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Detection License Plates on the Spatial Resolution Digital Pictures to Smart Car Parking

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Abstract: To identify a vehicle, License Plate identification technology is the key technology of intelligent transport system, finding a stolen vehicle, monitoring traffic flow, in town management, highway tolls etc. The major issue in such applications is to detect the exact location of plate, because finding the location of number plate could vary and as well as its size and color; many of the vehicles have an uncertain difference in License plate position, location and unclean License Plate. In this paper we have conducted a very fresh survey of most authentic techniques of license plate detection from a car, we studied different techniques and compared them; we figured out every technique has its own limitations, every method gives best results under some certain conditions so do bad results, we figured out all we need to do is to have locus of control, we shall control the environment we are working in, some techniques works good in dark light, some for bright light etc; every technique has its own parameters to identify license plate; this paper will lead you to choose the best technique for detection just according to your circumstance; you wouldn't have to waste much more time in order to figuring out the suitable algorithm, as well as will inform you its accuracy percentage.

Keywords: DWT (Discrete wavelet transform), PET (plate extraction time), SCW (sliding concentric window), ANN (artificial neural networks), GNN (genetic neural networks), RGB (Red Green Blue)

1. Introduction

Vehicles License plate is a technology of image processing. Vehicles License Plate detection is a type of automatic vehicle recognition. . The important role of license plate detection is to control traffic rules automatically and managing law enforcement on public roads. Since every vehicle carries a unique License Plate, no external cards, tags or transmitters need to be recognizable, only License Plate. It is also used for manage traffic, control border, access control, calculation of parking time and payment; previously the popular technologies were used to identify vehicles are VIN technologies and e-tags which were expensive and had a big issue in common; if a new car comes than first you would have to install any of these technology in that car then you would be able to identify that car so to eliminate that factor the best way to identify a vehicle is to identify it's number plate with a simple camera. Different detection algorithm for detecting License Plate is presented. Shall give brief description, functionality how a method works in different environment. Numerous methods exist in License Plate Location but we shall discuss those methods which will give the most accurate results in critical situations like lighting distance effects etc. Some methods work for still images, some for videos and some for sequence images. We shall also discuss which method is best for lighting, distance, and other invariant. In this paper we have total of 4 sections, in section each sub-section elaborates the technique for license plate detection and its limitations; in section 3 a comparison in form of table is given and in the last section number 4 we have provided conclusion. Below in fig.1 there is a representation of different techniques:

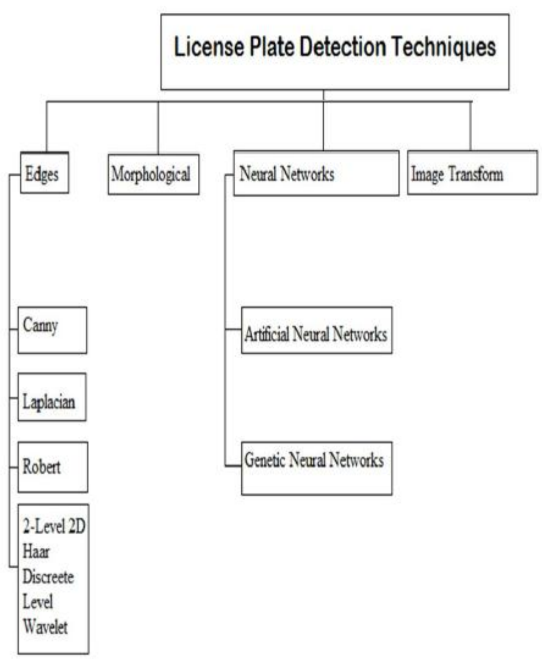


Figure 1: Classification Diagram

2. EDGE DETECTION APPROACHES

- **SOBEL OPERATOR**

It is one of the most useful techniques in image processing very popular in image processing as shown in the application of License Plate Detection [3-8]. Sobel Operator is a classical edge detector. With the License Plate of small integer valued filter into vertical and horizontal directions by using of (3x3) mask to convolve the image. The mask preferred is applied to the whole image and this mask process square pixel at a time on image. It represents a two dimensional spatial gradient measurement. Due to small integer values the Sobel operator is relatively expensive.

- **LEVEL 2D HAAR DISCREETE WAVELET**

2-level 2D Haar DWT method is an excellent method for detecting edges. It gives more detail about the vertical edge density and intensity of License Plate separately. It also removes that object which contains less information that causes the noise in the vertical edges background. In short, it differentiates between vertical edges and background noise. It works based on the gray scale image, first of all gray scale images converted and divided into four sub band images through 1-level 2D Haar DWT.

