EFFECTIVE METHOD OF LICENSE PLATE LOCALIZATION AND SEGMENTATION OF VEHICLES

Manisha Shirvoikar, Jairam Parab, Vinay Mirashi, Ramesh Kudaskar
Department of Electronics and Telecommunication,
Goa College of Engineering, Goa University, Goa, India

ABSTRACT

License plate localization and segmentation (LPLS) uses image processing and character segmentation. This technique can further be used in character recognition technology in order to identify the license plate. In recent years the number of vehicles has increased drastically especially cars so this system finds good applications in the traffic monitoring. LPLS system is a kind of an intelligent transport which will overcome the difficulty in tracking vehicles for the purpose of parking admission, traffic management and law enforcement especially at state borders, electronic toll collection, surveillance devices and safety supervision systems. The system consists of three main modules Localizing the license plate, Detecting the license plate and Extracting the number plate area and Segmenting the numbers and characters in the plate.

KEYWORDS *— Pre-processing, License plate extraction, Character segmentation, bounding box.*

I. INTRODUCTION

In recent years, License Plate Localization and segmentation (LPLS) is a method used in character recognition to identify vehicles by their license plates. This method have been widely used as a core technology for security or traffic applications such as in traffic control, parking lot access control, and information management. Mostly we see that the cars have to be stopped at toll booths or parking lots for paying the toll fee or parking fee and also keeping track of each vehicle manually which is a time consuming process. In order to automate these processes and make them more effective, a system is required to easily identify the vehicle [1]. Using the vehicle's license plate a particular vehicle can be identified. This will help us identify and register vehicles and provide the reference for further vehicle tracking and activity analysis.

License plate Localization and Segmentation contains three parts, license plate detection, extraction, and segmentation. The main purpose of this proposed idea is to obtain segmented characters from the extracted license plate from an image provided by a camera. In this paper using various morphological operations first the license plate area is detected. Then using bounding box method license plate is extracted and characters are segmented. Also conversion from two rows to one is used for segmentation of license plate having two rows.

II. LITERATURE SURVEY

Nelson *et a*l described the method in which in pre-processing, the sobel operator is used for detecting horizontal and vertical edges [2]. Low pass filter used for noise removal and smoothing. Using geometric properties license plate is localized by detecting rectangular shape. Character Segmentation is done using Thin Window Scanning method. Character Recognition was carried out using Artificial Neural Network (ANN). The advantage of the proposed systems is that it works for all types of license plates having either white or black background with black or white characters respectively. The limitations of license plate reading include constraints on camera location and positioning, limited success in less-than-ideal conditions, and the evolving machine vision technology. Yungang Zhang *et a*l proposed algorithm on Chinese number plate for pre-processing is carried out in following

manner size normalization, determination of plate and object enhancement[3]. Horizontal segmentation is done using Hough transformation. The vertical segmentation algorithm is based on projection analysis. Their advantages were that the algorithm for horizontal segmentation, using Hough Transformation, solves the problem of rivet, rotation, and illumination variance. Vertical segmentation algorithms restrain the influence of plate frame and space mark. The disadvantage was their system would not work on number plates with two rows. Kaushik *et al* proposed vehicle license plate detection (VLPD) method consists of three main stages [4]. A novel adaptive image segmentation technique named as sliding concentric windows (SCWs) used for detecting candidate region; colour verification for candidate region by using HSI color model on the basis of using hue and intensity in HSI color model verifying green and yellow LP and white LP, respectively; finally, decomposing candidate region which contains predetermined LP alphanumeric character by using position histogram to verify and detect vehicle license plate (VLP) region. Disadvantages were it is sensitive to the angle of view, physical appearance and environment conditions.

III. PROPOSED TECHNIQUE

In the proposed idea of work the image of vehicle is captured and preprocessing is performed on image to eliminate noise and enhance information in image for further processing by system. License plate is detected and the actual license plate is extracted. After extraction the characters are segmented from the extracted license plate. The block diagram of proposed work is shown in Fig. 1.

