Smart Surveillance For CCTV Traffic Information Using Big Data Analytics

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ABSTRACT- *Design the framework to analyze the digital data set in the form of video. Using image processing technique to convert video into frames. Predict feature vectors and estimate the motion. Based on these vectors, predict the speed of the vehicle. In this paper we propose a new method for automatically calculating traffic occurred places, and to find the speed of the vehicles, volume of the vehicles. That are calculated based on Background Subtraction, Motion Estimation, vehicle detection techniques using HSV data's to predict it.*

Keywords—Data set, motion, feature vectors, Background subtraction;

I. INTRODUCTION

Video Image Detection Systems (VIDSs) and CCTVs are used for traffic monitoring. The VIDS researched so far are used for vehicle detection, traffic volume and vehicle speed measurement, and so on. However, VIDS has some limitations. First, cameras are installed at a fixed angle, and hence only few vehicles are detected in limited area. As a result, a camera cannot be used flexibly. Second, because the area is limited, it impossible to check the traffic status beyond the area. On the contrary, CCTV overcomes these limitations. CCTV can detect vehicles in wider areas because it has spinning function. Further, it can detect situations beyond a particular area, enabling possible traffic monitoring and collecting information. Moreover, CCTV has advantage on the cost side when compared to the VIDS. Therefore, here we are using CCTVs instead of the VIDS.

We propose a method to calculate traffic volume and vehicle speed after vehicle detection. First, we set up detecting lines with sixteen points. Second, we extract and save pixel data from each frame of the points. Then, vehicles are detected according to the pattern change of the Value (Brightness) in pixel data. Subsequently, after vehicle detection is complete, and then the traffic volume and vehicle speed is calculated.

This paper consists of five chapters. Chapter II introduces review of the previous studies, and Chapter III introduces the analysis data and analysis process that were used in this study. Next, Chapter IV presents the results of the analysis and test. Finally, Chapter V concludes the study.

II. REVIEW OF PREVIOUS STUDIES

There are various works related to this study for analyzing traffic data using CCTV image data. W.C Lee proposed a method to estimate space occupancy from CCTV videos as a qualitative measure of monitoring traffic condition. Thus, through video image processing, he presented a method to estimate space occupancy by detecting a moving vehicle[1].

G.S Hong et al. developed a vision- based monitoring system for traffic analysis and surveillance. They proposed a method to obtain a video in real-time from CCTV installed at an intersection or on road. They further extracted various color and geometrics, and distinguished between vehicle types using the direction of vehicle movement. A result of traffic volume showed high detection rate (90.1%)[2].

W.C Lee studied a real-time background generation and update method for vehicle detection using online CCTV video. He tried to detect a rapidly moving vehicle, which was exactly suitable to real-time scenarios. Additionally, he studied increasing efficiency and reliability when a vehicle detection considering advantage of temporal difference method and background subtract method as a background update method[3].

Yang Wang presented a method for real- time moving vehicle detection through cast shadow removal based on conditional random field. The result of experiment effectively fuses contextual dependencies and robustly detects moving vehicles under heavy shadows even in gray scale video[4].

Amol Ambardekar et al. proposed a new traffic surveillance system that works without prior, explicit camera calibration, and has the ability to perform surveillance task in real-time. In this paper, the vehicle classification uses two new techniques: color contour-based matching and gradient- based matching. Their experiments on several real traffic video sequences demonstrate good results for their foreground object detection, tracking, vehicle detection, and vehicle speed estimation approaches[5].

However, because these researches need to process all pixels of CCTV images for vehicle detection, it increases image processing time. Therefore, an effective method is needed for vehicle detection in order to decrease the processing time.

III. DATA AND ANALYSIS METHODOLOGY

We describe the video data and calculation method for traffic volume and vehicle speed in this section. The temporal scope is approximately 9 min of the approximately 1 h and approximately 2 min 30 s of approximately 4 h. The spatial scope is the road near the Hoedong- jeolgaeji and Yet-sicheong in Busan.

A. CCTV Video Data

The CCTV video data are provided from BUSAN METRO PORITAN CITY, at thirty frames per second. For analysis of the pattern change, we extract pixel data from the video. The extracted data consists of x- and y-coordinates, Hue, Saturation, and Brightness(Value) (HSB or HSV), as shown in TABLE I.

TABLE I. Example of extracted HSV data

X	Y	Hue	Saturation	Value
0	0		19	92
0	1	3	20	91

B. *Line Selection*

We select lines on a lane for vehicle detection. After we select vertical and horizontal lines like red lines in Figure 1, we extract the HSV data from contact points of the lines. Here, we use only the data value as shown in Figure 2 (c), because there is no pattern change in hue and saturation when a vehicle passes the lines in Figure 2 (a) and (b).

C. Vehicle Detection

If a vehicle enters a particular line, it is detected, and the data is checked for the pattern until a vehicle escapes last line. The check process is as follow.□Similarity of average of Value when a vehicle passed. □The number of frames changed when a vehicle passes.

First, a contact point is compared by using two conditions. Then, if one of them is satisfied, we judge the same vehicle. For example, if a vehicle enter the Line1 as returned (line 8-15 Algorithm 1). The method for calculating traffic volume is as follows. If step is C completed, then increase the traffic volume.

