Journal of Advances in Computer Research
Quarterly pISSN: 2345-606x eISSN: 2345-6078
Sari Branch, Islamic Azad University, Sari, I.R.Iran
(Vol. 6, No. 3, August 2015), Pages: 1-8
www.jacr.iausari.ac.ir

License Plate Detection Using Sobel Operator

Khosro Kamalatabar Malekshah✉, Hossein Nematzadeh, Homayun Motameni
Department of Computer Engineering, Islamic Azad University, Sari Branch, Sari, Iran
khosromalekshah@yahoo.com; nematzadeh@iausari.ac.ir; motameni@ iausari.ac.ir

Received: 2014/05/31; Accepted: 2014/08/25

Abstract

The license plate edge detection is the most important step of the process of plate identification. Plate recognition system is an automated system that captures vehicle location, vehicle license plate accurately on various vehicles at different times of day and night sets. In this paper the issue of searching the exact location of the license plate from the input images using Sobel operator for edge detection and image processing and histogram analyzing techniques for candidate areas restriction has been examined.The proposed method is tested on the database containing 250 different input images with different background, size and angles in different lighting condition and during different times of the day on different kinds of vehicles (cars, vans and trucks and etc). And the rate of the correct extraction of the exact location of the license plate was 88.4% .The response time and the processing speed of the proposed method is faster in Comparewith *existing works.*

Keywords: *Image Processing, License Plate, Sobel Operator, Histogram Analysis*

1. Introduction

With thepassageof more than half billion cars in the world providing a mechanism to control and Manage are considered as one of the challenges of this century. All the vehicles have their own identification number, which is a major determinant of their identity [1,9]. Car plate recognition process is divided into two main sections: [2]

First, to find places where plaque is dedicated to the image and extract;

The second part is done in two steps including the following:

• Separate the individual plate elements

• Reading elements

The purposeof thisarticle is the extraction of the location of the license plate from theinput images. The extraction of the place of the license plate is important in that reading the characters and ID of the license plate is impossible until the exact location of the plate is identified.Image qualities, lighting condition, different angles of the camera, background mixing with the image and etc are potential problems in this work.

There are different procedures for finding the exact location of the license plate includeedge detection, morphologic operation, pattern identification andSobeloperator.Majidpour et al presenteda method in order to detect license plates in grayscale images through edgedetection technique [2].

Since there is strong data on the edge of the plate we usually begin with finding vertical edges from the input image. Areas with high density of edge can be among candidates of the plate.

For recognition of such areas the density of the edges should be calculated in a local neighborhood. To do this, existing edges in the local neighborhood of every spot of the image should be counted. Thus, a matrix with the dimension of the original image will be constructed.This matrixcan beregarded asagrayscale image.Usingmatrixesraisesthe volume of the processing.Ashtari et al's methodwasbased onidentifyingapattern in the image[3].Abolghasemi and Ahmadifard (2007) presented a techniquebased onidentifyingapattern in theimage[4].Therefore, to identify the location of the license plate in the image we need to find a constant feature which is fixed in all license plates.

Due to this fact, this feature can be the shape of the new national license plates which are consistent with global standards.Radmard et al used mosaic classifications and Sobelmask respectively.

Faraji and Safabakhsh (2006) used the color and edge data to find blue area and then it uses chromatic edge detection and by aninnovativethreshold detection it recognize the location of the plate[5].

Radmehr et al's (2010), scanned the input image by dividing the image into mosaics and then initiated the scanning process[6]. Zheng et al's (2005), used Sobel masks because the edges of the plate has been processed[7]. In the proposed method in the first step all the rows of the image will be traveled and then those rows, which do not have blue Pixel will be omitted. After the first threshold detection which is a simple way for image segmentation we use the second threshold detection to omit the non-plate areas more precisely.

And then we use two operators of vertical and horizontal mask to obtainan appropriate threshold.

Working in a colored environment causes more processing and slower rate of the processing.

