Challenges and Overview of License Plate Character Segmentation

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Abstract-License plate identification or recognition has become an important part of vehicle surveillance systems. This paper, reviews the basic methodologies used for identification of vehicle number plates. Over main concern in this paper is to review the edge based methods. Since edge detection based methods are simple and thus widely used for real time recognition of the license number plate Paper also briefly describes the various problems and shortcomings of the existing methods. Paper also addresses the problem of automatic number plate detection. Paper also reviews the various color spaces used for number plate identification. The basic results of the various edge detectors are also presented for different input images.

General Terms-License plate, Vehicle surveillance,, Thresholding based Segmentation.

Keywords-License plate identification, Edge detection, Thresholding, Segmentation, Fuzzy logic

1. INTRODUCTION

With the increasing demand of the vehicle surveillance systems demand for processing vehicles for traffic management and secularity has become a challenging field of research. This is commonly achieved either manually by a human agent or by automatic systems which is able to identify the vehicles number plates in real time [1]. Therefore, researchers have developed different recognition techniques for number plate recognition. There is various application areas where number plate identification can be used which include vehicle parking [8], border control for military application, Toll tax monitoring, or vehicle tracking [4].

In vehicle parking, number plates identification systems are used for counting the vehicles and there parking duration [8]. When a vehicle enters to the parking number plate is identified and saved as database. While vehicle leaves the parking a new set of number plate image is produced and is matched with the previous database. The time difference is used for calculating the parking time and charges.

As another application number plate identification systems may be used in access control. Access control means to allow only authorized vehicles of individual personnel. An application may be considered as; tracking of vehicle number plate for traffic surveillance is an important task [4].

2. PROBLEM AND SOLUTIONS

Researchers have to face various problems while automatic detection and recognition of license plate. Here we have explored few major problems. The first problem is the non uniformity of the license number plate models for different cities. It may also varies from one state to another and thus from vehicle to vehicle. Length of the number plates may also vary. Second prime difficulty is the low resolution of the number plates for vehicles in video frames under typical surveillance systems.

The expected solutions for these problems are to develop the sequential coordination of image and video processing tasks. This processing sequence may include, algorithms Viz. object tracking and segmentation, locating the license plate area, detecting number and its color.

3. CLASSIFICATION OF LICENCE PLATE SEGMENTATION

Based on the various methodologies used, license plate identification or segmentation methods are broadly classified as shown in Figure 1. The license plate identification methods are broadly classified to four main categories here. Among these edge detections is widely used for license plate segmentation.
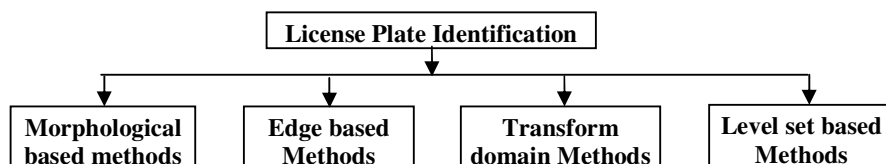

Figure 1. Broad Classification of License Plate Identification

The basically license plate identification system have three basic stages as shown in Figure 2.

Input Image

License Plate Extraction

Segmentation of Characters

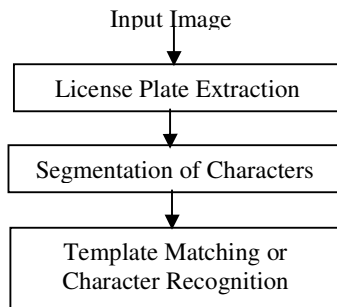Template Matching or Character Recognition

Figure 2 Stages of License plate extraction

First stage is used to extracts the area of license plate therefore; it is responsible for the efficiency of the segmentation. The segmentation is most important processes for the number plate recognition system and identification. It because efficiency of character recognition rely on segmentation stage. Failure of segmentation may cause error in character recognition

Here in this paper our main concern is on the intermediate Segmentation stage. It is assumed that the input license plate images are efficiently extracted from the vehicle image.

