

Vehicle License Plate Recognition System Based on Digital Image Processing

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Abstract—This paper analyzes the basic method of digital video image processing, studies the vehicle license plate recognition system based on image processing in intelligent transport system, presents a character recognition approach based on neural network perceptron to solve the vehicle license plate recognition in real-time traffic flow. Experimental results show that the approach can achieve better positioning effect, has a certain robustness and timeliness.

Keywords—vehicle license plate recognition; image processing; digital morphology

I. INTRODUCTION

Since the 21st century, with social development and improvement of living standards, the number of vehicles is continuously increased, the traffic conditions is worsening, which brought huge pressures to the society and environment. Intelligent transport system is a real-time, accurate, and efficient transportation management system built based on a relatively perfect road infrastructure and by synthetically using the advanced electronic technology, information technology, sensor technology and systemic engineering technology in ground transportation management^[1]. This system can solve the various road problems generated by the traffic congestion, thus receiving more and more attention.

Vehicle license plate recognition is one of the key technologies in the intelligent transport system, while its development is rapid, has been gradually integrated into our real life. Vehicle license plate recognition system can carry out automatic registration, verification, monitoring and alarm management, is an important part of modern highway toll management system, highway speed automatic monitoring system, highway surveillance, parking automatic charging management and other fields.

II. VEHICLE LICENSE PLATE RECOGNITION SYSTEM

A. Vehicle license plate recognition system overview

Vehicle license plate recognition system is mainly composed by hardware and software. The hardware part includes a control computer, one Ethernet camera, a UPS power supply and an interface control port. These sections ensure the car images intake and processing. The software part is divided into the Ethernet camera embedded front-end software and the processing software in the industrial computer.

Vehicle license plate recognition system usually consists of data acquisition (license plate image acquisition), license plate extraction, and license plate identification several major components, the system architecture as shown

in figure 1.

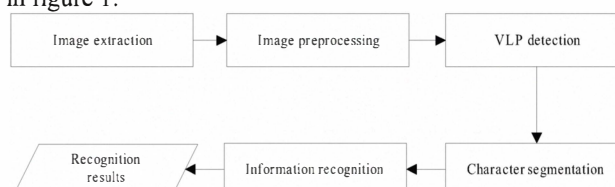


Figure 1. Vehicle license plate recognition system structure

In the vehicle license plate recognition system, the image acquisition is completed mainly by the hardware, which is to extract the foreground image of the vehicle, to convert the camera's video signal to digital image signals to be sent to the computer for processing. Because the impact of the natural environment and the lighting conditions, there are many disturbances in the license plate images, which brings inconvenience to the positioning of the license plate, so in order to better extract the license plates, it needs to preprocess the license plate image to ensure the license plate location quality. VLP detection, this part is the core of the system, and the implementation of which affects the performance of the whole system, which is mainly to use pattern recognition^[2], digital image processing, information theory and other knowledge to position and extract the license plate in the license plate images. Character segmentation and recognition, when the plate has been successfully extracted, it needs to segment the characters in which, and use prior knowledge to identify them to get the final results.

B. Key technologies of license plate recognition

1) *Vehicle license regional positioning technology*: it is to use the above characteristics to determine the true location of license plate. To accurately position the vehicle license plate from the images obtained from the natural scene is the key of the vehicle license plate recognition system, is also the most difficult step.

2) *Vehicle license plate character segmentation technology*: it is to divide the license plate region into a single character region for the follow-up license plate recognition module to identify the single characters.

3) *Vehicle license plate character recognition technology*: character recognition is the process of effective confirming the Chinese characters, English letters and numbers on the license plate on the basis of the accurate segmentation for the vehicle license plate character^[4].

III. VEHICLE LICENSE PLATE RECOGNITION SYSTEM BASED ON DIGITAL IMAGE PROCESSING

A. System design

Vehicle license plate recognition system structure as shown in figure 2:

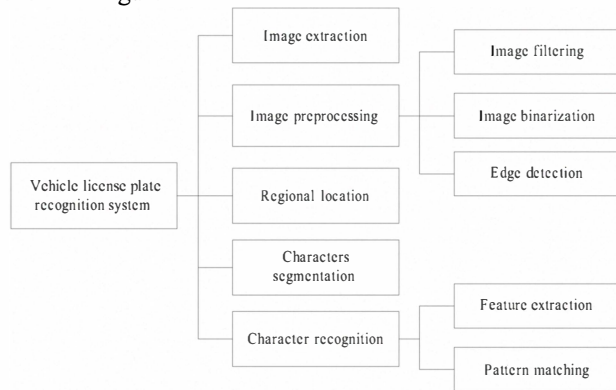


Figure 2. Vehicle license plate recognition system structure

1) The regional location of vehicle license

In the vehicle images, to position a car license plate is a difficulty of vehicle license plate recognition and image coding treatment. The positioning in the vehicle license is to extract the coordinates of the vehicle license plate area from the vehicle image, and then identify the license characters. It also needs to consider the distortion of the captured image, illumination uniformity, transmission impact and other reasons. If the captured image is vague, the license area is not obvious, and then the license area extraction will be greatly difficult. At present, the picture area extraction methods are static algorithm, character object extraction algorithm based on edge extraction and adaptive robust, the target search strategy algorithm based on color segmentation and other algorithms. The common starting point of those is to determine the location of the license through the characteristics of the license area.

