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Optimizing the Vehicle Plate Recognition Using the Mathematical Morphology

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ABSTRACT

Recognizing the location of vehicle plate is the most important step in identifying the vehicle license plate in the intelligent transportation management systems. Its recognition rate and the real-time have a very important role in recognizing it. This paper attempts to introduce an Algorithm which first finds vertical edges of vehicle plate image using the Sobel Operator and then extract the vehicle plate from the image by the histogram analysis and composing the morphological operators.
KEYWORDS: Vehicle plate recognition; mathematical morphology; transportation management systems

INTRODUCTION

The Automatic plate recognition is one of the important issues of modern life which has been combined with the progress of machine life. The wide range of this issue can be observed in modern urban life. A system should be designed and implemented for this matter in order to determine the exact location of vehicle plate in the image as well as identifying the numbers and letters of vehicle plate. However, there are difficulties in finding the exact location of vehicle plate including the poor quality received images, poor lighting conditions, different viewing angles, complex background, and illegible plate.

Processing time in plate recognition systems is different based on various techniques and has a special importance with regard to the applied environment. This paper has attempted to apply a combination of edge detection method, histogram analysis, and morphological operation; no much processing time is used and the processing is done fast.

Recognition of vehicle plate location

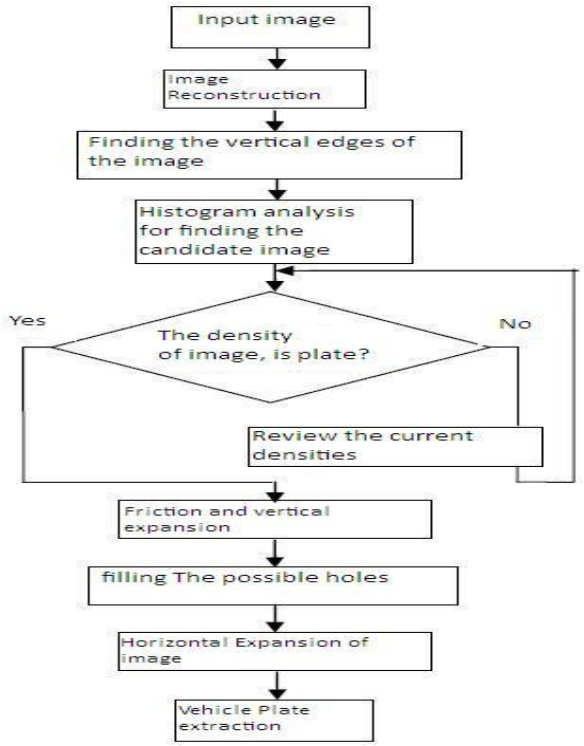

Figure 1: vehicle plate recognition steps

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There are several methods for extracting the vehicle plate such as the edge detection, histogram analysis, Hough transform and using the morphological operators. Since in most of the vehicle plates the numbers are with dark colors light background, the information of vertical edges seems strong and to have a greater density than other areas. In this system, first a color image is entered into the system and then the mentioned image is converted to the grayscale in order to increase the processing speed. Different stages of vehicle plate recognition are shown in Figure 1.

Since that in the proposed method the color information have not been used for extracting the vehicle plate information, the system can recognize the vehicle plate with different color. The steps of recognizing the vehicle plate are shown in Fig.1. Figure 2 shows the example of gray image for extracting the vehicle plate.

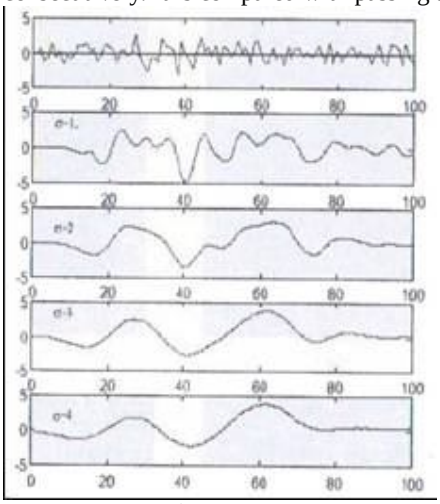
Figure 2: Example of gray image

Image Reconstruction

There are various filters which can help to reconstruct the initial image in order to easily find the edges of image. For instance, the Gaussian Filter eliminates the probable noise from the image. The Gaussian function is defined as the following equation:

$$h_{gau} = \left(-\frac{X}{\sigma^2}\right) e^{-\frac{x^2}{\sigma^2}}$$

In Figure 3, an example of a random signal is passed three times through the Gaussian filter with variance 1 consecutively. It is compared with passing through the Gaussian filter with variance 1,2,3,4.



