Application Research of Image Processing Technology in License Plate Recognition System

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Abstract: With the continuous development of China's automobile industry, China's automobile sales are getting higher and higher, and the traffic pressure is followed. The license plate recognition system is an important means to improve traffic management. The identification mark of each vehicle of the license plate is unique. By collecting and identifying the license plate information, it can judge the ownership of the corresponding motor vehicle in time, thereby strengthening the control of the motor vehicle, thereby improving the efficiency and effect of vehicle management. The paper mainly discusses the application of license plate recognition system based on image processing technology.

1. Introduction

The automobile license plate recognition technology can be divided into direct recognition and indirect recognition. Indirect recognition refers to identification using an IC card or a barcode, and the license plate information is stored in a barcode or an IC card, and the license plate information is identified by the scanner. However, barcode recognition requires scanning equipment with better performance. The hardware configuration of the IC card recognition system is more complicated and costly. Moreover, the IC card identification technology cannot verify whether the vehicle corresponds to the identified information in the case of non-uniform standards, and directly affects its recognition accuracy [1]. Direct recognition is the direct acquisition of vehicle image information, using image processing technology to directly identify license plate information. The direct recognition method adopts advanced image processing technology, which greatly improves the recognition rate and recognition speed of the license plate recognition and the system performs image processing after extracting the license plate information, which can better solve the problem of inconsistent information between the automobile and the license plate. It can be seen that image processing technology is very important in the license plate recognition system. The following is a detailed analysis of the application of image processing technology in the license plate recognition system.

2. License Plate Positioning

Usually, the license plate recognition system takes pictures of motor vehicles in a designated area to collect image information. This process requires positioning of the license plate. There are two types of commonly used license plate positions, namely, positioning based on the color characteristics of the license plate and positioning based on the texture features of the license plate. The former is mainly realized by applying the color difference between the license plate color and the car body [2]. At present, China's license plate color includes yellow, black, blue and white. The corresponding color distance map is established for these four colors, and then the optimal threshold method is adopted. Obtain the candidate area of the license plate, and then filter the texture features of the license plate to finally realize the license plate location. The positioning method based on the license plate texture feature is currently applied more. It mainly analyzes the frame characteristics of the license plate, the license plate character spacing, the license plate character characteristics, etc., and distinguishes the license plate from the other positions of the vehicle body, and finally achieves the purpose of positioning [3].

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3. Vehicle Image Preprocessing

The license plate recognition system acquires the image of the vehicle through the camera. Since the illumination, the shooting position, and the traveling speed of the vehicle have a direct influence on the license plate image, it is necessary to pre-process these images to reduce the calculation amount when extracting the image features and avoid wasteful storage. Space, improve system utilization and real-time identification. In the specific license plate recognition system, the key technologies of vehicle image preprocessing include the following aspects [4]:

Usually, the digital camera obtains the license plate image of the color pattern, and the color license plate image needs to be grayed out to obtain a faster recognition speed. The color pattern is RGB image, where R means red pixel, G means green pixel, B means blue pixel, three basic colors can be composed of any color, one color picture size is M*N, corresponding to one M*N* 3 three-dimensional array to store; and in the recognition process, each pixel of the color image contains R, G, B three components, which contain a number of information that is not relevant to the identification, which will cause some interference to the system identification. Therefore, the color image not only requires high space storage, but also has a long system recognition time, which directly affects the real-time performance of its recognition. Therefore, the first step in vehicle image preprocessing is to grayscale the image to save image storage space and improve recognition speed. The three values in the RGB model are equal, which represents a grayscale color, which is the gray value [5]. A variety of methods can be used to grayscale the image, such as the maximum method, the average method, the weighted average method, etc., wherein the weighted average method is most commonly used. The human eye is the most sensitive to green and the blue sensitivity is the lowest. The weighted average method is based on this visual model. A weighting coefficient is added to each of the R, G, and B components of the pixel, and then summed. The calculation method is as follows: :

$$f(i,j)=0.30R(i,j)+0.59G(i,j)+0.11B(i,j)$$

The maximum value calculation formula is:

$$f(i,j)=\max(R(i,j),G(i,j),B(i,j))$$

The average method is calculated as:

$$f(i,j)=(R(i,j)+G(i,j)+B(i,j))/3$$

The grayscale image is a picture composed of a monochrome image. The grayscale of the monochrome image is from 0 to 255, which can make the image show obvious brightness and darkness and rich black and white effect. In order to separate the recognition target and the background, the pixel of the target area is taken as 1 and the pixel of the background area is taken as 0, and the conversion of the gray image to the binary image is realized by image binarization processing. The purpose of image binarization is to accurately separate the background from the target. In the actual graph you binarization process, a threshold K is usually set. The image larger than or equal to the threshold is the target, and the other images are the background. This threshold segmentation method can obtain the ideal binary image. Let the processed grayscale image be f(x, y), and the transformation can obtain the binary image g(x, y). The entire binarization process can be expressed by the following formula:

$$g(x,y)=\begin{cases}1\, f(x,y)\geq k\\ 0\ \ f(x,y)\langle k\end{cases}$$

Different images should select the corresponding threshold method, including global threshold, local threshold, optimal threshold, etc., wherein the global threshold refers to selecting a constant threshold to act on each pixel of the entire image, and the global threshold can improve the processing speed of the image. However, this method is not suitable for images with complex backgrounds, and can be better applied to images with a single background image. The local threshold is a threshold for all pixels to be related to surrounding pixels. Since a threshold is

determined for each pixel of the image, the image applied to the complex and variable background pixels can also achieve better results, but the execution time is better [6].

The main function of spatial domain filtering is to remove the influence of noise introduced during image acquisition. Noise will reduce the low quality of the image and affect the processing of the image. Commonly used spatial domain filtering methods include mean filtering, median filtering, maximum filtering, and minimum filtering. Mean filtering is a commonly used method in image processing. It is a low-pass filter that removes high-frequency signals and eliminates sharp image noise. It replaces each image with the average value calculated by each pixel and its surrounding pixels. Of course, the mean filtering method also has certain deficiencies, which are inferior in processing image details. Because of its excessive processing content, denoising can also lead to the destruction of details, and the average filtering method is applied to complex images. Large, easy to cause excessive blur [7]. The median filtering method is a kind of nonlinear filtering, which sorts the gray values of the domain and then inputs the intermediate values of the set values to achieve the purpose of retaining the edge information and removing the noise. When selecting the field, you can select different shapes and different sizes of filtering windows, including rectangle, circle, line, square, etc. The filter window has different filtering effects. For the sharp image, select the cross window, if the image changes slowly and For longer outlines, choose a square or round window. The median filtering method is applicable to images of blocks with larger areas and more pixels, and is not suitable for images with too many sharp corners in the picture.

4. Character Segmentation

China's standard license plate usually has 7 characters, including Chinese characters, English letters and Arabic numerals. The characters are segmented according to the character information of the license plate, so that the next step is to prepare a satisfactory image source for license plate character recognition. Key technologies for character segmentation include the following [8]:

First, remove the border. After the pre-processing of the license plate image, there will still be some interference information, such as borders, notches, rivets, etc., and the interference information should be removed before the character segmentation, so as not to affect the character recognition. Determine the height ratio information of the character, and define the decision point when scanning the image. The license plate image is binarized, and the division between the character and the background has obvious black-to-white variation. When searching for the decomposition line of the character and the background, all the outside of the defined area defined by the decomposition line should be cut off to reduce The interference factor of the upper and lower borders of the license plate. Second, a single character split. After the interference information of the image is removed, the image characters are divided, and the threshold is set according to the width of each known character. If the width is equal to the threshold, the segmentation is performed to separate the 7 characters in the license plate. The limit value of the character segmentation is determined according to the standard of each character, and a region within the limit value is left to obtain a relatively accurate single character image. Finally, the characters are one. After the segmentation, the size of the characters is basically the same, but the external factors will still interfere with the segmentation process, and eventually the segmentation is excessive or the segmentation is missing. Therefore, the character processing is performed to make the length and width of the cut characters equal. The character processing can be complemented by the recursive difference, and the original image is f(x, y), f'(x, y), and is calculated by the following formula:

$$f'(x,2i)=f(x,2i+1)=f(x,i)\ i=0,1,2\cdots\cdots16$$

$$f'(3j,y)=f'(3j+1,y)=f'(3j+2,y)=f(j,y)\ j=0,1,2\cdots\cdots8$$

5. Character Recognition

Commonly used character recognition methods include feature matching method, template matching method, and the like. The feature matching method is mainly to design various classifiers

to compare the feature structure of characters and match the same image. The feature matching method is applicable to the recognition of Arabic numerals and letters with obvious features, which has certain repression for noise and tilt; however, the feature matching method cannot recognize the Chinese characters of the first character of the license plate because the Chinese characters are different in structure and the strokes are numerous. It is prone to problems such as fuzzy details and discontinuous strokes [9]. The feature matching method cannot be accurately identified. The template matching method is the most commonly used matching method in image processing. The method can be used to realize the recognition of the first Chinese character of the license plate. The template in the template matching method is a known small image, which searches for a target in a large image. If the target has the same direction, size, and image element as the small image template, a certain algorithm can be used to determine the image. The coordinate position of the target, and finally the template matching is completed. In the actual recognition process, if there are too many character templates, the matching time will be prolonged, and the noise and tilt of the character image will interfere with it, thus affecting the recognition result.

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