sms received by the customer will be charge 50 cent.

2. The system sometimes takes long time, due to server down and the traffic communication network get busy at the peak time.

3. There are too many numbers of bar code for one product, so this will make the customer confuse to insert the bar code numbers. The customer needs to check again and again to make sure the bar code number they send are correct.

4. For the elderly people, they might also face problem since most of the bar code are printed in a small size, so it is difficult for them to type in the bar code number.

There are lot of illegal 'Halal' logo that is currently being use in daily products. Here are some examples of the imitation of 'Halal' logo. As illustrated in Figure 1.

Figure 1. The 'Halal' logo that is illegal.

Figure 2. The 'Halal' logo provided by JAKIM and JAIN/MAIN.

There are several previous work presented by other researcher that indicate the similarity with research of this paper.

1. Michael Shneier [2] designed and developed road signs are detected by means of rules that restrict colour and shape and require signs to appear only in limited regions in an image. Using a template matching method and tracked through a sequence of images. This method is very fast and can easily be modified to include new classes of signs. He use ratios of RGB colours tailored to different classes of signs (warning, regulatory, informational, etc.). Because RGB colours worked better and did not require colour space conversion. He then used the sign outline as a mask in the sign recognition stage. Properties of each component are computed, including centroid, area, and bounding box, He used in a set of rules that accept or reject each blob as a sign candidate. If a blob is seen in five successive frames, it is confirmed as a candidate and goes on to the recognition phase of the algorithm. The recognition is achieved by using template matching.

2. Garcia [3] proposed a system for off line traffic sign detection using the Matlab Image Processing toolbox. The vision based traffic sign detection module developed manages 172 x 352 colour images in RGB (Red, Green, and Blue) format. The first step in the algorithm is to obtain the gradient image and its vertical edge projection. In the next step, the colour and shape analysis is performed. There are four types of traffic signs in the traffic code: prohibition, warning, obligation and informative. Depending on the shape and colour, the warning signs are equilateral triangles with one vertex at the top. Prohibition signs are circular having a specific figure in each case over a white or blue background and a red border. To indicate obligation, signs are circular, with a figure over a blue background. One of the most common techniques for the traffic sign segmentation is to use grey-level images, red component in their case, and to project pixels at the edges onto the axes. They used RGB because it can allow speed up for the detection process. Detection is carried out by projecting pixels at the edge onto the axis. This algorithm is valid for every type of road sign and there is a classification stage done, using a template.

3. Nishio [4] described an image recognition system in which top-down and bottom up approaches are integrated. The proposed system consists of a feature extractor performs low-level image processing in the first stage to obtain feature primitives. For the second stage, these primitives are grouped into feature candidates for recognition, using the perceptional rule. The interpreter infers what the object is, using intrinsic features selected from the feature candidates and knowledge of the object. If some problem exists, the interpreter builds up a hypothesis about the object and requests the extractor to verify it. This inference cycle of hypothesis and verification is repeated until the identification is completed. The extractor gives certainty scores, which are measures of

certainty such as similarity and area, to each feature candidate. The interpreter can then select intrinsic features with a high certainty score from these feature candidates. Additionally, the feature extractor can be driven at the request of the interpreter. In this case, image processing routines and parameters given to these routines can be appropriately selected.

3. Methodology

This section describes the methodology in order to perform the detection and recognition process. There 4 main phases need to be taken are:

i. Image Acquisition
ii. Image Preprocessing
iii. Detection Module
iv. Recognition Module

The detail of each phases are presented follows.

1. ***Image Acquisition***
A digital camera was used to capture the image of 'Halal' logo from a various product surface. Then, the images were manually loaded into the system.

2. ***Image pre-processing***
There were some techniques to process the images until the image of 'Halal' logo could be caught by the system. By using the Gaussian Blur effect technique, most of the the 'Halal' logo could be detected by the system.

