License Number Plate Recognition using Template Matching

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Abstract — *In this paper, recognition of characters written on a vehicle license number plate is proposed. Method used that is for the recognition of the characters from the license number plate and is based on template-matching. In this method , first the image of a car license number plate is taken as input, then pre-processing steps such as conversion to Gray-scale image, dilation, erosion, convolution is done to remove noise from the input image. Then each character in the number plate is segmented. Segmentation is done on the basis of connected components. Then after segmentation, recognition of characters is done by matching templates to the segmented characters. Matching is done on the basis of correlation between segmented characters and the templates in the database. In the last step, a text file shows the recognised number and the character from the input image. Simulation of the project is done in MATLAB.*

Keywords — *License number plate, template-matching Gray-scale, dilation, erosion, convolution, segmentation, correlation.*

I. INTRODUCTION

Automatic License Plate Recognition (ALPR) is a technology which automatically recognises number from vehicles license number plate. Vehicle's license number is a unique identity as no two vehicles can have same license number. So the recognition of this unique ID is very important as it has many uses. ALPR can be helpful in the case if any vehicle is involved in some crime such as accident, burglary, theft, violation of any traffic rules etc. By the recognition of license number, the criminal using that vehicle can be identified. It is also used by military for surveillance.

ALPR is an example of Optical character recognition (OCR). OCR is technique in which all the handwritten or printed is converted into editable form. So in ALPR, the characters in the image of the number plate are written in a text file which can be edited. Thus the unique number of the vehicle is recognised by a machine which was designed by humans or machine/computer. So in this paper, identification of Indian number plate is proposed which is based on template matching. Indian number plate consists of 10 characters of English language and numbers. Isolated images of all the alphabets of English language i.e. from A-Z and numerals from 0-9 are taken as templates. Then the characters on the number plate are segmented and are matched with the templates created. The closest match is then recognised as the printed character and is written in a text file.

There are several methods that were used for number plate recognition of vehicles. Some uses colour features for the recognition of license plate [1]. Some apply fuzzy disciplines to detect license plate and uses neural network for identification part [2]. Most of the systems first detects a vehicle and captures the vehicle image and then OCR is performed on it for recognition of number plate [3]. [4] paper describes smart vehicle screening system, which can be installed into a toll-booth for the recognition of vehicle license plate recognition using the image of vehicle captured by the camera . [5] paper uses three different algorithm for three different processes in ALPR. These algorithms are "Feature Based Number Plate Localization" for locating number plate, "Image Scissoring" algorithm for image segmentation and algorithm for character recognition using Support Vector Machine (SVM). Report in [6] uses algorithm for localization of yellow coloured plates using morphological operations and image segmentation is based on histogram method. Some uses feature matching Speeded up Robust Features (SURF) technique and advanced radial basis function for characters matching [7]. [8] paper deals with fast detection algorithm is used for the detection of Egyptian license plates that achieves a high detection rate without the need of high quality images from expensive hardware. [9] paper license plate detection is done by detecting edges using Laplace operator, Prewitt operator and Sobel operator. [10] paper presents the detection and recognition of scene-text by using part based tree detection scheme.

There are several methods that exist for the detection of license plate. In this paper, we propose a different method for the recognition of license plate which uses template matching algorithm for the recognition of characters on the license plate of a vehicle. For character segmentation, we have considered the connecting components which uses region shrinking

algorithm for separating each character from the image of a license plate. Noise reduction from the image is done by contrast stretching for obtaining better result and thus improving the performance of the proposed system.

Rest of the papers is organizes as follows. In section II, we gave an overview of proposed method license plate detection. Section III discusses the methodology used in template-matching for character recognition. Section IV discusses Template Matching Algorithm or license plate detection in detail. Section V shows the results of the simulation in MATLAB. Finally, we conclude our work in section VI with direction for future research.

II. PROPOSED METHOD FOR PLATE DETECTION

As we have already mentioned in the literature review that there are different methods for the detection and recognition of license plate of a vehicle. In this paper, the proposed method for the recognition of license plate of vehicles is based on template matching technique. In this technique, the characters on the license plate are segmented on the basis of connected components i.e. pixels belonging to same component or character are separated from the other characters. Since the characters on the number plate of a vehicle are isolated, so segmentation is made easy by using bounding box property of MATLAB. Each character on the number plate is enclosed with a rectangle i.e. bounding box used here. This type of segmentation is called region shrinking segmentation. In this approach, the regions of interest from the input image i.e. each character is segmented by taking connectivity property into account. 8-Connectivity of pixels is used in this paper.
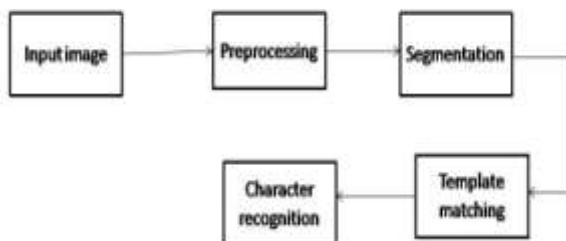

