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Detection of Indian Vehicle Number Plate

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ABSTRACT

A rapid increase in number of vehicles demands for the use of automated systems to maintain vehicle information. The vehicle information is highly required for both management and reduction of traffic. Number plate detection is an effective way for automatic vehicle identification. Some of the existing algorithms based on the principle of learning takes a lot of time and expertise before delivering satisfactory results but even then lacks in accuracy. In the proposed algorithm an efficient method for recognition for Indian vehicle number plates has been devised. The algorithm aims at addressing the problems of scaling and recognition of position of characters with enhanced visual quality and a good accuracy rate of 99.07%.

KEYWORDS : Neural Network; Template Matching; Sliding window; Normalized Cross Correlation.

Introduction

The population of India is increasing day by day, thus the number of private as well as public vehicles are also increasing with a great deal. This increase in number of vehicles is also serving a reason for increase in traffic and various crimes associated with it.. It has various applications in toll payments, parking management, road-traffic monitoring, security, crime identification etc [2]. These vehicle monitoring applications need to maintain a listing or detail of vehicles. Manual monitoring of vehicles is cumbersome and error prone because of weak and unreliable human memory. Thus, there is a need of a robust mechanism such as an automated vehicle detection and recognition system to handle this task efficiently.

Each vehicle is uniquely identified form its number plate. An Indian number plate contains the following ten characters in order. State code is a set of two alphabets. Followed by a state code there is a combination of two digits and alphabets for district information. At last a four digit actual registration number [3]. When a number from the number plate is correctly detected, the complete information about the vehicle and its owner can be retrieved.

Figure 1.1: the Right Indian License plate

RELATED WORK

Lazrus et al. [4] proposed an algorithm for vehicle number plate detection and recognition using segmentation and feature extraction using template matching. Koval et al. [5] proposed a method for deblurring the number plate images and recognizing them using feed forward neural network technique. Ozbay and Ercelebi [6] proposed smearing and dilation technique for automatic vehicle identification. Shidore and Narote [7] devised histogram equalization followed by dilation and erosion for plate area extraction. The devised method used SVM classifiers were used for character recognition. Kumar et al. [8] proposed a method based on edge detection using Hough transform. Massoud et al. [9] devised a system using dilation, smoothing and erosion. Chen and Luo [10] and Du et al. [2] located license plate using improved prewitt operation. Khalil [11] suggested an approach based on moving window with template matching technique.

Detection of Vehicle Number Plate for Indian vehicles contains three basic modules namely image pre-processing, candidate area extraction and character recognition [12]. In pre-processing, the image is being loaded and converted to gray or binary, followed by some de-noising techniques. In candidate area extraction, detection of number plate area and segmentation of characters is carried out. In character recognition, template matching and retrieval of characters is performed. Character recognition can also be performed by neural network but it needs periodical training for better efficiency. It also takes a lot of time and expertise for satisfactory results.

In the method using neural networks [13] a perceptron is trained by providing a sample set and few intelligent rules. The problem with neural networks is that training a perceptron is quite difficult and it involves huge sample sets to train the network. If neural network is not trained in an appropriate manner, it may not address scale and orientation invariance. But training network with a rule that solves these problems is even more difficult. Template matching [11] on the other hand is an easier technique as compared to neural networks. Also, it does not require powerful hardware to perform its operations. But it is susceptible to the problems of scale [14] and orientation [15]. There are certain factors which make the number difficult to recognize from the number plate.

i. Numbers are cluttered with other objects. It is difficult to tell which pieces go together as part.

ii. Parts of the number may be hidden behind other objects.
iii. The intensities of the pixels are determined much by lighting as opposed to the nature of the object. For instance black pixels on bright light will give much more intense pixels than the white surface in a gloomy light.

iv. Objects can be deformed in varieties of ways. There are wide varieties of different shapes that have the same name. For instance number '2' can be written in different ways.

v. Scaling is a huge problem in methods like template matching. The correlation differs vastly when the image is scaled [14].

vi. An image may be captured from various viewpoints. Changes in viewpoint cause changes in images thus the same information occurs in different pixels. This problem cannot cope up with standard machine learning approaches.

Scaling of characters in template matching may degrade the efficiency of character recognition. Characters with different sizes have different scales this is referred as scale variance. In order to handle such cases, a correlation is created for the templates. In this paper a new template matching model has been proposed to address scale variance.

PROPOSED METHOD

The proposed method is designed for Vehicle Number Plate Detection for Indian vehicles. In Fig. 1 the method for proposed number plate detection System is depicted. Number plate detection System consists of the following modules:

A. Pre-processing

In this module firstly an input image is taken from an external source such as database or camera which is converted to gray scale.

