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Managing ROI of EHMI for efficient vehicle detection on embedded system

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***Abstract*— This paper proposes a method of managing the region of interest (ROI) of the Equi-Height Mosaicking Image (EHMI) to detect vehicles with embedded systems. According to the forward vehicles status on the road, the ROI is managed for consistent performance. The proposed approach shows efficient computing performance on embedded systems without much loss of detection performance..**

Keywords—Vehicle Detection, Embedded system, GPU

I. INTRODUCTION

Recently, according to the statistical results of domestic traffic accident analysis system, traffic accident frequency is growing high in the last five years even in clear days. Also, accident frequency between the vehicle and the pedestrian is very high in number. Active research is being carried out in the computer vision field for driver's and pedestrian's safety around the world. Research on obstacle detection and tracking is one of the important technical elements of autonomous vehicles. It has been developed by domestic and foreign vehicle manufacturers. In addition, they have made real-time embedded system in order to protect the drivers and pedestrians. Section II explains related works of the vehicle detection. Section III explains an overview of the proposed system. Section IV gives detailed description of the proposed system. Section V and VI show the experimental results and give the summary with future work.

II. RELATED WORK

Grabowski[1], Moutakki[2], Toral[3] and Ying Che Kuo[4] studies show that they have developed a traffic analysis system for controlling the congested traffic. They have used the camera on the bridge in order to detect a large number of the vehicle. In addition, they have developed traffic analysis in real time on the embedded system. Toral and Ying Che Kuo detected only the regions of cars that pass on the road for efficient frame rate detection by low computing power system. As a result, the frame rate for vehicle detection was improved by the proposed method. However, they cannot detect vehicles outside the region of interest. This paper proposes a method of managing ROI detection for improving frame rate of vehicle detection and tracking using geometric information of road on the embedded system.

III. SYSTEM OVERVIEW

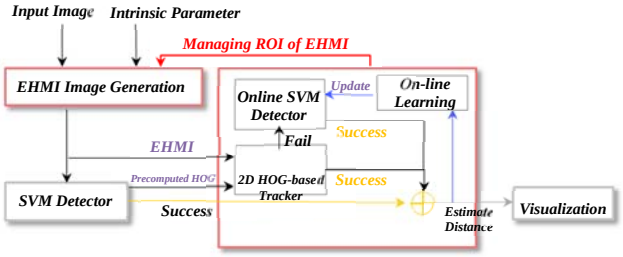

Figure 1: System overview

In proposed system image is captured from the driving vehicle on the flat road. The system has a camera mounted on top of the experimental vehicle to capture the frontal images. The captured images are used to correct the distortion and analysis of the road for detecting the vehicle. Then the Equi-Height Mosaicking Image (EHMI) [5] uses geometric information of the load. Later by using SVM detector the vehicle is detected and tracked. During this detection & tracking EHMI is managed in order to reduce the cost of vehicles detection on embedded system. Finally, the result is visualized with the detected vehicles and their distance is calculated from the system.

IV. EHMI MANAGEMENT FOR LOW-COMPUTING POWER EMBEDDED SYSTEM

While performing an advanced developing algorithm in embedded system, EHMI is generated for the entire image. The vehicle is detected and tracked in the generated image. At this time, there is a large computational cost for the detecting vehicle because of the region including unnecessary areas. So to solve this problem, the proposed method of managing the region detection with improved frame rate is as follows.

First, the whole EHMI is generated if in case the current status of road vehicle in not detected in the captured image. Continuously detect the vehicles on the left, right and front of the vehicle with a mounted camera in order to detect its surrounding regions. Region of the managed EHMI is generated

when the vehicles are detected in captured image. The generated EHMI contains the regions that may contain vehicles to be detected and can contain moving vehicles in the current frame that are detected in previous frame. The proposed method has improved frame rate compared to the previous methods because it generates images of different size according to the number of vehicles detected.

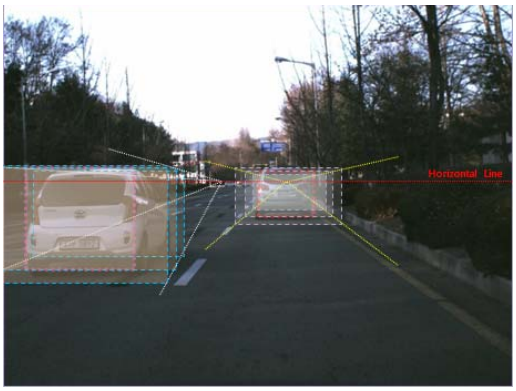

Figure 2: Region of focus on vehicle

V. EXPERIMENTAL RESULT

Experimental results of the proposed method in this paper are performed on the Jetson TK1 embedded system with windows based PC platform. Performance of it is an Intel core i7-4790K CPU with 28GB of RAM and NVIDIA GeForce GTX 780 graphic card. Image is captured using the mono 8mm camera of Fle3 with a resolution of 640x480 at a speed of 30fps. For training the SVM classifiers, a training dataset that contained a positive image of 8,215 vehicles, negative images of 14,507 non-vehicles are used.

The accuracy is measured with an F1 measure and it is compared with the performance of the proposed system in the PC platform and Jetson TK1 embedded system.

Table 1: Vehicle Detection Results

	Approach	***Detection Time***	***F1 measure***
PC-platform	Existing method	62.5ms	92.08%
PC-platform	Proposed method	25ms	91.42%
Jetson TK1	Existing method	117ms	92.08%
Jetson TK1	Proposed method	71ms	91.42%

Table. 1 shows the experimental results with PC-platform and Jetson TK1 uses the proposed method. Proposed method uses the GPU to detect the vehicle. So, it shows the difference in performance between PC-platform and embedded system.

The experimental results show that the proposed method has improved execution speed than the previous methods. It also shows that F1 measure is almost same between the two methods.

Figure. 3 shows the result of detecting the vehicle using the proposed method on Jetson TK1 embedded system.

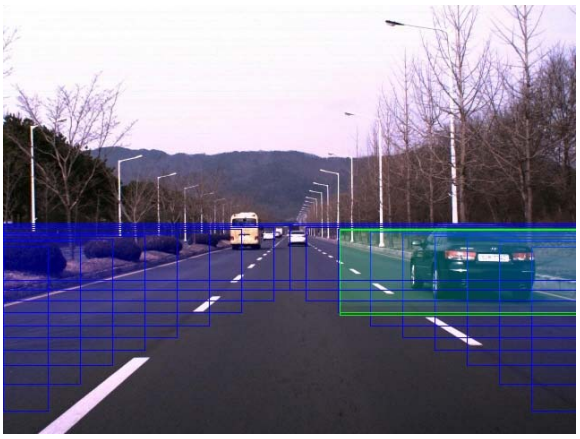

Figure 3: Result of the vehicle detection

VI. CONCLUSION

EHMI is managed according to the detected vehicle on embedded system. In addition, the proposed method has improved execution speed than the existing method. In future work, a system for both the vehicles and pedestrians detection in the real-time on embedded systems will be developed.

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