International Journal of Electronic and Electrical Engineering.
ISSN 0974-2174 Volume 6, Number 1 (2013), pp. 67-73

http://www.irphouse.com

Automatic Indian Vehicle License Plate Recognition

Karthikeyan T.[1] and Vinothkumar S.[2]

[1]Assistant Professor, Deptof ECE. Aksheyaa College of Engineering, Puludivakkam, Kancheepuram,
E-mail: kart_1729@yahoo.co.in
[2]Associate Professor, Deptof ECE.Aksheyaa College of Engineering, Puludivakkam, Kancheepuram.
E-mail: vinrain44@gmail.com

Abstract

Automatic Vehicle License Plate Recognition has many applications in traffic systems (highway electronic toll collection, redlight violation enforcement, border and customs checkpoints, etc. Inthis project, a smart and simple algorithm is presented for vehicle's license plate recognition system. The proposed algorithm consists of Four major parts: Image Pre Processing &Integral Edge Image, License Plate Localization, segmentation of the characters, recognition of the characters.

Keywords: Character recognizer, license plate recognition, plateregion extraction, segmentation, smearing, template matching, Matlab.

1. Introduction

The License Plate Recognition (LPR) system is an integrated hardware and software device, which has the ability to detect and read the characters from the license plate and convert it into electronic text like ASCII characters. Research has shown that majority of crimes in United States are related to vehicles. Thus, the ability of LPR system to automate the process of identifying vehicles of interest has revolutionized law enforcement and has improved public security. The input to the LPR system is a digital image of the front or the rear end of the vehicle's license plate, taken by the sophisticated cameras. Further processing on this image is carried out for the purpose of license plate detection. After the plate information is extracted from the image, it is further segmented to locate individual characters. There are several methods available in the market used for recognizing the characters on the plate i.e., Character

recognition using Feed Forward Neural Network, Template matching, etc. Each segmented characters are identified using one of these algorithms and converted into electronic data. This data can be used in various safety and traffic applications like tolling, law enforcement, and thus useful in Figure hting crime and fraud thereby improving public safety.

Automatic License Plate recognition is one of the techniques used for vehicle identification purposes. The sole intention of this project is to find the most efficient way to recognize the registration information from the digital image (obtained from the camera). This process usually comprises of three steps. The proposed algorithm consists of four major parts: Image Pre Processing &Integral Edge Image, License Plate Localization, segmentation of the characters, recognition of the characters. Thus, this project uncovers the fundamental idea of various algorithms required to accomplish character recognition from the license plate during Template Matching.

2. Proposed System

In this project, a smart and simple algorithm is presented for vehicle's license plate recognition system. The proposed algorithm consists of Four major parts: Image Pre Processing &Integral Edge Image, License Plate Localization, segmentation of the characters, recognition of the characters.

2.1 Pre Processing & Integral Edge Image

Images are acquire Image can be input to the system by different methods by analog camera, or by digital cameras. The algorithm described here is independent of the type of colors in image and relies mainly on the gray level of an image for processing and extracting the required information. Color components like Red, Green and Blue value are not used throughout this algorithm. So, if the input image is a colored image represented by 3-dimensional array in MATLAB, it is converted to a 2-dimensional gray image before further processing. The sample of original input image and a gray image is shown below:

Figure 1.a: Original Image. **Figure 1a:** Grayscale.

License plate can be detected as an area containing rich edge and textural information. To exploit this property the Sobel operator for vertical edge detection is used after converting the gray image.Experiments show that by detecting only vertical edges an accuracy of detection can be improved. Horizontal edges preserve minor edge information in the plate area. On the other hand there are a lot of horizontal edges in

the background making the detection process is less effective. Vertical edge map is binarized using adaptive threshold based on mean value and standard deviation of pixel neighborhood. Finally, integral edge image *I1* is computed using Matlab7.Highlight Desired Details such as Plate Details and vertical edge in the image.HDD performs AND-AND operation for each two corresponding pixel values taken from both Vertical response and threshold images. The AND-AND procedure for this process is illustrated in Figure 2.This scanning process will start moving from left to right and from top to bottom. After all pixels are scanned, the regions in which the correct LP exists are highlighted as shown in Figure 3.