3. ***Detection Module***
An RGB image, sometimes called as a true-colour image, was stored in MATLAB as an m-by-n-by-3 data array. It defined red, green, and blue colour components for each individual pixel. This type of images did not use a palette. The colour of each pixel was determined by the combination of the red, green, and blue intensities stored in each colour plane at the pixel's location. [10]

Figure 3. RGB image example.

i. Edge detection
The purpose of edge detection was to extract the outlined of different regions in the image; to divide the image into regions which were made up of pixels which had something in common. The Sobel mask was appropriate for images with low levels of noise and inadequate for noisy images. Therefore, it was suitable to apply to this system. The theory could be carried over to two-dimensions as long as there was an accurate approximation to calculate the derivative of a two-dimensional image. The Sobel operator performed a 2-D spatial gradient measurement on an image. Typically, it was used to find the approximate absolute gradient magnitude at each point of the input grayscale image. The Sobel edge detector used a pair of 3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows).

Figure 4. Example of the edge image.

ii. Converting image to binary image
Using 'im2bw' function, it converted an image to a binary image, based on a threshold. The function produced a binary images from indexed, intensified, or RGB images. Firstly, it converted the input image to grayscale format (if it was not already an intensified image), and then converted this grayscale image to binary by thresholding.[10]

Figure 5. The 'Halal' image converted to binary image.

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iii. ***Cropping the 'Halal' logo***
After the coordinate of the 'Halal' logo had been identified, the logo was cropped from the binary image. This process cropped a bigger picture that was together with its region around the logo. Then the cropped image (contains the image of 'Halal' logo) was analyzed in the recognition process as the input for Neural Network.

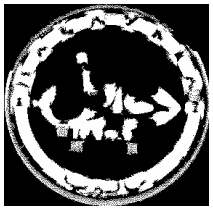

Figure 6. Crop 'Halal' image from binary image.

iv. ***Resizing the input***

The crop image had to be resized in order to feed into Neural Network. The image was resized to 50 by 50 pixels, where the width of the image is 50 pixels and the height was 50 pixels.

Figure 7. Image resized to 50 by 50 pixels.

4. ***Recognition module***

Neural Network was a powerful model in solving complex problems.[5] Since the neural network had natural potential of solving nonlinear problem and could easily achieve the input-output mapping, it was perfect to be used for solving the predicting problem. Neural network was an effective tool theory to predict a situation if appropriate model architecture and input data were available. Back propagation network referred to the algorithm used in these types of neural networks. This algorithm solved a rather thorny problem.

i. ***Preparing input for Neural Network***

The resized 50 by 50 binary image were loaded to the neural networks. The size of the input layer corresponded to an input image.

ii. ***Training data set for Neural Network***

A set of 'Halal' logo and five separated part of logo were collected to be used as training set for the neural network, all having the matrix of 50 by 50. Neural network training could be made more efficient if certain preprocessing steps were performed on the network inputs and targets. There were several preprocessing routines available in MATLAB.

iii. ***Defining and create the network***

A network was to be designed and trained to recognise the five-difference level of 'Halal' logo in variable size and situation. They were 'level 1 – 20%', 'level 2 – 40%', 'level 3 – 60% ', 'level 4 – 80%, and 'level 5 – 100%' according to the resemblance to the 'Halal' logo respectively.