Form 3: Results of passing a random signal through a Gaussian filter with different variances

Finding the vertical edges

The vehicle plate has numerous vertical edges due to the written numbers and letters on it; this feature can be used for finding its location in the vehicle image. Multiple algorithms have been suggested for finding the edge in image processing; among them the Sobel Operator has better performance because of the high speed and low processing volume compared with other methods. In fact, the edge in the Sobel method is the Sobel mask. Sobel edge detection method is one of the Stereotype-based methods. In the Stereotype-based methods, the concepts of gradient, Laplacian, or combination these two are used for initial detection of image edges.

−1	0	1
−2	0	2
−1	0	1

B

1	2	1
0	0	0
−1	−2	−1

A

Figure 4: Horizontal and vertical Sobel mask

Figure 5: Finding the vertical edges of image

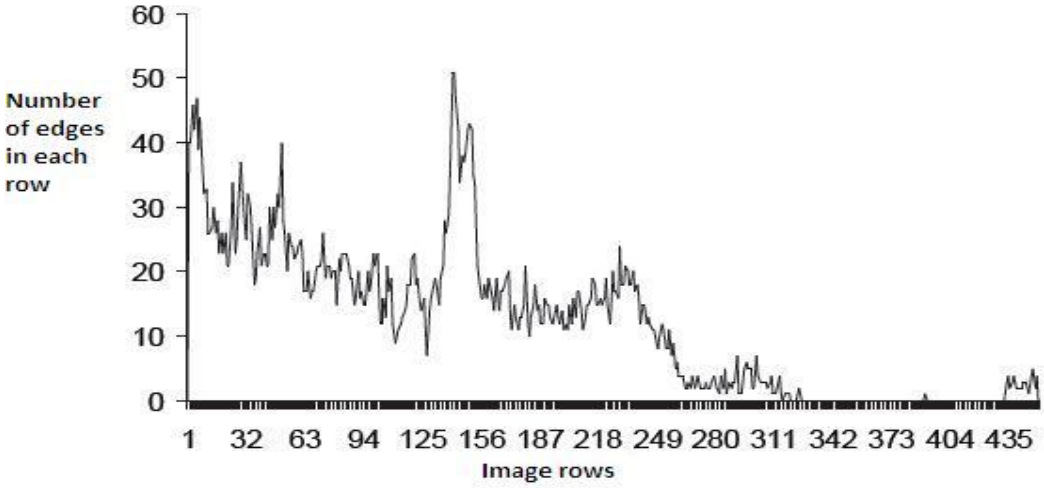


Figure 6: Image Horizontal Histogram of vertical edges

Figure 7: Two-candid Image of for the dihedral edge of the image

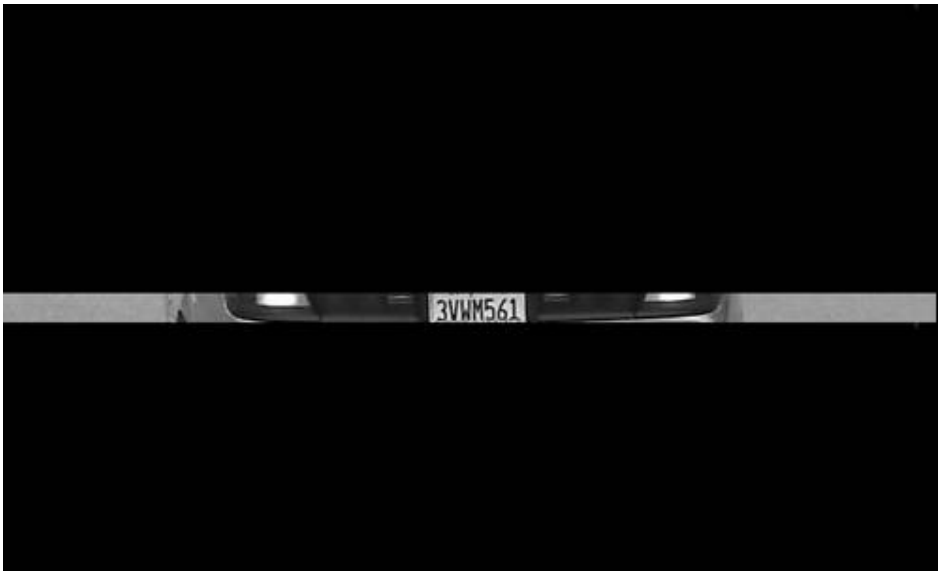


Figure 8: Candid grayscale image

Histogram analysis for finding the candid image

