

Intelligent Entrance Guard Control System to Regulate Alternate Two Way Traffic on a Single Track

Juan ZHU*, Jinli WANG, Xiaohui YANG

Electric Information College, Changchun Guanghua University, Changchun, Jilin, 130031, China

Abstract — In this paper we design an intelligent traffic entrance guard system for double direction single track based on car license plate recognition. Two cameras are placed in and out of the two directions to obtain the two-way traffic information. This information is then transmitted to a higher level computer, which analyzes the image in real time to identify the license plate, and a record is made of the time and direction. Control signals are sent to the entrance guard bar and traffic lights to command the vehicle movement. The intelligent entrance guard system provides the control for one way narrow entrance guard. It can also be used in wide entrance guard to change the travel direction of single and 2 way traffic. The system assist managers to regulate the vehicles at the entrance. The system has very wide applicability.

Keywords- entrance guard; license plate recognition; single channel; target recognition

I. INTRODUCTION

With the rapid development of economic in recent years, the entrance guard system is widely used in various kinds of management control system. Common entrance guard systems are: password entrance guard system, non-contact card entrance guard system, biometric entrance guard system, etc., in which non-contact card entrance guard system, RFID entrance guard system and license plate recognition entrance guard system are widely used in the entrance for cars. Non-contact card entrance guard system requires the user to deal with a visa card. The card stores the time the car go in the entrance guard could be used to billing. But in this method the driver need to stop the car and roll down his window and click the card to go in or out every time. The drivers, who have less skill, cannot stop the car in right place every time. They cannot reach the card machine, so they often open the car's door and click the card. This action occupies a certain time, easy to cause traffic jams. RFID access control card solve the problem. But the users need to report a RFID card in a certain place which makes some trouble for the users.

The system based on the car license plate recognition need only to install cameras in the entrance guard. Just like to put on a pair of eyes in entrance guard. The user does not need to park his car in the entrance guard and he also does not need any procedure.

This system has definite advantage. Therefore, the paper chooses the entrance guard system based on license plate recognition. Double direction-double channel entrance guard system has been widely used in community and company of city. When using this system, more time the system is waiting for vehicles. The entrance guard bar is also waiting for opening. It cost large number of energy to control the

entrance guard bar in the horizontal direction. So this paper studies the entrance guard system for double direction single channel based on car license plate recognition.

II. OVERALL DESIGN OF ENTRANCE GUARD SYSTEM

Entrance guard system for double directions and single channel needs to detect vehicles from two directions. Use two cameras to complete the mission. Two cameras send the images to upper computer persistently. The system extracts the vehicles and recognizes the license plate real-timely. There are four important operations in upper computer, license plate position, license plate recognition, and license plate matching and information storage. Control the entrance guard bar and the traffic light to command the vehicle's traffic according the car license plate information. This system also has the function of human- computer interaction. The diagram of this system is shown in figure 1.

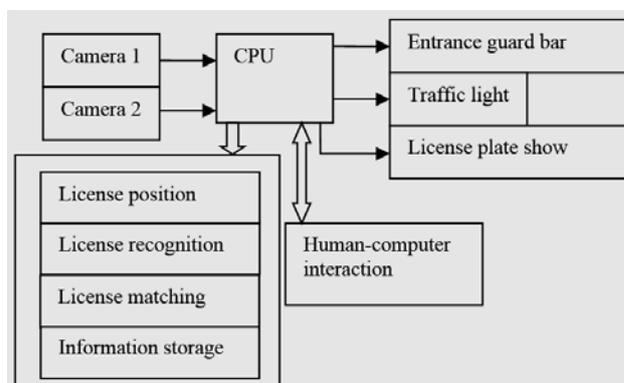


Figure 1. Diagram of the system.

Camera 1 monitors the inside of the gate and camera 2 monitors the outside of the gate. The two cameras should be placed in suitable place. A pair of traffic light consists of one red light and one green light. System could show the license plate on obvious screen.

III. LICENSE PLATE DETECTION

The current aspect ratio of the Chinese GB plate is between 1.5:1 and 3.2:1. The characters are composed of Chinese characters, letters and numbers. The background of car license plate is smooth when the license plate is clean. The characters are clear. Each character has the shape of rectangle. The aspect ratio is about 1:2. However we cannot get the ideal image of license plate because of shooting angle, illumination degree or the license plate wear or other uncertain factors. So we should process the image to detect the license plate. Firstly do some preprocess for the license plate image.