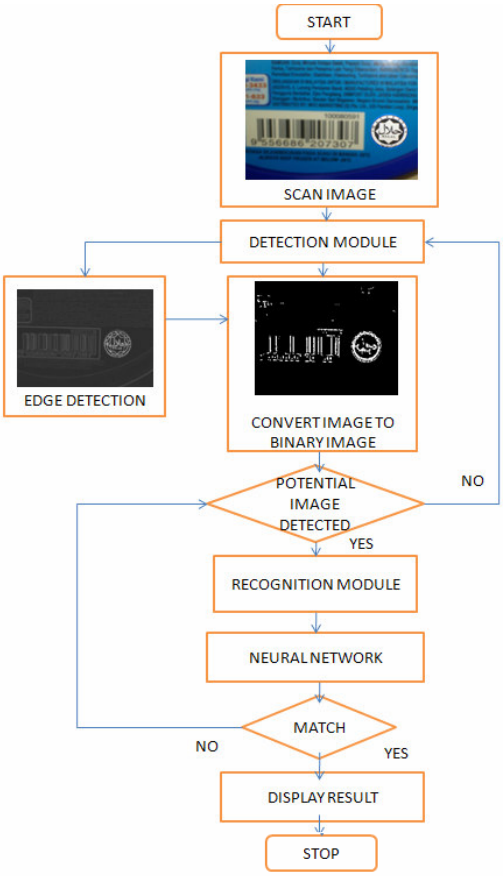

Figure 8. Flow Chart for the whole system.

4. Analysis And Result

1. Detection Module

There were various techniques to detect the 'Halal' logo such as using colour detection, template matching, edge detection, or corner detection using mask. The next part would be interrupted if this system (detection module) cropped a wrong 'Halal' logo. That means, this module was very important for the whole system. This was because, it helped to determine whether this project was successful or not.

i. 'Halal' logo study

'Halal' logo mostly printed on a packet of daily products. Therefore, it was printed on various surfaces such as paper, plastic, glass, wood, and metal. It was also printed with various colour and image around it. This would give some effects for the image processing. There were three types of unapproved 'Halal' logo, which we could find in daily products. They were; non-approved, imitation and expired logo. Figures 9, 10, 11, 12, 13 below, shows an approved 'Halal' logo from many countries. The *non-approved* 'Halal' logo was the logo, which was prohibited to be used in daily products. The *imitation* logo looked like the original logo. The *expired* logo was an approved 'Halal' logo used previous years ago, but today it has been dispersed. [9]

Figure 9. An approved 'Halal' logo by JAKIM (*Jabatan Kemajuan Islam Malaysia*).

Figure 10. An approved 'Halal' logo by 'Halal' Control e.K, from Germany.

Figure 11. An approved 'Halal' logo by Lembaga Pengkajian Pangan Obat-Obatan dan Kosmetik, The Indonesian Council of Ulama (MUI) from Indonesia.

Figure 12. An approved 'Halal' logo by The Central Islamic Committee of Thailand, from Bangkok Thailand.

Figure 13. An approved 'Halal' logo by China Islamic Association from Beijing China.

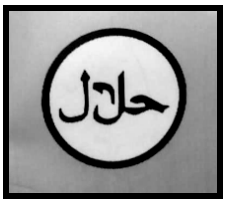

Figure 14. Example of the unapproved 'Halal' logo.

ii. Image preprocessing

The main factor that interrupted detection system was the background condition around the 'Halal' logo. Thus, the detection process became more complex and a lot of errors occurred when cropping out the right 'Halal' logo. To solve this problem, two ways were tried. Firstly, the normal image was given some adjustment of brightness and contrast. The background brightness and contrast of the normal image was adjusted into +70 (brightness) and -15 (contrast). This method gave some effects to the background. Table 1 and Table 2 showed the analysis summary for crop normal images condition and crop images condition with background brightness and contrast effect. The next solution was giving Gaussian Blur effect to the normal image. The effect was given 5 pixels in amount to the background of the normal image. The binary image for this effect (Gaussian Blur) was helpful to crop the right 'Halal' logo. Table 3 showed the analysis summary for crop image with this technique. Figure 15 shows the crop condition result by using the three types of 'Halal' image.

Table 1. Normal image condition.

Condition	Percentage
Successful crop	19.05%
Failed to crop	80.95%
Crop with no unwanted image	4.76%
Crop with unwanted image	4.76%
Not full image	9.53%
Wrong image	80.95%

Table 2. Image with background brightness and contrast effect.