Algorithm 1. Compare between points of contact

shown in Figure 3, then compare A of Line1 with A of Line2. After that, if both conditions are satisfied, then we compare the next contact point in B-B, C-C, and D- D order. If all If all contact points satisfy the two conditions, then we compare all contact points of Line2 with Line3. Finally, we check whether it is the same vehicle by comparing all contact points of Line3 with

Input: *FST_PL, SEC_PL*

Output: *CR* // *FST_PL* is the Value data list of first point

and *SEC_PL* is the Value data list of

second point

// the result of compare points of contact based on the Value change

Line4.Fig. 3. A method of the vehicle dection

Further, if lines and points of the contact extend as shown in Figure 4, it is possible to detect vehicles that turn right and left on the intersection. This requires a method that can process large amount of data.

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Fig. 4. Example of lines and points of contact on the intersection

D. Algorithm for the Compare between Points of Contact

The input data are the value data list of the first and second points in the process. The first procedure compares the similarity of the average value when a vehicle passed between the points of contact (line 5 of Algorithm 1). The second procedure compares the number of frames changed when a vehicle passes between the points of contact (line 6 of Algorithm 1). The third procedure compares the number of up and down inflection points as a value of when a vehicle does not pass between the points of contact (line 7 of Algorithm 1). Finally, after checking whether one of the three element satisfy the condition, the result of comparison between the points of contact is

1*compare_result*=FALSE; 2*similar_result*=FALSE; 3*frameCount_reuslt*=FALSE;
4*updownCount_result*=FALSE;

5*similar_result* = compareSimilarValue(*FST_PL*, *SEC_PL*);
6*frameCount_result* = compareFrameCount(*FST_PL*, *SEC_PL*);
7*updown_result* = compareUpDownCount(*FST_PL*, *SEC_PL*); 8**if** similar_result is TRUE **then**
9*compare_result* = TRUE;
10**else if** frameCount is TRUE **then**
11*compare_result* = TRUE;
12**else if** upDownCount is TRUE **then**
13*compare_result* = TRUE; 14**end if**
15*CR* = *compare_result;*
16**return** *CR*

E. Vehicle Speed Measurement

The vehicle speed, which is denoted by equation (1), is as follows. The parameter S represents the distance from entering first Line*i* to last Line*i*. The distance was referred to standard of lanes[6], and the distance rate per pixel was calculated for lane in image. After that, it calculated the distance between Line*i* and Line*j*. Further, the parameter S represents the number of frames that changed when a vehicle passed. Finally, the vehicle speed is calculated as per equation (1).

IV. ANALYSIS RESULTS

We calculated traffic volume and vehicle speed based on a method of analysis. The target is the urban highway and the road on the city. The result of the traffic volume verified by comparing the actual calculated result with the result calculated after observing through the naked eye of the CCTV video and vehicle speed were verified using vehicle speed information of NAVER Map Web page in Korea.

A. Analysis of the Result on the urban highway

Figure 5-(a) shows the results for 9 min, which detected 43 vehicles of the total 48 vehicles. The five missed vehicles cannot be detected because Values of the front and back in a container truck are different.

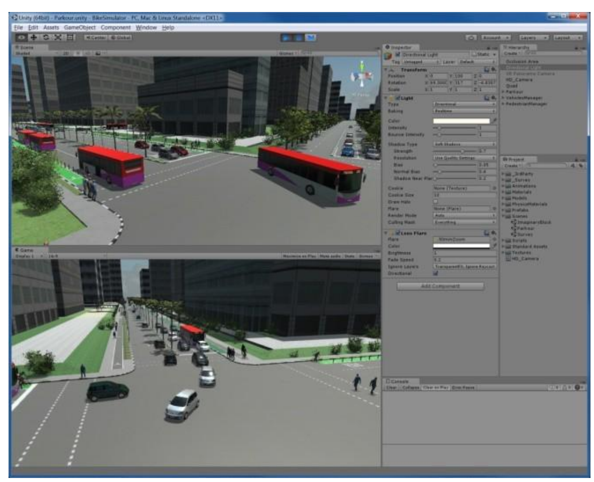
Figure 6-(a) shows the result of vehicles speed when the time scope is 9 min. Although it could not check the speed information in the past, the vehicle's average speed showed approximately 65 km/h ~ 75 km/h on average in the case of urban highways which corresponded with the experimental data. The result of the vehicular speed we calculated approximately
69.15 km/h showed similarities in comparison with the real vehicle's average speed.

B. Analysis of the Result on the Road of the City

The result of the Figure 5-(b) shows it detected all ten vehicles except the vehicles entering different lanes.

Figure 6-(b) shows the result of the vehicular speed for the road of the city. The vehicle's average speed of this road showed 35 km/h ~ 45 km/h which corresponded ith the experimental data, and the result about 44.14 km/h showed similarities in comparison with the real vehicle's average speed.

(a)The result on the road of the city Fig. 6. The result of vehicle's speed



V. CONCLUSION

We propose a method to compute traffic volume and vehicle speed on image pattern graph in this paper. First, we select lines to recognize vehicles in a lane. We then extract their pixel data from each image frame and save them. Because there are pattern changes of Value in pixel data, we know that the vehicles pass the lane. Experimental results show that our method has a high accuracy, which is more than 85%. In future work, we hope to enhance the reliability of the detected data by considering traffic conditions of each line. Further, we will try to detect vehicles in images of any locations.

VI. ACKNOWLEDGEMENT

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