

A new algorithm for license plate recognition based on improved edge detection and Mathematical morphology

Wu Dingyun,Zhang Lihong,Liang Yingbo

Department of physics and engineering, Zhoukou Normal University
Zhou Kou, P.R.China, 466001

Abstract—This paper describes the advantages and disadvantages of current vehicle license plate location algorithms. To problems of inaccurating in Location of the vehicle plate,a method of image segmentation and extraction based on improved edge detection and Mathematical morphology was presented. In the first place, a series of color images were changed into gray images , secondly , through calculates the difference of each pixel and neighborhood pixels to buildup images' edge,and it can make the license plate stand out; once again ,by adding the original image of the the results map which enhanced edge image,and it uses Sobel operator to extract the edge of objects in image;then the algorithm applies the dilation and erosion mathematical morphology of binary images to get the the image smooth contour ; finally, from locating the position area alignment in the X and Y directions to locating license plates,meanwhile,using the median filter and the dilation and erosion mathematical morphology,and template matching algorithm to recognize the license plate character. Because of the accuracy of the plate region extraction, the character can be extracted exactly from the plate region. It can improve the accuracy rate of the characters recognition. From the results of simulation, it is found that the new method proposed in this thesis is efficient.

Keywords-Mathematical morphology; license location; license plate recognition; edge detection

I. Introduction

Vehicle license-plate recognition is one of the key technologies of intelligent transportation system, It consists of three key links:license

plate locating, character segmentation and character recognition. license plate recognition system requests to detect the the plate area quickly, locating the license plate is the core technologies of intelligent transportation system,it directly affects segmentation character and efficiency of character recognition, and even affects the efficiency of whole system. the license location technology is the basis and prerequisite for the whole intelligent transportation system, it correctly would relate its subsequent processing would go on smoothly or not, therefore, license plate locating technology is the key technique and also the most difficult part of the technology. For now, to rapidly and accurately locate the license plate, scholars at home and abroad have done much research on it,and proposed many new and improved algorithm by them.it mainly includes:study of the extraction of color and texture feature based on license^[1];the plate localization methods based on gary image ^[2,3]; algorithm based on neural network^[4-6]; method base on wavelet transform in the locating of license plates^[7]; license plate location method based on morphology^[8]; license plate location method based on support vector machines^[9]; license plate location method based on edge detection^[10,11]; But, there are obvious limitations using single method to locate the license plate,it will need to integrates the corresponding countermeasures. Therefore, This paper proposes the segmentation algorithm of license,it can contribute to both veracity and real-time of the

Location of the vehicle plate. The detailed implementation as shown in Figure 1

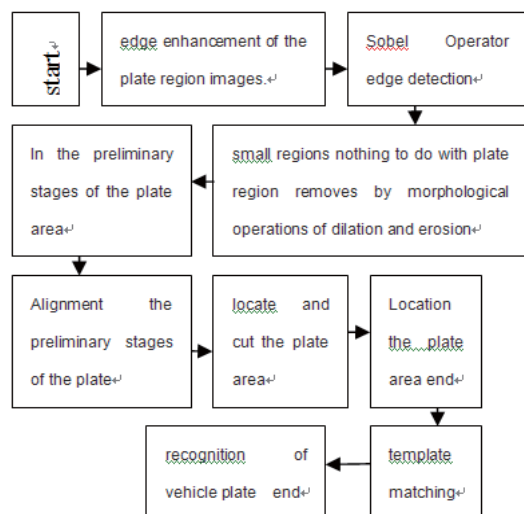


Fig 1 algorithms are described in forms of flow chart

II. METHOD DESCRIBED

A. edge enhanced

Edge enhancement is a method of image processing to make the image contour more presentable. The image enhancement method calculates the difference value of the each pixel and the neighboring pixels to enhance the image edge and highlight the licence plate.