Condition	Percentage
Successful crop	47.62%
Failed to crop	52.38%
Crop with no unwanted image	14.29%
Crop with unwanted image	9.52%
Not full image	23.81%
Wrong image	52.38%

Table 3: Image with Gaussian Blur effect.

Condition	Percentage
Successful crop	85.71%
Failed to crop	14.29%
Crop with no unwanted image	23.81%
Crop with unwanted image	28.57%
Not full image	33.33%
Wrong image	14.29%

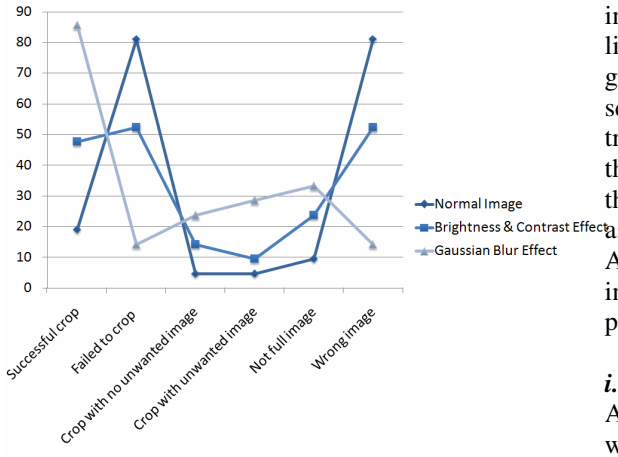

Figure 15. Graph shows the crop condition result by using the three types of 'Halal' image.

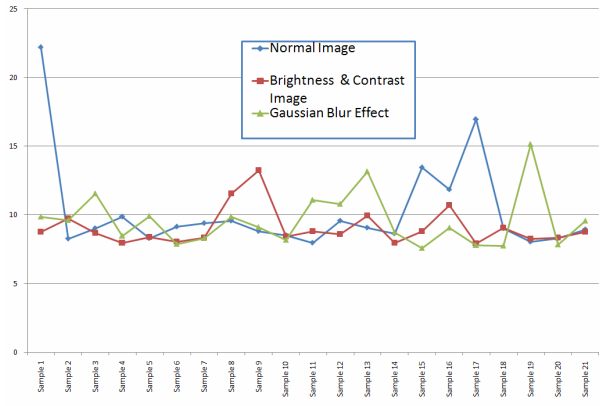

Figure 16. Graph of detection time for three types of 'Halal' image condition.

2. Preparation for Neural Network

The input for Neural Network was a binary image from the detection module.

i. Unwanted image

When cropping the 'Halal' logo from the binary image, there was a possibility that the cropped image contained some unwanted components. It occurred, when the 'Halal' logo images were attached with another crowded background images.

ii. Resizing the input binary image

The input data, which was the cropped image, was resized into 50 by 50 pixels before it was fed into the neural network system.

3. Recognition module

When the 'Halal' logo was detected, its classification took place through Neural Network. The networks were trained in three separate sections: Input layer, Hidden layer, and Output layer. Then the correlated inputs were classified into categories that were linearly separable. Back propagation network was a gradient descent method to minimize the total squared error of the output computed by the net. The training of a network by back propagation involved three stages: the forward of the input training pattern, the calculation, and backpropagation of the associated error, and the adjustment of the weights. After they were trained, the application of the net involved only the computation of the feedforward phase.

i. Preparing the input to Neural Network

After resizing the cropped logo, each character, which were in binary images types were transformed into matrix numbering. It contained only 0's and 1's. Since it was already resized the character into 50 by 50 pixels, the matrix also had the same size, 50 rows, and 50 columns. The total number of bits in the matrix was 2500. This matrix must be reshaped to form another matrix having 1 row and 2500 columns (1x2500) in order to be fed into the network as an input.

ii. 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-element output vector. The 10 elements of the output vector each represent a sign. The network is a two layer log-sigmoid/log-sigmoid network. The log-sigmoid transfer function was picked at the output because its output range (0 to 1) is perfect learning to output Boolean values. To operate correctly, the network should respond with a 1 in the position of the sign being presented to the network. All other values in the output vector should be 0. Figure 17 show the architecture for the neural network.

