2012 International Conference on Mechanical Engineering and Automation
Advances in Biomedical Engineering, Vol.10

Real Time and Automatic Vehicle Type Recognition System Design and Its Application

Wei Zhan[1], Junkai Yang[2,a]

[1]College of Computer Science Yangtze University Jingzhou, Hubei, China

Zhanwei814@gmail.com

[2]International School Beijing University of Posts and Telecommunications

Beijing, China

[a]yangjunkai91@gmail.com

Keywords: Image Processing; Image Recognition; Vehicle Type Recognition;

Abstract. Via a fixed camera, real time video including moving vehicles of a highway toll station is be collected, with technology of digital image processing and recognition, all frames include vehicle image can be detected automatically from the video, and vehicle type will be recognized automatically too. The system includes four modules: reading video and decomposing it into frames; moving vehicle detection; vehicle image processing and vehicle type recognition from image. Tests show that the system design is simple and effective. Vehicle image processing algorithm in the system is simpler than that of references and vehicle type recognition algorithm through counting black pixels number including in vehicle body contour is a new idea.

1. Introduction

Moving object recognition is an important branch in research on computer vision, the goal of vehicle recognition is to separate moving object from background and recognition. With rapid development of digital image processing and recognition technology, vehicle type recognition system [1]-[4] has become an important part of Intelligent Transportation System [5][6]. In recent references, there are a great many research on vehicle type recognition based on video, the primary method[7]-[9] of vehicle type recognition are: radio wave or infrared contour scanning, radar detection, vehicle weight, annular coil[10][11] and laser sensor measurement. Because vehicle type recognition result can be used in road traffic monitoring, vehicle type classification, automatic license plate recognition, so vehicle type recognition based on video is a hot research direction. In this paper, a real time vehicle type recognition system is designed for moving vehicle detection and recognition automatically from video.

2. System Architecture

The goal of system design includes vehicle type recognition automatically, traffic flow statistics and charge statistics. As Figure 1 shown, this system consists of four main modules: reading video capture card and decomposing video into digital image frames; moving vehicles detection; vehicle digital image processing module and vehicle type classification module. Video signal collected by camera is be digitized by video capture card, at the same time, real time video is be displayed on screen and digital image frames decomposed by system is be stored into memory for further processing.

978-1-61275-028-6/10/$25.00 ©2012 IERI

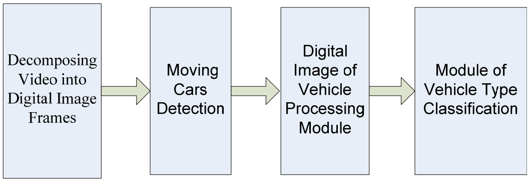

Figure 1 System Architecture

3. Detailed SystemDesign

3.1 Reading Video Capture Card and Decomposing Video into Frames

Program interface of video capture card is be packaged in a named DSStream.h head file, through this Software Development Kit(SDK) of video capture card, attribute of video collected by camera can be controlled, such as the following attribute: video input port, video standard, video file ratio of image frame, video file format, and so on. It is particularly worth mentioning is that current image frame's Device-Independent Bitmaps(DIB)[12] data of real time video can be get through SDK interface function DSStream_GetCurrentDiB include in DSStream.h head file, so a video file can be decomposed into one by one digital image frames, that is so called decomposing video into frames[13] which prepares for moving detection algorithm.

3.2 Moving Vehicle Detection Algorithm

For finding cars in video, the first step is moving vehicle detection [14], so a certain selected area in image should be compared with corresponding area of current AVI image frame, through comparing pixels' changing result in the detection area, passing vehicle can be find, the area is so called monitoring area which setting will directly influence the following image processing algorithm. In this system, a rectangular detection area is being selected. Fig.2 shows a sample how to select rectangular detection area, on the left, an black rectangular is the detection area, on the right there are three little rectangular image: the top is image cut in detection area, the middle is the background , the bottom is pixels' changing image in detection area. After computing, if pixels' changing ratio in detection area exceeds the threshold value, system thinks there is a car in detection area, at the same time, current vehicle image will be stored and be input into module of digital image processing.

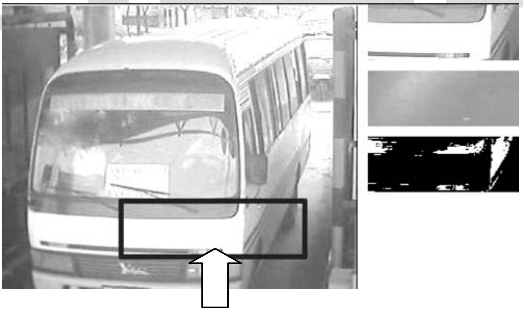

Figure 2 Rectangular Detection Area

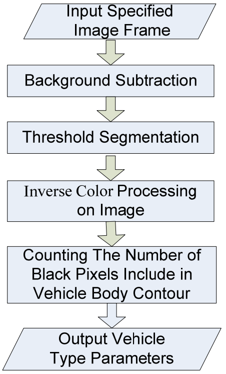

Figure 3 Processing Flow of Vehicle Digital Image

In the system, background is being selected manually and statically: that is when system is not on running and there is no vehicle passing in the rectangular detection, a statically image is being selected as background template.

