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License Plate Recognition Technology Development Research and Improvement

ZHANG Sheng[a],*

[a] School of Information Science and Electrical Engineering, Shandong Jiaotong University, Jinan, Shandong, China.
*Corresponding author.

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Abstract

License plate recognition technology is an important part of an intelligent transport system, widely used in highway tolls, unregistered vehicle monitoring, vehicle parking management, and other important occasions. Typical of the license plate recognition, algorithm is divided into three components, license plate localization, character segmentation, and character recognition. This paper summarizes the key technology of license plate recognition algorithm, and analyses the difficulties of improving the recognition rate. According to features of license plates, license plate character recognition methods in recent years were summarized and put forward, on the basis of the existing methods, improving system performance and accuracy.

Key words: License Plate Recognition; Localization of license plate; Recognition of characters

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INTRODUCTION

In recent years, license plate recognition technology as an important part of intelligent transportation system has received widespread attention. It can be widely used in highway and bridge toll station, city traffic monitoring systems, port and airport traffic vehicle certification systems, in order to improve the transport system of vehicle monitoring and management automation. Due to many of the existing algorithms for the system, because of the need to adapt to all kinds of complicated backgrounds, various types of vehicles to identify, changing colors, and the ability to adapt to weather changes caused by different illumination conditions, the current system has some problems. With the improvement of computer performance and computer vision theory and the development of technology, this technology will increasingly mature. In license plate recognition systems, vehicle image acquisition to processing of license plate characters is a complex process of image processing and pattern recognition. License plate recognition process in general can be divided into license plate localization, license plate segmentation, and character recognition. License plate localization is found in the given image of license plate location; License plate segmentation involves locating the license plate characters of the area one by one; Character recognition is the recognition of character from segmentation (Yuan,Du & Zhu, 2008).

1. LICENSE PLATE LOCALIZATION

License plate localization involves finding the entire vehicle's license plate area from the image, applying localization technology by license plate regional characteristics to determine the location of the license plate. Whether it is good or bad is directly related to the recognition rate of the whole system, and speed of recognition also has been a big influence. At present, people have put forward many different methods. A common starting point is to determine the plate by the features of the license plate area. License plate localization difficulties involve capturing image interference by environmental factors because of which the picture quality is difficult to guarantee. These factors interfere with other characters in the region, making accurate positioning difficult. (The license plate appears stained, worn, faded, etc, due to shade, motion image distortion, etc.) There are many types of license plate localization algorithm but in general it can be divided into the following several methods.

1.1 License Plate Localization Method Based on Neural Network

Nowadays, many neural networks are applied to license plate localization, including Pulse Coupled Neural Networks, Time Delay Neural Networks, and Discrete Time Cellular Neural Networks. Pulse Coupled Neural networks is usually generated by a lot of candidate regions, which may include license plate areas. Candidate regions are made by the pulse image. Experiments show that Pulse Coupled Neural Networks had at least an 85% detection rate. At present, the study and improvement of this algorithm is still ongoing. A time Delay Neural Network is a kind of multilayer forward feedback network. This method is based on color and the computing complexity is high.

1.2 License Plate Localization Method Based on Support Vector Machine

A support vector machine is a new type of machine utilizing method put forward by Vapnik *et.al* (Xu, Li & Yu, 2004), which is mainly used to solve the problem of pattern recognition when fewer samples are available. This method can achieve good classification results when training samples are rare. Kim *et.al* (Guo & Liu, 2008) implemented a support vector machine which analyzes the color and image texture characteristics of a license plate and combines the CAM Shift method effectively locating license plates in the video stream. However, this kind of treatment method is not applicable when the image is badly soiled or has a complicated background. This takes up too many real-time resources, and it is difficult to meet the requirements of practical application.

1.3 License Plate Localization Method Based on Adaboost Algorithm

The core idea of the Adaboost learning algorithm is to take a very small part of the key features of concentrated options of visual features to produce an effective classifier. Wu *et.al* (Serkan & Ergun, 2005) deleted most of the license plate area using the edge information, putting the rest of the region into the Adaboost classifier and then training the classifier to recognize the information, achieving good positioning results.

1.4 License Plate Localization Method Based on the Structure of Plate Texture

This method uses the structure of plate texture, edge, gray histogram, angular point, horizontal or vertical projection geometry characteristics combined with the image processing methods to determine the location of the license plate. When the localization method is used, the license plate area contains rich edge information. Zhang *et.al* (Almustafa & Obeid, 2011) , through edge detection technology to find the region where more edges existed using mathematical morphology algorithms for specific filling, combined the geometrical characteristics to find target recognition of the license plate. Cano *et.al* (Jia, He & Piccardi, 2004) interlaced scanning on the edge image of the license plate and implemented statistical edge numbers in each row, then set a threshold. When the number of edges is greater than the threshold value, the license plate area is determined.