Fig. 1 Steps of the proposed method

All the steps in the proposed method are shown with the help of a flow chart given in Fig. 1.
In the proposed method, the first step is to capture image of a vehicle license plate with the help of a digital camera of high resolution. Second step is the pre-processing done to the input image. It includes noise reduction, morphological operations like dilation and erosion is done to enhance the quality of the input image for better recognition. After pre-

processing, segmentation is done based on connectivity of the components or characters (region shrinking segmentation). Then the next step after segmentation and extraction of individual characters from the number plate, character recognition is done based on template-matching. Templates of English alphabets are created earlier. The segmented characters are matched with the standard templates. Matching is done using correlation function. The character with the maximum value of correlation function matched with the template is considered. Thus characters are recognised with the template matching algorithm. Therefore our goal is achieved i.e. license plate is detected as well as characters on it are recognised and written to a text file.

Fig. 2 License plate of a car

Images of car license are obtained from the internet as these images are of high resolution. The output is shown as an editable text file in which the recognised license number of the vehicle is written.

III. PROPOSED METHODOLOGY

Our proposed methodology includes several steps that we have followed for license plate recognition. These steps are as follows:
In the first step, the image of license plate is captured with the help of a digital camera of high resolution. The input image is then converted to a gray scale image as shown in Fig. 3.

Fig. 3 Gray scale image of car plate

The gray scale image is then passed to the median filter for noise reduction. Contrast of the image is enhanced by adjusting threshold value of the gray scale image
After this, morphological operations such as dilation and erosion are used. By doing this the quality of the image is enhanced and also it is used to detect the edges of the characters in the image as in Fig. 4 and Fig. 5.

Fig. 4 Dilated image of license plate

Fig. 5 Eroded image of license plate

After detecting the edges of the characters, the characters are filled with holes as shown in Fig. 6 so that these can be easily separated .

Fig. 6 Filled image of the license plate

Segmentation is done by using region properties of MATLAB i.e. regionprops and bounding box. Each character in the image is enclosed within a rectangle as in Fig. 7. Thus each character is extracted from each rectangle.

Fig. 7 Image with bounding boxes

After segmentation and extraction of each character, template matching is done. The segmented characters are then matched with the already designed templates using correlation function. The character with the maximum value of the correlation with the template image is considered.

In the final step, the matched or the recognised characters are written in a text file which is editable. Thus the target of recognising the characters from the license plate of number plate is achieved.
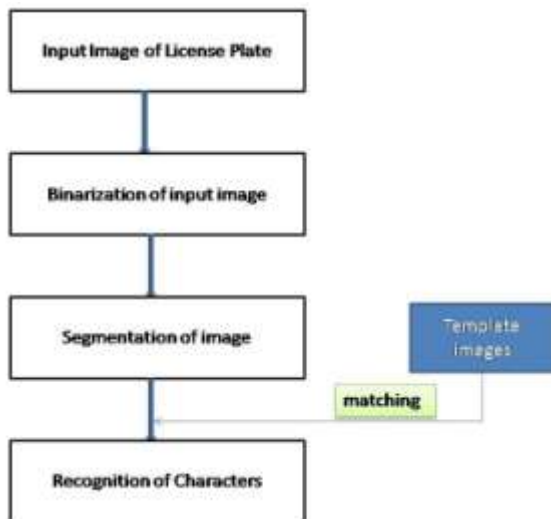
IV. TEMPLATE MATCHING

Fig. 8 Template Matching Algorithm

In order to analyse the matching of the characters from the image, the algorithm of template matching is explained in detail. The flow chart in Fig. 8 explains the steps that were followed in the algorithm:

In the above flow chart, the matching is done on the basis of correlation between the characters segmented from input image and the template images stored in the database.

A. Correlation

Correlation is a statistical technique that can show the relation between two variables. It shows whether the two variables are related to each other and also how they are related.

To find correlation between the pair of variables, the correlation coefficient (or 'r') as shown in equation given below is determined. The value of r ranges from -1 to +1. If the value of r is either 1 or -1 then the two variables are perfectly related. If r is close to 0, it means there is no relation between the variables. In this paper, the two images of characters i.e. one segmented from input image and the other from the template image are related on the basis of r. Correlation coefficient is calculated for the pair of images and the two images with maximum value of r are matched. Thus template images are matched with the isolated characters from the input image.