2) Image preprocessing

In order to identify the vehicle license from the video image, the original image is required to have appropriate brightness, higher contrast and can identify license plate video image. However, because that the camera usually works in an open outdoor environment, so the camera when shooting may affected by the distance between the camera and the license, their angle, the traffic speed, vehicle license plate clean degree and other factors, so that the license image may have blur, deflection, defects and other serious defects, therefore, it needs to preprocess the original image before the identification. The image preprocessing includes: image restoration, image enhancement, gamma correction, gray correction, color image grayscale, grayscale stretching, and other processes.

3) Vehicle license plate character segmentation and processing

After the license character image positioning and binary processing, the vehicle license is a level bar area only contains the license character, and to recognize the image

characters, these characters need to be segmented from the binary license image. Because the weak stain, loss and other factors of the vehicle license may make the image have greater image noise, while the image binary process making some useful information lost, which resulted in the blur, even incompleteness, adjacent characters adhesion of the license to be segmented, seriously affected the results of segmentation, therefore, the use of segmentation method with reference to the license character characteristics is effective.

The key of the license plate recognition system is key character feature extraction. In other words, how to select the feature vector which is not only easy to extract, but also easy to identify, as well as has the feature vector as little as possible^[6], and the characteristic parameters similar to the best sample characteristics, is the key of the feature extraction. Feature extraction and selection is crucial to the system identification, which basically determines the identification system performance and recognition accuracy, and even can affect the entire system identification effect.

4) Vehicle license plate character recognition

The key of the license plate character recognition is the character feature extraction and pattern matching. When feature extracting and pattern matching there are mainly the following ways: one is the use of character structural features and transform for feature extraction, this method has high tolerance to the character incline and deformation, but the computation is huge, requires high computer performance. Another is the use of character statistical features for feature extraction, at present, most character recognition systems use this method, and when extracting the character features, also the character projector features and profile features can be used to composed the character feature vector for feature matching, thus the results have a high recognition rate.

The specific processing flow of the system as shown in figure 3:

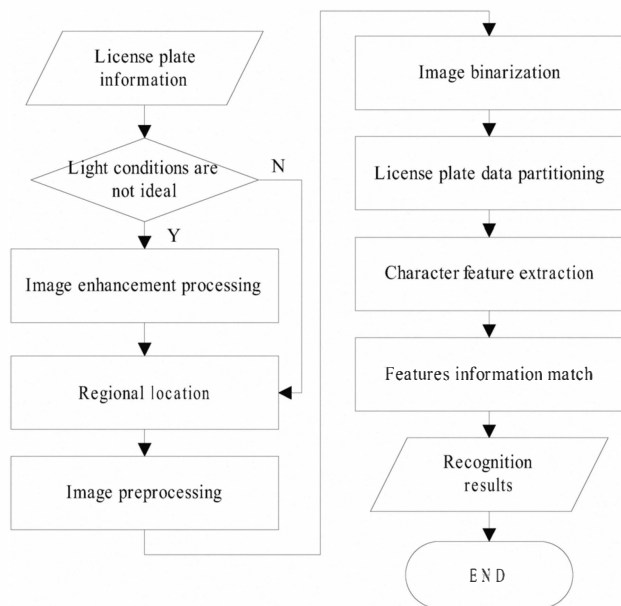


Figure 3. System specific processing flow chart

Based on the hundreds of pieces of the vehicle license images this paper carries out a license positioning and segmentation test, the results show that the correct rate can reach 96%. The automatic segmentation results can meet the requirements of character segmentation and recognition; and the recognition range is accurate, the area size is appropriate, there is no missed part of the license^[3]; for the image without ideal light conditions, an image enhancement can be carried out once to make the dynamic range of image gray expanded and the contrast enhanced, and then for the image positioning and segmentation, thus, to improve the accuracy of image segmentation.

B. System performance analysis

1) Accuracy analysis

In order to achieve the purpose of real-time processing, the algorithms used in this system are not involved with complicated mathematical functions, and in such circumstances the system achieves good results, because the parts the system involved are more, so the output of each part can be the input of the next part. Linked together, the previous module error necessarily will lead to the latter modules error. Therefore, the system is a typical serial system, and the overall accuracy depends on the product of the various part accuracy.

2) Difficulty analysis

In the image acquisition, the different object distances often result in different license plate sizes in the image. And the processing method of a fixed threshold adopted in the previous algorithm has not a universal adaptability. A fixed threshold can only handle a certain size of license plate images, but for other images with different sizes is helpless. Faced to a large number of license plate images with

different sizes, to find a new algorithm with wider applicability is not easy. In actual image acquisition, the noise, light has a great influence on the image quality. A lot of random noise disturbance, different perspectives of the light, light, resulting in license plate light and dark gray irregular changes. The irregular and uncertain occurrence of the deformation, noise and other interference information all make the clarity of the captured license plate image greatly reduced.

The difference of the angle when image collecting, the actual front license plate and the license plate incline will cause the captured license plate graphic to generate geometric deformation^[5]. And the license plate graphic geometric deformation, the different degrees of the deformation, also make the license plate positioning in the license plate image and the license plate character recognition more difficult. This requires the license plate location and recognition to have high anti-interference and robustness.

IV. CONCLUSION

Vehicle license plate intelligence recognition system as the core of traffic identification system will play an important role in the future traffic control. This paper studied the vehicle license plate recognition system based on image processing in the intelligent traffic system, proposed a character recognition solution based on neural network perceptron to solve the license plate recognition problem in the real-time traffic flow, and also had some research on the vehicle license plate character recognition algorithm, the test results showed that the system had high anti-interference and robustness.

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