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Vehicle Traffic Control System Using Depth Image

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ABSTRACT:- *In this paper, we propose the method of getting the traffic information using the depth camera. We install the depth camera where it can capture passing vehicles on the crossroad and obtain the volume of the traffic using the difference depth value of the vehicle and the road. We also obtain the velocity of the vehicle to trace the vehicle object in the depth image. Using this method, the traffic flow is more improved than using the existing fixed-time traffic signal system. We expect that city-combination traffic signal system can be constructed using proposed method.*

Keywords:- *Traffic flow, Traffic signal system, Depth camera, Depth Information*

I. INTRODUCTION

Recently, transportation losses cost had been increased due to the increase traffic jam as per rapid increase of vehicle. This transportation losses cost can make lower to establish a rational traffic signal system according to the vehicle flow. Currently, the most used traffic signal system is fixed-time control method, which doesn't consider the vehicle flows. Therefore, the method of check for vehicle traffic in real time and provision of the traffic signal according the vehicle traffic is required [1,2,3].

Traditional methods of check for vehicle traffic are 1) that a person directly check for it; 2) to check directly or to use image processing for the CCTV video. However, the method of checking directly is required extra staff. The method of image processing using CCTV, the color image, is affected by light or similar colors so it is difficult to obtain correct vehicle objects. In this paper, we propose the method of check vehicle traffic using depth image, which isn't affected by light or similar colors. We put up depth cameras where is can capture passing vehicles on each road in a crossroad and capture the depth image of passing vehicles. We can obtain the volume of vehicle traffic and speed of passing vehicles on the crossroad. The traffic flow can improve to using the obtained information of passing vehicles on crossroad to use proposed method.

II. IMPLEMENTATION OF THE VEHICLE TRAFFIC CONTROL SYSTEM USING DEPTH CAMERA

It put up depth cameras where it can capture passing vehicles on each road in a crossroad. At this time, the depth cameras put up on each road in the crossroad to capture all passing vehicles on the crossroad. Fig. 1 shows the example of installing depth cameras.