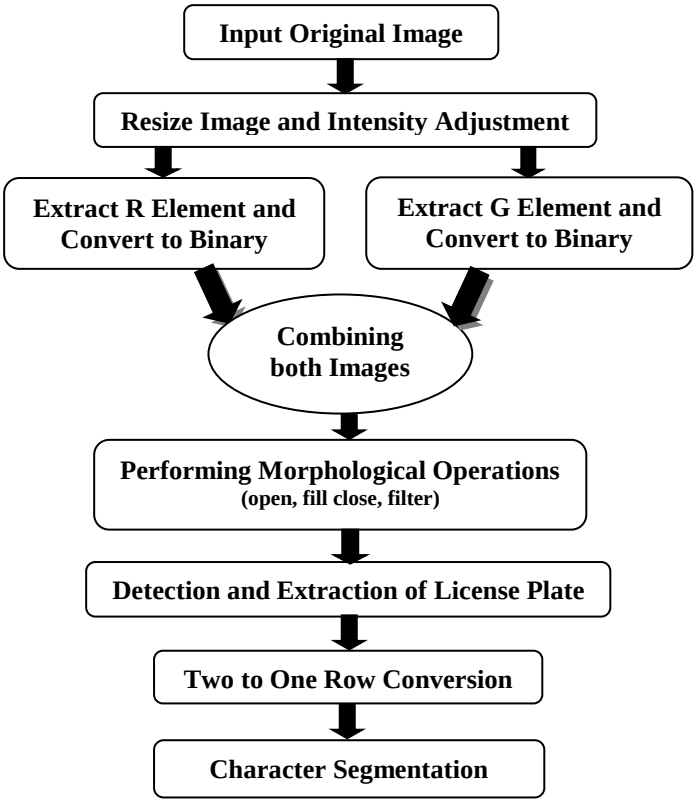


Figure 1 Block diagram of proposed idea

3.1 Acquisition of image

In this proposed work image can be acquired using different resolution cameras ranging from a VGA camera to high resolution digital camera, Fig. 2a. Images are taken at a distance of one to two meters from the vehicle with different background and illumination.

3.2 Pre-processing of image

Pre-processing of image is done to reduce the noise in the image, improve the contrast of the image and to increase the processing speed[1].

Normally in pre-processing of image original image is first converted to grayscale and then to binary but in our proposed idea from the RGB image we extract each content of RGB image that is red, green and blue(R,G & B).This R, G and B image are separately converted to binary and then combined together. By doing this we are able to get better binary image as compared to threshold method of converting grayscale image to binary. Binary image is shown in Fig. 2b.

Figure 2(a) Original Image **Figure 2(b)** Binary Image

3.3 License Plate Extraction

License plate extraction is the key step in license plate recognition, which influences the accuracy of the system significantly [1]. After detecting of number plate extraction of number plate is performed. Extraction is done to make the character segmentation easier; by using proper algorithm area other than license plate can be eliminated. While extracting the number plate care should be taken to ensure proper extraction of number plate area because car images can be captured from different distance and angle; due to which size of car and hence size of number plate will tend to change.
Extraction can be performed in two phase firstly removing the unwanted area other than license plate area and secondly cropping the plate area.

3.3.1. Candidate Regions Detection

To detect candidate plate region various morphological operations are performed on the image.
Morphological operations aim to remove unrelated objects in the image [6]. This operation helps in specifying the license plate region in the image. In our system opening, filling, closing and filtering is performed for detection of candidate region in image.
Opening is basically erosion followed by dilation [5]. It is used to eliminate all the pixels in regions that are too small to contain structural element given by equation 1. Dilation is performed by first creating a structural element and then moving this element over the image. If starting point of structuring element coincides with white pixels in the image the pixel remains unchanged, it moves to next pixels. If starting point of structuring element coincides with black pixels in the image, than it makes all the pixels black in the image covered by the structuring element. Dilation allows object to expand, fill small holes and connect disjoint objects. Erosion is similar to process of dilation but here pixels are turned to white. It suppresses the object boundaries and disconnects joints if the size of the structuring element is greater than the connecting pixel.
The opened image is filtered using median filter which removes noise and smoothen image as shown in Fig. 3a. Then filling operation is performed, which fills the gaps within the boundary of an object in binary image which causes the area within the boundary to be filled. Then multiply this filled image with binary image for identifying the required area, this way the number plate is detected as shown in Fig. 3b.

$$\boldsymbol{A \circ B = (A \ominus B) \oplus B} \qquad \textbf{(1)}$$

Structure B open aggregates A in equation (1).

