International journals of Advances in Electronics Engineering
Vol:1 Issue:1 ISSN 2278 - 215X

Content Based Retrieval for Number Plate Extraction of Vehicle

Samiksha Soni
Department of Electronics & Telecommunication,
National Institute of Technology Raipur, Chhattisgarh, India
samiksha.soni786@gmail.com

Mohammad Imroze Khan
Department of Electronics & Telecommunication,
National Institute of Technology Raipur, Chhattisgarh, India
imroze786@gmail.com

***Abstract*—Number plate recognition (NPR) is one of the most important applications of applying computer techniques towards intelligent transportation systems (ITS). In order to recognize a number plate efficiently, location and extraction of the number plate is the key step. Hence finding the position of a number plate in a vehicle image is considered to be the most crucial step of an NPR system, and this in turn greatly affects the recognition rate and overall speed of the whole system. This paper mainly deals with the detecting number plate location issues in Indian traffic conditions. The vehicles in India sometimes bare extra textual regions, such as owner's name, symbols, popular sayings and advertisement boards in addition to number plate. Situation insists for accurate discrimination of text class and fine aspect ratio analysis. Disparity of aspect ratios is a typical feature of Indian traffic. In this paper we proposed method which aims at identifying region of interest by using Sobel operator for edge detection and a series of morphological processing. This algorithm is tested on large database of images taken in different conditions provides the extraction of number plate with success rate of 95%.**

***Keywords*— Dilation, Sobel operator, RGB, pixels, gray scale, binarization**

I. INTRODUCTION

Automatic number plate recognition (ANPR) applies image processing and character recognition technology to identify vehicles by automatically reading their number plates. Automated number plate reading is a particularly useful and practical approach because, apart from the existing and legally required number plate, it assumes no additional means of vehicle identity. Although human observation seems the easiest way to read vehicle number plate, the reading error due to tiredness is main drawback for manual systems. This is the main motivation for research in area of automatic number plate recognition. Since there are problems such as poor image quality, image perspective distortion, other disturbance characters or reflection on vehicle surface, and the color similarity between the number plate and background vehicle body, the number plate is often difficult to be located accurately and efficiently. Security control of restricted areas, traffic law enforcements, surveillance systems, toll collection and parking management systems are some applications for a number plate recognition system.

So many researches of car identification have been approached by car number plate extracting and recognition, some of the related work is as follows. Color features based license plate detection [1] Lotufo, Morgan and Johnson [2] proposed automatic number-plate recognition using optical character recognition techniques. Johnson and Bird [3] proposed knowledge-guieded boundary following and template matching for automatic vehicle identification. Fahmy [4] proposed bidirectional associative memories (BAM) neural network for number plate reading. It's appropriate for small numbers of patterns. Nijhuis, Ter Brugge, Helmholf J.P.W. Pluim, L. Spaanenburg, R.S. Venema and M.A.Westenberg [5] proposed fuzzy logic and neural networks for car LPR. This method used fuzzy logic for segmentation and discrete-time cellular neural networks (DTCNN'S) for feature extraction. Choi [6] and Kim [7] proposed the method based on vertical edge using Hough transform (HT) for extracting the number plate. E.R. Lee, P.K. Kim and H.J. Kim [8] used neural network for color extraction and a template matching to recognize characters. S.K. Kim, D.W. Kim and H.J. Kim [9] used a genetic algorithm based segmentation to extract the plate region

In this paper, a simple but efficient number plate extraction method is proposed. The method used here is basically based on the morphological algorithms and connected components analysis, including four major stages, which are, RGB to gray-scale conversion which is explained in section III followed by image binarization and edge detection in section IV. For location of the number plate, morphological operation is explained in section V. Extracting the accurate location of the number plate is explained in section VI followed by result analysis in section VII. Although the proposed method is designed particularly for Indian vehicles, it can be readily extended to cope with vehicles of other countries also.

II. PROPOSED ALGORITHM

The proposed method is designed for real-time number plate extraction. Input to the system is an image which contains the number plate, acquired from about 4 meters away by a digital camera of the front or rear of the vehicle; and its output is the number plate region. The method comprises four major stages, which are: RGB to gray-scale conversion, image binarization and edge detection, analysis and dilation, connectivity trace and extracting the accurate location of the number plate, as shown in figure-1.