After completing the whole process it detects the LICENSE PLATE [10].

- **CANNY OPERATOR**

First of all convert the RGB image to gray scale image and then remove noise from the image then apply the canny edge detector on the image. The canny edge detection provides an exact detection of the License Plate and provides better Localization with very minute difference within the actual and provided edge [11]. The boundary of the object is represented by edges. Edges are also used to identify areas and shapes of the object.

- **ROBERT OPERATOR**

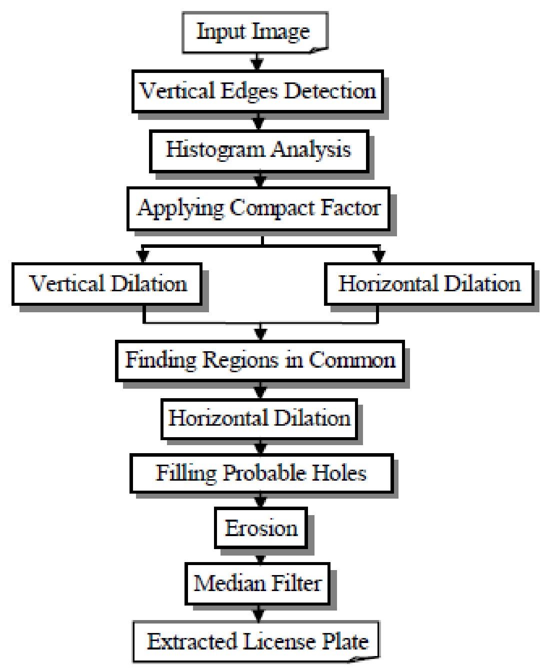
It computes the 2-D spatial gradient measurement and also highlights the high spatial gradient region corresponds to edges. It consists of a 2x2 convolution mask. In [12] it detects the LICENSE PLATE of the input image by down sampling. In [13] Robert operator first starts to detect the vertical edges of the input image and then it filters the image to get its horizontal edges.

- **LAPLACIAN EDGE DETECTION**

The Laplacian is a 2D isotropic measure of the 2nd spatial derivative of an image. It is similar to as Sobel operator. The only difference among them is that the Laplacian uses only one mask for both horizontal and vertical direction as in [13,14]. The mask approximates second derivate of the image and is very sensitive to noise. Noise reduction LOG is used which first smoothens the image with Gaussian filter and then applies Laplacian operator [13]

3. PROPOSED LPL SYSTEM.

Since our approach does not need color information, the system is able to locate license plates with different colors. The overview of the algorithm is shown in figure 2. Figure 3 depicts a sample of input image, which is gray-scale.



4. Vertical edges detection

Due to digits and characters, a license plate contains many vertical edges. This feature is employed for locating the plate in an image. Many approaches has been proposed for edge detection. Sobel mask has a good performance compared with others; indeed, it is fast and simple. In general, there are two masks for Sobel, horizontal mask and vertical one. Figure 3 shows these masks. We just use the vertical mask of Sobel. Supposing that the input image is not highly tilted, vertical edge detecting plays its role well enough. The result of edge detection is depicted in figure 4.

5. Histogram Analysis

Now we employ histogram analysis and find vertical projection of the edge image. To do this, we calculate the number of "ones" for each row of the image. Vertical projection is a diagram with two axes; vertical axis is the rows of the image, and horizontal axis shows the number of white pixels in each row. Figure 4 shows the vertical projection of the edge image too. The rows corresponding to the license plate usually have the highest values in the vertical projection. For this reason, the next step is finding the rows with the c% highest values in the projection. These are candidates for license plate. For reducing noise effects, a row is considered as a candidate, not only when its value is c% above, but also when the value of the next row is d% the value of the row. Simulations find values for c and d. We consider f rows before and after each candidate row as candidates too, and we continue processing on the regions determined by them. Figure 5 is the resulted candidate image, and Figure 6 is for comparison with the input image.

Figure 2.*A sample of database, input image*

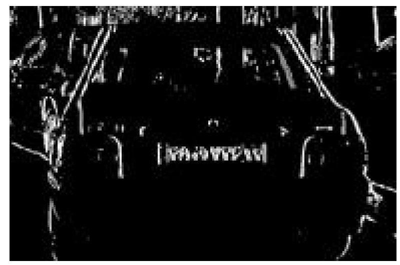


Figure 3. *Vertical edge detection result*

6. Definition of Compact factor

Due to vertical edges of structures such as fences or some parts of the vehicles, they can be selected as candidate regions. To prevent this, we propose the compact factor. A License plate has vertical edges in a narrow range, but those structures have vertical edges in a wide range. This feature is used in compact factor. This means that if we can calculate the quantity of compactness of the vertical edges, we can easily classify them. A simple criterion for this purpose is the number of deviations between "ones" and "zeros" and vice versa for each candidate row. The rows with e% minimum values belong to plate, so we omit the other rows from candidate regions. Vertical edges of the plate are close to each other, so for a row in the plate region, there so many cases in which consequent points are totally "ones" or "zeros" and this makes the