Although other work presented in this paper, Sobel method is used, but the method proposed in this paper by using image processing techniques have resulted in better and faster.

2.Licence plate detection

Detecting the location of the license plate of a car has 3 steps which are subdivided to other steps. These three steps are preprocessing, main processing, and extraction of the location of the license plate that are shown in Figure 1.In the following each activity of Figure 1 is explained.

2.1 Preproccessing

Initially,input colored imagesare convertedtograyscale to increase the speed of processing. A sample graysacle image is given in Figure 2.[8]

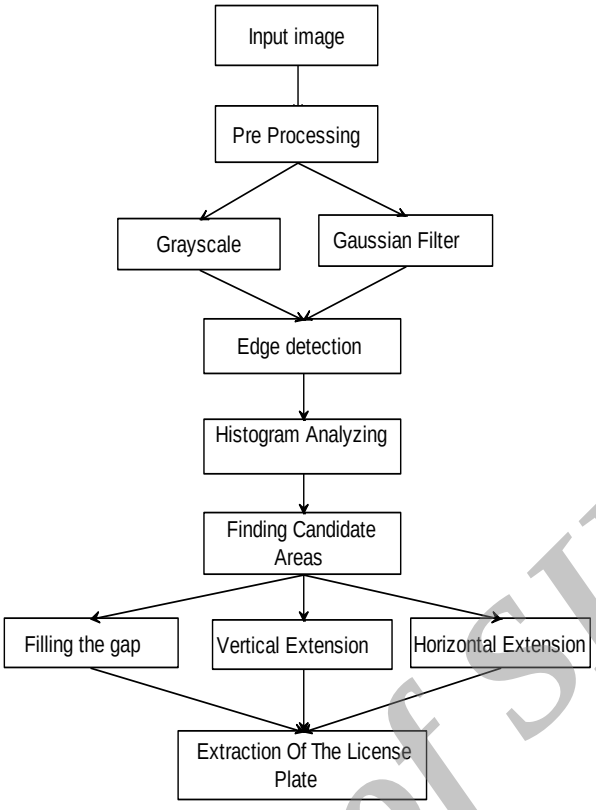

Figure 1. The main phases of the research

Figure 2. Grayscale Image

2.2 Gaussian filter

After moving the image to the grayscale, the probable noises in the image will be removed by Gaussian filter.

$$f = fspecial\left('gaussian', x, s\right) \quad (1)$$

2.3 Edge detection

The main processing part of the method starts from Section 2.3 and continues to Section 2.7. One of the important goals of edge detection is to find areas that contain important objects or meaningful parts in the image. [9] Edge is a sudden change in the light of the image. For example when there is a sudden change from black to white in the image we have an edge. Because of the numbers and letters written on the plate, it has a number of vertical edges.

Thisfeaturecan be usedto findits placein the image. Sobel operator is used because of its high speed and low processing volume and favorable performance compared with other methods. Sobel has two vertical and horizontal edge detection masks.

Since numbers and letters have many vertical edges we just use vertical masks in the proposed method. Thus, edge detection in this method is targeted to find vertical edges. Figure 3 shows the horizontal sobel mask. Figure 4 shows the Figure 2 vertical edge detection.

2.4Histogram analyzing

After finding the vertical edges of the image, we use histogram analyzing and in this way the horizontal histogram of the edge image will be found.

Therefore, for each row ofimage, points with the first grayscale will be counted and a graph will be developed which its horizontal axis is composed of lines of the image and its vertical axis is composed of the number of counted points. We considered those details of the image which has been achieved empirically and are in between of 10 to 55 percent above the graph. Figure 5 shows the horizontal histogram of Figure 4.