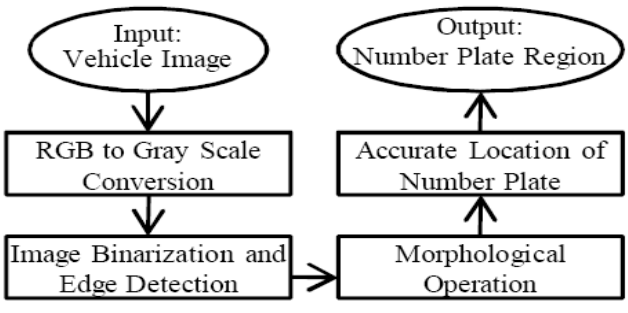

Figure 1. Flow of algorithm for proposed algorithm

Thus the algorithm will involve following steps:

- *RGB to Monochrome Conversion*: The original 24 bit color image is converted to gray scale and then using a fixed threshold is converted to monochrome.
- *Edge Detection*: The edges in the image are identified by using the Sobel edge detection operator.
- *Edge Improvement*: – Operations similar to dilation are carried out on the edge detected image to make it a solid edge.
- *Single Pixel Width Conversion*: We perform thinning operations by using two types of structuring elements, so as to reduce the border to single pixel width.
- *Improving the Thinning Output*: Unwanted pixels, for instance, ones that stick out from boundaries are removed, and the boundary is basically cleaned up.
- *Prior to Connectivity Check*: The boundary is further improved, so as to make it easier to trace it.
- *Connectivity Trace*: The left bottom corner of the number plate is located, and the white pixels are traced until the starting position is reached again.
- *Locating the Number Plate*: The coordinates of the corners of the number plate is extracted. The number plate is cut from the original color image using these coordinates and stored on the disk.

III. RGB TO GRAY-SCALE CONVERSION

In this section, RGB to gray-scale conversion is done, in order to facilitate the plate extraction, and increase the processing speed. Color image (RGB) acquired by a digital camera is converted to gray-scale image based on the RGB to gray-scale conversion technique. The basic idea of this conversion is performed by eliminating the hue and saturation information while retaining the luminance. The following equation (1) shows an optimal method for RGB to gray-scale conversion, [10]:

$$\Lambda\upsilon = 0.299 * P + 0.587 * \Gamma + 0.114 * B \quad (1)$$

IV. IMAGE BINARIZATION AND EDGE DETECTION

The gray-scale image resulted by the previous stage is converted to binary image (Black & White). This conversion is the most important stage in all phases of the NPR system, and more specifically for plate extraction phase. As known, the foreground and background colours of vehicle number plates are quite distinct. However, input images to the LPR system, often contain unevenly distributed gray intensities, or all the intensity values could lie within a small range, such as the images with poor contrast, or poor illumination. Therefore, the crucial point is to use an effective technique for binarization; otherwise, the method would fail to extract the number plate region from the vehicle image correctly. In order to overcome the illumination problems, our method performs this task using a well-known Otsu's method [11]. Otsu's method is one of the robust global binarization methods, and widely used for binarizing the gray-scale images due to its accurate results and high speed. As a result, the plate characters are appear clearly after binarization, as shown in figure -2.

(a) Original Color Image of Car (b) Binarized Image of Car

Figure 2. Images in Binarization step

Next step is edge detection using Sobel operator [12]. The Sobel operator performs a 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. The 'Sobel' operator is a 3*3 mask, which is convolved with the whole of the image to generate an edge detected output. There are different masks for detection of edges having different orientations. In our process we use the vertical & horizontal edge detection masks as shown in figure - 3.

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Figure 3. Sobel Convolution masks

These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by equation (2):

$$|G| = \sqrt{(Gx^2 + Gy^2)} \quad (2)$$

Typically, an approximate magnitude is computed using equation (3), which is much faster to compute.

$$|G| = |Gx| + |Gy| \quad (3)$$

The angle of orientation of the edge giving rise to the spatial gradient is given by equation (4):

$$\theta = \arctan(Gy / Gx) \quad (4)$$

Typically it is used to find the approximate absolute gradient magnitude at each point in an input gray scale image. Its larger convolution kernel smooths the input image to a greater extent and so makes the operator less sensitive to noise as shown in figure - 4.