Figure 3(a) Filtered Image **Figure 3(b)** Candidate Plate Area

3.3.2. Actual License Plate Extraction

Next Morphologically open binary image is carried out, which removes all connected components (objects) that have fewer than P pixels, producing another binary image as shown in Fig. 3c.

$$G(x_n) = \begin{cases} 1 & if\ g(x_n) \geq P \\ 0 & if\ g(x_n) < P \end{cases} \quad (2)$$

In equation 2, $g(x_n)$ specifies objects in binary image and P is the threshold value of the pixel and $G(x_n)$ is the output image.

After removing the unwanted area actual license plate is extracted. For this purpose bounding box method is used. . Bounding box is a rectangle which has minimum height and width that covers all pixels present in particular connected component or region. By using bounding box the respective row and column indices of the license plate area are found out and depending on these indices the characters are segmented. The cropped number plate is shown in Fig. 3d.

Figure 3(c) Removing Unwanted Area

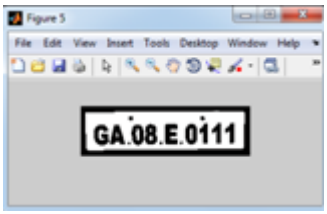


Figure 3(d) Extracted License Plate

3.4 Two to One Row Conversion

From various images it is found that, if the license plate has two rows than character segmentation is improper (i.e. the characters are not segmented in proper order).

To take care of two row license plate the license plate is scanned from top to bottom and the gap between two rows of the license plate is found, and license plate is divided into two parts as shown in Fig. 3e. After dividing, the two rows are concatenated to make it as one row; but before that it has to be checked whether height of both the rows are same. If there is difference in height of both rows than it should be equalised, for this different conditions are specified because the maximum difference in height will not be more than four as shown in Fig. 3f.

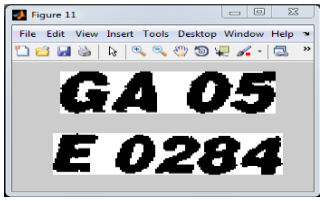


Figure 3(e) Rows Separation

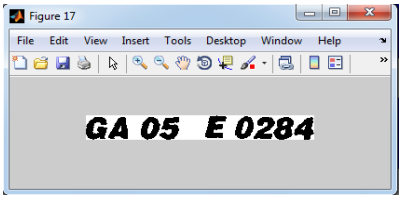


Figure 3(f) Two to Single Row

3.5 Character Segmentation

Character segmentation is the procedure of extracting the characters and numbers from the license plate image [8]. Segmentation of license plate characters plays1 an important role, which directly results on the accuracy of character recognition significantly.[1] Character segmentation aims at splitting the extracted license plate into a set of individual characters .In character segmentation the characters on the extracted license plate are isolated from each other without losing features of the characters. There are some widely used methods for character segmentation like static bounds, vertical projection, bounding box and connected component [7]. We have used bounding box to separate individual character from the license plate. Segmented characters are shown in Fig. 3g.

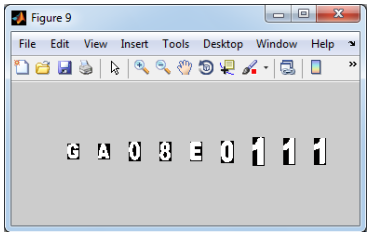


Figure 3(g) Segmented Characters

IV. RESULT

Various images of different sizes are captured and resized to 640 X 480. 20 images were taken in one particular angle; altogether 80 images were taken from four different angles. If the angle with which the images taken is decreased below 60° the extraction and segmentation were drastically affected. Images were taken with different illumination conditions and angles with varying distance. The proposed system works well for images taken within the range of 0.5mt-2mt and angle up to 60º. Success rate for each of the taken angle is shown in the table below.