judge the real time state for boring a well. the formula is as follows:

$$p_{i,j} = |p_{i,j} - p_{i,j+1}| + |p_{i,j} - p_{i+1,j}|$$

The principle of this method is as follows: firstly, shift to the right for each pixel, then the original image minus the image that are shifted; at the same time, shift to the above for each pixel, then the original image minus the image that are shifted. and the results will reflect the rate of colour. The result is zero when the region of image in pixels remained unchanged, that is the pixel is black; the result is the high rate when the region of image in pixels changed acutely; In order to

enhance image edges of both vertical and horizontal at the same time made the two results together, and used the obtained results as pixels in new image. The great difference of background color and the color of character is the main character of the color of characters of our country, this character may lead to better edge detection of vehicle license plate. original image is as shown in Figure 2, and image showing edge enhanced is as shown in Figure 3.



Fig 2 original image



Fig 3 image showing edge enhanced

B. Sobel Operator edge detection

Sobel Operator is one of most commonly Operator, it template is two 3×3 convolution kernel, as shown below.

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

every point of image is used to this two kernel to calculate convolution, one of whom

may hurt the vertical edges the most and the other who may hurt the horizontal edges the most, taking the maximum of convolution as output values of the point, calculation results show that a edge magnitude picture. It has definite directional character, the maximum amount of edge led the horizontal direction and the vertical direction, that is to say, Sobel Operator is the most important determinants of horizontal direction and the vertical direction, and it handling of heavily noised and gray gradient image well^[12], therefore, in this paper, it choose Sobel Operator. Image showing Sobel Operator edge detection is as shown in Figure 4.



Fig 4 Image showing Sobel Operator edge detection

C. small regions nothing to do with plate region removes by morphological operations of dilation and erosion

Under the same conditions, too many interruptions in the image has a low recognition rate, especially when background disturbance appeared as masses, it has far more effect on the play of the image recognition^[13]. Assuming

B signals the structural elements, f signals original image, x signals shift,, so f by B 's dilation is treated as $f \oplus B$, dilation is defined as: $f \oplus B = \{x | [(\hat{B})_x \cap f] \neq \Phi\}$;

and f by B 's erosion is treated as $f \ominus B$,

erosion is defined as: $f \ominus B = \{x | (B)_x \subseteq f\}$;

open operation is the operation dilation after erosion of image, it is defined as

$f \circ B = (f \ominus B) \oplus B$. In this paper, it can carry

on erosion to the vehicle, it removes details of picture as the image is darkened by it. Many people lose their life goals as they earn more and more money. The next part of the expansion of operations are that the least part of the corrosion are reintroduced into the image while enhancing the brightness of the whole image eroded. in the other word, It could not be vehicle card of the most useless details parts will be removed by operation in this section. After treatment, it was easy to tell that there is usually a large amount of connected domain, and most of these regions look too small, it is certainly not the coarse license plate area, real-time performance of Location of the vehicle plate are done, this step is very essential, too. Here, remove small pixels through the *bwareaopen*. Image showing small regions nothing to do with plate region removes by morphological operations of dilation and erosion is as shown in Figure 5.

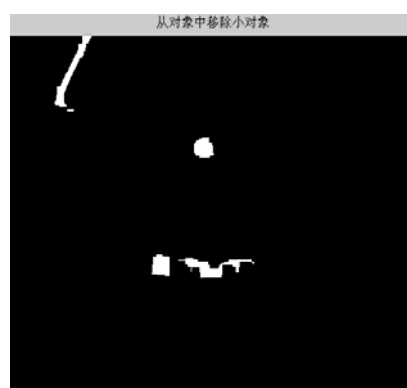


Fig 5 Image showing small regions nothing to do with plate region removes by morphological operations of dilation and erosion

D. Location of the vehicle plate

Based on approximate position of the vehicle

plate, under the conditions of below, up and down searching directions need to be processed

First, If all statistical blue pixels in one line and the average of one pixel in that approximate position of the vehicle plate had little difference, we think that this line is the line of the vehicle plate;

Second, determinate license plate area in the x direction as well as license plate area in the Y direction, then can be corrected license plate area. After Location of the vehicle plate, some steps such as grayscale transformations, filtration be needed to identify the the vehicle plate convenient. Image showing Location of the vehicle plate is as shown in Figure 6, and the preprocessing algorithm for License Plate Recognition is as shown in Figure 7.