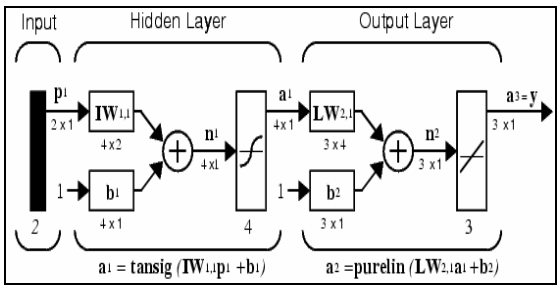

Figure 17. Architecture for Neural Network.

iii. Training the network

The neural networks had to be adjusted, or trained, so that a particular input led to a specific target output. For example, networks had to be adjusted, based on a comparison of the output and the target, until the network output matched the target. Batch Training (train) which was used in this project, made weight and biased changes based on an entire set (batch) of input vectors. The gradients were calculated at each training examples and added together to determine the changes in the weights and biases.

4. Result and Achievement

GUI (Graphical User Interface)

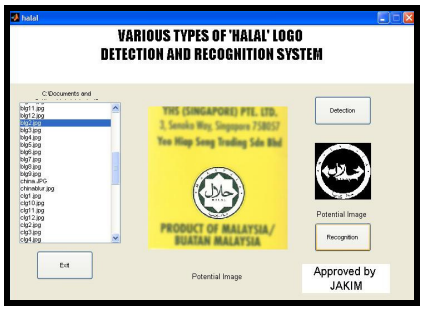

Figure 18. An approved 'Halal' logo by JAKIM.

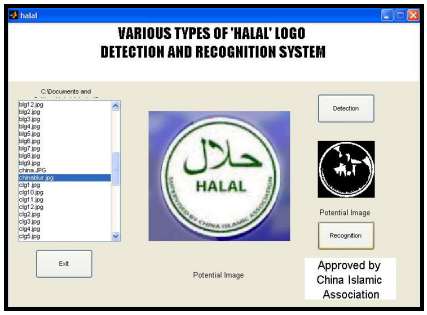

Figure 19. An approved 'Halal' logo by China Islamic Association.

According to the analysis and result, it showed that the objectives of this project are successfully achieved. From the last result [1], this project objective which was to build the detection module was successful and the process to learn about image processing for shape analysis and symbol classification in the difference environment and situation was also a success.

5. Conclusions And Future Work

1. Conclusion

The algorithm had two main modules: detection and recognition modules. In detection module, edge detection and shape classification with binary image were used to give segments to the image. The Gaussian Blur effect was chosen for the potential image background. This was because the difficulties to detect 'Halal' logo images from a crowded image occurred. From the previous experiment, 12 samples of 'Halal' logo were used to detect the logo and 91.67% was detected correctly [1], for the recognition process, the Neural Network was used to recognise 'Halal' logo after the logo had been detected. Neural Networks was a very powerful tool in recognizing the logo. The method used in this project, where the neural network was fed by 2500 bits of 1's and 0's, was considered having a large number of input bits to be analyzed, but the network was still able to give a better result for character recognition process. Developing and training the Neural Network for recognizing process needed a lot of time. The recognition performance depended on how the Neural Network was trained. It is recommended that to get a good result in recognizing the 'Halal' logo, more sets of binary logo should be used to train the network.

2. Future Work

To develop and improve this project, below are few recommendations that can be carried out:

i. Create a complete system with hardware.

ii. Use other methods for detection module such as template matching or colour detection.

iii. Create a system, which can detect the imitation of 'Halal' logo truth barcode number.

iv. Make a better algorithm to detect the logo in crowded background.

v. Design a better Neural Network architecture for 'Halal' logo recognition process.

vi. Develop a system, which can be used in real-time situation.

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