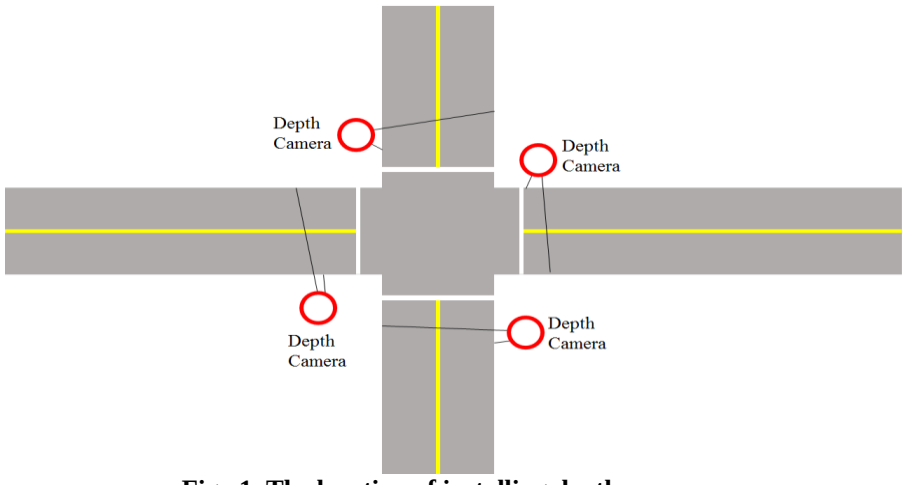
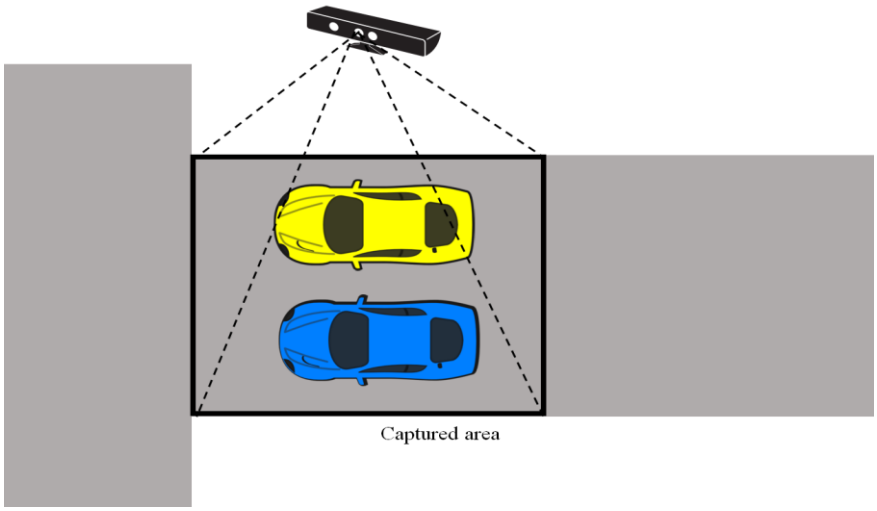
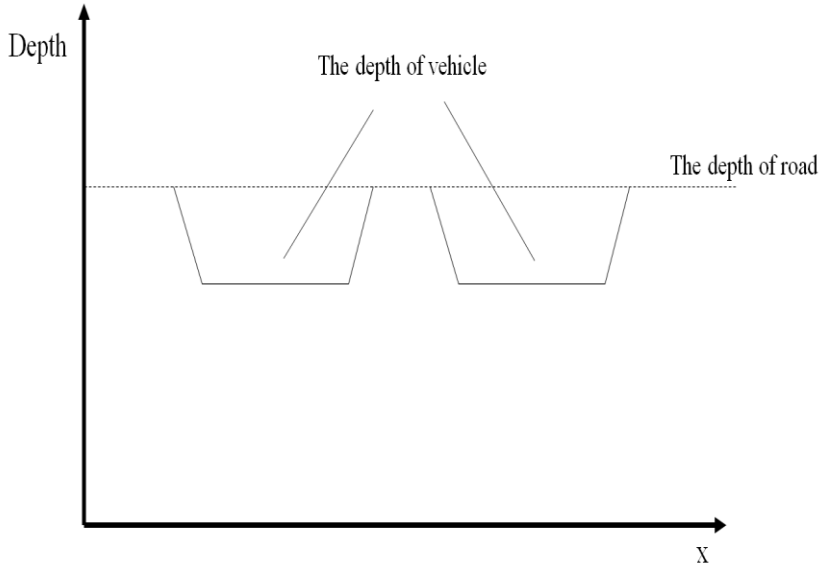


Fig. 1. The location of installing depth cameras.

After that, the road and passing vehicles may be captured by the depth camera like Fig. 2. When the depth camera capture the road and passing vehicles like Fig. 2 (a), the depth information of these is represented as Fig. 2 (b). In Fig. 2 (b), it has a noticeable difference between the depth information of the road and the depth information of the vehicle. The depth camera is installed where it is parallel to the road in Fig. 2. However, we can also distinguish the depth of the vehicle from the depth of the road when the depth camera is installed on any position. Thus, we can get the number of the passing vehicles to use difference in this depth information and to process a binarization and a labeling.



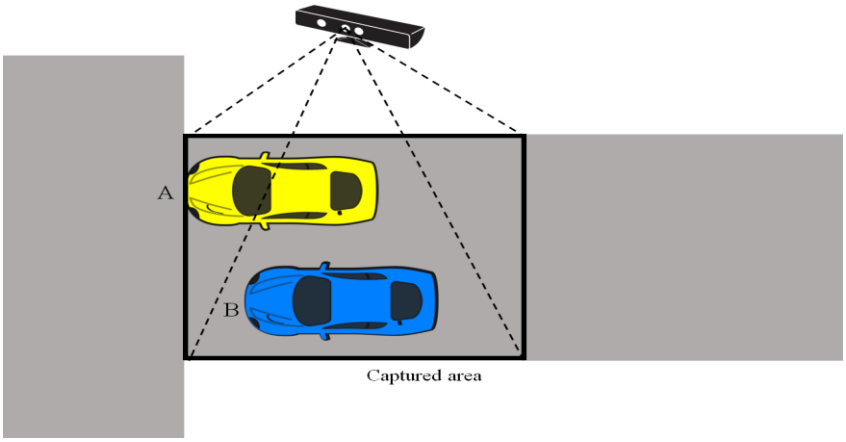
(a)