Fig 6 Image showing Location of the vehicle plate

E. template matching



Fig 7 the preprocessing algorithm for License Plate Recognition

It set up character library, the plate region images segmented match for character library. as shown in Figure 8.

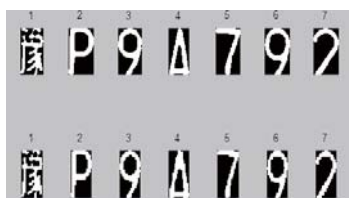


Fig 8 Image showing recognition of the vehicle plate

III. conclusion

We propose a new method for characters

recognition in the plate, This algorithm can accurately accomplish characters recognition. The experimental results show that the method is effective. There must still be something we need to improve upon in this algorithm, especially this algorithm shall not apply to the plate of characters on the top line, in my opinion, this will be the developing direction of research.

REFERENCES

- [1] Zhang Yin, Pan Yunhe. A new approach for vehicle license plate locating from color image. Journal of image and graphics, 2001, 6(4): 374-377.
- [2] Feng Guojin, Gu Guohua, Zheng Ruihong. Fast license plate location algorithm based on adaptive projection. [J] Infrared and Laser Engineering, 2003, 32(3): 285-288.
- [3] Yang Hao, Liu Yude. RESEARCH ON LICENSE PLATE LOCATION ALGORITHM [J]. RESEARCH ON LICENSE PLATE LOCATION ALGORITHM, 2008, 26(3)
- [4] Guang Li, Ruili Zeng, and Ling Lin. Research on Vehicle License Plate Location Based on Neural Networks [J]. Proceedings of IEEE International Conference on Innovative Computing, Information and Control, 2006(6): 363-366
- [5] Chen Jiankun, Fan Chunnian. Neural network based vehicle license plate location [J]. Journal of Liaoning Technical University (Natural Science Edition), 2005
- [6] Gang Li, Ruili Zeng, and Ling Lin. Research on Vehicle License plate Location Based Neural Networks [J]. proceedings of IEEE International Conference on Innovative Computing, Information and Control, 2006(6): 363-366
- [7] Ma Yongyi, Song Zheng. Application of Wavelet Transformation to Vehicle License Plate Location. [J]. Computer and Communications. 2008
- [8] Lu Yaqin, Wu Lingchao. A Method of License Plate Location Based on Morphology. [J]. Computer Engineering, 2005, 31(3)
- [9] Zhao Xiaoxia. Vehicle License Plate Location Based on Support Vector Machine [J]. MODERN ELECTRONICS TECHNIQUE, 2008, 31(9): 184-186
- [10] Wei Wu, Huang Xinhan. A method of number-plate locating based on the vertical edge characteristics of characters [J]. China Journal of Highway and Transport. 2000, 13(4): 88-90
- [11] Li Bo, Zeng Zhiyuan, Fu Xiangsheng. An Algorithm for License Plate Locating Based on Mathematical Morphology and Edge Characteristics [J]. Video Engineering, 2005, 24(7): 94-96
- [12] Gonzalez, digital image processing (MATLAB) [M]. Ruan Qiuqi, etc interpretation. Beijing: Publishing House of Electronics Industry, 2006
- [13] Liu Xing, Jiang Tianfa. Method of Eliminating Noise of Image in Intelligent Vehicle Plate Recognition System [J]. Journal of Wuhan University of Technology (Transportation Science & Engineering), 2005(5): 805-80