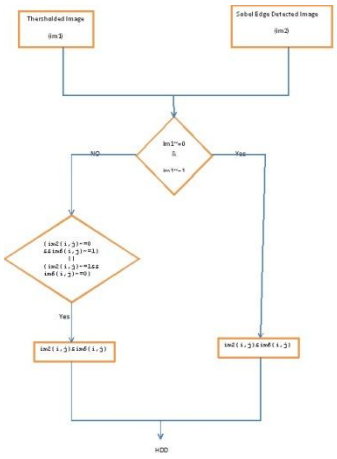

Figure 2: And - And Gate Logic.

Figure 3: Highlighted Desired Area.

2.2 License Plate Localization

Histogram is a graph representing the values of a variable quantity over a given range. In this Number Plate Detection algorithm, the writer has used horizontal and vertical histogram, which represents the column-wise and row-wise histogram respectively. These histograms represent the sum of differences of gray values between neighboring pixels of an image, column-wise and row-wise. In the above step, first the horizontal histogram is calculated. To find a horizontal histogram, the algorithm traverses through each column of an image. In each column, the algorithm starts with the second pixel from the top. The difference between second and first pixel is calculated. If the difference exceeds certain threshold, it is added to total sum of differences. Then, algorithm will move downwards to calculate the difference between the third and

second pixels. So on, it moves until the end of a column and calculate the total sum of differences between neighboring pixels. At the end, an array containing the column-wise sum is created. The same process is carried out to find the vertical histogram. In this case, rows are processed instead of columns. Referring to the Figure ures shown below, one can see that the histogram values changes drastically between consecutive columns and rows. Therefore, to prevent loss of important information in upcoming steps, it is advisable to smooth out such drastic changes in values of histogram. For the same, the histogram is passed through a low-pass digital filter. While p performing this step, each histogram value is averaged out considering the values on it right-hand side and left-hand side. This step is performed on both the horizontal histogram as well as the vertical histogram. Below are the Figure ures showing the histogram before passing through a low-pass digital filter and after passing through a low-pass digital filter.

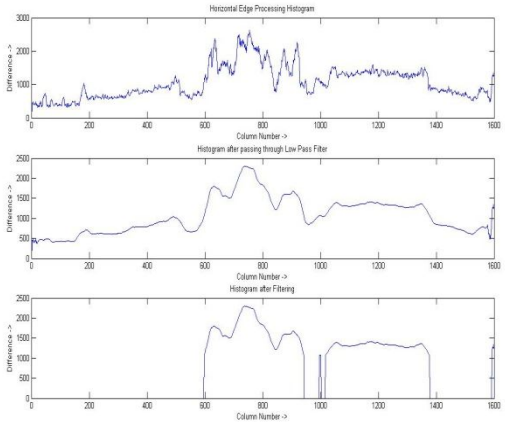

Figure: 5 Horizontal edge processing histogram.

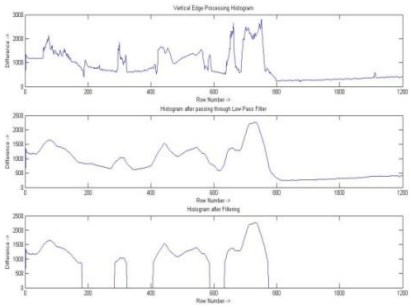

Figure 4: Vertical edge processinghistogram.

Once the histograms are passed through a low-pass digital filter, a filter is applied to remove unwanted areas from an image. In this case, the unwanted areas are the rows and columns with low histogram values. A low histogram value indicates that the part of image contains very little variations among neighboring pixels. Since a region with

a license plate contains a plain background with alphanumeric characters in it, the difference in the neighboring pixels, especially at the edges of characters and number plate, will be very high. This results in a high histogram value for such part of an image. Therefore, a region with probable license plate has a high horizontal and vertical histogram values. Areas with less value are thus not required anymore. Such areas are removed from an image by applying a dynamic threshold.

In this algorithm, the dynamic threshold is equal to the average value of a histogram. Both horizontal and vertical histograms are passed through a filter with this dynamic threshold. The output of this process is histogram showing regions having high probability of containing a number plate. The filtered histograms are shown below: The next step is to find all the regions in an image that has high probability of containing a license plate. Co-ordinates of all such probable regions are stored in an array. The output image displaying the probable license plate regions is shown below.

