INTEGRATED MULTIPLE LANE FREE FLOW VEHICLE ENFORCEMENT SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates to a multiple lanes free flow vehicle enforcement system, which can be employed by a super highway, a road, a bridge, a toll station and a specific place, so as to be an image enforcement mechanism of vehicle electric toll or just a enforcement mechanism. The present invention also can be combined with a database of VCU/license-plate blacklist for arresting stolen vehicles and false VCU etc.

2. DESCRIPTION OF THE PRIOR ART

In accordance with the traditional image enforcement system, multiple cameras have to be employed at different angles for gathering a complete full view. However, the multiple images gathered by this method have a low correlation thereamong which is uneasy to be compensated. Therefore, in the traditional image enforcement system, if the optical character recognition (OCR) is failed or if the back end matching is failed for the electric toll system, the operator has to find the correlations among lots amount of failed images. Furthermore, because the cameras gather the images at different angles, the operator will has less feeling of continuous space.

SUMMARY OF THE INVENTION

For solving the problem described above, the present invention provides an image registration unit for integrating individual images from multiple cameras at the same time into a single surround image altogether, so that the operator can feel the continuous space

more, and the time spent for analyzing and contrasting can also be simplified when proceeding a manual contrast.

The image enforcement system comprises an image gathering unit, a license plate identifying unit, an image registration unit and a vehicle-model identifying unit. The image gathering unit comprises a front (back) end sensing unit, a front (back) CCD (Charge-Coupled Device) camera, a frame grabber and a DIO card.

The front (back) end sensing unit is responsible for detecting a vehicle which enters a photographing area thereof and then transmits the sensed signal to the frame gabber through the DIO card so as to trigger the front (back) CCD camera to photograph multiple sets of single pictures of front (back) vehicle images, so that the license plate identifying unit can gather a plate number of the vehicle and the image registration unit can integrate the front (back) vehicle images at the same time into a single front (back) surround image altogether for facilitating manual contrasting by the operator.

The image registration unit is operated based on the method combining features and areas, including Visual Feature, Algebra Feature, Statistical Feature and Transform Coefficient Feature.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings disclose an illustrative embodiment of the present invention which serves to exemplify the various advantages and objects hereof, and are as follows:

Fig. 1 is a practical flowchart showing the system framework of the present invention; and

Fig. 2 is a schematic view showing the positions of the CCD cameras in a preferred embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Please refer to Fig. 1 which illustrates the practical flowchart showing the system framework of the present invention:

a. The front (back) end sensing unit is responsible for detecting the vehicle entering the front (back) photographing area;

b. The sensed signal of the vehicle is transmitted to the frame grabber through the DIO card so as to trigger the front (back) CCD camera to photograph multiple sets of single pictures of front (back) vehicle images; and

c. The license plate identifying unit gathers the plate number.

In the method described above, because the image gathering unit is triggered by the front (back) end sensing unit, the image gathering failure due to different speed of the vehicles or a mixture of different sizes of vehicles can all be avoided. Moreover, for avoiding double image gathering one single vehicle so as to cause large amounts of data and the persecution of back end contrasting, the present invention adopts a lock method for solving this problem. So-called lock is that after the front (back) end sensing unit senses the vehicle enters the sensing area and then automatically gathers the images, the image gathering unit will be locked until the front (back) end sensing unit senses that the vehicle is out of the sensing area.

Fig. 2 is a schematic view showing the positions of the CCD cameras for four lanes in a preferred embodiment according to the present invention. As shown in Fig. 2, the up-line front CCD cameras are named as UF 1~5, the up-line back CCD cameras are named as UB 1~5, the down-line front CCD cameras are named as DF 1~5 and the down-line back CCD cameras are named as DB 1~5. Under normal condition, if the up-line vehicle sensing area 1 (3) is triggered, UF2 (UF4) will process the image gathering and if the down-line vehicle sensing area 4 (6) is triggered, DF2 (DF4) will process the image gathering. When the vehicle changes the lane, UF1, UF3 and UF5 will process the image gathering if the up-line vehicle sensing area 2 is triggered, and DF1, DF3 and DF5 will process the image gathering if the down-line vehicle sensing area 5 is triggered. For avoiding the persecution for back end manual contrasting mechanism, if the license plate

identifying program can successful identify the images gathered from UF3 or DF3, UF1 and UF5 or DF1 and DF5 will not be used. Oppositely, if the license plate identifying program cannot successful identify the images gathered from UF3 or DF3, UF1 and UF5 or DF1 and DF5 will automatically process the identification and send the result to the back end manual contrasting mechanism.

Because it may simultaneously present the trucks and the automobiles in the multiple lanes free flow and the license plates of the automobiles might be covered by the trucks, the back end photographing mechanism is proposed for compensation. Namely, when it detects the speed of the vehicle is too slow, the back photographing function will be automatically initiated. In another word, as in a traffic jam, if the up-line vehicle sensing area 1 is triggered, UF2 and UB2 will process the image gathering, if the up-line vehicle sensing area 3 is triggered, UF4 and UB4 will process the image gathering, if the down-line vehicle sensing area 4 is triggered, DF2 and DB2 will process the image gathering, and if the down-line vehicle sensing area 6 is triggered, DF4 and DB4 will process the image gathering. As the vehicle changes the lanes, UF1, UF3, UF5, UB1, UB3, UB5 will process the image gathering if the up-lane vehicle sensing area 2 is triggered and DF1, DF3, DF5, DB1, DB3, DB5 will process the image gathering if the down-lane vehicle sensing area 5 is triggered. For avoiding the persecution for back end manual contrasting mechanism, if the license plate identifying program can successful identify the images gathered from UF 3 or DF 3, UF 1, UF 5, UB 1 and UB 5 or DF 1, DF 5, UB 1 and UB 5 will not be used. Oppositely, if the license plate identifying program cannot successful identify the images gathered from UF 3 or DF 3, UF 1, UF 5, UB 1 and UB 5 or DF 1, DF 5, UB 1 and UB 5 will automatically process the identification and send the result to the back end manual contrasting mechanism.