4. Literature Review

Image morphology based methods are simple and therefore widely used for license plate character segmentation. There are few methods which have utilized morphological operators and connected components for identifying the plate characters. In rest of the paper various plate segmentation methods are reviewed sequentially.

A. Review of edge detection based methods

Canny and Sobal edge detectors are used for finding the plate area and characters. S. Adebayo Daramola *et al* [4] have used hidden Markov Random Field (MRF) model for character extraction and recognition. Method uses the Sobel edge detector for finding the plate regions. But method seems bit probabilistic. Anish Lazrus *et al* [18] have proposed robust method for license plate location with segmentation and reorganization of characters present in the plate. For removing the noise Wiener2 filter was used to and Sobel filter is used for finding the edges and then finally connected components were determined.

Chittode J S *et al.* [8] have proposed an algorithm for monitoring and managing the car parking systems. They have proposed to use morphological operations for recognizing the number plate. C.N Paunwala *et al.* [9] have proposed to use image methodology for finding the ROI and for directional segmentation. ROI is defined as area including number plate which is used to recognize

the alphanumeric characters. Manisha Rathore et al. [11] have proposed new algorithm using MATLAB for extracting the number plate from the vehicle under different luminance conditions. Method uses basic image morphology for image segmentation. Extracted number plate image can be seen as text file for verification. This Number plate identification system was helpful for finding the stolen cars, and for identification of the vehicle in automatic traffic control system.

B. Review of Level set based methods

Mohammad Ghazal et al [3] have proposed license plate detection method using LAB colour space and level set method to locate the contours. Level set method is used for separating license plate from remaining image. Although method was efficient, but is an iterative method and is bit time taking .

C. Review of Connected Component based methods

Many researchers have used connected components for identifying the plate characters. R. Radha *et. al.*[5] have presents an simple but efficient morphological based approach, with filtering and finding connected components in order to locate the Indian number plates. Morphological dilation and erosion is performed on the edge detected image. The efficiency of the method degrades for damaged plates. In addition unwanted region like plate border is also extracted, which results false detection. For automatic license plate recognition Sarmad *et. al.* [1] have proposed to use connected component analysis method. paper have used optical character recognition (OCR) method for recognition of green Punjab plates.. Leandro Araújo *et.al.* [6] have utilized connected component analysis for character segmentation. For recognition contour of the segmented character method is used along with fundamentals Hausdorff Distance algorithm. Method seems slightly complex although efficient.

D. Review of Connected Component based methods

Wavelets transform which is implemented by Hsieh et. al. [13] locates multiple plates with different orientations in one image. Hough transform is another widely used transformation [16] which is used to extract features from the shape within the image. The Hough transform is used for to detect the skew in captured plate, and also for computing the skew angle.

The efficiency of each stage is dependent on the previous stage; therefore character recognition may be efficiently implemented only if the characters are segmented efficiently. Otherwise recognition rate of entire system will degrade. In general character segmentation is defined as minimal binary region which surrounds the characters. Since quality of the captured license plate degrades (blurred) due to motion, thus automatic character linearization and segmentation becomes complex.

5. Segmentation Methodology

There are many image processing techniques which are used for License plate character segmentation. Viz. Edge detection, Morphological dilation, thresholding and connected component analysis Edge detection methods are widely used with thresholding or morphological dilation for detecting the plate edges. to improve the efficiency of the character segmentation.