1.5 License Plate Localization Method Based on Color

Since license plate backgrounds are specific and different according to the car body and the color of the background itself, the license plate locating method is based on the license plate's background color, color-space distance, and similarity calculation, splitting each segment of the region with the desired color of the license plate image, then adopting this specific method and judging whether the area belongs to the license plate area to realize license plate localization. Lee *et.al* (Hasan & Rached, 2007), according to the characteristics of South Korean license plates, used the B a c k - Propagation Neural Network to classify the color of the license plate image into green, red, white, and other colors, a total of four classes, then used horizontal and vertical histogram analysis to determine license plate localization.

2. LICENSE PLATE SEGMENTATION

After license plate localization, segmentation involves splitting characters into individuals, making latter character recognition easier. Its main tasks are binarization and character segmentation.

2.1 Binarization

In the global threshold value method, a license plate image can be seen with the foreground characters and background in two parts. When the light on the plate is evenly distributed, binarization can find a suitable threshold to separate characters and background. When the illumination is uneven, the global threshold value is obviously unable to meet the needs of license plate binarization. At this time the local threshold value method must be used. The key point of image binarization processing is to select the threshold reasonably. When the threshold is set too small, it is too easy to cause noise; when the threshold is set too big, it will lower resolution and filter out a non- noise signal as noise.

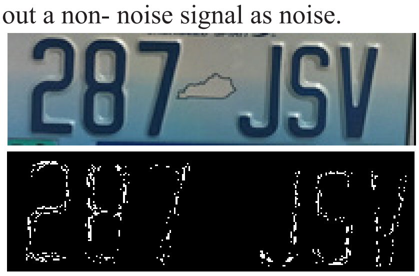

Figure 1
Comparison Between the Effect before and after Optimized by Color Cast

If we consider the factor of color cast in the process of binarization, it will raise the overall rate of recognition. Experimental statistics indicate that the R value of RGB format in the same color system should be the same. If we set the color cast to 00FFFF, we can improve the accuracy of grayscale display at the time of binarization. By repeated tests found as shown in Figure 1, the R value of the letter colors has to be 00 or FF when compared with all of the same color parts with the same R value in the matrix, and matched with all of points inside the binary lattice point area. This method is able to form a more accurate and complete character set in the final recognition, thus improving the accuracy and efficiency of recognition.

2.2 License Plate Character Segmentation

Here are two of the most common methods of character segmentation of the mainstream methods, vertical projection method, and unicom area analysis.

Character segmentation algorithm based on projection analysis. The projection method (Suresh, Mahesh & Rajagopalan, 2007) involves vertically projecting the license plate image after binarization, which means calculating each column according to the number of pixels in each license plate character along a horizontal direction, getting the minimum of gaps between the characters where we split position. This method works well in situations where the environment has less noise, less border disturbance, but poor adaptability regarding adhesion and interval, or when the license plate dot characters have border interference.

Character segmentation method based on connected domain analysis. Connected domain analysis (Rami & Subhash, 2010), according to the principle of the pixels belonging to the same characters, constitutes a connected domain, combining some *a priori* knowledge such as fixed height of license plate characters and fixed ratio relationship of space to implement license plate character segmentation.

Projection and connected domain analyses have their own characteristics, and are able to handle certain types of samples. But for practical applications in various complicated situations, they are still not entirely applicable, and even their advantages are complementary. YanPeng *et.al* Tsinghua University proposed a combination of connected domain analysis and projection analysis algorithms. This method first extracted characters that were connected to domains from candidate license plates using the clustering method to screen and analyze by a single character projection and deal with the condition of conglutination and fracture. For the purpose of removing false license plate samples, we introduced decision tree structure in the algorithm at the same time.

3. CHARACTER RECOGNITION

License plate character recognition is similar to the OCR system. Although it is a small, simple character set, the characters are fuzzy and easily affected by the environment. Therefore, license plate character recognition has considerable difficulties. To recognize license plate characters, the commonly used methods are based on the neural network method and the method based on template matching. The former has a large amount of fault tolerance, but the recognition speed is slow, and it is difficult to meet the real-time requirements. The second method has faster recognition speed, especially for the binary image, and it can meet the real-time requirements, so this method can gain higher recognition rates when the license plate image is clear and the pretreatment works better. Therefore, it is widely used nowadays. The features of the license plate character set, involve matching Chinese characters, English letters and numbers, template matching with digital templates, then analyzing the results grammatically, confirming the legitimacy of the results, and finally, excluding false identification results.

CONCLUSION

General license plate recognition algorithms can be split into license plate localization, character segmentation, and character recognition. All are based on analysis of domestic license plate characteristics, analyzing and summarizing license plate recognition algorithms, and proposing an optimization suggestion. Because of the complexity of the environmental background and diversity of license plate characteristics, there is still no perfect license plate recognition method. We can only intelligently judge all kinds of complicated situations and adopt a different strategy in the practical application. We can also take advantage of existing methods and complement them with each other, improving the processing speed and precision of automatic license plate recognition, finally obtaining a more practical and effective method of vehicle license plate automatic recognition.

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