Generally, the image obtained contains some irrelevant information or impurities such as holes, dirt particles and the background which must be removed. The noise is removed using median filter.

In this process of acquire an image before the image will be process to another stage. It is also to determine the average image quality of the vehicle license plate recognition algorithm to be work on [8]. The accuracy of the recognition will depend on the types of algorithm that had been used. For this capstone project, all the images are either captured by mobile phone camera or digital camera. The images will be stored as JPEG format from the camera to my Personnel Computer. I will use the function from MATLAB to convert the license plate from Colour JPEG image into gray scale format, proceed in using the MATLAB function to convert the vehicle JPEG image into gray scale format.

The initial threshold is set to zero. By calculating the size of input image, n window frames of equal size were found representing the overall image. A window frame moves on the input image and its local threshold is being calculated, the task is carried out for n window frames. Finally the average of n threshold values is calculated. This weighted threshold value is used to convert the image to binary scale.

B. Candidate Area Extraction

In this module the number plate area of Indian vehicles is located and extracted. The exact number plate area is being located and cropped from the original image. Then the components are detected.

Detection of components is done by starting with the top-left corner, the pixels are scanned from left to right in a top down fashion for any lower intensity pixels. If a lower intensity pixel is found, all the connected pixels of similar intensity are found and their information is stored in a set. Traversing along, if a pixel of higher intensity is encountered, the pixels are again scanned till a pixel of lower intensity is found. The process is again continued until all the connected pixels forming different components have been recorded.

Display of character area extraction

The connected components by default are ordered using their left-top values, thus the numbers in the number plate do not occur in correct sequence. Though the correct sequence in the image should be CG07N1100. In order to minimize the layout of the numbers in the number plate the information stored in the set is used and the values of collected components are compared with other component in the set according to the bottom left values. The process is initiated by selecting any two components and reading the information of their bottom-left pixel coordinates and comparing them. The lowest value is used to rank the component. This process is continued till all the bottom-left values of the components have been matched. The rank found as a result of this process is used as a label to identify the order of the component in the image.

C. Character Recognition

In this module the labelled characters are retrieved and recognized. The templates loaded are resized to the size of recognized characters. Normalized cross correlation template matching is used to find the best match. Templates from an existing template set are selected and resized according to the size of the components discovered in the process. Resizing is done in such a way that the scale variance is minimized. In the proposed algorithm, the height and width of the template image is resized to the height and width of the characters of the processed image.

Normalized Cross Correlation is performed between the components and the template image to find the degree of similarity between them. The value is obtained is compared to a given threshold. If the value of cross correlation is greater than the proposed threshold then the original threshold value is updated to the new one. If more than one correlation values exceed the previous threshold then threshold is updated to the highest among these values for the best match. The matched characters are retrieved and the result is stored in a text file.

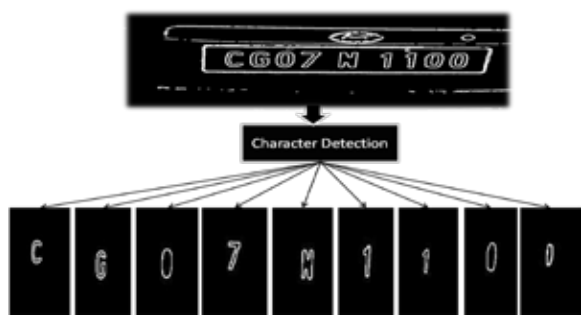

Fig. 3 Example of an image with acceptable resolution

IV. RESULTS AND ANALYSIS

In order to evaluate the success of the proposed method 60 vehicle image samples were checked. Otsu's method for threshold partitioning was modified using the average of every window threshold. The bottom left pixel coordinates were used to find the sequence of characters and label them accordingly in the sample image. Maximum cross correlation was found using template matching for recognizing the characters. As a result 59 in 60 were correctly detected and 59 in 60 were correctly recognized by this system. The overall accuracy rate is depicted in the following table:

Technology	Lazrus et al.[4]	Proposed Method
No. of sample	60	60
Samples correctly detected	57	59
Samples correctly recognized	58	59
Results	96.67%	99.07%

IV. CONCLUSION

This paper presents Detection of Indian number plate System algorithm is based on template matching. The algorithm used modified Otsu's method for threshold partitioning. Scale variance between the characters was reduced by maximizing the correlation between the templates. An algorithm is proposed to cope with scale variance by using template matching with Normalized Cross Correlation. It obtained the accuracy of 99.07%.

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