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Dynamic Obstacle Detection of Road Scenes using Equi-Height Mosaicking Image

Min Woo Park and Soon Ki Jung

School of Computer Science and Engineering, Kyungpook National University,
80 Daehak-ro, Bukgu, Daegu, Republic of Korea
Advisor/s: Soon Ki Jung
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1 Abstract

Today, many automobile companies and researchers have developed various safety systems to reduce fatalities by traffic accidents[1, 2]. In order to prevent traffic accidents by distracted driving, therefore, the proposed system presents the vehicle and pedestrian detection using a novel image representation called equi-height mosaicking system[3]. Furthermore, the proposed system additionally suggests the part-based side detection method using equi-height peripheral mosaicking image to detect approaching vehicles while driving.

The proposed system first presents the detection method of vehicle and pedestrian using road geometry in real-time. Especially, we propose the new image representation called equi-height mosaicking image to perform the GPU-based fast vehicle and pedestrian detection. The equi-height mosaicking image is generated by using a number of equi-height images that are made by results of road geometry analysis.

First of all, the proposed system performs the distortion removal. In this step, the proposed system removes the lens distortion and image skew using the distortion map in on-line. The distortion map is precomputed by distortion coefficients and skew rotation in off-line. After the distortion removal is completed, the proposed system analyzes the road scene to generate the equi-height images. The proposed system extracts the sampling position in the image. The sampling position is extracted with a regular interval based on a distance from the camera of the vehicle. Then, the proposed system estimates the height of equi-height images on a sampled position. When the road scene analysis is finished, the proposed system generates the equi-height image. The proposed system crops the image to make equi-height images using the sampled position and estimated height. Once equi-height images is generated, the proposed system resizes the equi-height images to a fixed height. Then, the proposed system concatenates the equi-height images to generate the equi-height mosaicking image. The equi-height mosaicking image is used to increase the processing speed in detection step.

When the equi-height mosaicking image is generated for fast speed, the proposed system performs the GPU-accelerated 1D search based detection using HOG-based SVM classifier on equi-height mosaicking image[4]. When vehicles or pedestrians are detected, the proposed system transforms the coordinates of detected region from equi-height mosaicking image to input image. Finally, the proposed system decides the detected vehicles or pedestrians by grouping for multiple detected regions using non-maximal suppression.

Correspondence to: <skjung@knu.ac.kr>

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After the forward vehicle detection is completed, we additionally present the part-based side detection method to warn the approaching vehicles such as the passing or cutting in vehicle. In order to effectively detect side-part of approaching vehicles, we also suggest the other new image representation called equi-height peripheral mosaicking image. All processes of part-based side detection are successively performed after the forward obstacle detection is finished. In the proposed system, the part-based side detection method uses the pre-made equi-height mosaicking image by input. The proposed system first extracts left and right side-regions of the driver as regular distance interval. For the effective processing, the proposed system performs the extraction of each side-region from pre-made equi-height mosaicking image. Then, it performs the image warping for extracted regions to express the side-part of the approaching vehicle more clearly if the approaching vehicle is existed. After the image warping for extracted regions is completed, the proposed system concatenates warped images to generate the equi-height peripheral mosaicking image for the fast detection. It also increases the processing speed in detection step.

When the equi-height peripheral mosaicking image is generated, the proposed system performs the GPU-accelerated 1D search based detection of front and rear side-parts using HOG-based adaboost classifier on equi-height peripheral mosaicking image. Then, it performs the coordinate transform for detected regions in two stages. After the coordinate transform is finished, the proposed system finally decides the detected side-part of approaching vehicle by grouping for multiple detected regions using non-maximal suppression.

In this paper, we suggest real-time approaches of two-types for the obstacle detection while driving. The first approach is forward vehicle and pedestrian detection method. The method detects the vehicle and pedestrian existed in front of the driver's vehicle while driving. The second approach is front and rear part-based side detection method of the approaching vehicles. The method detects the dangerous approaching vehicle such as fast passing or cutting in vehicle. The system applied proposed approaches shows high processing speed without reducing detection rate. For verification of the proposed system, it was tested on the actual vehicle[†]. In the future, we will focus on the improvement of the accuracy without reducing processing speed. And we will develop the fast and effective tracking algorithm suitable to equi-height mosaicking image.

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