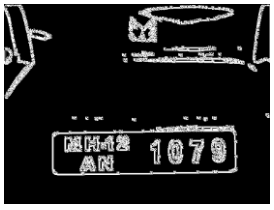

Figure 4. Edge detected image

Vol:1 Issue:1 ISSN 2278 - 215X

V. MORPHOLOGICAL OPERATIONS

The principal objective of this stage is to find out the rough location of the number plate [13]. This is achieved by a series of operation involving dilation, thinning, boundary extraction and connectivity trace on edge detected image shown in figure – 5.

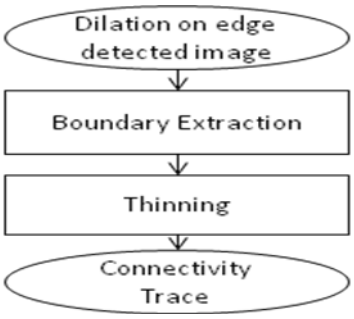

Figure 5. Flow of morphological process

- *Dilation*: It is used for growing image regions. It enlarges the foreground and shrinks the background. It is used to fill out gaps in boundaries of regions. It provides the improvement of edge detected image of previous step as shown in figure - 6.

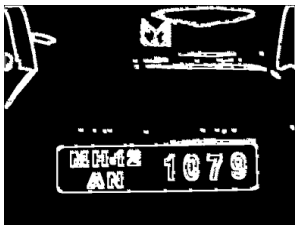

Figure 6. Output of Dilation

- *Thinning*: This is a morphological operation that is used to remove selected foreground pixels from binary images, somewhat like erosion or opening. It is used for skeletonization. In this mode it is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness as shown in figure - 7.

Figure 7. Output of Single Pixel Width Conversion

- *Boundary Extraction*: This process of involves eliminating unwanted pixels which are sticking out from the closed surfaces, in the output of single pixel width conversion and thus improving the corners of the detected closed shapes. Output of this step is shown in figure – 8.

Figure 8. Output of boundary extarction

- *Connectivity Trace:* Connectivity between pixels is an important concept and is used in establishing boundaries of objects and components of regions in an image, detecting the position of the number plate in the image and extracting its left bottom and right upper corner coordinates and the output is obtained as in figure – 9.

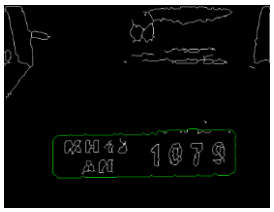

Figure 9. Output of boundary connectivity trace

VI. ACCURATE LOCATION OF NUMBER PLATE

The aim of this stage is to obtain the accurate location of the number plate region. It is proceeds as follow:

- *Feature extraction*: A set of conditions are applied for obtaining a number of candidate regions depending on the aspect ratio and the density for each object, by using the following equations [5-7]:

  $R = H / W$ (5)

  $Ar = H \times W$ (6)

  $D = n / Ar$ (7)

  where R, Ar and D represent the height to width ratio (aspect ratio), the object area (by pixels), and the density ratio (the number of pixels n in the bounding box to the object area ratio) respectively. The result of using the equations (5), (6) and (7) is eliminating most of the image objects, and keeping 1-3 candidate region(s).

- *Number plate region extraction* [14]: In most cases, the plate region is detected by the previous step. In case if more than one candidate region result; a set of other rules will be applied for specifying and extracting the accurate plate region, as follows:
  a. Priority is given to the objects located in the lower two thirds of the image.
  b. Priority is given to the objects, which correspond to the dimension of the standard number plates.
  c. Priority is given to the farthest objects from the image border. The final result of this method is shown in figure - 10.

Figure 10. Finally extracted number plate

Vol:1 Issue:1 ISSN 2278 - 215X

VII. RESULTS ANALYSIS

To evaluate the efficiency, our method has been tested using MATLAB over large database of colour images with a size of 640 × 480 × 24 pixel, acquired from about 4 meters away by a digital camera for real scenes. The tested images have been acquired from the front as well as from the rear of vehicles under various illumination and weather conditions (sunny, cloudy daytime, nigh time, rainy days...etc). The test results indicating that the success rate is 95 %. Based on these results, the method shows satisfactory and encouraging results, making it efficient to cope with some difficulties, such as, variations of the lighting conditions, complex background, and different kinds of vehicles and number plates.