TABLE 1. Experimental results

Angle	Extraction	Segmentation
90	98%	97%
80	98%	97%
70	96%	92%
60	84%	72%

V. CONCLUSION

The proposed algorithm for vehicle license plate detection, extraction, and character segmentation is designed and implemented. This method has been tested over 80 images captured with different illumination conditions, with varying angle, distance and with different camera resolution. The proposed algorithm gives satisfactory results. The drawback in this proposed idea is that for number plate having two rows, segmentation is not achieved as required since characters are getting segmented based on starting point of each character. Also the performance degrades if the illumination reduces substantially. The result shows that, number plate is extracted successfully with success rate of 89%. The future scope is to develop better algorithm for images captured with low illumination condition and also to achieve better segmentation of number plate having two rows.

ACKNOWLEDGEMENT

We are deeply indebted to our guide, Prof. Samarth Borkar for allowing us to carry out the project under his supervision. We also wish to thank Prof. (Dr.) H. Virani, head of Department, Electronics and Telecommunication Engineering, for constantly motivating us in our journey through this project. We are grateful to Prof. (Dr.) R.B.Lohani, Principal, Goa College of Engineering for his constant support and encouragement.

REFERENCE

[1]. Vinay Mirashi, Jairam Parab, Manisha Shirvoikar, Ramesh Kudaskar, Samarth Borkar, "License Plate Detection and Segmentation for Goan Vehicles", International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064.

[2]. C. Nelson Kennedy Babu, Krishnan Nallaperumal," An Efficient Geometric feature based License Plate Localization and Recognition", International Journal of Imaging Science and Engineering(IJISE), IJISE,GA,USA,ISSN:1934-9955,VOL.2,NO.2, APRIL 2008

[3]. Yungang Zhang, Changshui Zhang," A New Algorithm for Character Segmentation of License Plate ".

[4]. Kaushik Deb, Hyun-Uk Chae and Kang-Hyun Jo "Vehicle License Plate Detection Method Based on Sliding Concentric windows and Histogram", Journal of Computers, Vol. 4, No. 8, August 2009

[5].R. Gonzalez and R. Woods, "Digital Image Processing", 2nd ed., Prentice-Hall, New Jersey, 2001.

[6].Shidore,Narote,"Number Plate Recognition for Indian Vehicles", IJCSNS International Journal of Computer Science and Network Security, VOL. 11 no.2, Feb.2011.

[7].Chetan Sharma and Amandeep Kaur, "Indian Vehicle License Plate Extraction and Segmentation", International Journal of Computing Science and Communication Vol 2, No. 2, July-December 2011.

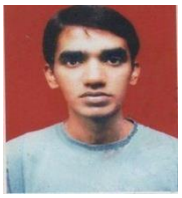
[8].Khalid W. Maglad, "A Vehicle License Plate Detection and Recognition System", Journal of Computer Science 8 (3): 310-315, 2012, ISSN 1549-3636

AUTHORS

Manisha Shirvoikar is pursuing her BE Degree from the Department of Electronic and Telecommunication Engineering in Goa College of Engineering (GEC), Goa University, Goa, India. Her research interests are in Image processing, Pattern recognition.

Jairam Parab received the E&C Diploma from the Department of Electronic and Communication, from Government polytechnic Bicholim, Board of Technical Education, Goa, India, in 2009. He is pursuing his BE Degree from the Department of Electronic and Telecommunication Engineering in Goa College of Engineering (GEC), Goa University, Goa, India. His research interests are in Image processing, Pattern recognition.

Vinay Mirashi received the EE Diploma from the Department of Electronic Engineering, from Agnel Polytechnic, Board of Technical Education, Goa, India, in 2010. He is pursuing his BE Degree from the Department of Electronic and Telecommunication Engineering in Goa College of Engineering (GEC), Goa University, Goa, India. His research interests are in Image processing, Pattern recognition.



Ramesh Kudaskar received the EE Diploma from the Department of Electronic Engineering, Government Polytechnic Panjim Board of Technical Education, Goa, India, in 2010. He is pursuing his BE Degree from the Department of Electronic and Telecommunication Engineering in Goa College of Engineering (GEC), Goa University, Goa, India. His research interests are in Image processing, Pattern recognition.