$$\begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix}$$

Figure 3. Horizontal Sobel Mask

Figure 4.Figure 2 after vertical edge detection

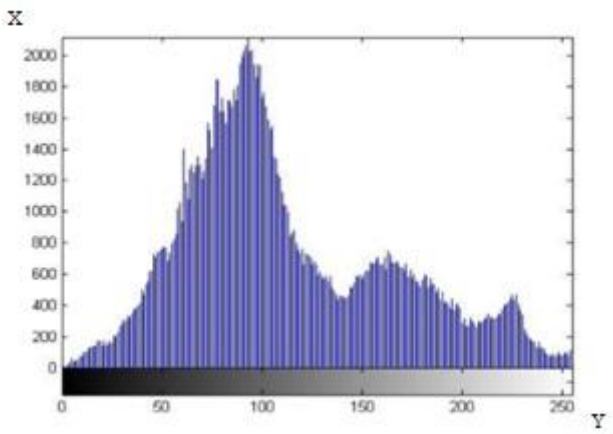

Figure 5.Horizontal histogram of Figure 4

2.5Finding Candidate Areas

After completing the preprocessing and histogram adjustment steps more important and specific details will be found in the image.In this step we have erosion on image. The erosion step is defined with Equation2. Erosion of A and B is equal to the set of all X points. In a way that if the displacement of B is equal to the size of X, again the point B is in the area of A.

$$A\ \Theta B = \{x \mid (B)_x \subseteq A\} \tag{2}$$

2.6Horizontal And Vertical Extension

Dilation of A to B is equal to the set of all Xs in which $(B)_x$and A overlap in at least one non-zero point . $(B)_x$is the symmetry of B around its center and then its transference with B. Dilation is actually the filling of the free space between two edges. If there is a cutting in a straight line in the edge detected image then we can fill this gap by dilation. The dilation step is given with Equation 3.

$$A\ \oplus B = \{x \mid (B)_x \subseteq A\} \tag{3}$$

2.7Filling The Gaps

Gap is a black point in a white space of an edge detected image. Since the area of the plate in the edge detected image is an integrated area, probable gaps will be filled. In this way the candidate areas will be constrained and we can find the exact location of the license plate in following steps. Now that lines are more closed and boundaries are more tangible we can fill closed environments which willcauseobjectsto beBold. Figure 6 shows Figure 4 which have been filled with gaps.

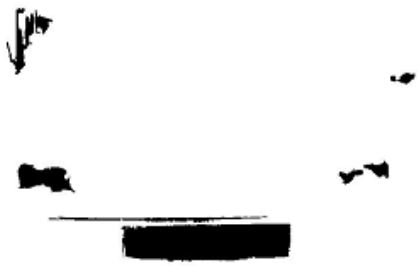

Figure 6. Application of gap filling in Figure 4

2.8 Extraction Of License Plate

So far we have eliminated some details of the image with different methods of processing the image. In the following steps we should separate candidate areas from those areas that do not have informational value. First we eliminate extra objects from the image and then we separate the plate area from the main image by putting frame around the area that could be the plate.

The main feature that we have extracted from the image so far is very clear. These features are big and small closed environments in the image. Each black space in the image is a closed environment. We first will create a Structuralstructure.Theneach of thesmall labeled packswill besurroundedwithina rectangle.

This feature will help us to achieveaspatialcoordinate for irregularstructuressuch astiltedorrotatedplates. In other word we will label the image.

These labels would be used toextract the exact location of license plate. Figure 7 shows these labels and candidate areas.Finding different objects and elements in the image may cause problem in finding the location of plate.

To reach our goal which is finding the location of the license plate we concluded empirically in the testing phase that the shape of the plate is an integrated shape about 2500 to 5000 pixel. We will find the exact location of the plate by using appropriate filter.

Having the coordinate of 4 angels of the plate in Figure 8, we cut this coordinate from the main image to achieve the final out put which is the location of the plate. Figure 9 also shows the extracted plate from the input image.