According to this method, it is similar that the first professional firstly checks if the front images from UF2, UF3, and UF4 or from DF2, DF3, and DF4 are successful ones. If the answer is negative, a second professional will then check whether the front-side images from UF1, UF5 or from DF1, DF5 are successful ones. If the answer is still

negative, a third professional will again check whether the back images from UB2, UB3, UB4 or from DB2, DB3, DB4 are successful ones or not. If the answer is negative, the fourth professional will then check whether the back-side images from UB1, UB5 or from DB1, DB5 are successful ones or not. The final outpost is the manual contrasting operator, the fifth professional. This method which utilizes multiple checking steps can effectively reduce the probability of image gathering failure so as to significantly increase the reliability of electric toll system. Although the amount of gathered image data will be increased, this multi-checking steps method can accelerate the calculation speed of the system. And, the cooperation of the front and the back photographs can effectively solve the problem that the automobiles are covered by the trucks in a traffic jam so as to avoid the image gathering failure due to the too small distance between vehicles which might be a way for the driver to avoid the fine. Because the traditional enforcement system for gathering complete full view has to employ multiple cameras for separately gathering images, if the back end matching is failed, the operator has to find the correlation among lots of images without less feeling of continuous space. The present invention for solving the problem proposes the image registration unit for integrating individual images from multiple cameras at the same time into a single surround image altogether so that the operator can feel the continuous space more and the time spent for analyzing and contrasting can also be simplified when proceeding a manual contrast.

In addition, the present invention utilizes a laser sensor to be a vehicle-model identifying unit. Through the profile information continuously gathered by the laser sensor, the vehicle model can be recognized. If this system is applied in the electric toll system, it can compare the vehicle model judged by the image enforcement system with the vehicle model set by the VCU so that the image enforcement system can directly write a ticket if the comparing result is different.

The present invention, when being compared with the other prior arts, further includes the advantages as follows:

(1) This present invention which utilizes multiple checking steps can effectively

reduce the probability of image gathering failure so as to significantly increase the reliability of electric toll system. Although the amount of gathered image data will be increased, this multi-checking steps method can accelerate the calculation speed of the system.

(2) The present invention employs the lock mechanism which can effectively prevent from double charge and double imaging so as to reduce the loadings of the back end automatic and manual contrasting mechanism.

(3) The cooperation of the front and the back photographs can effectively solve the problem that the automobiles are covered by the trucks in a traffic jam so as to avoid the image gathering failure due to the too small distance between vehicles which might be a way for the driver to avoid the fine.

(4) Even the vehicle passes through the toll lane communication area in a high speed (up to 250 Km/hr), the present invention still can correctly complete the transactions between the automatic chargeback and the image enforcement system so as to achieve the function of automatically charging.

(5) The present invention employs the image registration unit for integrating individual images from multiple cameras at the same time into a single surround image altogether so that the operator can feel the continuous space more and the time spent for analyzing and contrasting can also be simplified when proceeding a manual contrast.

(6) The present invention utilizes a laser sensor to be a vehicle-model identifying unit. Through the profile information continuously gathered by the laser sensor, the vehicle model can be recognized. If this system is applied in the electric toll system, it can compare the vehicle model judged by the image enforcement system with the vehicle model set by the VCU so that the image enforcement system can directly write a ticket if the comparing result is different.

Many changes and modifications in the above described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, to promote the progress in science and the useful arts, the invention is

disclosed and is intended to be limited only by the scope of the appended claims.

What is claimed is:

1. An integrated multiple lane free flow vehicle enforcement system, comprising:

an image gathering unit;

a license plate identifying unit;

an image registration unit; and

a vehicle-model identifying unit.

2. The integrated multiple lane free flow vehicle enforcement system according to claim 1 wherein said image gathering unit comprises a front (back) end sensing unit, a front (back) CCD camera, a frame grabber and a DIO card.

3. The integrated multiple lane free flow vehicle enforcement system according to claim 2 wherein said front (back) end sensing unit is responsible for detecting a vehicle which enters a photographing area thereof and then transmits the sensed signal to said frame gabber through said DIO card so as to trigger said front (back) CCD camera to photograph multiple sets of single pictures of front (back) vehicle images so that said license plate identifying unit gathers a plate number of said vehicle and said image registration unit integrates said front (back) vehicle images at the same time into a single front (back) surround image altogether, and when proceeding a manual contrast, the operator can feel the continuous space so as to simplify the time spent for analyzing and contrasting.

4. The integrated multiple lane free flow vehicle enforcement system according to claim 1 wherein said image registration judges the positions for connecting said images based on a similarity among calculated gray-levels.

5. The integrated multiple lane free flow vehicle enforcement system according to claim 1 wherein said image registration judges the positions for connecting said

images based on a similarity among calculated features.

6. The integrated multiple lane free flow vehicle enforcement system according to claim 5 wherein said features is one selected from a group consisting of an edge point, a block gray-level mean and a block gray-level standard deviation.