5.1 Edge detection

Edge detectors are required to detect and to localize the objects boundaries, It is observed that detection of fine edges is an ill-posed challenging problem. Sobel operator [4, 11] is widely used for license p;ate application. This operator calculate 2-D (X and Y) spatial gradient of an image and therefore emphasize region of high spatial gradient across the edges. An example of edge detection is shown in Figure 3 for Sobel edge operator.

a) original image   b) X gradient

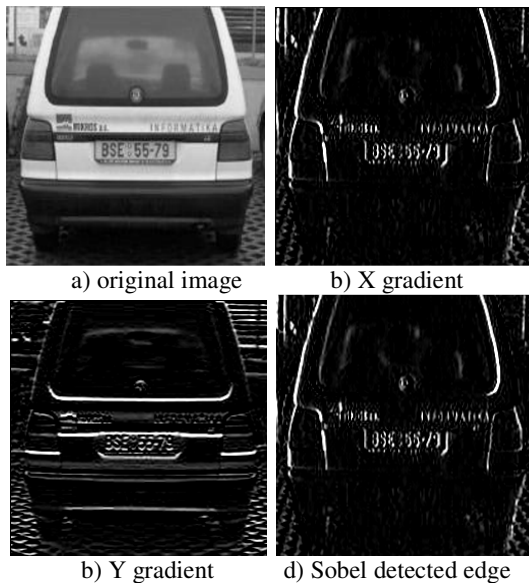b) Y gradient   d) Sobel detected edge
Figure 3 example of basic edge detection

Simplest method most commonly used for license plate segmentation is thresholding [10]. The global and adaptive thresholding techniques are used for obtaining binary representations of segmented character. The binary means black & white or monochrome representation of image. Thresholding based image segmentation is appropriate for analysis, since it defines clear boundaries of contained characters.. But thresholding based segmentation method works effectively for segmenting well defined regions only

5.2 Global Thresholding

Most common way of converting a gray level image to the binary image is to select a global threshold value Th from histogram of image [14]. Than gray level values less than threshold Th will be allotted black (0), and those beyond Th will be allotted white (1). The segmentation problem becomes one of selecting the proper values for the global threshold Th. This technique can be expressed as:
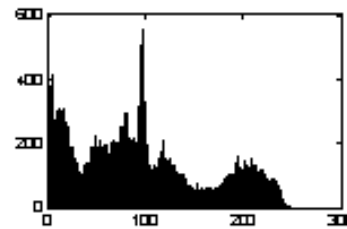
$$Th = T[p(x,y), f(x,y]   (2)$$

Where Th is selected global threshold value, x, y are coordinates of threshold points. Where $p(x,y), f(x,y)$ are gray levels of the image. Global threshold image $G(x,y)$ may be determined as:

$$G(x, y) = \begin{cases} 1 & if \quad f(x,y) > Th \\ 0 & if \quad f(x,y) \le Th \end{cases}   (3)$$

An example of segmentation using global thresholding is given in the Figure 4.

a) original image   b) Global Segmented image

c) Histogram with threshold
Figure 4 Example of global segmentation

5.3 Image Dilation

Image Dilation is also commonly used morphological operator for segmentation [5]. usually the edge detected image is dilated using an structuring mask matrix of predefined size and shape. An example of the image dilation for edge detected image in Figure 3(d) is given in Figure 5.
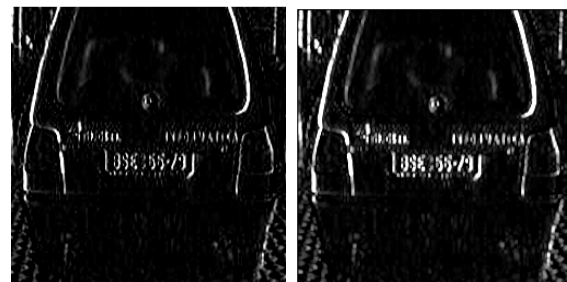
a) Edge image   b) Dilated image
Figure 5 example of dilation

6. Conclusion

In the paper various problems and challenges along with basic methodology for license plate identification is discussed and reviewed. The main concern in this paper was to review the various plate segmentation methods for character recognitions. Paper have also explains the basic methods of segmentation used for the license plate recognition. It is observed that edge detection based methods are widely used for plate identification. The method of connected components is efficient for character recognition and segmentation. but existing methods suffers from the unwanted boundary of the plate which may cause error in character recognition.