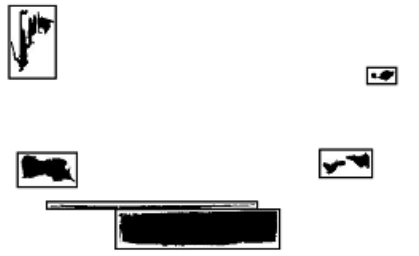

Figure 7. Candidate areas

Figure 8. The exact location of licese plate

Figure 9.The extracted plate from theinput image

3. Discussion

Presenting a better method compared to Radmehr et al and Zheng et al, the exact location of the license plate of a car in input images was found using a better edge detection and histogram analyzing and image processing techniques in this paper[5,7]. Radmehr et al, scanned the input image by dividing the image into mosaics and then initiated the scanning process. The big disadvantage of this research is the processing speed which is significantly reduced in the proposed method [5].Zheng et al's work was roughly two times faster but less accurate than Radmehr et al's work. Zheng et al also used Sobel mask however the focus of their research was on proccessing the edges of the plate [7].We achieved the highest detection power possible. In addition, by (converting) the picture to grayscale the volume of processing has been decreased and the speed of finding the exact location of the plate has been increased. Moreover, more than half the pictures have been captured at different hours of night and this has not been seen in previous studies. And different angles of the front and back of the car did not have significant negative impact on the final result. Table 1 shows the comparision with proposed method with existing methods in which the proposed method has the most accuracy in license plate identification. The wrong identification of candidate areas as a license plate was also the least in the proposed method. No plate location identification implicates the situation in which the method did not identify any candidate area as a license plate whereas morphology was the best. The dataset contained 250 images and the coding was done using MATLAB. Table 2 also shows the mean proccessing time in (ms) for each method in which the proposed method was the best.

Table 1. Comparision of proposed method with existing methods

Method	Accuracy in plate identification	Mislocating in plate identification	No plate location identification
Proposed method	88.4	6.4	5.2
Radmard et al., 2010	81.3	16.7	2
Zheng et al., 2005	77.3	22.7	0

Table 2. Mean processing time for each sample

Method	Proposed method	Radmard et al., 2010	Zheng et al., 2005
TIME (ms)	753	2000	900

4. Concluding Remarks

This paper proposed a new method in license plate extraction. The method was based on Sobel operator. Using the grayscale decreased the processing time. It was also shown how the proposed method had the best accuracy among morphology and edge detection method. The dataset contained 250 images and all the coding was done using MATLAB.

5. Reference

[1] Hungary Team (2007) License Plate Adaptive Recognition. Hungary Inc, http://www.platerecognition.info/index.htm

[2] Majidipour, T., Kafashi, E.(2013) License Plate location Using Vertical Patterns. First National Conference on Emerging Trends in Engineering and Data Recovery Forums University Roudsar and AMLASH

[3] Ashtari, A & Fathi, M & Amiri, A.(2008). The new method of identifying the license plate in recorded images ofViolation on the highways.EighthConference onIran'sshippingtraffic.

[4] Abolghasemi, V & Ahmadifard, A. (2007). The application of converting IFT in license plate identification system. Third Conference on Information Technology and Knowledge.

[5] Faraji,F & Safabakhsh,R.(2006). A new and rapid method for detection of the location of the license plate from complex images based on morphologic operation. FourthIranianConference on Machine Visionand Image Processing.

[6] Radmard,Gh & Radmard,M &Tahmasbi,H & Feizi derakhshi, M.(2010). early detectionplate with mosaic classification checked a random mosaic of images with the color space HSV. Second National Conference on Computer Engineering, Electrical and Information Technology - Sama - Hamedan

[7] Zheng, D. Zhao, Y., Wang, J. (2005) An efficient method of license plate location", ELSEVIER, Pattern Recognition Letters 26, 2431– 2438[9]

[8] Jiang, D., Mekonnen, T., Merkebu, T., Gebrehiwot, A (2012). car plate recognition system. Fifth IEEE International Conference on Intelligent Networks and Intelligent Systems.

[9] Scott E Umbaugh.(2009).computer imaging digital image analysis and processing .Southern lllinois University Edwardsville