After finding the vertical edges of image, the horizontal histogram of edge is found by the help of histogram analysis of figure 6. Thus, the number of points with the gray level 1 is counted for each row of image and a graph is formed, the horizontal axis of this graph is the image rows and the vertical axis is the number of counted points. They have the maximum horizontal histograms in the rows where the vehicle plate is placed.

Expanding in the horizontal and vertical direction; finding the overlap of these two images and expanding this overlapped image horizontally

Now, we expand the candid two-row image of Figure 7 one time horizontally and one time vertically and get the overlap of these two; we expand the resulting image horizontally once again.

Filling the probable holes

Since we want to have the vehicle plate area as a contiguous area, we fill the probable holes in this step.

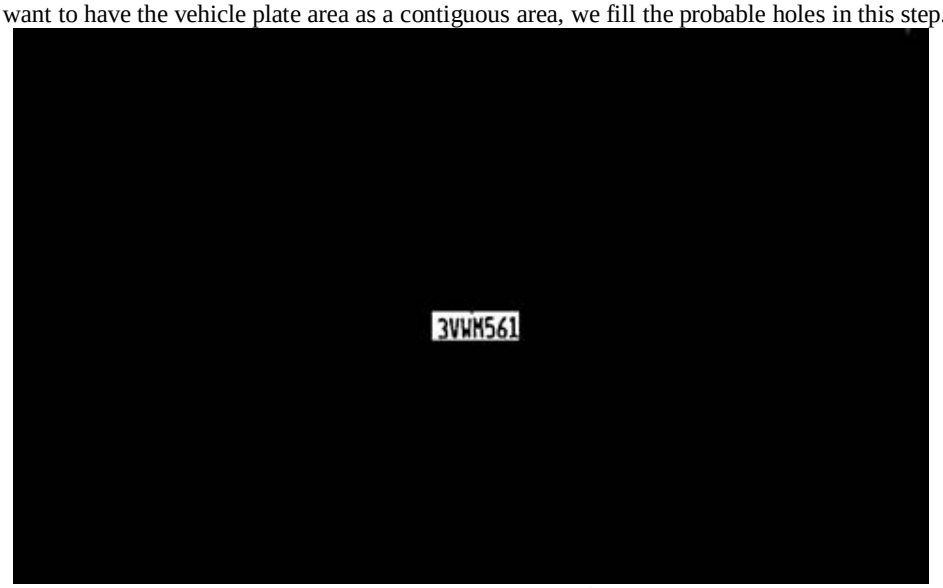


Figure 9: Finding the exact location of vehicle plate

Extracting the vehicle plate and the probable error

In this step, we get a filtered perimeter rectangular. The obtained rectangular is the vehicle plate and the image can be stored in a separate file. If the images have not had the high precision and resolution or appropriate

lighting conditions in this system, they will not have proper functions and the following errors will probably occur:

- Extracted larger area from the vehicle plate
- Extracted smaller area from the vehicle plate
- Extracted the wrong area as the vehicle plate

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