A. Image Preprocessing

When the image has low contrast, we need to enhance the contrast of the image. Suppose the coordinate of a point is (x, y) . The original gray value is $f(x, y)$. The enhanced gray value is $g(x, y)$. We can preprocess the image as equation 1.

$$g(x, y) = \frac{d - c}{b - a} f(x, y) + c \quad (1)$$

This method is called linear stretch. The principle of linear stretch is shown in figure 2.

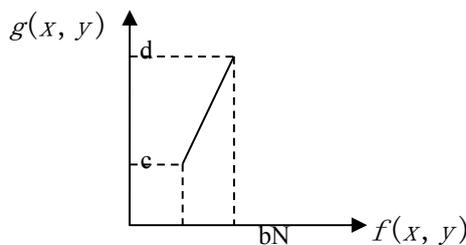


Figure 2. Principle of linear stretch

Here, d and c presents the max and min gray value of enhanced image separately, b and a presents the max and min gray value of original image separately. The renderings are shown in figure 3. Figure 3.(a) is the original image and 3.(b) is the stretch image.



(a)



(b)

Figure 3. Comparison of original image and image after preprocessing

B. License Position

The license plate localization process consists of coarse positioning and precision positioning.

1. Coarse positioning

In coarse positioning stage search the image according to the characteristics of the license plate. Find the boundary point according to the following steps. 1. The point which horizontal jump difference is less than a threshold value is license plate point. Search the coarse top and bottom edge according to the characteristics. 2. Search the coarse left and right edge in the above points. 3. Eliminate the license plate which does not meet the aspect ratio of license plate.

2. Precision positioning

First, the license plate needs to be tilted correction. When the license plate is horizontal, the horizontal projection plate has obvious trough which is formed by the gap of characters and the background. Therefore, get the tilt angle using the horizontal projection and correct the image. The specific process is as follows: Rote the coarse positioning image from -15 degree to 15 degree. Calculate the projection points, mean value and variance for every degree. The maximum variance of the angle is the final rotation angle. Correct the image to horizontal using this angle.

After correction, precision position the edge of the license plate image. Get the percentage of background pixels per line, and the jump difference between the adjacent upper and down. The max change is the top and bottom edge of the license plate. Calculate the horizontal projection between top and bottom. The first projection and last projection are the left and right edge separately. The results are shown in figure 4.



Figure 4. License plate position

C. Character Segmentation and Recognition

According to Chinese standard vehicle license plate, each plate is composed of seven characters, the license plate of the vertical projection should be included in the 6 troughs, each the size of the character owned by a reduced to 35 * 70.

License plate character recognition, the majority of the most simple method of template matching to identify, can be used to get the persisting template matching, character segmentation and match the Battachrayya coefficient value is:

$$\rho(p, q) = \sum_{u=0}^{M-1} \sqrt{p_u q_u} \tag{2}$$

Here q is the target character and p is the model character. u is the grey value. The distance of p and q is :

$$d = \sqrt{1 - \rho} \tag{3}$$

dis Bhattacharyya distance. The match degree of p_u and q_u is :

$$\omega(p_u, q_u) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{d^2}{2\sigma^2}\right) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{1 - \rho[p, q]}{2\sigma^2}\right) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{1 - \sum_{u=1}^M \sqrt{p_u \cdot q_u}}{2\sigma^2}\right) \tag{3}$$

However, template matching method for the similar character matching effect is poorer, such as 8 and B, and D, Q, and 5 S, and Z, 2, 1 and L these similar characters have subtle differences, therefore in the template matching,

matching to the fine matching characters. Search the edge of these characters to find the most similar character as the result.

The results are shown in figure 5.



Figure 5. License plate position

IV. SYSTEM CONTROL

The simplest case is only one direction car is waiting at the entrance guard. In this case, system detects the car license plate, and compares with the license plate with the database of community or company. If the license plate is registered, system will store the license plate, the passage time and travel direction. The manager could easily read the traffic flows. Control the entrance guard bar open and the corresponding traffic light turn to green. Allow the car go through the gate.

If the car is not registered in the district, system gives the query information to manager: could this car go through the gate? If manager's answer is yes, system controls the entrance guard bar open and the corresponding traffic light turn to green. And system will give the other query information: whether to register the license plate? If manager's answer is yes, the database of license plate will be updated. If manager's answer is no, system will do nothing. The flow chart of normal traffic is shown in figure 6.