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deviations minimum. Simulations find the acceptable value of e. For evaluating the performance of compact factor, refer to figure 7. As it is shown in its vertical projection, fence structure of the vehicle is also considered as a candidate region. Local maximum in the row 116 is due to this fence structure, as maximum in the row 325 is because of the plate. These two rows are shown in figure 8 and 9. Figure 10 illustrates candidate regions without considering compact factor. The above region is omitted if we consider this criterion.

7. Dilations

Now we use a morphological operator. The image of figure 4 is once dilated horizontally and the other time vertically. Another horizontal dilation is employed on the common bright pixels of these two dilated images. The structuring elements of dilations are 6-pixel horizontal or vertical lines.

Figure 4. Candidate regions in vertical edge image

Figure 5. *Candidate regions in input image*

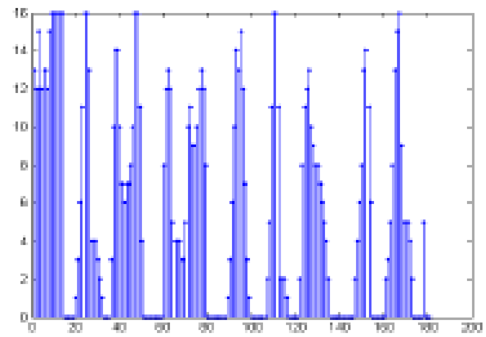

Figure 6. *Histogram Brightness of pixels of row 325*

8. EXPERIMENTAL RESULTS

The proposed method in the case of very low resolution and contrast is unable to perform its task well. There are some probable faults listed here:

- Fault No. 1: Extracting a region larger than the plate
- Fault No. 2: Extracting a region smaller than the plate
- Fault No. 3: Extracting a wrong region as the plate
- Fault No. 4: Being unable to extract any region

9. Result

The Database contains 400 images different in size, background, camera angle, distance, and illumination conditions. The performance of the system for c=15, d=70, f=20 and e=10 are shown in table 1. The performance of the method of

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[13] with our database is also illustrated in this table. Table 1 also shows the computational time needed by these methods for a typical 384*288 image [13]. We use a personal computer, Pentium-4 2.4 GHz, 256 MB RAM, for implementation. As it is shown, the proposed method is not only faster than the method of [13], but also it has a better performance on our database. The enhanced image undergoes the process of segmentation done using morphological operators. The segmentation is the process of partitioning the image into multiple segments. It is to simplify the representation of the image. The enhanced image is been segmented using morphological gradient operators.

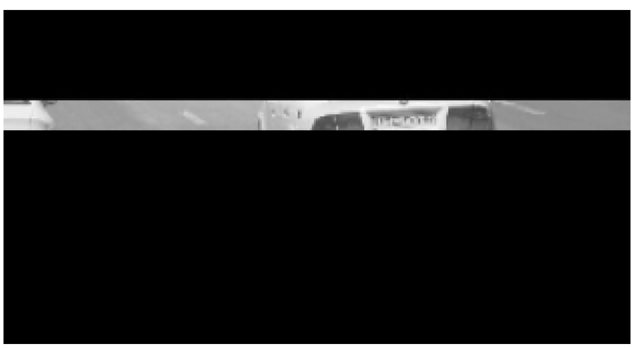

Figure 7. *Resulted image after employing median filter*

Figure 8. *The extracted license plate of figure 2*

Table 1. Comparison of the performance of two methods

		Correct location	Fault No. 1	Fault No. 2	Fault No. 3	Fault No. 4
No. of samples	Proposed method	334	31	17	11	7
	Method of [13]	307	23	61	9	0
Rate of correct location (%)	Proposed method	83.50	7.75	4.25	2.75	1.75
	Method of [13]	76.75	5.75	15.25	2.25	0.00
Computational time (ms)	Proposed method	32.4				
	Method of [13]	47.9				

10.Conclusion

In this paper, we proposed a real time and robust method for license plate location. Images of our database are complex and different in size, background, camera angle, distance etc. Considering all of these, the proposed method has the correct location rate of 83.50%. Preparing and introducing a standard database for making comparisons between proposed methods in this field is an essential work for future. Relating to the proposed method, finding some ways to calculate the optimum values for parameters such as c, d, e and f can be another future work.

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