Figure 7: Probable License Plate.

The output of segmentation process is all the regions that have maximum probability of containing a license plate. Out of these regions, the one with the maximum histogram value is considered as the most probable candidate for number plate. All the regions are processed row-wise and column-wise to find a common region having maximum horizontal and vertical histogram value. This is the region having highest probability of containing a license plate. The image detected license plate is shown below:

Figure 7a: Extracted Plate. **Figure 7.b:** Detected Plate.

2.3 Segmentation

In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining thecharacters individually. Firstly, image is filtered for enhancing the image and removing the noises and unwanted spots. Then dilation operation is applied to the image for separating the characters from each other if the characters are close to each other. After this operation, horizontal and vertical smearing are applied forfinding the character regions. The next step is to cut the plate characters. It is done by finding

starting and end points of characters in horizontal direction.The result of this segmentation is in Figure ure.

Figure 8: Segmented Characters.

2.4 Character Recognition

Before recognition algorithm, the characters are normalized. Normalization is to refine the characters into a block containing no extra white spaces (pixels) in all the four sides of the characters. Then each character is fit to equal size. Fitting approach is necessary for template matching. For matching the characters with the database, input images must be equal-sized with the database characters. Here the characters are fit to 36 ×18. The extracted characters cut from plate and the characters on database are now equal-sized. The next step is template matching. Template matching is an effective algorithm for recognition of characters. The character image is compared with the ones in the database and the best similarity is measured.

3. Experimental Results

Experiments have been performed to test the proposed system and to measure the accuracy of the system. The system is designed in Matlab 7 for recognition of Indian license plates. The images for the input to the system are colored images with various sizes. The test images were taken under various illumination conditions. The results of the tests are given by Table I.

Table 1

Units of LPR System	Number of Accuracy	Percentage of Accuracy
Extraction of Plate Region	10/12	83%
Segmentation	10/12	83%
Recognition of Characters	9/12	75%

Conclusion

In this paper, we presented application software designed for the recognition of car license plate. Firstly we extracted the plate location, then we separated the plate characters individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters. This system is designed for the identification Indian license plates and the system is tested over a large number of images. Finally it is proved to be 83% for the extraction of plate region, 83% for the

segmentation of the charactersand 75% for the recognition unit accurate, giving the overall system performance 80% recognition rates.

References

[1] Peter Tarabek, "Fast License Plate Detection based on Edge density and Integral Edge Image", 10th International IEEE Jubilee International Symposium on Applied Machine Intelligence and Information, January 2012

[2] Rob.G.J. Wijnhoven and Peter H.N. de With "Identify Verification using Computer Vision for Automatic Garage Door Opening", IEEE Transactions on consumer Electronics vol 57, No.2, May 2011

[3] Hinde ANOUAL, Sanna EL FKIHI, Abdellilah JILBAB, Driss ABOUTAJDINE "Vehicle License Plate Detection in Images",International Conference onMultimedia Computing and Systems (ICMCS), 2011

[4] A.W. G. C.D Wijetunge and D.A.A.C.Ratnaweera "Real Time Recognition of License Plates of Moving Vehicles in Sri Lanka" 2011 6th International Conference on Industrial and information Systems, ICIIS 2011, 2011.

[5] Jianyu Zhao, Shujian Ma, WeiminHan, Yang Yang and Xudong Wang "Research and Implementation of License Plate Recognition",Control and Decision Conference (CCDC), 2012

[6] ZuwenaMusoromy, Dr.SoodamaniRamalingam and NicoBekooy "Edge Detection Comparison for License Plate Detection", 11thInt.Conf. Control, Automation, Robotics and Vision, 2010

[7] XiaojunZhai, FaycalBenssali and SoodamaniRamalingam "License Plate Localisation based on Morphological Operations" 11thInt.Conf. Control, Automation, Robotics and Vision, 2010

[8] Otsu N. "A Threshold Selection Method for Gray Level Histograms" IEEE Transactions on System, Man and Cybernetics, Vol.9, no. 1, PP 62-66, January 1979.