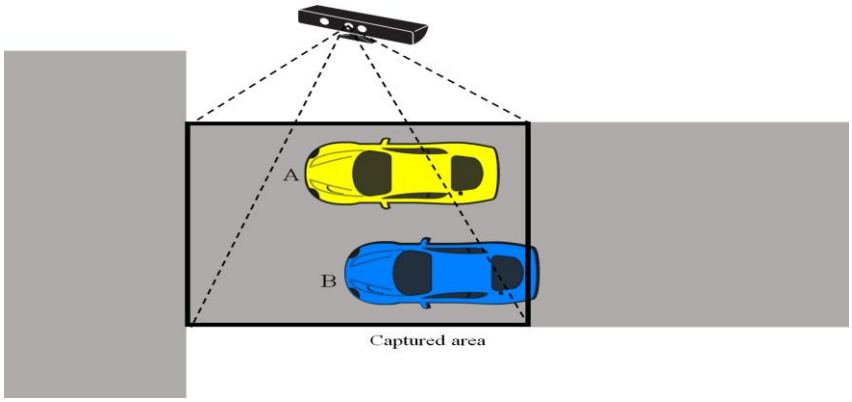
(b)

Fig. 2. The getting of depth information of the vehicle.
(a) Capturing the depth image of the road and vehicles.
(b) The depth information of the captured depth image on one Y-axis.

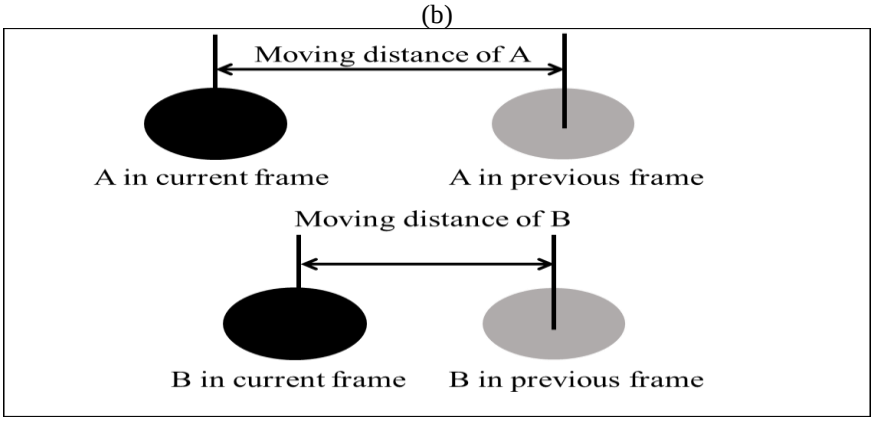
It can be measured the velocity of each vehicle to trace the vehicle object in interframe of depth image. It can get the actual distance of the vehicle moving distance by using the depth information and the location of the vehicle object in the depth image. Fig. 3 shows getting the moving distance to trace the vehicle object in depth image frames. When Fig. 3 (a) and (b) is captured sequentially, it can get the moving distance of each vehicle object as Fig. 3 (c). Thus, we can calculate the vehicle velocity to use this distance and the frame rate of the depth camera.



(a)



(b)



(c)

Fig. 3. Measurement the vehicle velocity using the depth camera.
(a) Captured previous frame. (b) Captured current frame.
(c) The vehicle objects in the depth image with a current frame and a previous frame.

We can get the traffic information of this crossroad with the volume of traffic vehicles and the velocity of each vehicle. Thus, it can make the traffic flow smooth to flexibly control the traffic signal using obtained traffic information.