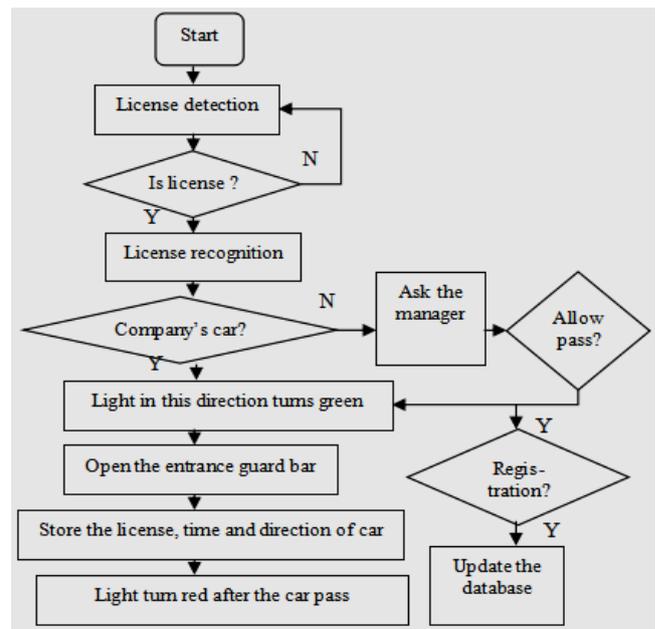


Figure 6. Flow chart for normal traffic.

When cars come to gate at the same time, one wants to go in and the other wants to go out, system should command the traffic. Based on the principle of traffic unobstructed, first come first go, first out second in, design the working process of this system. When two-way car is detected at the same time, the cars in the gate go out first. When there is no car in the gate less than 30s, the cars out of the gate go. When there are cars still at 30s, cars in the gate wait. Cars out of the gate go. Cars alternate go 30s. The flow chart for alternate traffic is shown in figure 7.

The current aspect ratio of the Chinese GB plate is between 1.5:1 and 3.2:1. The characters are composed of Chinese characters, letters and numbers. The background of car license plate is smooth when the license plate is clean. The characters are clear. Each character has the shape of rectangle. The aspect ratio is about 1:2. However we cannot get the ideal image of license plate because of shooting angle, illumination degree or the license plate wear or other uncertain factors. So we should process the image to detect the license plate. Firstly do some preprocess for the license plate image.

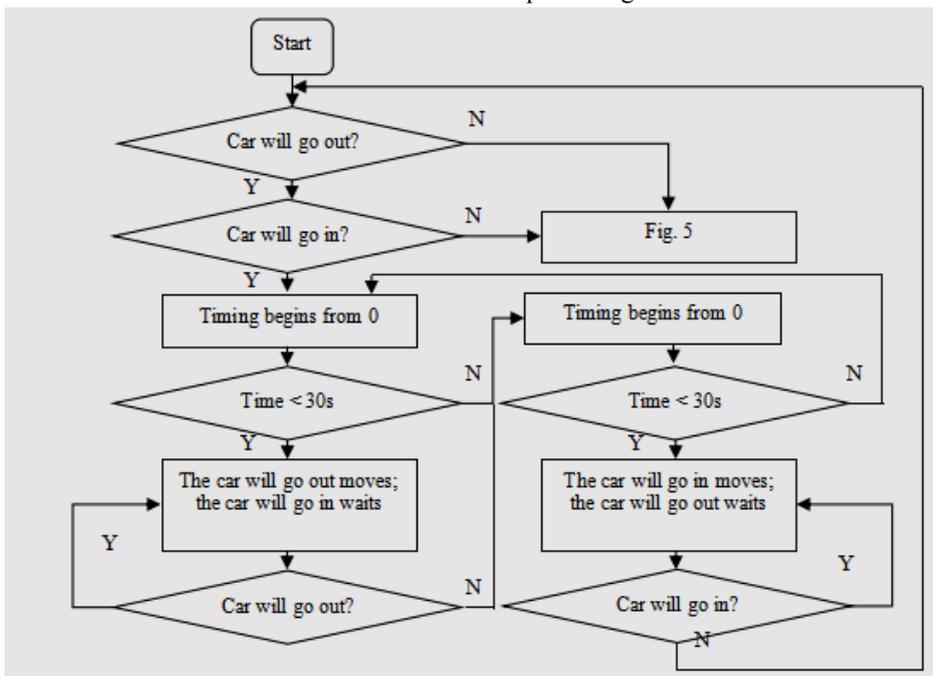


Figure 7. Flow chart for alternate traffic.

V. CONCLUSIONS

Intelligent traffic entrance guard system for double direction single channel based on car license plate recognition is needed for current use. This system can work on narrow gate which has great application value. Also the system could be extended, as one mode of double direction and double channel traffic entrance guard system. When vehicles are not many, system could select the work mode double channel or single channel. This is conducive to the traffic management of the district security.

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