How to judge weather a car in or out of the detection area: a threshold value is be set when system initializes, such as 5% or 10%, if change ratio in detection area of the image be is more than this threshold value, system thinks there is a moving car in detection area, otherwise, there is no vehicle.

3.3 Module of Vehicle Image Processing

As Figure 3 shows, it is vehicle image processing algorithm flow:

Background subtraction [7]: Figure 4 is image needed processing, Figure 5 is background and Figure 6 shows subtraction result of Figure 4 and Figure 5.

Algorithm of Threshold segmentation is consisting of two steps: first is calculating global optimal threshold, second is calculating binarization image through global optimum threshold value.

(1) Calculating global optimal threshold: RGB Data of every pixel is be read out in order to calculating global optimal threshold using global optimal threshold algorithm.

(2) Calculating binarization image: Using value of global optimal threshold, binarization image is be calculated out, as follows:

$$g(x,y)\begin{cases}0, & |d(x,y)|< Threshold \\ 255, & |d(x,y)|> Threshold\end{cases} \tag{1}$$

where $g(x,y)$ is binarization image, threshold is a global optimal numerical value. Figure 7 shows threshold segmentation image.

Experiment shows that inverse color processing on image can get better intermediate results, popular speaking, anti-color processing is that black and white pixels is be reversed on binarization image. After this process, vehicle body contour image will be get, as Figure 8 shows.

Figure 4 Car Image

Figure 5 Background

Figure 6 Image after Subtraction with Background

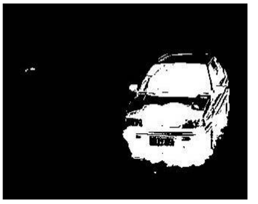

Figure 7 Image after Threshold Segmentation

Figure 8 Image after Inverse Color

3.4 Module of Vehicle Type Recognition

Vehicle type characteristic data and vehicle type recognition algorithm[1] will influence recognition accuracy, common vehicle type classification algorithm are: vehicle recognition based on neural network, models based on support vector machine identification, genetic algorithm based on wavelet decomposition and genetic algorithm (GA). Algorithm mentioned above are complex, but in this paper, a simple and effective algorithm of extracting vehicle type parameters is be designed, that is by counting number of black pixels include in vehicle body contour.

Repeated experiments show that for the car image after inverse color, the bigger car the more black pixels include in vehicle body contour, so the black pixels' total number include in vehicle body contour is be analyzed as vehicle type characteristic data. Figure 9 shows vehicle classification algorithm which includes two parts: algorithm of extracting vehicle type characteristic data and algorithm of vehicle type classification.

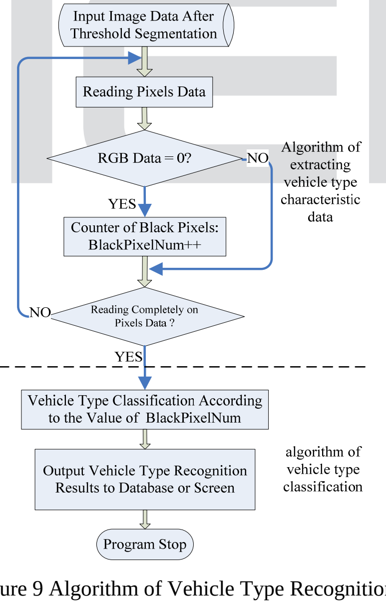

Figure 9 Algorithm of Vehicle Type Recognition

4. System Test

4.1 Test on Non-motor Vehicle

Figure 10 shows when one person goes into monitor area, system has not recognized the person as a car, system flag of vehicle in and out has not change, which shows that setting of the rectangular image detection region and the threshold segmentation value are reasonable and effective

4.2 System Test on Cars Fleet

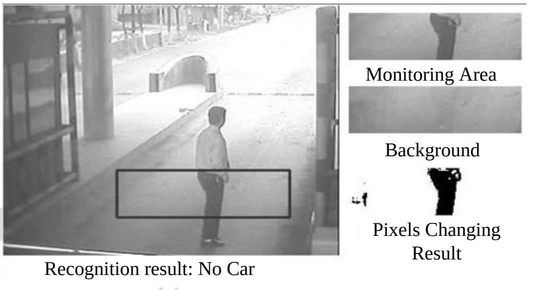

Figure 10 Test on Non-motor Vehicle

As shows in Figure 11, there is a cars fleet, system has not response timely, cars in fleet has not be separated timely by system which leads to recognition error. More effective algorithm need be designed to solve this difficult recognition problem, at the same time, it is a key question in the future research.