VIII. CONCLUSION

A simple but efficient number plate extraction method is presented in this paper. The proposed method is mainly designed for real-time Indian number plate, and can be readily extended to cope with number plates of other countries. The methods we have proposed efficiently extract the number plate from the color image of a car. The algorithm we have designed is aimed towards a user. The user decides which .bmp file has to be processed. The event of opening a file from the disk in the view window corresponds to the image appearing in the view after the clicking of the camera.

For locating the number plate, we processed the original color image by first converting it to monochrome, and then applied the various algorithms on this monochrome image, at the same time we kept the color image intact. Using the extracted coordinates, we cut out the number plate from the original color image. Thus, there is no loss of information.

REFERENCES

[1] W. Wei, M. Wang, and Z. Huan, "An automatic method of location for number plate using color features," International Conference on ImageProcessing, pp. 782–785, 2001.

[2] R.A.Lotufo, A.D. Morgan, and AS. Johnson, 1990, "AutomaticNumber-Plate Recognition," Proceedings of the IEE Colloquium on Image analysis for Transport Applications, V01.035, pp.6/1-6/6, February 16, 1990.

[3] A.S. Johnson, B.M. Bird, 1990, "Number-plateMatching for Automatic Vehicle Identification," IEE Colloquium on Electronic Image and Image Processing in Security and Forensic, Aprl, 1990.

[4] M.M.M. Fahmy, 1994, "Automatic Number-plate Recognition : Neural Network Approach," Proceedings of VNIS'94 Vehicle Navigation and Information System Conference, 3 1 Aug-2 Sept, 1994

[5] J.A.G. Nijhuis, M.H. Ter Brugge, K.A. Helmholt, J.P.W. Pluim, L. Spaanenburg, R.S. Venema, M.A. Westenberg, 1995, "Car License Plate Recognition with Neural Networks and Fuzzy Logic," IEEE International Conference on Neural Networks,1995

[6] H.J. Choi, 1987, "A Study on the Extraction and Recognition of a Car Number Plate by Image Processing," Journal of the Korea Institute of Telematics and Electronics, Vo1.24, pp. 309-3 15,1987.

[7] H.S. Kim, et al., 1991, "Recognition of a Car Number Plate by a Neural Network," Proceedings of the Korea Information Science Society Fall Conference, Vol. 18, pp. 259-262, 1991

[8] E.R. Lee, P.K. Kim, and H.J. Kim, 1994, "Automatic Recognition of Car License Plate Using Color Image Processing," Proceedings of the International Conference on Image Processing

[9] S.K. Kim, D.W. Kim, and H.J. Kim, 1996, "A Recognition of Vehicle License Plate Using a Genetic Algorithm Based Segmentation," Proceedings of 3rd IEEE International Conference on Image Processing, V01.2., pp. 661-664, 1996

[10] J. Duan, G. Qiu, "Novel Histogram Processing for Colour Image Enhancement", in: Proc. IEEE Int. Conf. Image Graph., 2004, pp. 55-58.

[11] N.Otsu, "A threshold selection method from gray-level histogram", IEEE Transactions on Systems and Cyber net, SMC-8, pp.62-66, 1978.

[12] Jian-Feng Xu, Shao-Fa Lai Mian-Shui W," Car License Plate Extraction Using Color And Edge Information", Proceedings of the Third International Conference on Machine Learmng and Cybemetics, Shanghai, 26-29 August 2004

[13] Jun-Wei Hsieh, Shih-Hao Yu, and Yung-Sheng Chen, "Morphology-based license plate detection from complex scenes," Proceedings of 16th Intemational Conference on Pattem Recognition, vo1.3, pp.176-179.2002.

[14] Marwan D. Saleh1, H. Mellah1, Ahmed Mueen2. N. D. Salih1An Efficient Method for Vehicle License Plate Extraction978-1-4244-2328-6/08/$25.00 © 2008 IEEE