III. SIMULATION RESULTS

We simulate the efficiency of the traffic flow control using the proposed method in this paper. At this time, we compare the efficiency of proposed method and the existing fixed-time signal control method. In our simulation, we suppose the crossroad is as Fig. 4. We also suppose that only one road in this crossroad get passing permission at a time and the passing rate on the road is 1 vehicle per second. The crossroad using the fixed-time signal control method is supposed that each road is permitted passing 25 seconds per minute. The

proposed method is supposed that the passing permission is distributed as the volume of vehicle traffic in each road in the crossroad. In this simulation, the vehicle traffics used the simulation is represented as Table 1.

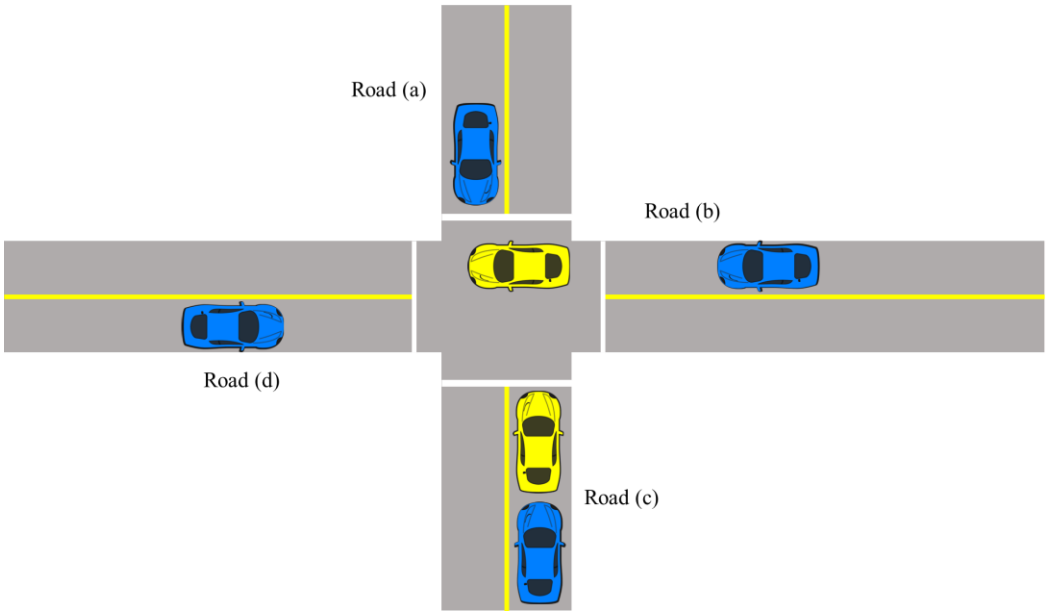


Fig. 4. The crossroad used the simulation.

Table 1. The vehicle traffics used the simulation.

Road	The input vehicle traffics to the crossroad per a minute			
	Simulation 1	Simulation 2	Simulation 3	Simulation 4
a	25	30	40	70
b	25	30	10	10
c	25	30	40	10
d	25	10	10	10

.

The result of the simulation is represented as Table 2. In this simulation, the efficiency of the traffic flow control is better if there is more passing vehicle. In fixed-time signal control method, the volume of passing vehicles is more than the volume of input vehicles on the crossroad when the traffic is not in the uniform distribution in each road. Thus, may cause traffic jam. On the other hand, all vehicles can pass the crossroad in the proposed method. Although the real-world traffic is tidal so the efficiency of the proposed method is not correct in real-world, we assume that the efficiency of the traffic flow using the proposed method will be better than the existing signal control system.

Table 2. The simulation result.

Simulation No.	The input vehicle traffics to the crossroad per a minute	
	The fixed-time method	The proposed method
1	100	100
2	85	100
3	60	100
4	55	100

IV. CONCLUSION

In this paper, we propose the method of getting the traffic information using the depth camera and controlling the traffic signal using this information. We also prove that the traffic flow can be improved by the proposed method as the simulation. If the accurate measurement of the traffic information using proposed method with the depth camera is possible, the multi-directional traffic flow in a crossroad can be controllable at real-time. If the traffic signal system is controllable, then the connected traffic signal system can also be controllable complexly thus we expect that city-combination traffic signal system can be constructed.

ACKNOWLEDGEMENTS

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