The correlation coefficient can be calculated using the formula given below:

$$ r = \frac{1}{n-1} \sum \left(\frac{x - \overline{x}}{s_x} \right) \left(\frac{y - \overline{y}}{s_y} \right) $$

where r = Correlation coefficient of (x_1, y_1), (x_2, y_2), (x_3, y_3)................... (x_n, y_n) observations,

n = Number of observations,

$\overline{x}$ = mean of x_1, x_2..............x_n observations,

$\overline{y}$ = mean of y_1, y_2..............y_n observations,

S_x = total observations of x,

S_y = total observations of y.

The simulation of correlation function is done in MATLAB using corr2 function. The value of r in this case lies between 0 and 1. The character with the maximum value of r is matched with the corresponding template image. The character with the maximum value of r is matched with the template image.

V. SIMULATION RESULT

The simulation of this paper is done in MATLAB version R2012a (7.14.0.739). The license number on the image of the number plate is converted into an editable text file. The algorithm is tested on the small dataset of 60 images. All the images of the license plates are obtained from the internet.

Fig. 9 Final output of recognition of license number

Figure 9 shows the output of the recognition of number plate as an editable text file.

VI. CONCLUSION

ALPR is very important in avoiding many crimes like theft, accidents, burglary etc. In ALPR, the image of vehicle license plate is captured and the license number of vehicle is recognized using various algorithms so that the information related to vehicle owner is obtained. In this paper we have proposed a method in which the image of license plate is captured and then noise reduction is performed on it so as to get better results. After this, segmentation and recognition of characters is done using template matching. But the technique can be used only for binary images and not for RGB images. Also template matching algorithm is not flexible as it strictly specifies the size of the templates to be fixed as 24x42. Future work can be done on this paper by removing this inflexibility so as to enhance the rate of recognition.

REFERENCES

[1] A.H. Ashtari, Md. Jan Nordin and Mahmood Fathy, "Iranian License Plate Recognition System Based On Colour Features", IEEE Transactions, vol. 15, no. 4, pp. 1690–1705, August 2014

[2] Shyang Linchang, Li-Shien Chan, Yu-Chung Chung, Sei Wan Chan, "Automatic License Plate Recognition", IEEE Transactions for Intelligent Tranportation System, vol. 5, no 1, pp. 42-53, March 2004..

[3] Cheokman Wu, Leichan On, Chan Hon Weng, Tong Sio Kuan., "A Macao License Plate Recognition System", IEEE Conference on Machine Learning and Cybernetics , vol.7, pp.4506-4510, August 2005.

[4] Kapil Bhosale, Jagdish Jadhav, Sumit Kalyankar, Prof. R. Bhambare, "Number Plate Recognition For Toll Collection", International Journal of Emerging Technology And Advanced Engineering (IJETAE), vol. 4, issue 4, pp. 729-732, April 2014.

[5] Amrinder Kaur, Sonika Jindal, Richa Jindal, "License Plate Recognition Using Support Vector Machine", International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), vol. 2, issue 7, pp. 403-407, July 2012.

[6] Vandini Sharma, Prakash C. Mathpal, Akansha Kaushik, "Automatic License Plate Recognition Using Optical Character Recognition On Yellow Colour License Plates", International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), vol. 3, issue 5, pp. 12984-12990, May 2014.

[7] Abhay Chaturvedi, Nidhi Sethi, "Automatic License Plate Recognition Using SURF Features", International Journal of Computer Applications (IJCA), vol. 70, no.27, pp. 37-41, May 2013.

[8] Amr. E. Rashid, "A Fast Algorithm For License Plate Detection". International Conference On Signal Processing Image Processing and Pattern Recognition (ICSIPR), pp. 44-48, February 2013.

[9] Liao Yu, "Research On Edge Detection in License Plate Recognition," The 2nd International Conference on Computer Application and System Modelling, pp. 1139-1142, April 2012.

[10] Cun Zhao Shi, Chun Heng Weng, Bai Hua Xiao, Song Gao, "Scene Text Recognition Using Structure-Guided Character Detection And Linguistic Knowledge", IEEE Transactions on Circuits and Systems for Video Technology, vol. 24, no.7, pp.1235-1250, July 2014.

[11] Anjali Sharma, Dr. Ajay Kumar Singh, "CBIR through CDH using Query by Group", International Journal of Computer Trends and Technology (IJCTT), vol. 28, no. 1, pp 21-27, October 2015.