5. Conclusions

Vehicle type recognition technology can be widely used in statistics of traffic and toll automatic. The system design is simple and effective, algorithm of vehicle image processing is simpler than that of references, there are only 3 steps: first is background image subtraction, second is threshold segmentation, the last is inverse color processing on image, large number of experiments show that the algorithm of vehicle image processing in this system is simply to achieve. Especially to say compared with complex vehicle type recognition algorithm mentioned in references, algorithm of counting the number of black vehicle image processing in this system is simply to achieve. Especially to say, compared with complex vehicle type recognition algorithm mentioned in references, algorithm of counting the number of black pixels included in vehicle body contour is new approach. But through system test on real AVI files, we find two points need improvement: a dynamic background model estimation algorithm will be add into the system in order to detach moving cars out of background more precisely; another is that a shadow detection and elimination algorithm will be add in the system in the future work.

References

[1] Wei Zhan. Research of Vehicle Recognition System for the Road Toll Station Based on AVI Video Flow, China University of Geosciences, 2006.

[2] Wei Zhan, Zhiqing Luo, Research of Vehicle Type Recognition System Based on Audio Video Interleaved Flow for Toll Station. Journal of Computer, in pressing.

[3] Wei Zhan, ZhiQing Luo. System Design of Real Time Vehicle Type Recognition Based on Video for Windows (AVI) Files. 2011 International Conference on Intelligent Computing and Information Science(ICICIS 2011), Chongqing, China 2011.

[4] Wei Zhan. Moving Object Detection from Video with Optical Flow Computation. INFORMATIONAN-AN INTERNATIONAL INTERDISCIPLINARY JOURNAL, in pressing.

[5] BaoJui Tian. Research on Automatic Vehicle Recognition Technology in Intelligent Transportation system, XiDian University, pp.23-26,2008.

[6] WeiCai XIA. Video-Based Vehicle Classification Method Research, HuaZhong University of Science & Technology, pp.1-2,7,16,24-29, 2007.

[7] Rafael C. Gonzalez. Digital Image Processing (Second Edition) .Publishing House of Electronics Industry, 2005.

[8] ChenGuang Ji. Vehicle Type Recognition Based on Video Sequences, Journal of LiaoNing University of Technology(Natural Science Edition), Vol.30,pp.5-7, 2006.

[9] Zhijin CAO. Vehicle Detection and Classification Based on Video Sequence, ZheJiang University,pp.20-46, 2004.

[10] ZhijJin CAO, HuiMing TANG. vehicle Type Recognition in Video, Computer Engineering and Applications, pp.24,226-228, 2004.

[11] ShiYi XIONG. Research of Automobile classifying method based on Inductive Loop, ChangSha University of Science and Technology, pp,2-5, 2009.

[12] YongLong Xiao.Fast Decomposition of Avi Data Stream by Using Functions in VFW Library. Journal of Information Engineering University, pp.2-3, 2002.

[13] Rui Lang. Digital Image Processing with Visual C++, BeiJing Hope Electronic Press, 2003.

[14] ZhiJin CAO, HuiMing TANG. Vehicle Detection, Tracking and Classification in Video Image Sequences, Journal of Computer Applications:pp.3,7-9, 2004.

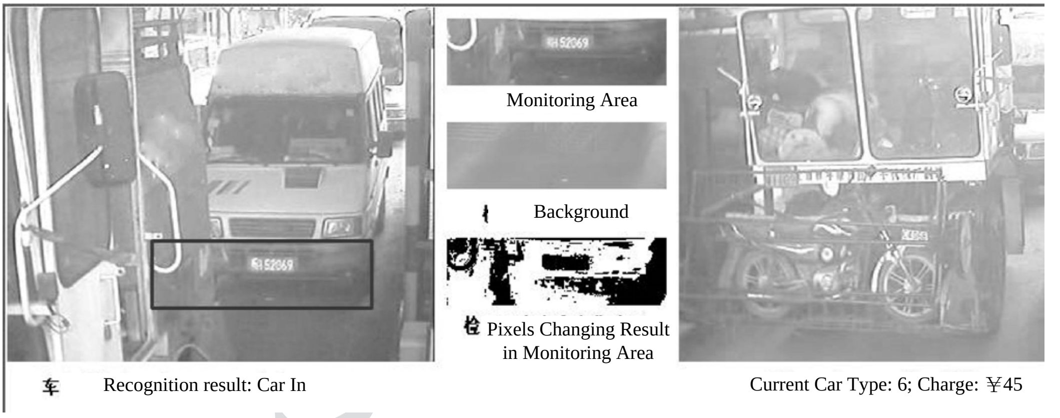

Figure 11 System Test on Cars Fleet