Another widely used method is thresholding. Both global and local thresholding is used for segmenting the license plates. But still due to various available character types and colour schemes the license plate segmentation is a challenging field of research. And it is also required to reduce the computation cost of the methods for implementation in real time.
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7. ACKNOWLEDGMENTS

8. REFERENCES

[1] Sarmad Majeed Malik, and Rehan Hafiz, "Automatic Number Plate Recognition Based on Connected Components Analysis Technique", IEEE 2nd International Conference on Emerging Trends in Engineering and Technology (ICETET'2014), UK, 30-31, 2014.

[2] Bai Hongliang , Liu Changping , "A hybrid License Plate Extraction Method Based on Edge Statistics and Morphology", Proceeding ICPR '04 Proceedings of the Pattern Recognition, 17th International Conference on (ICPR'04) Vol. 2 831-834, 2004.

[3] Mohammad Ghazal, Hassan Hajjdiab, "License Plate Automatic Detection and Recognition", IEEE International Conference 2013..

[4] S. Adebayo daramola1, E. Adetiba1, A. U. Adoghe1, j. A. Badejo1, I. A samuel1, T. Fagorusi1, "Automatic vehicle identification system using license plate", International Journal of Engineering Science and Technology (IJEST), Vol. 3 No. 2 Feb 2011

[5] R. Radha, C. P. Sumath, "A novel approach to extract text from License plate of vehicles", Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.4, August 2012.

[6] Leandro Araújo, Sirlene Pio, David Menotti, "Seg0ent5ng and rec6gn5z5ng the 35cense *3ate Charecters", IEEE international conference.

[7] W. Osman, H. A. Obaida, E. A. Khater, and D. Hataba, "Vision-based automatic detection of unauthorized vehcile for oil field surveillance," Abu Dhabi University, Tech. Rep. 2012/1, Oct. 2012.

[8] J.S. Chittode and R. Kate, "Number plate recognition using segmentation," International Journal of Engineering Research & Technology, Vol. 1 Issue 9, November- 2012.

[9] C N Paunwala and S Patnaik, "A novel multiple license plate extraction technique for complex background in Indian traffic conditions," International Journal of Image processing, Vol-4,Issue-2,pp 106-118 2011.

[10] Rajesh k. Rai, Puran Gour, Balvant Singh,"Underwater image segmentation using CLAHE enhancement and thresholding", International Journal of Emerging Technology and Advanced Engineering (IJETAE)) Vol. 2 Issue 1, 2012.

[11] Manisha Rathore and Saroj Kumari, "Tracking Number Plate from Vehicle using MATLAB", International Journal in Foundations of Computer Science & Technology (IJFCST), Vol. 4, No. 3, May 2014

[12] Yassin M.Y.Hasan and Lina J.Karam, "Morphological text extraction from images," IEEE Transactions on Image Processing, vol. 9, no. 11, pp. 1978-1983, November 2000.

[13] Ching Tang Hsieh, Y.S.J., K.M. Hung, "Multiple license plate detection for complex background". Proceedings of International Conference on Advanced Information Networking and Applications, 2:389-392, 2005.

[14] Neetu Sharma, Paresh Rawat,, "E book on Underwater Image Segmentation using thresholding, Lambart publication Germany 2011.

[15] S Kranti and K Pranathi, "Automatic number plate recognition", International Journal of Advancements in Technology,vol-2, no-3, pp408-423, July 2011

[16] Onorej Martinsky, "Algorithmic and Mathematical principals of automatic number plate recognition system", Thesis, Brono University of Technology, 2007.

[17] Pandya and M Sing," Morphology based approach to recognize number plates in India," International Journal of Soft Computing and Engineering,Vol-1, Issue-3, pp 107-113, June2011

[18] Anish Lazrus, Siddhartha Choubey, Sinha G.R., "An Efficient Method Of Vehicle Number Plate Detection And Recognition", *International Journal Of Machine Intelligence*, Volume 3, Issue 3, Pp-134-13, 2011.